

Zentrum für Entwicklungsforschung

DEALING WITH BRIBERY IN AN EMISSION TAX SCHEME

**THEORETICAL AND EXPERIMENTAL EVIDENCE
BASED ON THE INDONESIAN CASE**

Deden Dinar Iskandar

der
Hohen Landwirtschaftlichen Fakultät

der
Rheinischen Friedrich-Wilhelms-Universität
zu Bonn

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Dealing With Bribery in an Emission Tax Scheme: Theoretical and Experimental Evidence Based on the Indonesian Case

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This dissertation is stemmed from the necessity of finding the optimal mixture of emission tax policies that induces the compliance under the presence of bribery, by taking the case of Indonesia. The Indonesian government has designed the emission tax to prevent environmental degradation attributed to the production process of polluting firm. However, the implementation of emission tax may be impeded by several nonmarket issues. Firstly, there is a contradiction of interests regarding the implementation of tax between the government and the polluting firms. The firms may incline to undertake the actions against the compliance with tax regulation. Secondly, the complication of emission taxation escalates when bribery in the taxation office prevails. The prevalence of bribery is alleged to provide a disincentive for the tax compliance of the firms.

Motivated by the necessity of emission tax and the nonmarket conditions expressed above, the main objective of this dissertation is to provide the clue regarding the optimal emission tax schemes that induce the compliance under pervasive bribery. In particular, this study aims to contribute to environmental policy literature by examining the role of financial reward on emission tax compliance under the presence of bribery. The existing literature mostly examine the impact of corruption and financial reward on compliance in separation, while the combined impact of the reward and bribery has not been investigated.

The objectives of this dissertation are approached using game theoretical and experimental methods. These approaches are useful to predict the performance of new policy designs, where the relevant empirical data have not been established. The common critic on game theoretical approach is that the method relies heavily on the assumption that the economic agents are fully rational and driven by the benefit maximization motive. Therefore, simultaneous use of these approaches is expected to fill the gap between the prediction of optimal decisions and the actual economic behaviour.

Based on the research findings, the proposed emission tax schemes under the presence of bribery and costly monitoring would be a combination of low tax rate, high sanction for evasion, combined with low financial reward for the compliant firms. Enforcement policies directed toward corrupting tax officials

that eventually lead to the increase in the cost of bribery is also recommended. Theoretical findings indicate that the optimal mixture of enforcement policy on tax officials consists of a high financial reward for revealing the tax evasion and a lower sanction for taking the bribe.

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Der Hintergrund dieser Dissertation liegt in der Notwendigkeit zur Findung eines optimalen Mix aus Emissionssteuergesetzgebungen, die deren Einhaltung in der Gegenwart von Bestechlichkeit begünstigen, anhand des konkreten Falls Indonesien. Die indonesische Regierung hat die Emissionssteuer mit dem Ziel entworfen, die Umweltverschmutzung zu begrenzen, die aus dem Produktionsprozess verschmutzender Firmen resultiert. Die Umsetzung einer Emissionssteuer kann jedoch durch einige marktunabhängige Faktoren beeinträchtigt werden. Erstens gibt es einen Interessenkonflikt zwischen Regierung und verschmutzenden Firmen hinsichtlich der Einführung der Steuer. Demnach könnten Firmen potenziell Maßnahmen ergreifen, die nicht im Einklang mit der Steuergesetzgebung stehen. Zweitens wird die Emissionsbesteuerung zusätzlich erschwert, wenn Bestechlichkeit der Steuerbehörden gegeben ist. Das Vorhandensein von Bestechlichkeit wird als Anreiz zur Nichteinhaltung der Steuergesetze durch die Firmen angesehen.

Angesichts der Notwendigkeit einer Emissionssteuer und der oben beschriebenen, marktunabhängigen Faktoren ist das Hauptziel dieser Dissertation die Beschreibung einer optimalen Emissionssteuergesetzgebung, die zu einer Einhaltung derselben angesichts allgegenwärtiger Korruption führt. Insbesondere soll diese Studie einen Beitrag zur aktuellen Umweltpolitikliteratur liefern, indem sie die Rolle von finanziellen Belohnungen bei der Einhaltung von Emissionssteuergesetzen vor dem Hintergrund von Bestechlichkeit beleuchtet. Die bisherige Literatur beschäftigt sich indes überwiegend mit den unabhängigen Einflüssen von Korruption und finanziellen Belohnungen auf die Einhaltung von Gesetzen, während der gleichzeitige Einfluss von Belohnung und Bestechung noch nicht untersucht wurde.

Die Fragestellungen dieser Dissertation werden mittels spieltheoretischer und experimenteller Ansätze untersucht. Diese Methoden bieten sich an, um Prognosen zur Wirksamkeit neuartiger Gesetzgebungsmodelle zu erstellen, zu denen noch keine relevanten empirischen Beobachtungen verfügbar sind. Allgemein wird kritisiert, dass der spieltheoretische Ansatz stark auf der Annahme vollkommen rationaler und Nutzen maximierender Agenten beruht. Entsprechend kann man erwarten, dass durch die Lücke zwischen der Vorhersage optimaler Entscheidungen und tatsächlichem ökonomischem

Verhalten durch die gleichzeitige Anwendung der beiden genannten methodischen Ansätze geschlossen werden kann.

Basierend auf den Forschungsergebnissen bestünde das empfohlene Steuermodell unter der Annahme von Bestechlichkeit aus einer Kombination aus einem niedrigen Steuersatz, hohen Strafen für Steuerhinterziehung und einer geringen finanziellen Belohnung für Firmen, die sich an die Gesetze halten. Außerdem empfehlen sich Maßnahmen zur Durchsetzung, die auf korrupte Finanzbeamte abzielen und ultimativ zu einem höheren Kosten von Bestechlichkeit führen. Theoretische Ergebnisse zeigen, dass eine optimale Mischung von Durchsetzungsmaßnahmen mit dem Fokus auf Finanzbeamte aus hohen finanziellen Belohnungen zur Aufdeckung von Steuerhinterziehung und niedrigeren Strafen für die Annahme von Bestechungsgeldern besteht.

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Abbreviations and Acronyms

APINDO	:	<i>Asosiasi Pengusaha Indonesia</i> (Indonesian Employers Association)
BKF	:	<i>Badan Koordinasi Fiskal</i> (Fiscal Coordination Office)
FOC	:	First Order Condition
ICW	:	Indonesia Corruption Watch
KITSDA	:	<i>Kepatuhan Internal dan Transformasi Sumber Daya Manusia</i> (Internal Compliance and Human Resource Transformation)
KPPP	:	<i>Kantor Pemeriksaan dan Penyidikan Pajak</i> (Tax Audit and Investigation Office)
MoF	:	Ministry of Finance

Chapter 1

INTRODUCTION

The subject of this dissertation is motivated by the necessity of regulation in environmental management. The role of environmental regulation is stemming from the problem of externality, a situation in which the actions of one economic agent affect the utility of others in an uncompensated way. In the absence of regulations, the social cost resulting from the actions of the economic agents will exceed the private cost and the environmental quality will be compromised. Since the market cannot define the private property rights for the environmental quality, the government intervention to regulate environmental problems becomes necessary (Siebert, 2008).

The primary objective of environmental regulation is to restrict environmental damage and to maintain the utilization of the environment at the efficient level, which allows the economic agents bearing the full implication of their actions (Crew and parker (ed), 2006). Environmental regulations are commonly classified into two broad categories, command-and-control and market-based instruments. Command-and-control refers to a direct regulation applied at various stages of production. This instrument may prevent the use of inputs or production techniques if they are considered dangerous for the environment. Direct regulation could also be directed to set the quota of the produced goods and the emitted pollutants.

While the command-and-control instruments constrain the polluting firms with rigidity in achieving the environmental goals, market-based instruments provide the firms with a greater range of choices in achieving environmental improvement along with incentives to encourage the environmental improvement in a more effective way. Market-based instruments provide the flexibility to firms to decide what level of environmental efforts they intend to establish, considering the economic incentive they expect to obtain (Hahn and Stavins, 1992). Economists believe that market-based instruments will work more efficiently in achieving environmental objectives than the command-and-control, since these instruments delegate the decision making to the polluting firms with private information regarding firm-specific cost of pollutant reduction (Hahn and Stavins, 1992; Crew and parker (ed), 2006). Different firms can determine a different level of production, and the corresponding pollutant generation, regarding the expected economic incentive from the instruments. One of the most commonly discussed

market-based instruments is the emission tax. Emission tax is defined as a tax levied on the physical unit (or the substitute of it) that has a negative effect on the environment (Fullerton et al., 2008). The tax is not only projected to reduce the emitted pollutant, but also expected to generate revenue for the government to improve social welfare (*double dividend hypothesis*).

In the case of Indonesia, the cost of environmental degradation has been highlighted in the Country Environmental Analysis by World Bank (2009). According to the analysis, environmental degradation could raise significant health problems and other welfare costs resulted from climate-change. The World Bank analyses that the environmental degradation cost will grow at the same level of annual growth rate. The analysis also indicates that the industries significantly contribute to the severity of the pollution level.

The Indonesian government has not yet succeeded in reducing the rate of environmental damage and the level of pollution. Thus, to prevent a further environmental degradation, the government has designed the implementation of emission tax (Hasan and Puspitasari, 2008). The role of the emission tax has found more ground since the enactment of The Environmental Act No 32/2009. This Act is the last amendment of the first Environmental Act No. 4/1982 on Environmental Management and Protection in Indonesia. The current Act provides the legal basis for the government to levy the tax for environmental purposes. The National Action Plan Addressing Climate Change of Indonesia (2007) has classified the emission tax into carbon tax and environmental tax. While the base for environmental tax is the volume of pollutants in general, the carbon tax will be based particularly on the volume of emitted carbon-dioxide.

Abimanyu¹ explains that the main objective of environmental tax is to reduce the discharge of industrial waste into environment (Kompas, 2008). The adoption of environmental tax is crucial considering the increasing level of production waste discharging into the rivers, on to the land, and into the air in Indonesia. Abimanyu states that the implementation of environmental tax could be considered an attempt to raise the responsibility of industries for polluting the environment.

Due to pollution, the availability of clean water in Indonesia tends to decrease. Water resources degradation rate is accounted for 15-35% per capita annually. Monitoring on 30 main rivers in Indonesia reveals that most

¹ The Head of Fiscal Policy Office, Ministry of Finance of Indonesia.

of river water cannot be used for standard water, drinking water, and other usage that requires the same water quality (WEPA, 2012).

Technical details of environmental tax have not been agreed yet. The tax had been proposed by the government to be charged at 0.5 % from total production-cost of polluting firms, however, this proposal had been rejected by the parliament due to strong criticism toward the determination of tax base. If the parliament passed the tax proposal, the generated revenue would be around 4 trillion IDR or approximately 4.5 billion US\$ (Antaranews, 2007). Despite the failure, the enactment of the tax is considered crucial since it can reduce the level of pollution and generate revenue for the government. Hilman² states that the tax-base of environmental tax will be more clearly defined (Kontan, 2008). The tax should be based on the *polluter-pay-principle*, where the polluting firms pay the tax proportional to their produced pollution.

The carbon tax is designed to decrease the level of carbon-dioxide emission. The vast contribution of carbon-dioxide emission in Indonesia is mainly coming from forestry sector, which amounts to 80 % of total GHG emission in 2007 (PEACE, 2007). However, the emission from fossil-fuel combustion is rising rapidly and becoming a significant concern for the future. Emission from fossil-fuel combustion is growing at 6% annually, and predicted to exceed the emission from forestry sector after 2030 (USAID, 2008).

According to the Green Paper on Economic and Fiscal Policy Strategies for Climate Change Mitigation in Indonesia (2009), the carbon tax will be enacted in 2014, started at IDR 80,000.00 (approximately US\$ 9) a ton of carbon dioxide and rising 5 per cent in real terms annually until 2020. The carbon tax will be aimed at the industries that use the combustion of fossil-fuels. The carbon tax is also targeting other industries that contribute to carbon-dioxide emission. For instance, Witoelar³ identifies the palm oil as an industry potentially to be taxed (The Jakarta Globe, 2009). In Indonesia, extensive tracts of forest have been converted for oil-palm plantation. This land-use conversion along with deforestation is the main sources of carbon-dioxide emission from forestry sector (USAID, 2008).

Ministry of Finance (2009) projects the implementation of carbon tax to reduce emissions from fossil-fuels combustion by 10% of bussiness-as-usual levels in 2020. The tax is also predicted to generate a tax revenue flow of

² The Deputy for Nature Conservation Enhancement and Environmental Destruction Control, Ministry of Environment of Indonesia.

³ The Environmental Minister of Indonesia.

around 95 trillion IDR annually (approximately 10 billion US\$). This revenue can be used to alleviate poverty and improve income distribution in Indonesia, to cut other corporate taxes and compensate the industries for the losses incurred by the carbon tax, and to support the emission abatement (Ministry of Finance and Australia Indonesia Partnership, 2009).

Crew and parker (ed) (2006) suggest that the implementation of market-based instruments should also consider nonmarket conditions. These conditions include the monitoring and enforcement mechanism, adequacy of information, and institutional settings. In line with the observation of Crew and parker (ed) (2006), this study considers several nonmarket issues in formulating the emission taxation in Indonesia.

Firstly, there is a contradiction of interests regarding the implementation of tax between the government, represented by Ministry of Finance (MoF), and the firms. The MoF is concerned with ensuring tax compliance, enforcing the taxpayers to report and pay accurately their tax liability in accordance with the applied regulation. On the other hand, the firms perceive the implementation of the tax adding extra expense on their production costs. They may incline to decrease the cost by undertaking the actions against the compliance with tax regulation. Due to the high cost of monitoring, the compliance behaviour of the firms is not fully observed by the MoF. Martowardojo⁴ mentions that the corporate tax compliance is still low (Koran Jakarta, 2011). He points out that only 3.6% of the registered firms in Indonesia compliantly file their corporate tax. Secondly, the complication of taxation problem is increased with the presence of bribery in the taxation office. Bribery is alleged to provide a disincentive for tax compliance of firms. The most-recent survey of Bribery Perception Index, conducted by Transparency International Indonesia in 2010, reveals that the taxation office is still included among the highest bribery-receiving agencies in Indonesia.

The government of Indonesia has tried to eradicate the systemic corruption in public offices by enacting a number of anti corruption laws. For instance, the Law No. 31/1999 on the Eradication of the Criminal Act of Corruption, which is amended later by the Law No.20/2001. Government also involves the participation of public in eradicating corruption. In 2000, government has issued the Government Regulation No. 71/2000 on the Procedure for Implementation of Public Participation and Provision of Appreciation in the Prevention and Eradication of the Criminal Act of Corruption. A centralized agency to eradicate corruption, which is called the Corruption Eradication

⁴ The Finance Minister of Indonesia

Commission, has been established in 2002 to counteract corruption in governmental agencies whose functions are related to public services.

Regarding the corruption eradication in taxation office, the MoF has introduced the bureaucratic reform in 2007. The reformation includes the increase in officials' salary, enactment of anti-corruption regulations and formation of internal agencies to supervise the performance of officials, and implementation of online tax filling system to prevent the potential of bribery (Horhoruwet al, 2012).

Amid those efforts, the corruption in Indonesia (including that in taxation office) is still pervasive. The primary challenge of combating corruption is that the monitoring mechanisms in Indonesia are mostly under-resourced. Supervising governmental agencies still lack of capacity to handle the corruption, especially in investigation and surveillance. Other impediment is the weak coordination amongst Attorney General's Office, National Office, and Corruption Eradication Commission. This hinders the effective prosecution of corruption cases (UNODC, 2012).

Government has shown intention and efforts to eradicate systemic corruption, and certain anti-corruption measures have been attempted by MoF to prevent the corruption in taxation office. While the government still struggle with the large scale campaign on corruption eradication, the attention should also be paid to avert marginal corruption in any specific governmental program, including the bribery in the case of emission tax. Therefore, it is necessary to embed the anticipation of bribery within the emission tax scheme to reduce the potential failure on enforcing the compliance.

Given the necessity of emission tax and the nonmarket conditions expressed above, the first objective of this dissertation is to provide the clue regarding the optimal emission tax design that induce the compliance under imperfect monitoring and the presence of bribery. The optimal emission tax in this dissertation is depicted as the outcome of strategic interaction between the MoF, tax officials, and the polluting firms.

There has been a growing literature on environmental policy that incorporates the issue of compliance. Bontems and Bourgeon (2005) develop a theoretical model of environmental tax where the regulator designing environmental policy may monitor the emission level by commencing a costly audit. They find that the threat of monitoring may induce the polluters to reduce their pollution levels. A similar result is found by Dasgupta et al. (2001) and Foulon et al. (2002) in their empirical studies, showing that

impact of inspection and threat of inspection are significant in decreasing pollution. Macho-Stadler and Perez-Castrillo (2006) find that environmental tax compliance will increase with the intensity of monitoring.

Although still rare, the link between corruption and environmental compliance at micro level has been examined in the existing literature. For instance, Damania (2002) and Wilson and Damania (2005) examine the interplay between corruption, environmental policy and environmental outcomes. Their theoretical model suggests that the presence of corruption worsens the compliance with environmental policy and degrades the environmental outcomes.

Most literature on environmental policy focuses on the role of auditing and fines to encourage the compliance, yet the application of financial reward for compliance has scarcely been investigated. The need for introducing a positive incentive into the tax policy has been mentioned in a few studies (Falkinger and Walther, 1991; Swierzbinski, 1994; Feldet al 2006), however, empirical evidence of the impact of financial reward on compliances is still equally rare. Experimental studies conducted by Torgler (2003), Bazart and Pickhardt (2010), and Kastlunger et al. (2011) are among a few studies to demonstrate that compliance is higher with the availability of financial reward.

Existing literature mostly examine the impact of corruption and financial reward on compliance in separation, while the combined impact of the reward and bribery has not been investigated. This study aims to fill that gap. This study is expected to extend the environmental policy and tax compliance literature, particularly by examining the role of financial reward on emission tax compliance when the bribery is prevalent. This contribution is the second objective of this dissertation.

The objectives of this dissertation are approached using game theoretical and experimental methods. Game theoretical method is a tool to analyse the strategic interaction in which the result of a party's choices depends on the decision of others. The approach fits the approach of this study, which is focusing on the problem of strategic interaction between different parties that act rationally and take into account other's choices before formulating their strategies. The common critic on this approach is that the method relies heavily on the assumption that the economic agents are fully rational and driven solely by the motivation to maximize their benefit. The experimental approach could relax the assumption of rationality, allowing the possibility that economic agents do not necessarily take decisions based

on a logical consideration. This approach could fill the gap between the actual economic behaviour and the prediction of the theoretical model. Both game theory and experimental approaches are useful to investigate a policy design when the required empirical data are limited, or even unavailable. These approaches are particularly important to predict the performance of new policies prior to their instalment, where the relevant empirical data have not been established.

To the best of the author's knowledge, the theoretical and experimental research to formulate the emission tax scheme has never been conducted in Indonesia. This study is important for policy purpose, since tax compliance is worst within the corrupt administration in many middle-income countries such as Indonesia (Purohit, 2007). Therefore, more attention should be paid on finding alternative policy mixture to improve that situation. Inspired by the case of Indonesia, this study might also provide the insight for other developing countries that share the similar institutional setting.

This dissertation is structured as follows. After this introduction chapter, the second chapter describes the problem of taxation and the prospect of emission tax in Indonesia. The description lays the foundation to construct the theoretical model and experimental design in the following chapters. The third chapter presents the theoretical model formulating the optimal emission tax schemes to induce compliance. The fourth chapter provides the experimental results of the impacts of emission tax design on compliance behaviour. The last chapter concludes the whole findings of this dissertation.

Chapter 2

INSIGHT FROM IN-DEPTH INTERVIEW: TAX NONCOMPLIANCE, BRIBERY, AND THE PROSPECT OF EMISSION TAX IN INDONESIA

2.1. INTRODUCTION

The main objectives of the Ministry of Finance (MoF) are to manage the state budget and to safeguard the state revenue by means of tax collection. Consequently, tax compliance is a topic of great interest to the MoF. Tax compliance is defined as the willingness of a taxpayer to report and pay accurately their tax liability according to regulation (Rothet al, 1989). The MoF is also concerned with ensuring a good performance of tax officials during tax collection and preventing any leakage of tax revenue due to officials' corruption. Corruption can be defined as the utilization of public office for private gain, including utilization of public office to take advantage of those who are dealing with the government through bribery (Wilson and Damania, 2005).

The achievement of those objectives may be impeded by several factors. Firstly, tax collection will obviously increase the cost of the firms, and rational firms may learn that the cost can be lessened by decreasing their tax compliance. Secondly, the tax officials may be motivated by the maximization of personal benefit. This pursuit of personal benefit can trigger dysfunctional attitudes of the officials, which leads to the leakage of tax revenue.

Attempting to investigate those taxation problems, the objective of this chapter can be derived into more specific directions; to look into the issue of tax noncompliance and to observe bribery practice among tax officials in Indonesia. Existing literature on tax compliance and corruption consider these subjects to be directly related to the problem of monitoring mechanism. Therefore, this study also aims to explore the adequacy of supervision on tax compliance and the sufficiency of inspection mechanism on corrupting behaviour among tax officials in Indonesia. The inability of these mechanisms to observe the performance of firms and tax officials indicates the presence of asymmetric information. Asymmetric information can lead to a hidden action problem, a situation in which the firms and tax

officials may act in an unknown way to the MoF and contradict the MoF's objectives.

Another objective of this chapter is to provide a description regarding the adoption of emission tax in Indonesia. Emission tax is described as a tax levied on the physical unit, or the substitute of it, which has a negative effect on the environment (Fullerton et al., 2008). The revenue of emission tax could be allocated to improve the environmental quality or directed toward non environmental welfare. The National Action Plan Addressing Climate Change of Indonesia (2007) mentions the emission tax as one of the fiscal instruments to support government's environmental programs. According to the Action Plan, the emission tax includes the environmental tax and the carbon tax. The base for the environmental tax imposition is the volume of pollutants in general, while the carbon tax is charged specifically on the volume of emitted carbon dioxide. This research seeks to provide the hint regarding the prospect of emission tax in Indonesia, especially on the necessity of the tax and its acceptability from the side of the firms.

The data are obtained through in-depth interviews with the key informants. The in-depth interview approach is used to elicit information and to obtain a comprehensive understanding of the interviewee's position. It also enables the exploration of compelling issues for further investigation.

The following section provides a brief review on the legal basis for emission tax and the taxation system to provide the insight regarding how the system works in Indonesia. The next section describes the problem of taxation and the prospect of emission tax in Indonesia, and explains the method through which these information are obtained. The main findings of this chapter are summarized in the last section.

2.2. REVIEW OF THE LEGAL AND INSTITUTIONAL CONTEXT

The Environmental Act No. 39/2009 on Basic Stipulations on Environmental Management, which is replacing the Act No. 4/1982 and the Act No. 23 /1997, states that the objectives of the environmental management are to establish the sustainable development by regulating the use of the environment, to prevent environmental damage, and to mitigate the degradation of environmental quality caused by pollution. The Act defines the pollution as the infiltration of substances or elements into the environment that degrades the quality of environment, leading to a failure of

environmental functions. The Act No. 32/2009 explicitly states that one of the standards for the environmental management in Indonesia is the Polluter Pay Principle. It is further explained in the Act that all parties responsible for inflicting the pollution are compelled to provide compensation for the negative consequences suffered by the environment.

The Environmental Act in Indonesia has provided a variety of legal instruments to prevent environmental degradation. These legal instruments are covering the administrative, civil, criminal, and fiscal law. Administrative law consists of environmental use arrangement, environmental audit, and administrative sanction. Civil law focuses on repairing environmental damage and environmental restoration. Criminal law concerns with environmental crime and the application of sanction. Fiscal law addresses the imposition of environmental tax/levies on the responsible parties for activities that affect the environmental quality.

The Environmental Act No. 39/2009 includes tax as a fiscal instrument of environmental management. The tax has two functions. Firstly, the budgetary function where the taxes are expected to generate more revenue for the government. Secondly, the regulatory function where the taxes serve to regulate the economic activities that discharge the emission, to prevent pollution and environmental degradation, and to provide compensation for people who are victimized by environmental damage. The tax is aimed at the polluters, and the tax payment should be based on the volume of their taxable pollutants.

The Environmental Acts in Indonesia also provide the legal basis of the monitoring mechanism to ensure the compliance of economic agents on environmental regulation. According to the Acts, the appointed governmental agencies have the power to supervise the compliance of the parties responsible for any activity with applicable environmental regulation, to order an environmental audit when the violation against regulation is suspected, and to conduct an investigation for environmental crime.

The taxation in Indonesia is consigned under the responsibility of the Ministry of Finance (MoF). The MoF has the control on taxation, including the issuance of taxation laws and regulations, collection of taxes, and enforcement of compliance with the taxes obligation.

According to Taxation Law No. 6/1983, which has been modified lastly by Law No. 28/2007, the taxation in Indonesia applies the self-assessment system. This system provides the taxpayers with full responsibility to calculate, report, and pay their tax obligation. In this system, the functions of tax

officials are limited to delivering information regarding taxation procedures and regulations, provide administrative service, and monitor the compliance of taxpayers through tax inspection.

Nasution, the Director of the Taxation Office, explains that monitoring on the taxpayers' compliance in Indonesia applies the profiling and benchmarking mechanism (Suara Merdeka, 2009). Profiling refers to the activity of developing database, covering the income and the taxes payment of the taxpayers. The database will enable the tax office to establish a benchmark that can be used further as a standard in measuring the degree of tax compliance and an early indication of noncompliance. The benchmark is determined by comparing the volume of tax payments among taxpayers in the same cluster of income. Benchmarking could provide direction for further tax inspection, to examine the suspected tax evasion.

Finance Minister Decree No. 199/2007 defines inspection as the series of collecting and processing information or evidence, conducted objectively and professional according to inspection standards, in order to examine the compliance of taxpayers in fulfilling their tax obligations. The inspection can be categorized into field inspection and office inspection. The field inspection means that the inspection is conducted in the taxpayers' place, while office inspection refers to an inspection conducted in the office of tax officials. Inspection is undertaken by tax officials or, if necessary, experts appointed by the taxation office. The noncompliance behaviour of taxpayers includes the failure to submit the tax report, submitting the inaccurate tax report, and refusal to pay the tax obligation. In the case that noncompliance is found during the inspection, the taxpayers will be charged with a sanction.

Finance Minister Decree No. 33/2007 describes that the tax officials should comply with the ethical code of the MoF. According to the ethical code, tax officials have the obligation to work with professionalism, transparency, and accountability. Tax officials are expected to provide optimal service to taxpayers. This regulation also explicitly states that tax officials are prohibited to misuse their authority directly or indirectly for personal benefit, and prohibited accepting any forms of gift (from taxpayers and other parties) which is suspected to induce their integrity. Tax officials who violate the ethical code will be charged with administrative sanction and demanded to return the loss of tax revenue due to their action.

Monitoring on the performance and behaviour of the MoF's officials is directed by Inspectorate General of Ministry of Finance. According to the Finance Minister Decree No. 143.1/2009, Inspectorate General has the

mandate to enforce the task accomplishment of the officials in accordance with the laws and regulations. In order to carry out the mandate, Inspectorate General is authorized to formulate the supervision policies, to implement the performance monitoring and budget control, and to support the eradication of corruption within the MoF. The supervision of Inspectorate General is aimed to encourage the internal compliance with laws and regulations within the MoF, to oversee the dysfunctional behaviour of MoF's officials through surveillance and investigation, and to promote the clean government within the ranks of the MoF.

Directorate General of Taxation, one of Directorates General within Ministry of Finance, also has an internal unit with similar functions as Inspectorate General. This unit is called Directorate of Internal Compliance and Human Resources Transformation (*Kepatuhan Internal dan Transformasi Sumber Daya Manusia/KITSDA*). KITSDA is mandated to monitor the performance and the compliance of officials within the taxation office. While Inspectorate General is dealing with the performance of the MoF's employees in general, the responsibility of KITSDA is limited only to supervise the officials of the taxation office. Finance Minister Decree No. 184/2010 states that KITSDA is established to formulate and execute the enforcement policy on the compliance of tax officials. The main functions of KITSDA, according to the Decree, are preparing the practicable standards of compliance and performing the inspection to examine the compliance of tax officials.

2.3. RESEARCH METHOD

This study uses the in-depth interview, a technique that includes intensive individual interviews with a few respondents to elaborate their perspectives on a particular issue or situation. In-depth interview is useful for the research intended to explore certain issues in-depth, providing a more comprehensive picture regarding a specific issue of interest.

The interview is designed to be semi-structured. A semi-structured interview is categorized into the guided interview where general questions are asked, and additional questions are allowed to arise spontaneously during the interview as a result of the discussion. The approach combines a predetermined series of open questions to stimulate discussion with the spontaneous enquiries to elaborate further specific topics or responses that arise during the interview (Punch, 2008). Different to a structured interview with standardized and limited set questions; semi-structured interview does

not restrict respondents to a set of predetermined answers. In fact, semi-structured interview is classified as guided only in the sense that some forms of the interview have been prepared earlier to provide the outline for the conversation.

As has been described in the introduction, the study is intended to elaborate the problems of corporate taxation and to provide the hint regarding the adoption of emission tax in Indonesia. The taxation problems could be specified further into violations against tax compliance and the presence of bribery. The topics of inquiry to probe the taxations problem are the tax compliance issue, monitoring mechanism on tax compliance, the issue of tax officials' corrupt behaviour, and the monitoring mechanism to ensure the compliance of tax officials with the standards and ethical codes. Concerning the prospect of emission tax implementation in Indonesia, the interviews focus on elaborating the perception of respondents on the necessity of emission tax and the acceptability of the tax implementation by the business community.

The respondents are selected from various agencies, representing different stakeholders in taxation, to enable the elaboration of the situations from different perspectives. Those agencies are the Tax Audit and Investigation Office (*Kantor Pemeriksaan dan Penyidikan Pajak/KPPP*), the Directorate of Internal Compliance and Human Resource Transformation (*Direktorat Kepatuhan Internal dan Transformasi Sumber Daya Manusia/KITSDA*), the Indonesian Employers Association (*Asosiasi Pengusaha Indonesia/APINDO*), the Fiscal Policy Office (*Badan Koordinasi Fiskal/BKF*) and Indonesia Corruption Watch (ICW). To provide the inside-views on the problem of taxation, this study also adds tax officials in the list of respondents.

The selected agencies have different concerns. The priority of the KPPP is to ensure the compliance of taxpayers. KITSDA is concerned with the compliance of tax officials to the standards and ethical code. APINDO is representing the interests of firms when dealing with government policy and other circumstances crucial for their business activities. Relevant with the objective of the organization to support the creation of a clean government, ICW focuses on watching the corrupt behaviour in the governmental agencies. Tax advisors from the tax consultant agency are involved in providing more elaborated descriptions on the real practice of taxation.

The experts from the university with relevant academic expertise are included as the respondents of in-depth interview. The inclusion of those experts is expected to give a more general and neutral assessment on the

taxation from the academic view. The experts are not only selected on the basis of their academic expertise, but also their professional interaction with the business community and bureaucracy. Therefore, the interviewed experts are not only able to offer theoretical and normative opinions, but also to provide the practical explanations.

The interviews took place in the offices of the respondents during working hours. The interview was started with an introduction, during which the interviewer explained the context of the study and the objectives of the interview. Afterwards, the interview carried on by following the prepared short list of open questions and probing the answers of respondents with related inquiries. The guiding questions were designed comprehensibly to stimulate more elaborating responses from the respondents.

The interviews were conducted in September 2009 in Indonesia. During the interviews, the conversations were recorded, after having the permission from the interviewees. The small notes were taken to complement the record and to emphasize the intriguing points expresses by the respondent for further elaboration. However, the interview with tax officials was not following the same procedures. They insisted that their names would not be revealed and they refused to be recorded. The interview was not able to elaborate information in-depth, since they acted cautiously.

2.4. THE FINDINGS

This section presents the main findings from the interviews. The information obtained from the respondents is grouped according to the main issues that are intended to assess in the interview. Since the respondents come from various backgrounds and competencies, the emphasizing of elaborated issues during the interview are different from one to the other. The overview of the results is presented in the following table.

Table 2.1
Overview of interview results

No.	Interviewee	Key Response to:		
		Incident of Tax Noncompliance and Monitoring Mechanism	Practice of Bribery and Monitoring Mechanism of Tax Officials	Prospect of Emission tax in Indonesia
1	APINDO	<ul style="list-style-type: none"> • Tax noncompliance 	<ul style="list-style-type: none"> • Bribery practice 	<ul style="list-style-type: none"> • Necessity of emission tax • Firms' lack of awareness • Potential low acceptance
2	Tax Advisor	<ul style="list-style-type: none"> • Tax noncompliance • Imperfect monitoring 	<ul style="list-style-type: none"> • Bribery practice 	<ul style="list-style-type: none"> • Firms' lack of awareness • Potential low acceptance
3	KPPP	<ul style="list-style-type: none"> • Tax noncompliance • Imperfect monitoring 	<ul style="list-style-type: none"> • Bribery practice • Imperfect monitoring 	
4	KITSDA	<ul style="list-style-type: none"> • Tax noncompliance 	<ul style="list-style-type: none"> • Bribery practice • Imperfect monitoring 	
5	ICW		<ul style="list-style-type: none"> • Bribery practice • Imperfect monitoring 	
6	BKF	<ul style="list-style-type: none"> • Tax noncompliance 	<ul style="list-style-type: none"> • Bribery practice 	<ul style="list-style-type: none"> • Necessity of emission tax • Potential low acceptance
7	Environmental Economics' Expert			<ul style="list-style-type: none"> • Necessity of emission tax • Firms' lack of awareness • Potential low acceptance
8	Public Economics' Expert 1	<ul style="list-style-type: none"> • Tax noncompliance • Imperfect 	<ul style="list-style-type: none"> • Bribery practice • Imperfect monitoring 	<ul style="list-style-type: none"> • Necessity of emission tax • Firms' lack of

		monitoring	awareness
9	Public Economics' Expert 2	<ul style="list-style-type: none"> • Tax noncompliance • Imperfect monitoring 	<ul style="list-style-type: none"> • Bribery practice • Imperfect monitoring
10	Industrial Economics' Expert	<ul style="list-style-type: none"> • Tax noncompliance 	<ul style="list-style-type: none"> • Bribery practice • Necessity of emission tax • Potential low acceptance
11	Tax Officials	<ul style="list-style-type: none"> • Tax noncompliance • Imperfect monitoring 	<ul style="list-style-type: none"> • Bribery practice • Rogorous monitoring

Note: The bullets indicate the issues whose presence is confirmed by the interviewees.

2.4.1. The Incident of Tax Noncompliance and Monitoring Mechanism in Indonesia

Almost all respondents agreed that noncompliance behaviour on tax payment was still present in Indonesia. The interviewee from KPPP stated that tax compliance in Indonesia was still lower than that of other Asian countries. Although the accurate data was hard to assess, he believed that there were still a lot of firms understating their tax liability. He also mentioned the necessity of changing the paradigm of imposing the compliance. Instead of the enforcement by punishment, he suggested to try enhancing the compliance with more positive incentives, such as providing a better service in tax administration and offering a financial reward for compliant taxpayers.

Two anonymous tax officials stated that most of firms were trying to hide their true income, and the task of tax officials was to audit the accuracy of the tax reports. The audit process was laborious and time-consuming. Although the audit could not be directed toward the entire submitted reports, however, most audits were able to verify the truthfulness of the assessed reports.

The interviewee from KITSDA stated that the unwillingness to pay the tax (which he believed as the basic characteristic of the firms) was the main motivation of tax evasion. The interviewed expert of Industrial Economics also agreed that the level of tax compliance was low. Tax payment was costly

for the firms, and the firms tried to decrease the cost by evading the tax. Based on his discussion with the firms and tax consultants, he explained that tax noncompliance was mostly conducted through accounting manipulation of financial records. The firms still filled their tax reports, but the report had been understated and the declared value of the taxable objects was lower than the actual amount.

He mentioned three rationales to justify the noncompliance behaviour of the firms. The first reason was relating with the transparency of tax revenue utilization. The firms were not well informed about the purpose and the allocation of the tax revenue. The second reason was concerning the trust of firms on the credibility of the government in managing the tax revenue. The firms were not convinced that the tax revenue would be allocated solely for public facility and services without leakage due to corruption within the bureaucracy. The third reason was more pragmatic; the firms perceived that the facility brought to them by the government was still insignificant. These reasons discouraged the firms from paying the tax accurately and compelled them to reduce their tax reports.

The interviewee from APINDO stated that the firms had no intentions to evade the taxes. However, he stated that the rate and variety of corporate taxes in Indonesia were burdening. The taxes were not well organized and the procedures were complicated. Therefore, the incidents of noncompliance might arise due to the firms' unawareness of tax regulations. He added that the perception on the corruptibility of tax officials could not be omitted entirely, although the government had tried to improve the integrity of the taxation office. That conviction discouraged the firms to comply with the tax regulations. He argued that the taxpayers, including the firms, had contributed to the economic development in Indonesia. Therefore, he claimed that the firms deserved better services and rewards from the government.

The interviewed tax advisor described that the main practice of tax noncompliance was understating the tax report, where the firms reported their tax liability lower than the actual value. He stated that tax reporting was like a gambling game for the firms. Due to the fact that taxation in Indonesia adopts a self-assessment system, firms could purposely understate the tax report and played with the probability of being audited. They expected to get a gain in the absence of tax auditing, and were prepared to accept the sanction once the audit was commenced.

He added that interpretation of regulations could also affect the compliance behaviour of the firms. Tax noncompliance was not only driven by the firms' gain seeking behaviour, but might also be caused by the difference in interpreting the regulations. When a disagreement regarding the interpretation of tax liability arose between firms and tax officials, the Directorate of Taxation would handle the dispute, and the firms were usually deemed noncompliant. This imbalance in power, where the Directorate of Taxation had the authority to interpret as well as to implement the regulation, also contributed to the degradation of motivation to comply. The firms perceived that their effort to comply with the procedures was futile, since they would be sanctioned eventually for unanticipated reasons.

The interviewee from BKF stated that the current incident of tax noncompliance was lower due to the improvement of tax filling procedures. This statement was supported by the interviewed expert of Public Economics. However, he argued that the manipulation of tax report was still a common practice in Indonesia. He believed that the potential of tax manipulation would persist so long as the tax system allowed the taxpayers to assess and report their tax liability independently. The other interviewed researcher and expert in Public Economics also agreed that the tax noncompliance could not be omitted completely, since the probability of being inspected was low and the expected benefit of noncompliance was relatively higher than the sanction.

Most respondents agreed on the flaw of monitoring mechanism on tax compliance, which could not expose the entire incidents of evasion. The interviewee from KPPP stated that examining the accuracy of the tax report was difficult. It was impossible to check the accuracy of all reports due to the limitation of human resources and budget availability. He added that a robust monitoring system should be supported by a good availability of data. Currently, the micro data of firms' performance is still lacking. Developing database of the firms could be the best way to provide for accurate examination of the tax report. However, obtaining the comprehensive information from individual firm was costly. The feasible alternatives were profiling and benchmarking. Profiling referred to the activity of developing the data of the firms, which would be the basis for benchmarking. Benchmarking was operationalized through finding the average figure of taxable income from the same cluster of the firms, and using this information as a benchmark to assess the acceptability of the reports. These processes were expected to provide preliminary indicators of suspected tax evasion, which could be followed up with the audit.

The interviewed tax advisor explained that it was extremely difficult to examine all submitted reports due to the shortcoming of tax office personnel. In the current tax practice in Indonesia, the priority of tax auditing was given to verify the claim of tax extra-payment return proposed by the firms. He concluded that it was impossible to check the accuracy of all tax reports. Therefore, the chance of moral hazard by understating the tax report was widely open. The interviewed Public Economics expert agreed that monitoring the tax compliance was difficult and costly. In his opinion, the best practice of monitoring should be the implementation of online transaction recording in which all the transactions of the firms went through the Directorate of Taxation database. However, this system was not currently feasible in Indonesia. The other Public Economics expert also indicated that monitoring mechanism to ensure the compliance of firms was costly. Furthermore, the sanction imposed to noncompliant firms was low.

2.4.2. The Practice of Bribery and Monitoring Mechanism of Tax Officials

The interviewee from KPPP explained that the practice of bribery in the taxation office was decreasing after the tax reformation in 2007. The tax reformation included the increase in tax officials' salaries and the instalment of the tax online system. The online system enabled the firms to submit their tax report online, and restricted the face-to-face interaction between the firms and the tax officials. However, he also admitted that incidents of bribery could not be eliminated since tax auditing still required firms and tax officials to meet, and bribery usually occurred during this process.

He added that another problem arose after tax reformation. Tax reformation decreased the chance of corruption, however, this was not always beneficial for the tax revenue generation. Previously the corruption level was higher, but it was compensated by the persistent effort of tax officials to audit the tax reports. The officials intensively checked the accuracy of the reports, because they expected to extract a bribe from the cheating firms. On the other hand, the government was also better off since the total amount of collected tax revenue was higher, although there was a leakage due to bribery. However, tax officials' efforts to audit the tax were not as laborious after the reformation, since the chance of getting the bribe was more restricted. Therefore, he suggested that the tax officials were provided with the additional financial incentive, which was based on their performance on collecting and auditing the tax.

The interviewee from APINDO stated that tax officials were relatively cleaner now, but the presence of bribery had not been omitted entirely. He

explained that it was still a common practice for tax officials to extract the bribe by manipulating the firms' unawareness of tax regulation. According to his opinion, it was the task of tax officials to guide and to teach the firms about the tax regulations. However, instead of providing the assistance, tax officials deliberately let the firms made mistakes during the tax assessment. When the tax officials and the firms met during an auditing process, the officials showed the error of tax calculation and treated to charge heavy sanction on the firms. Tax negotiations would take place afterwards, where the tax officials offered the reduction of sanction if the firms agreed to provide the bribe.

The interviewed tax advisor stated that the imbalance of power between tax officials and firms could lead to bribe extraction, in which the tax officials forced the firms to provide a bribe by threatening them with heavy sanction due to their failure to comply with regulations. The extraction could be initiated with the difference of interpreting the tax regulations between firms and tax officials. The firms often believed that they had obeyed the regulation, while tax officials concluded the opposite. In this case, bribery became a way to escape the unanticipated sanction.

The interviewee from BKF stated that the possibility of bribery in taxation still existed. However, he believed that the incident of tax collusion had decreased since the implementation of online tax filing system. This new installed system restricted the meetings between the tax officials and the firms thus decreased the potential of tax negotiations between those two parties.

Two anonymous tax officials agreed that the bribery between tax officials and the firms might happen. The cheating firms tried to lessen the tax payment by approaching the officials and offering the bribe. However, they argued correspondingly that this bribery incident could not indicate the behaviour of tax officials in general. One of them further added that the internal supervision mechanism within Taxation Office was more rigorous after the bureaucratic reform introduced by MoF in 2007. It alerted the officials to be more compliant with ethical-codes since any indisciplinary actions were subject to sanctions.

The interviewee from ICW admitted that the MoF had initiated an internal reformation to eradicate the corruption; however, he believed that the mentality of tax officials hardly changed. The reformation was mainly conducted at the policy level, yet still a lot of chances for bribery at the operational level. He mentioned that the bribery mainly occurred during the

auditing process, where the officials met the firms to examine the accuracy of the tax reports. Since the interaction between tax officials and the firms could not be avoided, he argued that the bribery within Taxation Office was still a common practice in Indonesia. He also believed that the corruption within Taxation Office was a systemic instead of a personal behaviour. He quoted the statement from one tax official, that junior tax officials were advised to extract the bribe from the audited firms and share the earnings with their superiors.

The pervasive bribery in taxation practice was also recognized by the interviewed expert of Industrial Economics. He stated that bribery was an ordinary practice in Indonesia. This practice was difficult to eliminate since it was beneficial for both taxpayers and tax officials. He also indicated that tax officials might take advantage of taxpayers' lack of knowledge regarding the regulation to extract the bribe. Once the calculation of tax liability between tax officials and the reporting firms differed, the tax officials usually asked for bribe to release the firms from the punishment for noncompliance. The two interviewed experts of Public Economics supported the statement that the bribery still existed in taxation case and the monitoring mechanism to prevent the bribery was still ineffective.

The interviewee from KPPP recognized the existence of internal monitoring mechanism within the General Directorate of Taxation to combat the corruption, however, he considered the appointed department (KITSDA) unable to observe the behaviour of all officials. The interviewee from ICW also shared the same opinion that KITSDA could not totally prevent the practice of corruption due to the limited number of personnel.

The interviewee from KITSDA stated that his department was authorized to monitor and to inspect the compliance of tax officials with the regulations and the code of ethics. The inspection was mainly conducted after receiving a complaint regarding the attitude of tax officials. He acknowledged that the availability of personnel within his department was still lacking. This limitation impeded the performance of his department to prevent the corrupt behaviour of tax officials. He added that the same condition was also applied to the General Inspectorate of Ministry of Finance. The inspectorate main responsibility was to ensure the compliance of the Ministry of Finance employees with the regulations and code of ethics. Nevertheless, the General Inspectorate could not fully examine the behaviour of employees of the MoF due to the similar problem of resources deficiency.

2.4.3. The Prospect of Emission tax in Indonesia

The interviewed expert in Environmental Economics stated that the environmental problem was not the main priority of the government in Indonesia. The government still focused on the conventional development issues such as of poverty, income inequality, and unemployment problems. Consequently, the national budget allocated to environmental purposes was still insufficient. Although she admitted that the government of Indonesia had shown a concern toward environmental problems by announcing various environmental regulations, the effectiveness of those regulations environmental management in Indonesia was still deficient. She argued that this ineffectiveness could stem from two reasons, the low compliance of the polluting firms toward regulations and the inadequacy of enforcement efforts by the government. The regulated economic agents were often averse to complying with the regulations that would incur extra cost. In Indonesia, the enforcement efforts were insufficient since the available resources allocated on environmental management were inadequate.

She argued that the environmental situation in Indonesia was not well managed due to the lack of common understanding among all stakeholders such as the government, society, and the firms regarding the issue of the environment. She stated that the emission tax were necessary in Indonesia. However, she added that the success of the tax implementation was questionable since the awareness of environmental problems was still lacking.

She also stated that taxation in Indonesia, in general, was still lacking transparency. For instance, environmental tax should be collected by the government to discourage environmentally harmful activities, and the tax revenue should be directed to repair the environmental degradation due to the residual of the production process. However, the collected tax revenues were pooled together, and the allocation of tax revenues was not separable, despite the source of the taxes.

The interviewed expert of Public Economics emphasized the importance of defining the main objectives of emission tax in Indonesia. He stated that there were two objectives of emission tax; to generate the tax revenue (budgetary function) and to control the emission (regulatory function). The emission tax should be able to synergize those two functions, in the sense that the tax was not only aimed at increasing the government revenue but more importantly to put a limit on polluting emission. He argued that the source of emission should be identified first, then the tax should be levied

selectively only on the firms that emit the pollutants. The tax should be based on the generated emission; so that the polluting firms that emit more pollutants paid higher emission tax.

Concerning the prospect of emission tax implementation, he stated that the government could impose the tax although the awareness of the firms on environmental issues was still deficient. The adoption of emission tax would provide the firms with two choices regarding their polluting behaviour. The first choice was abating their emission, while the second choice was paying the tax proportional to the generated emission and allowing the government to use the collected tax revenue to finance public abatement. The government should ensure that the accrued tax would be allocated to mitigate the negative impact of emission on environmental quality. He provided the illustration of a water pollution case. Currently the polluting firms with insufficient technology to decontaminate the production waste simply discard the waste into the river. If the government taxed the firms for discharging the pollutants, the collected revenue of emission tax could be used to build the liquid waste distillation tanks for the polluting firms in the same area. He further argued that technically measuring the emission as the base of tax would not be a problem since the required technology was applicable in Indonesia.

The interviewed tax advisor and the interviewee from KPPP admitted that there was a lack of interest on the issue of environmental degradation on the firms' side. However, interviewee from KPPP acceded that firms generating harmful pollutants should be taxed. They agreed on one point that the firms would be reluctant to be charged with an additional tax, since currently there had been various corporate taxes in Indonesia. The interviewed expert of Industrial Economics also warned that the emission tax, although theoretically necessary, would become a burden for the firms and potentially lead to evasion.

The interviewee from BKF focused on the plan of carbon tax, the other type of emission tax apart from environmental tax. The carbon tax would be levied on the carbon generating firms according to the volume of emitted carbon, or other materials that could be the proxies for the emitted carbon (such as the volume of the required energy for the production process). In order to prove the accuracy of the reported emission, the tax office could use the service of the third parties (environmental consultants) to audit the emission. Although it was possible that the environmental consultants and the tax officials were agreed to take a bribe from the firms to allow the

manipulation of the reported emission, he assumed that most of them would try to keep their integrity. He mentioned that carbon tax on fossil fuels for household consumption, mainly gasoline for automobiles, was also considered. However, he commented that a more suitable policy on gasoline consumption for automobiles was a subsidy reduction (since gasoline was heavily subsidized in Indonesia) instead of imposing the tax on gasoline use. He also added that the implementation of carbon tax should be carefully designed, since there were many corporate taxes levied by the regional government and additional tax would be an extra burden for the firms.

2.5. SUMMARY AND CONCLUSIONS

This chapter is intended to describe the problems of taxation in Indonesia and to provide a hint regarding the implementation of emission tax. The taxation problems are originated from the conflicting objective between the MoF, firms, and tax officials and the asymmetric information. The conflicting objectives lead to the tax noncompliance and bribery practice, while the problem of asymmetric information results in the inability of the monitoring mechanism to observe the tax compliance of firms and to examine the performance of tax officials.

In-depth interview reveals that all respondents agree on the persistence of tax noncompliance. The main practice of tax noncompliance is understating the tax liability. Firms submit an inaccurate tax report, of which the declared tax liability has been undervalued. The interview reveals various reasons behind the firms' noncompliance behaviour. The first reason is that the tax payment is costly for the firms. Furthermore, there are various corporate taxes in Indonesia that should be obliged by the firms. The heavy taxes burden contributes to the reluctance of the firms to pay the tax accurately. The second reason is the lack of transparency in tax revenue utilization, so that firms are unaware about the allocation of the collected tax by the government. The third reason is the issue of trust, firms are dubious that tax revenue will be allocated solely for public facilities and services without leakage due to corruption within the bureaucracy. The fourth reason is the perception of firms that the received services and facilities, in return for tax payments, are still insufficient. The fifth reason is the firms' unawareness of tax regulations and procedures. The firms have the intention to pay the tax correctly; however, they are deemed noncompliant either because they do not comprehend the regulations or have a different interpretation of the

regulations. The last reason revealed during the interview is the low monitoring and sanctioning rate. Provided that the probability of being inspected is low and the benefit of noncompliance is relatively higher than the sanction, the practice of tax noncompliance will persist.

The main practice of corruption within tax officials is bribery, where firms and tax officials collude to negotiate tax or a sanction reduction in exchange for bribes. The interview results indicate that although the practice of bribery is decreasing, the practice cannot be completely omitted. It is also revealed that tax officials may take advantage of firms' unawareness of tax regulations to extract a bribe. Tax officials threaten the firms with a heavy sanction (if they are deemed noncompliant), and the firms are forced to pay the bribes. Bribe extraction could happen partly due to the imbalance of power between tax officials and firms. The taxation office has the authority to interpret the tax regulations. In the case when differing opinions occur regarding the interpretation of the regulations, the interpretation from the officials will be referred to.

Within the structure of the Ministry of Finance, there are two units responsible for monitoring the compliance of tax officials with the regulations and preventing the violation of the code of ethics. The first unit is the Inspectorate General of Ministry of Finance, and the second is the Directorate of Internal Compliance and Human Resources Transformation. These units have the authority to conduct the inspection of officials' compliance with regulations and investigate the suspicion of authority misuse. The Inspectorate General of Ministry of Finance is responsible to ensure the compliance of all the employees within the Ministry of Finance, while the responsibility for the other unit is limited only on establishing the compliance within the Directorate of Taxation. However, the interviews' results indicate that those units are unable to monitor the performance of tax officials and prevent the occurrence of bribery practice, due to the inadequacy of available resources and systemic characteristic of bribery.

Inferring from the in-depth interview results, the implementation of emission tax is necessary to reduce environmental degradation. The emission tax should not only aim at increasing the government revenue but more importantly to put a limit on the polluting emission. Interviewed experts state that ideally the revenue from emission tax should be targeted to correct the negative impact of the emission. This statement appears to contradict the double-dividend hypothesis of emission tax. Emission tax has two functions according to the standard environmental economics literature.

The first function of environmental tax is to regulate the pollution and, thus, improve the environmental quality. The second function is to generate revenue for the government, and the proceeds can be allocated to produce public goods. The government can reduce other distortionary taxes, and thereby create an economic gain, due to this revenue generation ability. This process is defined as revenue-recycling effect. These two functions of environmental tax can lead to the final outcomes referred to as the double-dividend, where the society receives both the improvement of environmental quality and the revenue-recycling (Hackett, 2006).

Nevertheless, the statement that emission tax revenue should be directed on public abatement reflects the urgency of the government's concerns on the environmental issue in Indonesia, where the allocation of the national budget does not appear to prioritize the environmental problem while the environmental degradation is constantly increasing. According to Kambuaya (2011), the budget allocated for environmental purpose amid the widespread environmental problems is still inferior to the budget share of other government expenditures in Indonesia.

The results of the interviews indicate the possible low acceptability of emission tax. Besides the fact that firms will try to avoid additional cost, this obstacle could be occurred due to the firms' lack of awareness of the environmental problems and the reluctance of firms to pay another tax additional to currently existing corporate taxes. The reluctance to pay emission tax could also be triggered by the lack of transparency in the utilization of tax revenue. Therefore, the firms cannot distinguish whether the tax revenue is truly allocated to compensate for the harmful impact of production activities on the environment.

Theoretically, the implementation of emission tax will be able to lessen the adverse impact of production waste although the government does not necessarily direct the utilization of tax revenue on public abatement. The emission tax charges the polluters proportionally to the generated pollution. Therefore, the adoption of emission tax will encourage them to decrease the volume of emission or to adopt more environmentally friendly technology. The reluctance of firms to pay the taxes due to the obscurity of the taxes revenue utilization could be originated in the sceptical perception toward the integrity of bureaucracy in Indonesia. The firms are unconvinced that the collected revenue would be allocated for public goods' provision without leakage due to corruption within the bureaucracy.

This chapter reveals the presence of firms' noncompliance and tax officials' corruption in Indonesia. Inability of the monitoring mechanism to observe the tax compliance of firms and to examine the conduct of tax officials with regard to the practice of corruption is also confirmed. Furthermore, the interview finds a compelling issue. Instead of relying on the sanction to enforce the compliance of firms and tax officials, enforcement could take an alternative way in the form of providing positive incentive. Another conclusion that could be drawn is the necessity of emission tax, although the evasion should be anticipated.

Chapter 3

EMISSION TAX SCHEME UNDER THE PRESENCE OF BRIBERY: THEORETICAL FINDINGS MOTIVATED BY THE CASE OF INDONESIA

3.1. INTRODUCTION

The cost of environmental degradation in Indonesia has been highlighted in the Country Environmental Analysis by World Bank (2009). According to the analysis, environmental degradation is projected to lead to significant health and other welfare costs. The World Bank predicts that the environmental degradation cost will grow in the future at the same annual GDP rate. The efforts of the Indonesian government have not yet succeeded in reducing the rate of environmental damage and pollution carried by the industries. Thus, to prevent a further environmental degradation and to raise the responsibility of the polluting firms, the government has planned to implement the emission tax (Hasan and Puspitasari, 2008).

The results of the in-depth interview as presented in chapter two verify the necessity for the emission tax adoption. However, the results also suggest that the tax evasion should be anticipated. The tax will obviously increase the cost of the firms. From the viewpoint of the industry, cost can be lessened by minimizing its tax compliance. Since monitoring mechanism to enforce the compliance is costly, compliance behaviour of the firms is not fully known to the government's agency. In this case, the firms may tend to evade their tax liability. The findings of in-depth interviews have confirmed the presence of tax evasion and the deficiency of the monitoring mechanism on the compliance behaviour of the firms in Indonesia. Tax evasion is an illegal action designed to lessen tax liability, particularly by underreporting the tax objects. Underreporting refers to the activity of taxpayers who intentionally declare the tax liability less than the actual amount. In the case of emission tax, evasion could be translated into underreporting the actual level of emission to reduce the tax payment.

The problem of taxation is complicated further by the issue of corruption. The survey of Transparency International Indonesia in 2010 places the taxation office at the top of the list of corrupt governmental institutions in Indonesia. This fact is consistent with the in-depth interview findings, which indicate that the corruption at the mid and low level of the taxation office is

still persistent, and the monitoring efforts to prevent dysfunctional behaviour of tax officials is still deficient. Although the government has tried to introduce the reformation in the taxation sector, including the increase in tax officials' remuneration and stricter internal monitoring within the Taxation Office, the practice of corruption cannot be entirely eradicated. The internal monitoring unit is responsible for supervising the compliance of officials with the standards. However, this unit cannot effectively observe the behaviour of tax officials due to the limitation of resources.

Corruption has been considered in the existing environmental literature at the macro level as one of the major causes for environmental damage. The cross-countries comparative study of Desai (1998) indicates that violations on environmental policies could become stronger when corruption takes place. The study shows that corruption by the mid and low level of officials is endemic in industrializing countries, and the infringement on environmental regulation is widespread. Using panel data from a mix of developed and developing countries from 1982 to 1992, Damania et al. (2003) provides evidence that corruption leads to poor policy formulation, management, and enforcement that could become serious problems for environmental sustainability. These findings are supported by the cross-countries study of Morse (2006). Using the data of Corruption Perception Index (CPI) and Environmental Sustainability Index (ESI), the study suggests an adverse relationship between corruption and environmental sustainability.

Rose-Ackerman (1978) distinguishes two types of corruption. The first type occurs in the relationship between the citizens and the elected policy makers, which typically leads to policy distortions. The second type exists in the bureaucracy, where the practice of bribery may hamper the intended effects of policies. Similar to the classification of corruption proposed by Rose-Ackerman (1978), the World Bank (2000) defines the corruption into two categories, grand and petty corruption. Grand corruption refers to attempts to influence the policy making by delivering payments to the politicians, while the petty corruption indicates the bribes directed to the administering officials in an attempt to elude the consequences of certain policies. Consequently, the grand corruption afflicts the policy setting while the petty corruption impedes the level of compliance.

This study will deal with the issue of petty corruption in the environmental context, the bribery that occurs at policy implementation level between the polluting firms and the officials. The study of bribery in an environmental perspective is crucial since the significance of enforcement will be weakened

when the officials engage in bribery (O'Connor, 1994). Under the presence of bribery, the violator of environmental regulation can be exempted from the penalty because of the financial influence that they may utilize to bribe the officials. The decline of deterrence effectiveness will hamper the attempt to restrict environmental degradation. However, the issue of bribery is less-researched in the environmental literature at the micro level, particularly concerning the compliance behaviour of the regulated polluters.

This theoretical study is aimed at investigating the scheme that will improve compliance with emission tax under the presence of bribery. This study may help the government in which the system is afflicted with bribery, such as Indonesia, in finding the policy mixture to aid the enforcement of emission tax compliance. Inspired by the case of Indonesia, this study may offer the insight for other developing countries that share the similar characteristic of institutional situation and taxation setting.

The rest of the paper is ordered as follows. The next section following this introduction part, will present the brief review of literature on similar issues of environmental taxation. The theoretical model is presented afterwards. The model will describe the optimal behaviour of firms and the tax officials, and formulate optimal policy for Ministry of Finance (MoF). The last section will provide the conclusion.

3.2. THEORETICAL LITERATURE REVIEW

As described by Polinsky and Shavell (2000), the literature on environmental regulation and enforcement follows from studies on optimal penalties in the law and economics. The theoretical study of Harford (1978) is among the first research on the emission tax compliance. Harford extends the seminal work of Becker (1968) on crime and punishment⁵ to examine the compliance behaviour of the firm under imperfectly enforceable pollution taxes, assuming that the firm aims at expected profit maximization. He derives a conclusion from his theoretical study that the actual pollutant level of the firm is determined by the pollution tax rate, while the probability of detection and the severity of sanction only affect the reported pollutant but not the actual pollutant. Therefore, increasing the fine and intensity of the audit will lead to more tax compliance, but not to a lower level of pollution.

⁵ Becker (1968) establishes the strand of economics of crime, which focuses on dissuasion of potential crime by punishment on the basis of observable and verifiable behaviour.

Further interpretation of his theoretical results concludes that increasing the tax rate will lessen the emitted pollutants. However, a higher tax rate will decrease the reported pollutants in a bigger scale, thus, suggesting an increase in the tax evasion. Reinganum and Wilde (1985) consider the detection probability and sanction rate in their analytical model. The impact of detection probability and noncompliance penalty on tax compliance are postulated as positive, and they conclude that some combination of these variables will provide an optimal tax policy. However, they do not determine the proper combination in their paper.

Bontem and Bourgeon (2005) examine the optimal environmental taxation and enforcement policy in the principal-agent problem setting. Their theoretical study models the setting with a self-reporting system, where the abatement cost is unknown to the regulator and emission level can be detected through a costly audit. Their result points out that the optimal level of tax will be higher than Pigovian's level because of the adverse-selection problem. The firms may hide the true level of emission to decrease the tax liability; therefore, the tax should cover the costly enforcement to prevent the tax evasion. Further results show that the optimal auditing effort of the regulator's agency is inversely related to the tax paid by the firms and their pollution levels.

The study of Macho-Stadler and Perez-Castrillo (2006) also focuses on the optimal audit policy to ensure compliance with environmental tax. Their theoretical study on the impact of the audit policy on an individual firm, finds that the audit has a deterrence impact on both the actual level of emission and the reported emission. This result is different with the theoretical findings of Harford (1978) that suggest the increase in audits increases the tax compliance but does not decrease the level of emission. The difference is due to a different hypothesis on the audit policy. Macho-Stadler and Perez-Castrillo (2006) argue that when the auditor decides to distribute the auditing intensity in a population of firms, the auditor may allocate the limited resources in a method where the firms do not behave as assumed by Harford (1978). Their analysis also suggests further that firms will always evade the environmental tax, unless the monitoring budget is exceptionally large.

The effectiveness of environmental policies is often hampered by corruption. The theoretical study of Damania (2002) extends the literature by examining the problem of pollution tax in a corrupt bureaucracy. The analysis reveals that spending resources to monitor the emission is unproductive in the

setting plagued with bribery, unless the severity of prosecution is increased adequately. According to his analysis, the optimal emission tax requires that the net marginal benefits from the instrument for pollution and corruption deterrence are equalized. This finding contradicts the Pigovian principle that emission tax should be equal to the marginal damage from pollution. In the corrupt system, a higher tax provides a stronger incentive to underreport, which should be balanced by increasing the auditing. Therefore, the optimal solution requires the marginal benefit from taxation to be traded off against the marginal benefit from auditing. This result implies that the ability of the government to control the emission is strictly limited if the auditing is expensive. He also finds that the tax rate rises with the reported emission while the audit rate decreases with the reported emission.

The study of Wilson and Damania (2005) is among a few theoretical studies on the interplay between bribery and emission tax. Bribery may determine the level of compliance, since it reflects the payment by the regulated firms to the regulator's agency for avoiding the consequences of an environmental policy. Their study considers the setting in which the firm creates pollution and the government as the regulator tries to control it by setting emission tax. The regulator delegates the task of observing the level of emission to the inspector. The tax liability paid by the firm is based on the reported emission assessed by the inspector. Since it is mutually beneficial to both of them, the inspector and the firm may engage in bribery and agree to underreport the actual emission level. The audit conducted by the regulator can reveal the true emission level with a certain probability, and the penalty will be imposed on both the firm and the inspector. The results of their study suggest that under the presence of bribery an increase in the emission tax rate induces a decline in the actual emission, since higher taxes increase the cost of production and thus, reduce the production and pollution levels. Nevertheless, a higher tax raises the payoff from tax evasion that leads to an increasing level of noncompliance. The study also shows that a higher fine reduces the emission and noncompliance level.

Most theoretical literature on environmental policies and taxes focus on the role of auditing and fines imposed on the compliance. The impact of financial reward on compliance with environmental policies has scarcely been investigated. Swierzbinski (1994) introduces the financial reward as an additional instrument of deterrence policies in environmental taxation. He examines the optimal environmental tax when the abatement cost of polluting firms is unknown to the regulator and observing the actual emission is costly. The enforcement effort of the regulator is restricted with

the limitation of available resources. His model allows the regulator to choose the reward for the compliant firms, apart from conventional deterrence instruments such as penalty and auditing.

The findings of his study suggest that the optimal scheme will be similar to a deposit-refund system. The system refers to the plan where the firms are charged with the environmental tax and the reward is given afterwards following the auditing process for the compliant firms (whereas the cheating firms are inflicted with the penalty). Further results suggest that when the maximum possible fines for violations are lower than the maximum reward, the decision to decrease emission is determined by the probability of monitoring. On the other hand, if the maximum available reward is lower than the maximum fine, compliance's decision is mostly driven by the variation in the tax rate.

The role of financial reward has scarcely been considered, even in the wider literature of tax evasion. The study of Falkinger and Walther (1991) is among a few papers that are concerned with the potential influence of monetary reward. Falkinger and Walther (1991) introduce the pecuniary reward as an economic incentive for tax payment into their tax evasion model. Their theoretical analysis shows that the introduction of the reward leads to a welfare improvement of the taxpayers and thus, discourages the taxpayers to evade the tax.

Among a few papers that analyse the impact of financial reward and the bribery on compliance with emission tax, none observes the effect of financial reward and the bribery in combination. This study intends to fill that gap. This study is expected to contribute to emission tax literature by examining the role of financial reward on the compliance under the presence of bribery. Furthermore, this study also includes the bribe rate (the cost of bribe) as one of the compliance determinants under the presence of bribery, a variable that has not been considered in the literature of environmental compliance.

3.3. THE MODEL

This study intends to analyse the optimal emission tax scheme to encourage compliance. Ministry of Finance aims to regulate the pollution emitted by the polluting firms through the implementation of emission tax. In the self-assessment taxation system, the MoF provides the polluting firms with the

right to assess the emission level. The firms submit the report and pay the tax liability accordingly to tax officials acting as the agents of the MoF. To enforce the compliance of firms and prevent the firms from underreporting the emission level, the MoF charges the noncompliant firms with sanction and compensates the compliant firms with monetary reward. The MoF delegates administrative authority to tax officials, entrusts the officials to accept the emission report and collect the tax from polluting firms, audit the emission, and deliver the sanction or reward. To encourage the officials performing the delegated tasks honestly, the MoF charges the penalty for the corrupt officials and reward the officials who reveal the underreporting.

The model in this theoretical study refers to the work of Wilson and Damania (2005) on the interplay between petty corruption and emission tax compliance. The petty corruption reflects the bribery practice between the polluting firms and administering officials, in which the bribe is provided by the firms to avoid the consequence of environmental policies. For simplicity, the model of Wilson and Damania (2005) focuses on the case of a single firm that emits pollution as a result of the production process, which is regulated through an emission tax. The model adopts the normalization that each unit of output generates a unit of emission.

Given the problem of asymmetric information, the government in the model of Wilson and Damania (2005) should rely on the service of an inspector to assess emission levels. The tax is levied on the emission level reported by the inspector hired by the government. The firm may offer a bribe to the inspector to persuade a report of emission below the actual level. The level of reported emission and the bribe rate are determined through bargaining, and the model solves the equilibrium level of emission report and bribe rate with Nash bargain. The government can authorize an audit to deter noncompliance. If any underreporting activity is revealed during the audit, both the firm and the inspector will be prosecuted.

Deviating from the model of Wilson and Damania (2005), this study assumes that the report of emission levels is a private decision of the firm instead of a joint decision between the firm and the government agent. According to Taxation Law No. 28/2007, the taxation in Indonesia applies the self-assessment system. This system provides the tax payers with a full responsibility to calculate, report, and pay their tax obligation. The findings of in-depth interview also indicate that the meeting between the firms and tax officials is limited due to the installment of online tax filling system. Furthermore, this assumption is consistent with the problem of costly

monitoring where the MoF may not be able to assign the examination of all firms in a due time. Therefore, the firm decides the level of reported emission independently and the tax official only chooses the firms to audit after receiving all reports.

The MoF in this study may offer the financial reward to encourage the compliance of the firms, thus, expanding the model of Wilson and Damania (2005). The necessity of financial reward for compliance is confirmed with the findings of in-depth interview as presented in the chapter two of this dissertation. Following Swierzbinski (1994), the reward scheme resembles a deposit-refund system. The reward is given after the accuracy of the emission report is confirmed with the audit. Firstly, the firm submits the emission report and pays the tax accordingly, and then the firm receives a rebate if the reported and actual emission levels are identical. However, the government is also committed to charging a sanction if the actual emission is inconsistent with the initial report. The present model extends the existing literature of emission tax compliance by bringing together the influence of financial reward and bribery, in the setting where the financial reward is introduced under the presence of bribery.

Consider a firm discharges emission (e) as a result of the production process. Following Wilson and Dalmania (2005), this study adopts the normalization that one unit of output generates a single unit of emission. Emission leads to environmental damage $\varepsilon[e]$, with $\varepsilon' > 0$ and $\varepsilon'' > 0$.

To internalize the pollution cost and raise the responsibility of the polluting firms, the MoF charges an emission tax (t) on each unit of emission. The tax is levied on the level of reported emission (r). The accrued tax revenue ($t r$) can be used by the MoF for social benefits, either for environmental purposes or the provision of other public goods. The social benefit from emission tax is expressed by $\lambda[t.r]$, where the benefit (λ) is the function of tax revenue and characterized by $\lambda'[t.r] > 0$ and $\lambda''[t.r] < 0$. The social benefit increases with a higher tax revenue.

The MoF provides the firm with full authority to assess and report their emission levels to the tax official, which is acting on behalf of the MoF. The firm may cheat by reporting emission level below the actual level, and thus, underpaying the tax. To encourage the compliance of the firm, the MoF punishes the cheating firm that reports incorrect emission level with a sanction. The sanction will be levied proportionally to the amount of avoided tax. The amount of the sanction is expressed by $s t (e - r)$, where s is the sanction rate. To provide more incentives for the firms to comply with

emission tax, the MoF may provide a monetary reward to the compliant firm that reports the true level of emission. The monetary reward will be offered proportionally to the amount of tax paid liability and expressed by $i t e$, where i is the reward rate. Since the true level of emission is unknown to the MoF, the sanction and reward can only be decided after the level of emission is examined through an audit.

The audit is conducted after the firms submit their report and pay the tax. Since the budget is limited, the audit cannot observe the emission level of all firms. Therefore, the firm can only be audited with a certain probability, ρ . The probability of the firm getting audited is characterized by $\rho[\tilde{a}+r]$, where the probability (ρ) is a function of the audit budget of the MoF (\tilde{a}) and the reported emission of the firm (r). The properties of the audit probability with regard to the audit budget are defined with $\rho'[\tilde{a}]>0$. The probability of being audited is higher (lower) when the budget allocated by the MoF on audit increases (decreases)⁶. On the other hand, properties of audit probability with regard to reported emission are expressed with $\rho'[r]<0$ and $\rho''[r]>0$. The probability of getting audited is lower (higher) if the reported emission level is higher (lower). The last condition is consistent with the existing literature, which demonstrates that the optimal audit frequency is decreasing with the report (see, e.g. Heyes, 2000; Damania, 2002; Wilson and Damania, 2005).

The MoF authorizes the tax officials to collect the tax, audit the report, and deliver the sanction or financial reward to the suitable firm. Tax officials get a fixed wage, w , for performing their task. The audit frequency is determined by the MoF in accordance with the available budget, while the decision on which firms to be audited is left to the officials. The officials decide which firms to audit among all firms that have submitted the reports. If the audit confirms that the firms underreport the emission, and consequently underpay the tax, the officials proceed to administer the sanction. On the other hand, in the case where the financial reward for compliance is available, tax officials deliver the monetary reward for firms that submit the accurate emission level.

The cheating firm may try to bribe the tax official to elude the sanction. The tax official decides the rate of the bribe that should be paid in exchange with the sanction exemption. The amount of the bribe is assumed to be

⁶ For the sake of simplicity, this study assumes that the probability of audit is a linear function of the allocated budget on audit ($\rho''[\tilde{a}]>0$). The budget increase will be translated into higher audit frequency, thus probability of audit, at a constant scale.

proportional to the amount of sanction and expressed by $b s t (e-r)$, where b is the bribe rate.

To encourage tax officials performing the task honestly, the MoF conducts an inspection to examine the behaviour of the tax officials and imposes the penalty to the corrupt officials. The penalty is a function of unreported emission ($e-r$), with $p'[e-r] > 0$ and $p''[e-r] > 0$, meaning that the severity of penalty is increasing with the size of underreported emission. The probability that the corrupt official is inspected given by $\sigma[\hat{a}+r]$, where the inspection probability (σ) is a function of the MoF's budget allocated on inspection (\hat{a}) and the reported emission of the firm (r). The probability is characterized by $\sigma'[\hat{a}] > 0$ ⁷, $\sigma'[r] < 0$ and $\sigma''[r] > 0$. It indicates that the probability of inspection is higher (lower) when the budget allocated on inspection is higher (lower) or the reported emission is lower (higher). In addition to the penalty, the MoF introduces the monetary reward for the tax officials to reveal the underreporting emission, proportional to the recovered loss from the unpaid tax (revenue from sanction). The amount of the reward is given by $\eta s t (e-r)$, where η is the reward rate for the tax officials. The officials who find the evasion may directly propose the reward from the MoF. This reward scheme is stemmed from the basic insight of principal-agent theory, where a principal (the MoF) can encourage agents (tax officials) to perform optimal actions, although the principal only able to observe the outcome of the agents' actions, through incentive provision.

The strategic interaction between the MoF, tax official, and polluting firm is modelled as a three stages game. In the first stage, the MoF sets the emission tax rate and enforcement instruments to deter noncompliance of polluting firms and tax officials. In the second stage, the official decides the optimal bribe rate. Considering the values of enforcement instruments and the bribe rate, the polluting firm decides the optimal level of reported emission. The game will be solved using backward induction. Backward induction is a common iterative procedure for solving sequential games. In the backward induction, the optimal strategy of the last player to move in the game is determined first. Then, the optimal decision of the next-to-last moving player is solved, given the action of the last player. The process continues until the strategies of all players are solved (Shor, 2005). In this

⁷ Similar to the probability of audit faced by the firm, the probability of tax official being inspected is also assumed to be a linear function of the allocated budget on inspection, therefore $\rho''[\hat{a}] > 0$.

study, first the optimal reported emission level of the polluting firm is solved, and then the optimal bribe rate of the tax official is determined. The optimal policy for the MoF is formulated afterward, once the optimal decision of the firm and the official are obtained.

3.3.1. The optimal behavior of the firm

The optimal behaviour of firms in determining the reported emission is analysed under two different situations with regard to bribery situation, the setting without bribery and the setting with bribery. In each setting, first the optimal behaviour of the firm is observed without the availability of financial reward. Afterward, the financial reward is introduced and optimal decision of the firm is examined.

3.3.1.1 The optimal behavior of the firm under the absence of bribery

The MoF relies on sanction and audit to deter the noncompliance. The MoF announces the emission tax rate (t) and sanction rate for noncompliance (s). The MoF also announces the available budget for the auditing purpose. The firm is aware that the probability of being audited (ρ) is determined by the audit budget of the MoF (\tilde{a}) and the reported emission (r).

The firm makes a decision regarding the optimal reported emission (r) given the announced tax rate (t), sanction rate (s) and the audit probability (ρ). The profit from emitting the pollutant is expressed by $\pi[e]$, where e is the actual level of emission, with $\pi'[e] > 0$ and $\pi''[e] < 0$. It is assumed that one unit output linearly correlates with one unit of emission; therefore, e may reflect the level of output.

The payoff of producing emission for the compliant firm is given by $\psi_c^e = \pi - te$. The payoff is simply the difference between the profit of production that discharges emission and the emission tax payment. The payoff of the noncompliant firm, which submits the report (r) lower than actual emission (e), is defined by $\psi_c^r = \pi - (t.r + \rho st(e - r))$. The payoff consists of the profit of generating emission less than the cost of the tax payment and expected sanction from tax evasion. Obviously, if the firm decides to submit the correct emission report, ψ_c^r , will be equal to ψ_c^e . The gain from underreporting emission and evading tax payment is given by the following equation.

$$\psi_c = t(e - r) - \rho st(e - r) \quad (1)$$

Equation (1) is simply the difference between the payoff of cheating and the payoff of compliance. The gain is the saved tax payment from submitting the emission report lower than the actual level, less the expected penalty for underpaying the tax. The noncompliant firm decides the level of reported emission that maximizes the gain. The condition for optimal reported emission is given by First Order Condition (FOC) of equation (1).

$$\frac{\partial \psi_c}{\partial r} = -t + \rho st - \frac{\partial \rho}{\partial r} st(e - r) = 0 \quad (2)$$

Rewriting equation (2) in terms of r ,

$$r = e - \left(\frac{\rho st - t}{\frac{\partial \rho}{\partial r} st} \right) \quad (3)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

Equation (3) implies that it is optimal for polluting firm to report the emission level accurately if the marginal gain of underreporting the emission is zero, meaning that the saved tax payment is equal to the expected sanction for each change of underreported emission. However, the optimal report will be less than the actual emission level if that condition is not achievable. In the latter case, the optimal report will be lower than the actual emission and the gap between the two levels indicates the marginal gain of underreporting emission.

The impact of each enforcement instrument on optimal reported emission is demonstrated by comparative statics, deriving from of the equation (2) using implicit differentiation.

$$\frac{\partial r}{\partial t} = -\frac{1 - \left(\rho s - \frac{\partial \rho}{\partial r} s(e-r) \right)}{\frac{\partial^2 \rho}{\partial r^2} st(e-r) - 2 \frac{\partial \rho}{\partial r} st} \quad (4)$$

$$\frac{\partial r}{\partial s} = \frac{\rho t - \frac{\partial \rho}{\partial r} t(e-r)}{\frac{\partial^2 \rho}{\partial r^2} st(e-r) - 2 \frac{\partial \rho}{\partial r} st} \quad (5)$$

$$\frac{\partial r}{\partial \tilde{a}} = \frac{\frac{\partial \rho}{\partial \tilde{a}} st}{\frac{\partial^2 \rho}{\partial r^2} st(e-r) - 2 \frac{\partial \rho}{\partial r} st} \quad (6)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

Comparative statics of tax rate impact on optimal reported emission in equation (4) shows that optimal report is decreasing with the tax rate (t). However, equation (4) provides an intriguing intuition that the optimal reported emission may increase with the tax rate, if the marginal expected sanction is higher than the marginal expected benefit from evasion as the tax rate changes. This possibility is justified since the size of sanction increases with the evaded tax, therefore, a higher tax rate will lead to a bigger sanction. A firm will attempt to avoid the larger sanction by increasing the reported emission as the tax rate increases. However, this condition requires the MoF to set exceedingly high audit frequency and sanction severity, which are less likely obtainable in the reality due to the limitation of budget.

Equation (5) and (6) show that optimal reported emission increases with the sanction rate (s) and audit budget (\tilde{a}). A higher sanction rate for noncompliance and a higher audit frequency due to the increase in the

budget will impose more pressure on the firm to increase the reported income.

When the MoF introduces the financial reward for compliance, the expected payoff from generating emission to the compliant firm is defined by $\psi_c^e = \pi - te + \rho ite$. Now the firm may expect an additional income in the form of a financial reward for reporting the true level of emission. A financial reward is conditional upon probability of the audit since the reward is granted after the accuracy of the report is confirmed through auditing. The payoff from reporting accurately is the profit from generating emission and the expected financial reward less the cost of tax payment. The payoff to the noncompliant firm from generating emission is given by $\psi_c^r = \pi - (tr + \rho st(e - r))$. The payoff is the profit less the tax payment, the expected cost of the sanction and the expected loss of financial reward for compliance. The gain from underreporting emission is given by the following equation.

$$\psi_c = t(e - r) - \rho(st(e - r) + ite) \quad (7)$$

The gain is the saved tax payment from submitting the understated emission, less the expected sanction and the loss of financial reward for compliance. The condition for optimal reported emission that gives a maximum payoff to the firm is given by FOC of equation (7).

$$\frac{\partial \psi_c}{\partial r} = -t + \rho st - \frac{\partial \rho}{\partial r}(st(e - r) + ite) = 0 \quad (8)$$

The optimal reported emission is obtained by rewriting the equation (8) in terms of r.

$$r = e - \left(\frac{\left(\rho st - \frac{\partial \rho}{\partial r} ite \right) - t}{\frac{\partial \rho}{\partial r} st} \right) \quad (9)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

When the financial reward is available, the optimal reported emission is higher than the previous report without the reward at equation (3). After the introduction of a financial reward, the marginal cost of underreporting emission is higher and it leads to the decrease in marginal gain of evasion for each unit change of reported emission.

The impact of each enforcement instrument on optimal reported emission is demonstrated by comparative statics below, using implicit differentiation on equation (8).

$$\frac{\partial r}{\partial t} = - \frac{1 - \left(\rho s - \frac{\partial \rho}{\partial r} (s(e-r) + ie) \right)}{\frac{\partial^2 \rho}{\partial r^2} (st(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} st} \quad (10)$$

$$\frac{\partial r}{\partial s} = \frac{\rho t - \frac{\partial \rho}{\partial r} t(e-r)}{\frac{\partial^2 \rho}{\partial r^2} (st(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} st} \quad (11)$$

$$\frac{\partial r}{\partial \bar{a}} = \frac{\frac{\partial \rho}{\partial \bar{a}} st}{\frac{\partial^2 \rho}{\partial r^2} (st(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} st} \quad (12)$$

$$\frac{\partial r}{\partial i} = \frac{-\frac{\partial \rho}{\partial r} te}{\frac{\partial^2 \rho}{\partial r^2} (st(e-r) + ite) - 2\frac{\partial \rho}{\partial r} st} \quad (13)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

Comparative statics show that optimal reported emission is decreasing with the tax rate (t) and increasing with available audit budget (\tilde{a}), sanction rate (s), and financial reward rate (i). Comparison of the instruments' impact on reported emission before and after the introduction of financial reward shows that the negative impact of the tax rate impact on reported emission is lower when the financial reward is provided. The same case also applies to the impact of the sanction rate and the available budget for audit. It shows that the insertion of financial reward pushes out the impact of other enforcement instruments.

It is intriguing to see from equation (10) that theoretically the positive impact of the tax rate on the reported emission is more achievable with the implementation of a financial reward. The marginal cost of evading the tax (the sum of the expected marginal sanction and the expected marginal loss of financial reward) may exceed the marginal benefit of evasion per unit change in reported emission, if the probability of the audit is high enough and it is accompanied with extremely high sanction and financial reward rate.

The comparison of sanction and financial reward impact on the reported emission yields an ambiguous conclusion. The impact of financial reward will be higher than the impact of the sanction if the optimal reported emission as expresses in equation (9) is close to the actual level. On the other hand, the impact of the sanction is superior to the financial reward if the optimal reported emission is much lower than the actual emission. A financial reward is only given to the firm that reports its emission level truthfully. Although the firm increases the emission report, the reward will not be granted if the requirement to declare the actual level is not met. Shifting the noncompliant to compliant behaviour by reporting the true level of emission is less favourable to the firm if the expected gain from cheating is much

higher. Therefore, the financial reward is only attractive for the firm if the gap between the optimal report and the actual level of emission is narrow.

On the other hand, the intensity of sanction is defined by the degree of noncompliance; the gap between the reported and actual levels of emission. The sanction will be more severe if the size of the underreported emission is wider. A sanction allows the polluting firm to adjust its behaviour according to the tolerated level of expected loss. The firm may adapt to the severity of the sanction by manipulating the report. If the sanction is more severe as the sanction rate increases, the firm may lower the expected cost by increasing the reported emission. Therefore, the impact of a sanction will be more considerable than a financial reward when the gap between the optimal report and the actual emission level is wide. However, the sanction does not necessarily induce the firm to declare the real emission level.

3.3.1.2. *The optimal behavior of the firm under the presence of bribery*

The previous case models the optimal behaviour of the polluting firm when tax officials are prevented from having a corrupting behaviour. This section will observe optimal behaviour of the firm when the officials are willing to engage in bribery.

When the financial reward is not offered, the payoff to the firm that correctly reports the true level of emission is expressed by $\psi_c^e = \pi - te$, the difference between the profit of generating emission (π) and the emission tax payment ($t e$, where t and e are tax rate and real emission level respectively). The payoff of the cheating firm that submits a reported emission (r) lower than actual emission (e) is defined by $\psi_c^r = \pi - (tr + \rho bst(e - r))$. The payoff is the profit of generating emission less the cost of understated tax payment and the expected cost of evading the tax. Since the tax officials are willing to engage in bribery, the sanction to the cheating firm is replaced by bribe, $bst(e - r)$, where b is bribe rate and s indicates the sanction rate. The bribe rate demanded by the corrupt officials is positive but less than 1, $1 > b > 0$, suggesting that the total amount of bribe should be less than the sanction. It is clear that if the total amount of bribe is at least equal to sanction⁸, the rational firms will avoid engaging in bribery. The condition of audit probability (ρ) is given by $\rho'[\tilde{a}] > 0$, $\rho'[r] < 0$ and $\rho''[r] > 0$, where \tilde{a} and r are audit budget and reported emission respectively.

⁸ where $b = 1$, meaning that the demanded bribe is 100 percent of the sanction.

The gain from underreporting emission for the noncompliant firm is presented by the following equation.

$$\psi_c = t(e-r) - \rho bst(e-r) \quad (14)$$

The gain is composed of the saved tax payment from underreporting emission less the expected cost of bribe if the report is getting audited. The firm decides the level of the emission report that maximizes the payoff. The FOC is given by the following equation.

$$\frac{\partial \psi_c}{\partial r} = -t + \rho bst - \frac{\partial \rho}{\partial r} bst(e-r) = 0 \quad (15)$$

Rewriting the FOC in terms of r will provide the following condition of optimal emission report.

$$r = e - \left(\frac{\rho bst - t}{\frac{\partial \rho}{\partial r} bst} \right) \quad (16)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

Equation (16) shows that the optimal level of reported emission is lower than the optimal report when bribery is prevented in equation (7). Instead of the sanction, the cost of evading the emission tax under the presence of bribery is determined by the bribe. Since the expected evasion cost is lower, the firm will gain more benefit by increasing the size of underreported emission through reduction of the reported emission.

The following comparative statics provide the impact of each instrument on reported emission.

$$\frac{\partial r}{\partial t} = - \frac{1 - \left(\rho bs - \frac{\partial \rho}{\partial r} bs(e-r) \right)}{\frac{\partial^2 \rho}{\partial r^2} bst(e-r) - 2 \frac{\partial \rho}{\partial r} bst} \quad (17)$$

$$\frac{\partial r}{\partial s} = \frac{\rho bt - \frac{\partial \rho}{\partial r} bt(e-r)}{\frac{\partial^2 \rho}{\partial r^2} bst(e-r) - 2 \frac{\partial \rho}{\partial r} bst} \quad (18)$$

$$\frac{\partial r}{\partial \tilde{a}} = \frac{\frac{\partial \rho}{\partial \tilde{a}} bst}{\frac{\partial^2 \rho}{\partial r^2} bst(e-r) - 2 \frac{\partial \rho}{\partial r} bst} \quad (19)$$

$$\frac{\partial r}{\partial b} = \frac{\rho st - \frac{\partial \rho}{\partial r} st(e-r)}{\frac{\partial^2 \rho}{\partial r^2} bst(e-r) - 2 \frac{\partial \rho}{\partial r} bst} \quad (20)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

Optimal reported emission is decreasing with the tax rate (t). The decrease in the reported emission (r) as the tax rate increases, is larger than the reduction of reported emission under the absence of bribery in equation (4) and equation (10). The previous result as shown by equation (4) gives a hint that the increase in the tax rate may increase the optimal reported emission if the intensity of audit and severity of the sanction is high enough to offset the benefit of cheating, and that possibility is even bigger when a financial reward is offered in equation (10). However, when bribery becomes prevalent, it is less likely that the increase in the tax rate will lead to a higher

reported emission. Although the audit is conducted more frequently, bribery shrinks the deterrence power of the sanction.

The optimal report is increasing with the available budget on audit (\tilde{a}), sanction rate (s), and bribe rate (b). The impacts of the audit budget and sanction rate under the presence of bribery are equal to those under the absence of bribery. Given that the bribe rate is lower than the sanction rate, the impact of the bribe rate on the reported emission (equation (20)) is stronger than the impact of the sanction rate (equation (18)). Although the sanction rate is set at a higher rate, the actual effect is weaker once tax officials are willing to omit the sanction for the bribe. Therefore, the optimal behaviour of a cheating firm will be more influenced by the bribe rate instead of the sanction rate.

When the MoF introduces the financial reward for compliance, denoted by i (where i , t and e are reward rate, tax rate, and actual emission level respectively), the payoff of generating emission for the compliant firm under the presence of bribery is described by $\psi_c^e = \pi - te + \rho i t e$. The payoff is the gain from generating emission (π) and the expected financial reward ($\rho i t e$), less the cost of emission tax payment ($t e$). The payoff for the noncompliant firm is given by $\psi_c^r = \pi - (tr + \rho bst(e - r))$, the profit of generating emission less the sum of underpaid tax payment and expected bribe. The gain from underreporting emission is given by the following equation.

$$\psi_c = t(e - r) - (\rho(bst(e - r) + ite)) \quad (21)$$

The gain consists of the tax saving resulted from underreporting the emission less the expected bribe cost and the loss of financial reward for reporting the emission truthfully. The FOC of equation (21) is following.

$$\frac{\partial \psi_c}{\partial r} = -t + \rho bst - \frac{\partial \rho}{\partial r} (bst(e - r) + ite) = 0 \quad (22)$$

The optimal reported emission (r) can be obtained by rewriting equation (22) in terms of r .

$$r = e - \left(\frac{\left(\rho bst - \frac{\partial \rho}{\partial r} ite \right) - t}{\frac{\partial \rho}{\partial r} bst} \right) \quad (23)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

The current optimal reported emission is higher than the report without the offer of financial reward (equation (16)). Financial reward increases the marginal cost of underreporting emission and reduces the marginal gain from the evasion. However, since the bribe practically replaces the sanction (hence reduces the marginal cost of underreporting), this optimal report is lower than the report when financial reward is granted in the absence of bribery (equation (9)).

The comparative statics derived from the FOC in equation (22) are presented below.

$$\frac{\partial r}{\partial t} = - \frac{1 - \left(\rho bs - \frac{\partial \rho}{\partial r} (bs(e-r) + ie) \right)}{\frac{\partial^2 \rho}{\partial r^2} (bst(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} bst} \quad (24)$$

$$\frac{\partial r}{\partial s} = \frac{\rho bt - \frac{\partial \rho}{\partial r} bt(e-r)}{\frac{\partial^2 \rho}{\partial r^2} (bst(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} bst} \quad (25)$$

$$\frac{\partial r}{\partial \tilde{a}} = \frac{\frac{\partial \rho}{\partial \tilde{a}} bst}{\frac{\partial^2 \rho}{\partial r^2} (bst(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} bst}$$

(26)

$$\frac{\partial r}{\partial b} = \frac{\rho st - \frac{\partial \rho}{\partial r} st(e-r)}{\frac{\partial^2 \rho}{\partial r^2} (bst(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} bst}$$

(27)

$$\frac{\partial r}{\partial i} = \frac{-\frac{\partial \rho}{\partial r} te}{\frac{\partial^2 \rho}{\partial r^2} (bst(e-r) + ite) - 2 \frac{\partial \rho}{\partial r} bst}$$

(28)

Where $\frac{\partial \rho}{\partial r} < 0$.

The optimal reported emission is decreasing with the tax rate (t) and increasing with the available budget of the MoF allocated on audit (\tilde{a}), sanction rate (s), bribe rate (b), and financial reward rate (i). Under the presence of bribery, the negative impact of a tax rate on reported emission is smaller when a financial reward for compliance is introduced. It suggests that the firm will be less responsive to the change in the tax rate, and the increase in the tax rate will induce less reduction of reported emission compared to that without financial reward. However, the deterrence impact of sanction rate, audit budget, and bribe rate on the optimal report is also weaker when the reward is offered.

Similar to the previous situation without the availability of financial reward, the impact of the bribe rate on the optimal report is higher than the impact of the sanction rate. To the cheating firm, the actual punishment for underreporting is determined by the bribe rate set by the corrupt official. Therefore, the firms will be more influenced by the bribe rate rather than the formal sanction rate.

The impact of financial reward will be higher than the impact of the sanction only if the optimal reported emission as expressed in equation (23) is approaching the actual level, otherwise the impact of the sanction will be superior to the impact of financial reward.

The financial reward will have a greater impact on reported emission than a bribe only if the optimal reported emission is close to the actual emission level, and the bribe is so expensive that it is approaching the size of the sanction. Bribing to evade the sanction is less appealing than the anticipation of financial reward when the size of requested bribe is almost equal to the sanction. Once the gap between the optimal report and the actual level is narrowed, shifting from noncompliance to compliance behaviour will be less costly for a firm. However, reporting accurately will create a considerable loss of gain for the cheating firm if this gap is wide and the size of bribe is considerably smaller than the sanction. In this case, the firm will be inclined to underreport the emission and anticipate the bribe.

Financial reward is less significant to stimulate the compliance of the firm when bribery is not curbed. The bribe nullifies the severity of a sanction, decreases the marginal cost of evasion and thus raises the gain of underreporting emission. On the other hand, the cost of evading the emission tax is higher when the financial reward is available; therefore, a decrease in the bribe rate will be responded by the cheating firm with a lesser reduction in reported emission.

3.3.2. The optimal behavior of the tax official

The optimal behaviour of the tax official is observed under two different cases regarding the availability of a financial reward for revealing underreported emission. The first case observes the optimal behaviour of tax officials when a financial reward is not offered, while the second case examines the optimal behaviour when the financial reward is available.

In the first case, the payoff to the tax official from exposing underreported emission is simply defined by $\psi_i^h = w$, where w is the fixed wage. The corrupt tax official decides the optimal bribe rate (b), given the probability of inspection (σ) and the penalty for taking the bribe (p). The probability that the corrupt official is inspected given by $\sigma[\hat{a}+r]$, where \hat{a} represents the MoF's budget allocated on inspection and r symbolizes the reported emission of the firm. The probability is characterized by $\sigma'[\hat{a}] > 0$, $\sigma'[r] < 0$ and $\sigma''[r] > 0$. The penalty is a function of unreported emission ($e-r$), with

$p'[e - r] > 0$ and $p''[e - r] > 0$, indicating that the penalty for taking bribe is increasing with the size of the unpunished evasion.

The payoff from the taking a bribe and allowing the evasion is expressed by $\psi_t^b = w + (bst(e - r) - \sigma p)$. The payoff is the sum of fixed wage plus the expected income from taking the bribe ($bst(e - r)$, where b , s , t , e , and r are bribe rate, sanction rate, tax rate, actual emission, and reported emission respectively). The income from accepting the bribe is the amount of the bribe proportional to the sanction, with a proportion b , less the cost for accepting the bribe (the expected penalty if the official is inspected, σp).

The gain of accepting the bribe is the difference between the payoff for allowing the evasion and the payoff from exposing the underreported emission. The gain is represented by the equation below.

$$\psi_t = bst(e - r) - \sigma p \tag{29}$$

The maximum payoff from taking the bribe is reached when the marginal payoff as the bribe rate changes is equalized to zero. The FOC of equation (29) is formulated by the following equation.

$$\frac{\partial \psi_t}{\partial b} = \left(st(e - r) - \frac{\partial r}{\partial b} bst \right) + \left(\sigma \frac{\partial p}{\partial(e - r)} \frac{\partial r}{\partial b} - p \frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b} \right) = 0 \tag{30}$$

Where $\frac{\partial \sigma}{\partial r} < 0$.

Equation (30) can be rearranged with respect to b to find the optimal value for bribe rate.

$$b = \frac{st(e-r) + \left(\sigma \frac{\partial p}{\partial(e-r)} \frac{\partial r}{\partial b} - p \frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b} \right)}{\frac{\partial r}{\partial b} st}$$

(31)

Where $\frac{\partial \sigma}{\partial r} < 0$.

The bribe rate will be optimal to tax official if it equalizes the expected marginal gain of a bribe and the marginal penalty as the bribe rate changes. Implicit differentiation on FOC in equation (30) provides comparative statics, demonstrating the impact of each enforcement instrument on the optimal bribe rate.

$$\frac{\partial b}{\partial \hat{a}} = \frac{-\frac{\partial \sigma}{\partial \hat{a}} \frac{\partial \rho}{\partial r} \frac{\partial r}{\partial b}}{\frac{\partial^2 \psi_t}{\partial b^2}}$$

(32)

$$\frac{\partial b}{\partial p} = \frac{-\frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b}}{\frac{\partial^2 \psi_t}{\partial b^2}}$$

(33)

Where

$$\frac{\partial^2 \psi_t}{\partial b^2} = -2 \frac{\partial r}{\partial b} st - \frac{\partial^2 p}{\partial(e-r)^2} bst + \left(\sigma \left(\frac{\partial p}{\partial(e-r)} \frac{\partial^2 r}{\partial b^2} - \frac{\partial^2 p}{\partial(e-r)^2} \left(\frac{\partial r}{\partial b} \right)^2 \right) + p \left(\frac{\partial^2 \sigma}{\partial r^2} \left(\frac{\partial r}{\partial b} \right)^2 - \frac{\partial \sigma}{\partial r} \frac{\partial^2 r}{\partial b^2} \right) \right)$$

and

$$\frac{\partial \sigma}{\partial r} < 0, \quad \frac{\partial \rho}{\partial r} < 0.$$

Optimal bribe rate is increasing with the available budget allocated on inspection (\hat{a}) and severity of penalty (p). The increase in these two instruments leads to a higher expected cost of accepting the bribe. This increase will be responded by the tax official with increasing the bribe rate to compensate the potential loss. Given that $\frac{\partial \sigma}{\partial \hat{a}} < 1$, the impact of the penalty on the bribe rate (equation (33)) is stronger than the impact of the budget allocated by MoF on inspection (equation (32)).

In the second case, the MoF provides a financial reward to the officials who are able to reveal the evasion. After the introduction of a financial reward, the payoff to the tax official for exposing underreported emission is defined by $\psi_i^h = w + \eta st(e - r)$. The payoff consists of fixed wage (w) and the financial reward proportional to amount of the sanction (the revenue accrued to the MoF from the revealed evasion) with a proportion η , where η indicates the financial reward rate. The payoff for concealing the evasion in exchange of bribe is similar to the payoff before financial reward is introduced, $\psi_i^b = w + (bst(e - r) - \sigma p)$.

After financial reward is available, the payoff from accepting the bribe is defined by the following equation.

$$\psi_i = bst(e - r) - (\sigma p + \eta st(e - r)) \quad (34)$$

FOC of equation (34) is following.

$$\frac{\partial \psi_i}{\partial b} = \left(st(e - r) - \frac{\partial r}{\partial b} bst \right) + \left(\sigma \frac{\partial p}{\partial (e - r)} \frac{\partial r}{\partial b} - p \frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b} + \eta \frac{\partial r}{\partial b} st \right) = 0 \quad (35)$$

Where $\frac{\partial \sigma}{\partial r} < 0$.

Rearranging equation (35) in terms of b , to find the optimal value for bribe rate, results in the following condition,

$$b = \frac{st(e-r) + \left(\sigma \frac{\partial p}{\partial r} \frac{\partial r}{\partial b} - p \frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b} + \eta \frac{\partial r}{\partial b} st \right)}{\frac{\partial r}{\partial b} st} \quad (36)$$

Where $\frac{\partial \sigma}{\partial r} < 0$.

It can be easily recognized from the equation (31) and (36) that the optimal bribe rate is higher with the prospective of earning a financial reward. The bribe rate should be high enough to compensate the potential loss from concealing the evasion, not only the loss from the expected penalty but also the potential reward for exposing the underreported emission. The comparative statics are as follows.

$$\frac{\partial b}{\partial \hat{a}} = \frac{-\frac{\partial \sigma}{\partial \hat{a}} \frac{\partial \rho}{\partial r} \frac{\partial r}{\partial b}}{\frac{\partial^2 \psi_t}{\partial b^2}} \quad (37)$$

$$\frac{\partial b}{\partial p} = \frac{-\frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b}}{\frac{\partial^2 \psi_t}{\partial b^2}} \quad (38)$$

$$\frac{\frac{\partial b}{\partial \eta} = \frac{\frac{\partial r}{\partial b} st}{\frac{\partial^2 \psi_t}{\partial b^2}} \quad (39)$$

Where

$$\frac{\partial^2 \psi_t}{\partial b^2} = -2 \frac{\partial r}{\partial b} st - \frac{\partial^2 p}{\partial (e-r)^2} bst + \left(\sigma \left(\frac{\partial p}{\partial (e-r)} \frac{\partial^2 r}{\partial b^2} - \frac{\partial^2 p}{\partial (e-r)^2} \left(\frac{\partial r}{\partial b} \right)^2 \right) + p \left(\frac{\partial^2 \sigma}{\partial r^2} \left(\frac{\partial r}{\partial b} \right)^2 - \frac{\partial \sigma}{\partial r} \frac{\partial^2 r}{\partial b^2} \right) + \eta \frac{\partial^2 r}{\partial b^2} st \right)$$

and

$$\frac{\partial \sigma}{\partial r} < 0, \quad \frac{\partial \rho}{\partial r} < 0.$$

The bribe rate is increasing with the allocated budget on inspection (\hat{a}), the penalty for taking a bribe (p), and the financial reward rate (i). Given that $\frac{\partial \sigma}{\partial \hat{a}} < 1$, the impact of a penalty on the optimal bribe rate is stronger than the impact of the budget spending on inspection. The comparative statics show that the impact of financial reward on the bribe rate is bigger than the penalty. Financial reward provides a stronger impact than the penalty since the official may apply for the reward directly after discovering the tax evasion; while on the other hand, the charge of penalty is subject to the probability of being inspected.

The impact of inspection spending and penalty on the bribe rate is higher when the financial reward for revealing evasion is available. In contrast to the optimal behaviour of polluting firm, the presence of financial reward does not crowd out the impact of other enforcement instruments since the reward directed to the tax official is not conditional on the probability of inspection. The official who finds the violation on emission tax is eligible for the reward, after providing evidence of evasion to the MoF, without waiting to be inspected. Therefore, the financial reward can be considered a direct loss to the official for taking the bribe. As the probability of an inspection and penalty increase, the marginal cost is higher since the reward is added up to the direct cost of taking the bribe. The rational tax official will attempt to compensate the cost with a higher bribe rate.

3.3.3. The optimal policies of Ministry of Finance

The MoF intends to internalize the environmental cost of pollution to the polluting firms and to utilize the tax revenue on social benefits, such as environmental programs and public goods' provisions. The gain from taxing the emission is the social benefit from emission tax, which is a function of tax revenue ($\lambda[tr]$), less the environmental damage as a function of actual emission ($\varepsilon[e]$) since taxing the emission also reflects the permit to emit the pollutant. . It is assumed that the level of actual emission (e) is influenced by the emission tax rate (t), with $e'[t]<0$ that indicates an increase in tax rate will encourage the firm to lower their emission.

Enforcing compliance with emission tax will accrue a cost to the MoF. The enforcement cost is the sum of costly enforcement instruments, including the cost of sanction for noncompliant firms (S), penalty for the tax officials (P), financial reward for compliant firms (I), and financial reward for the honest tax officials who are able to reveal the evasion (Π)⁹. Those costs are defined by $S[s+(e-r)]$, $P[p+(e-r)]$, $I[i+e]$, and $\Pi[\eta+(e-r)]$, indicating that the expenses of those instruments are the functions of the rate of each instrument and the size of the evaded tax (except the expense of financial reward for compliant firms, which is determined by the size of actual emission). The characteristic of those instruments are given by $S'[s]>0$, $P'[p]>0$, $I'[i]>0$, $\Pi'[\eta]>0$, $S'[e-r]>0$, $P'[e-r]>0$, $I'[e]>0$, and $N'[e-r]>0$, meaning that the expense is greater as the rate of each instrument and the evaded tax (or the actual emission in the case of financial reward for compliant firm, I) is higher. The payoff of the MoF is the gain of the emission tax less the cost of emission tax enforcement, and formulated as follows.

$$\psi_m = (\lambda - \varepsilon) - (S + P + I + \Pi) \quad (40)$$

The MoF chooses the level of tax rate and enforcement instruments that maximize the payoff from emission tax. Taking into consideration the optimal

⁹ Since the size of budget allocated on audit (\tilde{a}) and inspection (\hat{a}) are determined by the available resource of MoF instead of the size of noncompliance, those instruments are assumed to be exogenous variables and excluded from the optimal decision of MoF.

behaviour of the firm with respect to tax where $\frac{\partial r}{\partial t} < 0$, $\frac{\partial e}{\partial t} < 0$, and assumed that $\frac{\partial(e-r)}{\partial t} > 0$ ¹⁰, the payoff of the MoF with respect to t will be obtained under the following FOC.

$$\frac{\partial \psi_m}{\partial t} = \frac{\partial \lambda}{\partial r} \left(r - \frac{\partial r}{\partial t} t \right) + \frac{\partial \varepsilon}{\partial e} \frac{\partial e}{\partial t} - \frac{\partial(S+P+\Pi)}{\partial(e-r)} \frac{\partial(e-r)}{\partial t} = 0 \quad (41)$$

The optimal tax rate can be obtained by rewriting FOC in equation (41) in terms of t .

$$t = \frac{\left(\frac{\partial \lambda}{\partial tr} r + \frac{\partial \varepsilon}{\partial e} \frac{\partial e}{\partial t} \right) - \left(\frac{\partial(S+P+\Pi)}{\partial(e-r)} \frac{\partial(e-r)}{\partial t} \right)}{\frac{\partial \lambda}{\partial tr} \frac{\partial r}{\partial t}} \quad (42)$$

The optimal tax rate is equal to marginal gain from the emission tax less the marginal cost of enforcement to prevent the evasion for each unit of adjustment in social benefit as the tax rate changes. The optimal behaviour of the firms indicates that the reported emission, and the actual emission by assumption, will decrease with the tax rate. Therefore, the gain of the emission tax consists of the social benefit from tax revenue and the reduction in environmental damage as the tax rate increases. The optimal tax rate is negatively related to the marginal cost of enforcement. If the increase in tax rate is responded by higher evasion which leads to a higher

¹⁰ This assumption is following the seminal work of Harford (1978), which finds that the increase in tax rate decreases the reported pollutants in a greater scale than the reduction of the actual emission level. These findings suggest that increasing the tax rate will escalate the evasion. This assumption is also based on the fact that decreasing the actual level of emission is more difficult to manage (since it requires the application of new technology or adjustment of the production process) than manipulating the reported level of emission.

enforcement cost, the tax should be kept at low rate to maintain the optimal condition for the MoF.

According to the subject to whom the policies are directed, the instruments available to the MoF can be classified into two categories. The first category is directed to enforce the compliance of polluting firms, consisted of the sanction and financial reward. The second category includes penalty and financial for revealing the evasion, is aimed to maintain the compliance of tax officials.

The condition for the optimal sanction rate (s) is obtained from FOC of the MoF's payoff in equation (40) with respect to s and defined by the following equation.

$$\frac{\partial r}{\partial s} = \frac{1}{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S + P + \Pi)}{\partial(e - r)} \right)} \quad (43)$$

The equation above implies that the optimal measures are subject to the responses of polluting firms in reporting their emission. The optimal sanction rate could be found by substituting $\frac{\partial r}{\partial s}$ with corresponding impact of the sanction on optimal reported emission of the polluting firm. Since the responses are different according to the availability of financial reward and the willingness of tax officials to engage in bribery, the optimal sanction will be unique within each situation. Let s_1, s_2 be the sanction rates without and with the availability of financial reward respectively under the absence of bribery, and s_3, s_4 be the sanction rates without and with the provision of financial reward in the prevalence of bribery. The optimal sanction rates are following.

$$s_1 = \frac{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S + P + \Pi)}{\partial(e - r)} \right) \left(\rho - \frac{\partial \rho}{\partial r} (e - r) \right)}{\frac{\partial^2 \rho}{\partial r^2} (e - r) - 2 \frac{\partial \rho}{\partial r}} \quad (44)$$

$$s_2 = \frac{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S + P + \Pi)}{\partial(e-r)} \right) \left(\rho - \frac{\partial \rho}{\partial r} (e-r) \right) - \frac{\partial^2 \rho}{\partial r^2} ie}{\frac{\partial^2 \rho}{\partial r^2} (e-r) - 2 \frac{\partial \rho}{\partial r}}$$

(45)

$$s_3 = \frac{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S + P + \Pi)}{\partial(e-r)} \right) \left(\rho - \frac{\partial \rho}{\partial r} (e-r) \right)}{\frac{\partial^2 \rho}{\partial r^2} (e-r) - 2 \frac{\partial \rho}{\partial r}}$$

(46)

$$s_4 = \frac{b \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S + P + \Pi)}{\partial(e-r)} \right) \left(\rho - \frac{\partial \rho}{\partial r} (e-r) \right) - \frac{\partial^2 \rho}{\partial r^2} ie}{b \left(\frac{\partial^2 \rho}{\partial r^2} (e-r) - 2 \frac{\partial \rho}{\partial r} \right)}$$

(47)

Where $\frac{\partial \rho}{\partial r} < 0$.

The optimal rate of sanction (s) should be equal to the marginal benefit of sanctioning adjusted by the optimal reported emission of polluting firms due to sanction. The benefit of sanctioning consists of the environmental benefit and the reduction of enforcement cost as reported emission increases.

In general, optimal sanction rate depends on the magnitude of its impact on the reported emission. Considering the optimal responses of the firm on the sanction, the optimal rate could be higher in the situation without the availability of financial reward, both in the absence and the presence of bribery. Under the presence of bribery, the sanction rate could be smaller with the availability of financial reward.

The condition of optimal financial reward rate (i) for compliant firms, which is obtained from FOC of the MoF's payoff in equation (40) with respect to i is following.

$$\frac{\partial r}{\partial i} = \frac{1}{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)} \right)} \quad (48)$$

Optimal reward rate could be obtained by substituting $\frac{\partial r}{\partial i}$ with the corresponding impact of financial reward on optimal reported emission of polluting firm. Let i_1, i_2 be the financial reward under the absence and the presence of bribery, the optimal rates are the following.

$$i_1 = \left(\frac{\left(2 \frac{\partial \rho}{\partial r} s - \frac{\partial^2 \rho}{\partial r^2} s(e-r) \right) - \frac{\partial \rho}{\partial r} e \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)} \right)}{\frac{\partial^2 \rho}{\partial r^2} e} \right) \quad (49)$$

$$i_2 = \left(\frac{b \left(2 \frac{\partial \rho}{\partial r} s - \frac{\partial^2 \rho}{\partial r^2} s(e-r) \right) - \frac{\partial \rho}{\partial r} e \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)} \right)}{\frac{\partial^2 \rho}{\partial r^2} e} \right) \quad (50)$$

Where $\frac{\partial \rho}{\partial r} < 0$.

The optimal financial reward may increase if the marginal reported emission is higher. However, if the firm is not responsive to the financial reward, it will be optimal for the MoF to provide a smaller reward. In the case where bribery prevails, the magnitude of financial reward impact is dropped. Therefore, the MoF should decrease the financial reward to maintain the optimal payoff. Based on the fact that the impact of financial reward is lower

than sanction, the budget to support the financial reward should be lower than the allocated budget on the sanction.

The second category of enforcement is aimed at maintaining the compliance of tax officials under the presence of bribery. This category includes a penalty for taking the bribe and financial reward for revealing the evasion. Although the instruments are directed at tax officials, the final objective is to encourage the compliance of the polluting firms by making the bribery more costly.

The condition for optimal penalty is the following.

$$\frac{\partial b}{\partial p} = \frac{1}{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)} \right)} \quad (51)$$

The equation above implies that the optimal penalty is defined by the responses of polluting firms to the change in the bribe rate, and the response of corrupting officials to the penalty. The optimal rate could be found by substituting $\frac{\partial b}{\partial p}$ with the corresponding impact of penalty on the optimal behaviour of tax officials. Let p_1, p_2 be the penalty for the corrupt tax official under the absence and the presence of financial reward, the optimal penalties are the following.

$$p_1 = \frac{\left(-\frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b} \right) \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)} \right) + \left(2 \frac{\partial r}{\partial b} st + \frac{\partial^2 p}{\partial(e-r)^2} bst - \sigma \left(\frac{\partial p}{\partial(e-r)} \frac{\partial^2 r}{\partial b^2} - \frac{\partial^2 p}{\partial(e-r)^2} \left(\frac{\partial r}{\partial b} \right)^2 \right) \right)}{\frac{\partial^2 \sigma}{\partial r^2} \left(\frac{\partial r}{\partial b} \right)^2 - \frac{\partial \sigma}{\partial r} \frac{\partial^2 r}{\partial b^2}} \quad (52)$$

$$p_2 = \frac{\left(-\frac{\partial \sigma}{\partial r} \frac{\partial r}{\partial b}\right) \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)}\right) + \left(2\frac{\partial r}{\partial b} st + \frac{\partial^2 p}{\partial(e-r)^2} bst - \sigma \left(\frac{\partial p}{\partial(e-r)} \frac{\partial^2 r}{\partial b^2} - \frac{\partial^2 p}{\partial(e-r)^2} \left(\frac{\partial r}{\partial b}\right)^2\right) - \eta \frac{\partial^2 r}{\partial b^2} st\right)}{\frac{\partial^2 \sigma}{\partial r^2} \left(\frac{\partial r}{\partial b}\right)^2 - \frac{\partial \sigma}{\partial r} \frac{\partial^2 r}{\partial b^2}}$$

(53)

Where $\frac{\partial \sigma}{\partial r} < 0$.

Equation (51) shows that the optimal penalty for corrupting officials is increasing with magnitude of the impact on the bribe rate. If the impact is stronger, the optimal penalty can be set at a higher rate. The optimal penalty rate when a financial reward is available (equation 53) could be lower than the rate without the financial reward (equation 52).

The optimal financial reward for the tax officials for revealing the evasion is defined by the following condition.

$$\frac{\partial b}{\partial \eta} = \frac{1}{\left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial(S+P+\Pi)}{\partial(e-r)}\right)}$$

(54)

The optimal financial reward rate for the officials (η) could be obtained by substituting $\frac{\partial b}{\partial \eta}$ with the corresponding impact of financial reward on optimal behaviour of the tax official. The optimal reward is given by the following condition.

$$\eta = \frac{\frac{\partial r}{\partial b} st \left(\frac{\partial \lambda}{\partial tr} t + \frac{\partial (S+P+\Pi)}{\partial (e-r)} \right) + \left(2 \frac{\partial r}{\partial b} st + \frac{\partial^2 p}{\partial (e-r)^2} bst - \sigma \left(\frac{\partial p}{\partial (e-r)} \frac{\partial^2 r}{\partial b^2} - \frac{\partial^2 p}{\partial (e-r)^2} \left(\frac{\partial r}{\partial b} \right)^2 \right) - p \left(\frac{\partial^2 \sigma}{\partial r^2} \left(\frac{\partial r}{\partial b} \right)^2 - \frac{\partial \sigma}{\partial r} \frac{\partial^2 r}{\partial b^2} \right)}{\frac{\partial^2 r}{\partial b^2} st}$$

(55)

Where $\frac{\partial \sigma}{\partial r} < 0$.

Equation (55) indicates that optimal reward for tax officials is increasing with the size of the impact on the bribe rate. If the impact becomes greater, the optimal financial reward may increase to reach the optimal payoff for the MoF. The optimal financial reward could be higher than the optimal penalty, since the optimal behaviour of the tax officials suggests that the impact of financial reward on bribe rate is greater than the impact of the penalty.

3.4. CONCLUSION

This theoretical study is intended to provide the clue regarding the optimal emission tax that induces the compliance. The model refers to the work of Wilson and Damania (2005) on the interplay between bribery and emission tax compliance. Deviating from the model of Wilson and Damania (2005), the model in this study assumes that the emission report is an independent decision of the firms instead of being a negotiated agreement between firms and government agents. This assumption is consistent with the applied self-assessment taxation system in Indonesia, which enables the firms to decide the level of emission report privately. This assumption is also relevant to the costly monitoring situation, which requires the officials to select the submitted reports with higher possibility of inaccuracy before auditing the firms. The model extends the study of Wilson and Damania (2005) by incorporating financial reward to invoke higher compliance level. Following Swierzbinski (1994), the reward scheme resembles a deposit-refund system, where the reward is given after the accuracy of the emission report is confirmed. This theoretical research expands the environmental compliance

literatures by examining financial reward and bribery in combination, which has never been done in the existing studies.

The study firstly solves the optimal behaviour regarding the reported emission of polluting firms, given a set of policy instruments announced by the MoF and the bribe rate determined by tax officials. Different optimal conditions for reported emission are developed under different assumptions of financial reward availability and the prevalence of bribery. After the optimal decisions of the firms are solved, this study formulates the optimal decision of tax officials in determining the bribe rate, given the enforcement policies set by the MoF. Optimal decisions of tax officials are constructed under different settings regarding the availability of financial reward for revealing the tax evasion. Finally, taking into consideration the optimal behaviour of both polluting firms and tax officials, the MoF decides the optimal enforcement policy. The elements of policy mixture include of the sanction for noncompliant firms, financial reward for compliant firms, penalty for corrupting tax officials, and financial reward for tax officials to reveal the evasion.

In general, optimal reports of polluting firms are decreasing with the tax rate and increasing with sanction, audit probability, financial reward for compliance, and bribe. Under the presence of bribery, the optimal reported emission of polluting firms is lower than without bribery. The availability of financial reward increases the optimal report, although the increase becomes smaller when the bribery prevails. The availability of financial reward is also able to mitigate the negative impact of emission tax on reported emission. On the other hand, financial reward lessens the impact of the sanction and audit probability.

The highest impact on reported emission under the presence of bribery is demonstrated by the bribe, and the second highest impact is given by the sanction. The impact of the sanction is superior to the financial reward in increasing the report when the gap between the optimal reported emission and the actual emission is wide.

Contrary to the optimal behaviour of polluting firm, the optimal behaviour of a tax official in deciding the bribe rate is more affected by the financial reward instead of the penalty. Furthermore, the availability of financial reward for discovering evasion does not crowd out the impact of other enforcement instruments. For instance, the impact of the sanction on optimal bribe rate remains the same as before and after the introduction of financial reward. This difference is stemmed from the difference between

the reward disbursement mechanism for the firms and the officials. In the model, compliant firms may only get the reward if they are audited by tax officials with a certain probability. On the contrary, officials who are able to find the noncompliance may directly propose for financial reward by submitting the report of tax evasion to the MoF.

The MoF should incorporate the optimal behaviour of polluting firms and tax officials when deciding the optimal level of policy instruments. The optimal tax rate should be balancing the benefit of tax with the cost of enforcement and the decline of the environmental gain due to tax evasion. In the case where the evasion is high and the capacity of government to disburse the tax revenue on the environmental program effectively is limited, the optimal emission tax rate will be lower than the Pigovian rate.

The optimal sanction and financial reward for the polluting firms are defined by the optimal response of the firms and the marginal benefit of each instrument, consisted of the increase in environmental benefit and reduction of enforcement cost due to the increase in reported emission and tax payment. Since reported emission is more responsive to the change in expected sanction than to the change in expected financial reward, the optimal sanction for the noncompliant firm could be higher than the compliance reward to maintain the optimal payoff for the MoF.

The optimal penalty levied and financial reward for the tax officials depends on the marginal benefit of each instrument (a higher environmental benefit and a lower enforcement cost as the reported emission increase), optimal response of tax officials, and optimal response of polluting firms to the bribe rate. Since the bribe rate is more responsive to the change in financial reward than the change of expected penalty, the optimal financial reward for revealing the evasion could be higher than the penalty.

Based on those theoretical findings, the best combination of emission tax schemes in the presence of bribery with costly monitoring would be a low tax rate with high noncompliance sanction and low financial reward for polluting firms, in combination with high financial reward for tax officials who are able to discover the evasion and moderate penalty for the corrupt tax officials.

Chapter 4

COMPLIANCE BEHAVIOUR UNDER THE PRESENCE OF BRIBERY: EXPERIMENTAL SUPPORT FOR EMISSION TAX IN INDONESIA

4.1. INTRODUCTION

The theoretical approach in the chapter three provides the analysis of the optimal emission tax scheme under the presence of bribery. The theoretical method offers a framework to deal with institutional design. However, dealing with institutional setting has to consider the complication of the real economic activity. A significant complication appears in the behaviour of the real economic agents, which may not be simply driven by utility maximization as assumed in the game theoretical approach. Laboratory experiment can provide the information regarding how people will behave to the particular economic design, thus, verifies the prediction of theoretical approach. In this sense, the laboratory experiment can be considered a complement to the theoretical method, to compensate the limitation of theoretical results due to the complexity of real economic system (Roth, 2002).

Plott (1982) describes the experimental method as an approach to examine the human behaviour in the economic decision settings with the experiments. This method brings real people into the laboratory (or the field) in which they decide real choices and earn or loss financial payoff as the consequence of their decision. The main elements of the experiment are the environment, the institution, and the incentive. The environment is composed of the economic agents (the experimental subjects) with the corresponding characteristics such as social values, resources and information. The institution consists of the rules that regulate the action (and interaction) of the economic agents. The experimental methods allow the researcher to control the institutions and incentives faced by the subjects to examine the main issues of interest (Alm, 2011). Changing these elements in a controlled laboratory setting enables the deduction of the determinants of behavioural change.

A laboratory experiment can be employed to examine a policy design without prior empirical information. This approach enables the researcher to observe the performance of new institutions and to suggest the

improvement based on the observation results (Smith, 2003). This characteristic is crucial since it is difficult to obtain the data prior to the implementation of the examined policies. For instance, the data of compliance as a response to a newly proposed emission taxation scheme is impossible to obtain since the response will not be available before the reform takes place. On the other hand, the information regarding how the regulated subjects will behave under different schemes is important for policy purposes.

According to Alm (2011), another important feature of the experiment is its ability to generate the information of individual or group decisions in the settings where the institutions and incentives can be manipulated independently, in order to investigate the responses to the isolated changes in those elements. Therefore, the impact of each determinant can be observed in isolation without the influence of compounding factors. In the case of empirical research on emission tax, the compliance of the taxpayers given certain policy scheme may be confounded by unidentified factors, leading to difficulty in observing the impact of individual determinants within the policy mixture. Laboratory experiments may provide a helpful solution by enabling the separate impact of each determinant to be generated and compared.

Roth (1987) classifies the objectives of experiment into three broad categories. The first category is "Speaking to Theorist", involving the experiments intended to test the well-established theories. The second category is "Searching for Facts", involving the experiments designed to observe the impact of the variables of which the existing theory cannot provide a profound explanation. The third category is "Whispering in the Ears of Princes", identifying the experiments motivated by certain policy issues of interest. The majority of the experiments have been enlisted in the first two categories thus far. However, currently the experiments are gradually employed to inform the policy maker regarding specific subjects of relevance (Alm, 2011).

Referring to the classification of Roth (1987), the experimental study of this dissertation could be more suitably grouped within the third category. This study is intended to investigate the compliance behaviour of the regulated polluting firms as the response to emission tax schemes under different designs. This is important since the implementation of the schemes will have significant and irreversible outcomes.

In particular, this experimental study aims to compare the compliance behaviour and the effect of determinants within the emission tax scheme on the compliance behaviour of polluting firms, under different bribery settings. Emission tax scheme in this research is a combination of tax rate, sanction rate, reward rate, bribe rate, and auditing probability. This experiment sets the determinant variables to act independently and simultaneously in designed games. This setting enables the observation of the individual effect of each determinant while controlling other influential variables.

The rest of the paper is ordered as follows. The next section following the introduction part will present the brief review of experimental literature on tax compliance. The method and the conduct of the experiment are described afterwards, followed by the section presenting and discussing the experimental results. The last section is the conclusion and policy recommendation.

4.2. LITERATURE REVIEW

The literature on environmental regulation and enforcement follows from the studies on optimal penalties in the law and economics (Polinsky and Shavell, 2000). Despite the difference in the intended tax's objectives, the issue of compliance with the emission tax is identical to the problem of compliance with the other taxes. The initial literature of tax compliance could be traced back to the work of Becker (1968) on the economics of crime. In his analysis, criminals are considered rational individuals who seek to maximize expected utility. Criminals make an economic decision by judging the benefit of the crime against the probability of detection, conviction, and punishment. Increasing the component of detection and punishment will reduce the economic reward of the crime. Allingham and Sandmo (1972) apply the economics of crime approach to taxpayer compliance; in which taxpayer is assumed to weigh the potential costs of noncompliance against its potential benefits. The costs are a function of detection probability and the punishment for underpayment, while the benefits are a function of tax rate and income level. The model presents the insight that tax evasion is negatively correlated with the tax rate, detection probability and severity of punishment.

The first experimental research on tax compliance by Friedland et al. (1978) examine tax evasion behaviour with three explanatory variables: tax rate, audit frequency, and magnitude of fine. The experiment reveals a significant

increase in probability and occurrence of tax evasion as the tax rate increases. They conclude that the tax rate is the most influential determining factor for tax evasion. The experimental result also suggests that the compliance is more influenced by the magnitude of fine than by audit probabilities. The latter result is supported by Park and Hyun (2003) who find that the magnitude of fine affects the compliance stronger than the probability of audit. However, Friedland (1982) reports that audit intensity affect the compliance more than the severity of the fine.

Beck et al. (1991) investigate the effects of variations in determinant variables, including tax rate, penalty rate, and audit probability on reported taxable income. The results support their hypothesis that risk-neutral taxpayers will increase their compliant behaviour as the detection probability and penalty rate increase. However, different with the finding of Freidland et al. (1978), the tax rate is not found to influence the compliance behaviour of taxpayers. Insignificant effect of the tax rate is also found in an experiment by Baldry (1987) and a study by Porcano (1988), both experiments investigate the self-reported compliance behaviour.

Alm et al. (1992a) conduct the experiment with declared income as the dependent variable and independent variables employed in their experiment are income, tax rate, fine rate, audit rate, and public goods (for some sessions). The results show that higher tax rates significantly lessen the tax compliance. The fine is also found to deter the evasion, although the impact is virtually zero. Alm et al. (1995) show that fines are only effective in combination with high audit frequency. Their experiment suggests that the interaction of both variables is more salient than their separate effects.

A Meta Study by Blackwell (2007) based on twenty laboratory experimental studies examines the impacts of conventional economic determinants of tax compliance: the tax rate, the penalty rate, and the probability of audit. In addition, the study also includes the effect of a public good “return” to tax payment. The study finds a strong evidence that increasing the penalty rate, audit probability, and marginal-percapita return to the public good positively affect the tax compliance, but finds no statistically significant effect of the tax rate on the compliance.

There is a large experimental tax compliance literature, well surveyed by Torgler (2002). The survey suggests that while tax rate, auditing, and fines affect the compliance, it is also true that social and institutional factors systematically matter. Taxpayers may as well be driven by moral rules and

sentiments. They might bear moral costs if they do not pay the taxes and act as free-riders.

With regard to the issue of tax compliance and corruption, the analytical research of Chander and Wilde (1992) suggests that the expected government revenue may be lower in the presence of corrupted officials. Moreover, when bribing is allowed and tax evaders are willing to pay the bribe, the increase in fines and tax rates may lower the tax returns. A more recent experiment by Bilotkach (2006) examines the issue of tax evasion by companies through underreporting activity. He develops the game in which a businessman can hide part of his profit and offer a bribe to the official. The results reveal that once it becomes known that supervising officials agree to accept bribes, participants offer bribes more aggressively and the magnitude of underreporting increases.

The effect of reward on tax compliance has been considered, although the experimental study on this topic is still rare. The study of Alm et al. (1992b) examines the effects of financial reward on compliance behaviour with multiple periods experiment. Compared to a control condition, tax compliance is higher in the reward conditions. However, the authors point out that the increase in compliance is primarily achieved by extreme tax compliance behaviours: it is either fully complying or entirely evading the tax obligation. Torgler (2003) conducts a one-shot experiment with professionals from Costa Rica as participants. Tax compliance in this experiment is higher when the financial reward is offered for an accurate income report. Bazart and Pickhardt (2010) conduct the experiments in which the reward is given in the form of a lottery for audited and completely honest reports. The results show that the financial reward has a positive impact on compliance. However, Kastlunger et al. (2010) conclude from their experiment that providing the reward to the honest taxpayers does not generally increase the tax revenue. They propose that when the chance of reward for tax honesty is given, taxpayers seek one of the two goals: either they advance for the higher additional income from tax evasion, or they proceed toward obtaining the reward by complying with the tax obligation.

Among those papers on tax compliance, none observes the effect of financial reward and the bribery in combination. This study intends to fill that gap. Employing experimental method, this study is expected to contribute on emission tax literature by examining the role of financial reward on the compliance behaviour under the presence of bribery. Furthermore, this study also includes the bribe rate (the cost of a bribe) as one of the

compliance determinants under the presence of bribery, a variable that has not been investigated in the existing experimental literature.

4.3. METHOD

The experiments are designed to observe the decision behaviour of the subjects when the institutional setting and the incentives change. There are several critical conditions of the experimental method as defined by Smith (1992). Those conditions include non-satiation, salience, reward dominance, privacy, and parallelism. Non-satiation indicates that the subjects prefer a bigger reward medium to the smaller one. This condition is necessary for the subjects to base their decisions on the relative magnitude of the payoffs. Salience means that the rewards received by the subjects are directly correlated to their choices so that the subjects are aware that their decisions affect their outcomes. Salience is necessary to manipulate the subjects to experience the costs and benefits of the decisions, encouraging them to consider the profitable decisions in the experiment seriously. Reward dominance suggests that the rewards are large enough to compensate the subjective costs or benefits of participating in the experiment. Privacy implies that the subjects only know their payoffs and are not aware of others. This condition is aimed to isolate the decision of each subject from the subjective value of the other subjects' payoff. Parallelism indicates that the setting of the experiment replicates as much as possible the crucial features of the naturally occurring world.

Along the lines of most laboratory experiments, this study employs university students as the participants. A common criticism on laboratory experiments with undergraduate students is that they are a very specific segment of the population. It raises the issue of population validity, focusing on whether or not the decision of the students in the experiment is suggestive for the decision of the real economic agents. However, Baldry (1987) states that the responses of students are not different with other subjects under the same laboratory settings. The reason for this equivalence is that the cognitive processes in the experiment are the same between subject pools (Alm, 1998). There are several replications of the experiments, which is previously conducted with students, with relevant subjects as the participants (managers, traders, and professionals). Despite some observed minor differences, these studies reveal that the general patterns of behaviour are well corresponding to those of student participants (Krause et

al., 2004). Alm et al. (2010) present the data to demonstrate that the experimental responses of students are rarely different from the response of other experimental subjects. They conclude that student and non-student respond correspondingly as experimental subjects.

Students have been employed in various experiments to investigate the firms' behaviour. Fehr et al. (1993) in the first experimental study on the existence of wage exchanges employ students in their research to imitate the interaction between firms and workers. Other researches on wage contracts from Fehr and Gächter (2000), Fehr and Falk (1999, 2003), and Brandts and Charness (2004) also use students to assume the role of firms. Students are also recruited as subjects in the experiments on firms' behaviour in the oligopolistic setting (Le Coq and Orzen, 2006; Morgan et al., 2006; and Orzen, 2008).

The laboratory experiment is often criticized as being an oversimplification, and more effort needs to be made to minimize the gap between the experimental design and the particular environment of interest (Krause et al., 2004). Torgler (2002) and Richardson (2008) have indicated that the tax compliance varies across countries with different culture, suggesting that the experiment cannot ignore the importance of the environment in which the experiment is conducted. Therefore, to diminish the distance between the experimental settings and the real environment of interest, the experiment is conducted in Indonesia since it is expected to calibrate the taxation situation in the respective country.

The participants are recruited from senior undergraduate students of Faculty of Economics, from Diponegoro University, Indonesia, mostly those who are in their third year of study. Economics students are chosen because they are expected to play the game in which they represent the businessmen who should make an economic decision, given the instruments indicated in economics terms. Although the game could also be played by other subjects, it is easier to explain the procedure of the experiment to participants who have been familiar with the employed terminology. Recruitment is made by printing the announcement, and students interested to join are registered. Participants are assigned into different treatment groups randomly from the pool of applicants. The participants do not know the description of the experiment in advance. They are only aware that they are recruited to participate in a game on economic decision making. This procedure helps to eliminate the problem of self-selection bias. Upon arrival in the lab, the participants are given a printed instruction containing the rules of the

experiments. Preparing the printed instruction of the game also ensures that the experiment could be replicated in a comparable way.

The participants are paid according to their decisions during the experiment. In line with the principles of salience and reward dominance, the subjects are paid according to their decisions during the experiment with a significant monetary reward to invoke their economic motive. The privacy principle is established by prohibiting the subjects to communicate in any possible way once the experiment has commenced. Following the standard procedures (see Alm, 2011), the experiments in this study are administered in a consistent manner to allow replicability. The experiments are also set as simple as possible, avoiding unnecessary complications, to prevent the subjects becoming confused. The instructions of the experiments are prepared in an understandable way to the subjects, avoiding the use of examples that may lead the subjects to fix on certain mental images that could mislead their decision.

4.3.1. Experimental design

4.3.1.1. The model

The experiment aims to understand the implication of enforcement parameters on compliance behaviour of the firms, under the implementation of reward and the presence of bribery. The experiment is divided into four models. The first two models represent clean taxation setting without the practice of bribery, while the other two models indicate the taxation situation afflicted with bribery. In each setting, the first model only employs conventional fiscal instruments such as the tax rate, probability of audit, and sanction rate, and the other model will introduce the reward rate as an additional fiscal instrument to influence the compliance behaviour of the firms. The models under the presence of bribery include the bribe rate as the additional determinant of compliance behaviour. The classification of the models is presented in the table below.

Table 4.1
Classification of experimental models

	No reward	With reward
No bribery	Model 1	Model 2
With bribery	Model 3	Model 4

Model 1 is the basic model that simulates the taxation condition under the absence of bribery when the reward for telling the truth is not available. The firms generate the income which is assumed to be linearly correlated with the discharged emission and pay the emission tax based on the voluntary reported emission. The firms face the probability of audit, and the detected cheating firms should pay the sanction on the unpaid tax. Three parameters that affect the behaviour of tax compliance in this model are tax rate, probability of audit, and sanction rate.

$$\psi = \pi - (tr + \rho(S)) \quad (1)$$

Where $S = st(e - r)$

The payoff of the firms (ψ) is the income associated with emission (π) less the tax payment (tr), where t is a tax rate and r is the amount of income they report voluntarily. If during the auditing they are detected cheating, their income will be further reduced by the sanction (S) proportional to the size of the unpaid emission tax ($t(e-r)$). e is the actual emission and the gap between actual and reported income ($e-r$) represents the size of evasion. The amount of sanction is given by $st(e-r)$, where s is a sanction rate. The probability of getting audited is indicated by ρ .

Financial reward as an additional determinant of compliance behaviour is introduced in model 2. This model represents the situation in the absence of bribery where the reward is given to the compliant firms who report the accurate amount of emission, after the reports are checked. In this treatment, the firms are not only punished for cheating, but they are also encouraged to report truthfully by providing them the financial reward to do so. The determinant parameters used in this model are tax rate, probability of audit, sanction rate, and reward rate.

$$\psi = \pi - (tr + \rho(S - \alpha I)) \quad (2)$$

Where $S = st(e - r)$ and $I = ite$

Similar to the first model, the basic payoff of the firms is the income associated with discharged emission less the emission tax payment. Their income will be deducted further by a certain amount of sanction if they are caught cheating. However, if they are verified to submit the accurate report, they will be given a financial reward, I . I is defined by $i t e$, where i is the financial reward rate. The amount of the reward is proportional to the amount of the accurate tax payment. α is a choice parameter with the value of 1 if the firms are compliant and reporting the true amount of emission.

Model 3 imitates the situation where the bribery exists, while the reward for reporting the true level of emission is not available. This model closely represents the current taxation situation in Indonesia, where the bribery is common and the government does not provide a financial reward for the firms for submitting accurate reports. Bribery provides the option for noncompliant firms to choose between paying the penalty and paying bribe to avoid the sanction. The bribe is designed to be lower than the sanction, matching the real-life situation. The determinant parameters in this treatment are tax rate, probability of audit, sanction rate, and bribe rate. The bribe rate is introduced in this treatment to indicate the bribing price that has to be paid by the firms.

$$\psi = \pi - (tr + \rho(\beta B + (1 - \beta)S)) \quad (3)$$

Where $S = st(e - r)$ and $B = bst(e - r)$

The payoff is closely similar to the model 1. However, instead of being charged to pay the sanction, the detected cheating firms are offered the option to pay the bribe. The bribe is proportional to the amount of the sanction. It is defined by $bst(e - r)$, where b is the bribe rate as a percentage of the sanction. β is a choice parameter of which the value is one if the firms decide to pay the bribe.

Model 4 is the most complex model, in which all determinants used in the preceding three models are employed. Apart from the traditional parameter such as the tax rate, probability of audit, and sanction rate, the reward rate and bribe rate are also incorporated in the model. This model indicates the situation under the presence of bribery, where the reward for reporting

truthfully is available. Being allowed to bribe for evading the sanction, the firms will be inclined to cheat instead of reporting honestly. However, when the reward is offered, they should make a choice between the benefit of cheating and the benefit of reporting truthfully. The payoff is indicated by equation (4).

$$\psi = \pi - (tr + \rho((\beta B + (1 - \beta)S) + \alpha I)) \quad (4)$$

Where $S = st(e - r)$, $B = bst(e - r)$, and $I = ite$

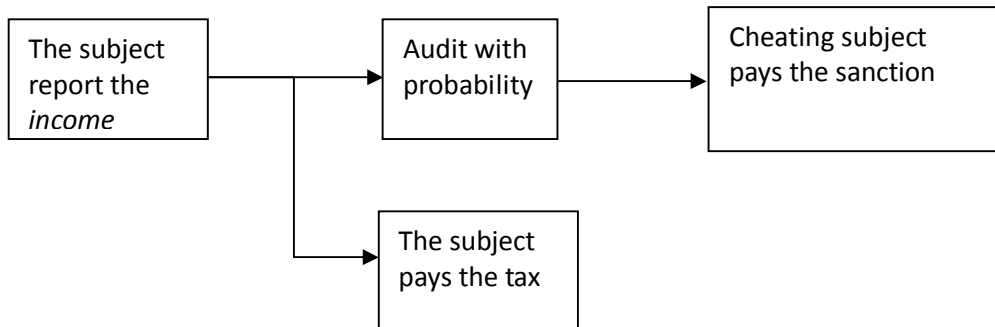
α and β are the choice parameters. The value of α is 1 if the firms decide to report the true level of emission. β indicates the decision of cheating the firms, of which the value is 1 if the cheating firms prefer to pay the bribe instead of the sanction.

4.3.1.2. *The operationalization of experiment*

This experiment is designed to be simple enough without losing the basic features of a real situation intended to be calibrated. This experiment assumes that the emission is constant and the main concern of the firms is to decide the level of emission that should be reported. The experiment examines the compliance behaviour of the experimental subjects within four different treatments. Each treatment is based on the respective setting formulated in the model. For the sake of simplicity, the emission in the model is replaced by the money income in the experiment.

Treatment 1 is constructed based on the model in the equation (1) when the bribery and the financial reward are absent. The choice variable that should be decided in treatment 1 is the reported income. The constant variable, the variable that is kept constant during the experiment, is the fixed income. The treatment variables, variables controlled by the experimenter and changed over time (round) to check the response of the subjects, are tax rate, sanction rate, and probability of audit. Given the value of constant variable and treatment variables, the subjects should make a decision regarding the amount of income that they intend to report.

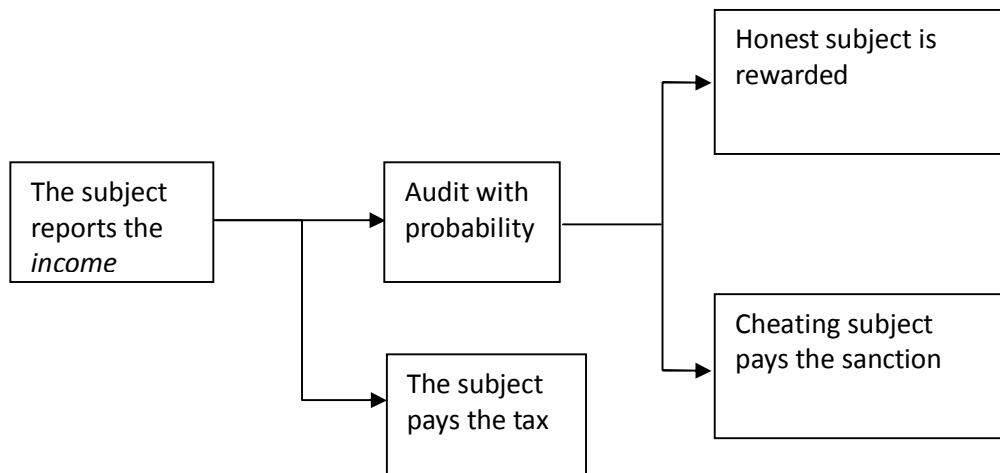
Figure 4.1
Sequence of actions in treatment 1



The sequence of actions in treatment 1 is illustrated in Figure 4.1. Firstly the subjects decide the amount of income that they are willing to report, given different values of the treatment variables. Reporting the true amount of money means complying, while reporting less than the received money is considered cheating. After the subjects submit the reported income, their income will be deducted by the amount of tax proportional to their reported income. The report will be audited with a certain probability. The subjects who are found cheating will be punished by subtracting the amount of money equivalent to the sanction from their income.

In the treatment 2, the reward is given to the honest subjects after their report is checked. The subjects decide the amount of reported income given the value of the tax rate, sanction rate, reward rate, and probability of audit. The sequence of action in treatment 2 is shown in Figure 4.2.

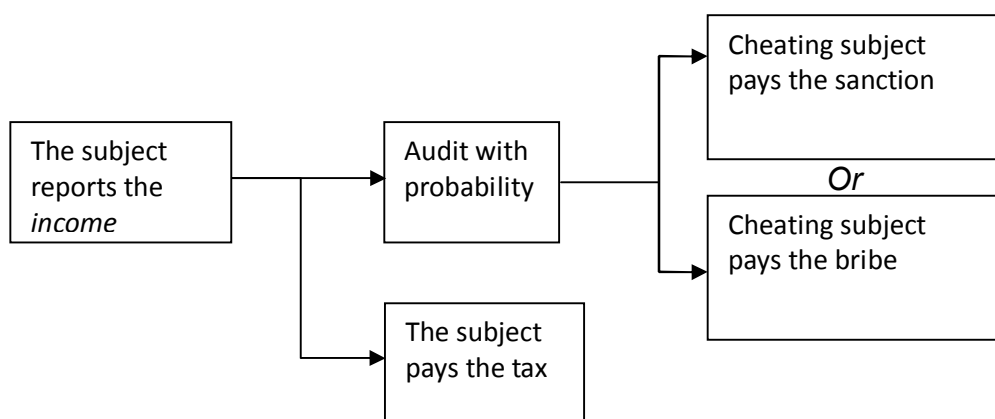
Figure 4.2
Sequence of actions in treatment 2



After the subjects decide their reported amount and submit the report, they will be audited with a certain probability. The audited subjects will have two possible outcomes. Their income will be reduced by the certain amount of the sanction if they send an incorrect report, or increased by a certain amount of reward if they submit a true report.

The treatment 3 calibrates the situation afflicted with bribery while the financial reward for compliance is not available. The treatment variables that should be considered in making report decision are tax rate, sanction rate, bribe rate, and probability of audit. The sequence of actions in treatment 3 is illustrated in Figure 4.3.

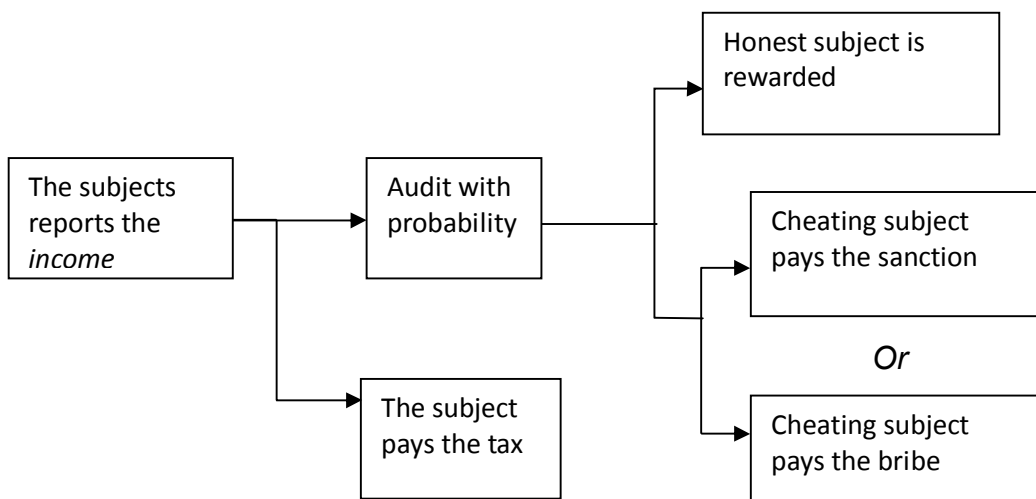
Figure 4.3
Sequence of actions in treatment 3



In the treatment 3, the cheating subjects who get audited will be provided with two options, charged with the sanction or paying the bribe which is less than the sanction. On the other hand, the outcome of the honest subjects will be indifferent whether they are audited or not.

Treatment 4 replicates the situation when the bribery exists and the government tries to encourage the compliance by providing the financial reward for the compliance. The choice variable that should be decided by the subjects is the reported income. Treatment variables are tax rate, sanction rate, bribe rate, reward rate, and probability of audit. The sequence of actions is presented in Figure 4.4.

Figure 4.4
Sequence of actions in treatment 4



The design is similar to the treatment 3. However, in this treatment the subjects will get the reward once the auditing process confirms the accuracy of their reports. In treatment 4, the experimental subjects are not only obliged to pay the cost of cheating (in terms of sanction or bribing costs) but also eligible to receive the reward after their report is checked.

The game in all treatment groups consists of 24 rounds, during which the subjects are given fixed income in each round. The subjects start their decision making in each round with the identical income, and they should

decide the amount of the reported income given the changing value of treatment variables. The list of the variables is presented below.

Table 4.2
The experimental variables

Variables	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Choice variable				
Reported income		√	√	√
Treatment variable				
Tax rate		√	√	√
Sanction rate		√	√	√
Reward rate		-	√	-
Probability of audit		√	√	√
Bribe rate		-	-	√
Constant variable				
Fixed income		√	√	√

The values of treatment variables for all treatments are measured in percentage, ranging from low, moderately high, and extremely high. During the experiment, the value of treatment variables is randomly picked up so that the different combination of determinant values occurs in each round. The gap between the value of variables is set distinctly wide so that the difference is noticeable to the subjects.

Table 4.3
Values of treatment variables

Treatment variables	Value
Tax rate	5%, 40%, 80% (<i>of the reported income</i>)
Sanction rate	105%, 140%, 180% (<i>of the unpaid tax</i>)
Reward rate	5%, 40%, 80% (<i>of the paid tax</i>)
Probability of audit	5%, 40%, 80%
Bribe rate	5%, 40%, 80% (<i>of the sanction</i>)

The values of all treatment variables, except sanction rate, are set to 5%, 40%, and 80%. The values of the sanction rate are higher than 100%, indicating that the subjects who get the penalty should firstly pay the unpaid tax, and then pay the amount proportional to the unpaid tax as the punishment. One of the three stated values is picked up randomly before the experiment; therefore, there is a different combination of treatment variable's value in each round. The calculation of treatment variables in terms of monetary units is presented below.

Table 4.4
The calculation of the monetary value of treatment variables

Treatment variables	Base of calculation
Tax	$(\text{tax rate}) \times (\text{reported income})$
Sanction	$(\text{sanction rate}) \times (\text{tax rate}) \times (\text{real income} - \text{reported income})$
Financial reward	$(\text{reward rate}) \times (\text{tax rate}) \times (\text{real income} - \text{reported income})$
Bribe	$(\text{bribe rate}) \times (\text{sanction rate}) \times (\text{real income} - \text{reported income})$

The calculation is set to mimic the calculation of those instruments in the real situation. Although the calculation indicates that one percent change in sanction rate would yield a smaller change in the payoff than the same percentage change in the tax rate, it cannot be simply interpreted that the subjects will react to one percent increase in sanction rate in a lower reported income than the same percentage of the tax rate. The implication of each instrument on compliance behaviour should be investigated statistically using the econometric method.

Before the experiment is conducted, the participants are asked to fill in a simple questionnaire regarding risk attitude. The questionnaire consists of the questions assessing the perception of participants regarding certain statements. The available choices are ordered using the Likert Scale. The questionnaire mainly refers to the risk characteristic assessment using by financial investment companies. Since the risk attitude of each subject is

varied, the data of risk attitude will be helpful to explain the individual decisions of the subjects during the estimation of experimental results.

4.3.1.3. Data analysis

Random selection yielded various combinations of treatment values for each round in all the treatments. Each combination resulted in a different optimal reported income that would give the subjects a maximum payoff. After the data from the experiment is collected, the optimal and the actual reported income will be compared to see whether the decisions of the subjects follow the optimal choice.

The compliance behaviour of the subjects among four different treatments is compared using the t-test. The t-test is a statistical method to examine the mean differences between two groups. T-test may also compare the proportions of binary variable, given that the mean value of the binary variable is substantively meaningful (Park, 2009).

Standard econometric techniques are used to analyse the determinants of compliance behaviour. The proxies of compliance are regressed on determinant variables using panel data regression. The repetition of games in each treatment provides the panel dataset, where the participants' decision responding to the changing values of determinant variables are observed over time. Panel data allow controlling variables that change over time but not across participants (treatment variables that are determined by the experimenter); and a variable which is different from participant to participant but does not change over time (risk attitude of participants).

The random effect model is preferred to analyse the panel dataset resulted from the experiment. The argumentation behind the random effect model is that the variation among participant is assumed to be random and uncorrelated with the value of determinant variables included in the model. This assumption is justified since the value of determinant variables over time is selected randomly by the experimenter, independent of the attribute of participants. Random effect is also preferable if the differences in participants' characteristics (risk attitude) are assumed to influence their decisions. The random effect model assumes that the error term of cross-sectional unit in the model is not correlated with the independent variables, therefore, allowing the time-invariant variables to be used as explanatory variables (Dougherty, 2006).

However, the choice of the random effect model should be justified by statistical procedures. Following standard procedure on panel data

regression, the analysis on panel dataset will use Hausman test to select between random effect and the fixed effect model. The Hausman test checks whether there is a significant correlation between the unobserved characteristics of cross-sectional unit and the regressor. If the presence of correlation is rejected, the random effect model is more powerful and efficient. However, if the significance of the correlation is confirmed, then the random effect model will be inconsistent and the fixed effect model should be chosen (Greene, 2002).

4.4. THE CONDUCT OF THE EXPERIMENT

The experiment took place in the Faculty of Economics, Diponegoro University, Indonesia. Four games (treatments) were run on four different days on 20th, 21st, 27th, and 28th of October 2010. Each treatment consisted of two sessions and each session had 24 rounds and took two hours to complete. The combinations of treatments' value were randomly ordered for all games. Each session was expected to be played by a group of 15 students, so that 30 students were involved in each treatment. The subjects were assigned to each treatment group randomly. However, three students who should be participating in treatment 1, 2, and 4 cancelled their participation just before the experiment begun. Therefore, these three treatments were played with 29 students in total. Since the experiments were dealing with simple income calculation, calculators were provided to each subject during the experiment to assist the calculations. Prior to the experiment, the subjects were asked to fill the simple questionnaire regarding the financial risk preference, to capture the possibility that risk attitude of subjects affected their compliance behaviour.

In the experiment, the real economic terms were used to identify the treatment variables. Therefore, the treatment variables were named as *tax*, *sanction*, *financial reward*, *audit probability*, and *bribe*. Contrary to the procedure proposed by Alm (2011) which suggested the use of neutral words in describing the rule and treatment variables during laboratory experiment, the real economic terms were used in the experiment to build a direct reference to the real economic phenomena. The real economic terms was expected to encompass the subjective perception of the subjects, the perception influenced by the surrounding social context that was unique to

each different environment¹¹. Given an identical treatment in the experiment, this dissimilarity might create different responses from the subjects with different social contexts.

At the beginning of the experiment, the instructions of the game were read to the subjects. The instructions were also printed and handed out to subjects to provide them with a better comprehension about the game's rules. Subjects were informed that they would receive a certain amount of money as a fixed income in each round. The fixed income was always identical in each round, and their decision should be based on the single income given in a particular round (as opposite to the accumulated income).

Subjects were required to report the amount of income they received in each round. As the consequence of receiving money, subjects were obliged to pay the laboratory tax, which was calculated as a percentage of the voluntarily reported income. Subjects were notified that the size of the tax that would be deducted from their income depend on how much money they declared in the report.

The subjects were informed that it was impossible to check the accuracy of their report during the experiment, due to limitation of time availability. Therefore, the experimenter would only review the selected reports randomly. If the audited reported incomes that were incorrect, the sanction would be imposed and translated into a further reduction of the subjects' income. The subjects were told that they were prohibited from making any communication during the game. All subjects were given the identity number written on the card which was distributed randomly. The identity number was used in substitution for their real identity during the experiment.

In the treatment 1, subjects were given an envelope containing the income card, with the real monetary value that has been decided by the experimenter, reported income card, and announcement card. The reported income card provided the space in which they could write any amount of income that they want to report. Their reported income would be the base to decide the amount of money that would be drawn from them. The information with respect to treatment variables was written in the announcement card.

¹¹ For instance, the subjective perception of the subjects in Germany of the word *sanction* and *bribe* might be different with the subjects in Indonesia.

The income card, reported income card, and announcement card were submitted in the same envelope. The envelope would be opened during the experiment only if it was selected (based on certain probability) to be checked. Once they were found cheating, they would be given the sanction card in the next round. The card charged them with the penalty in the real monetary unit that would be deducted from their income.

The reward was introduced during treatment 2, and the value of the reward rate was written in the announcement card. After the subjects had written the reported income, all the cards were collected in the same envelope. Several envelopes were checked according to the decided probability of audit. The cheating subjects were handed sanction cards in the next round, while the subjects who wrote the right amount of received income were awarded the reward card in the next round. The reward card stated the amount of real money that would be added to their income.

Treatment 3 calibrated the situation where the bribery practice existed. The instruction, which was read and handed over to subjects, clearly stated that the cheating subjects who were caught might pay the bribe in exchange of the sanction. The amount of the bribe was determined by the experimenter¹². The value of the bribe rate was printed on the announcement card.

After subjects made the decision and all the cards were collected, the auditing was conducted. The cheating subjects were given the sanction cards in the next round. However, differently to the sanction cards in the previous two treatments, the card in treatment 3 was not only displaying the amount of money that would be deducted from the subjects as the sanction, but also offering them the amount of bribe they might pay to avoid the sanction. The subjects could pick the amount of money that would be subtracted from their income by checking the sanction or bribe option.

Treatment 4 was simply the combination of treatment 2 and treatment 3, the treatment that represented the situation where the bribery was practiced, and reward for submitting the true report was implemented. The treatment variables were tax rate, sanction rate, reward rate, bribe rate, and probability of audit. The values of all treatment variables were given in the announcement card. Following the auditing process, after all envelopes were

¹² It replicated the real situation in which the tax officer had more bargaining power to impose the price of the bribe, and the companies should comply with their bargain, as implied by the findings of in-depth interview in chapter two.

collected, subjects who submit the right amount of received income were awarded a reward card in the next round and the cheating subject would be given the sanction card with the option of bribing.

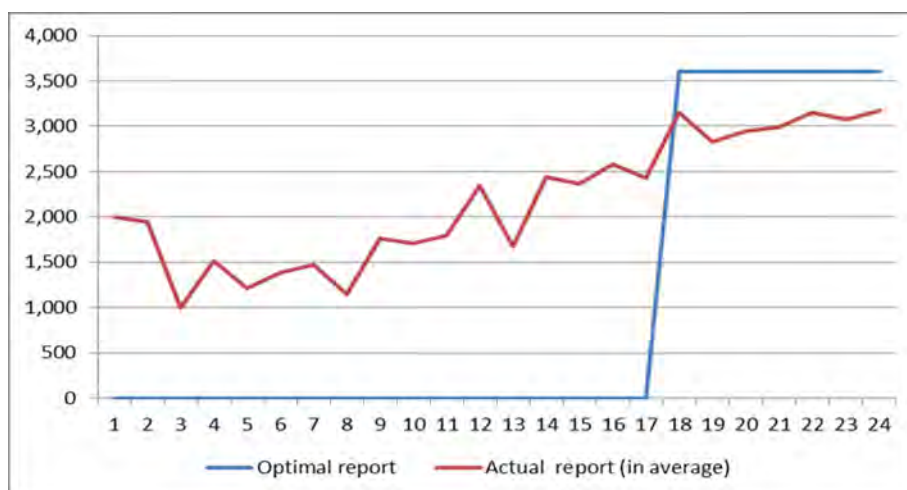
4.5. RESULTS

4.5.1 Comparison of optimal and actual reported income

Random selection yielded various combinations of treatment values for each round in all treatments. Each combination resulted in different optimal reported income that would give the subjects maximum payoff. This section presents the comparison of optimal and actual reported income submitted by subjects. Since the payoff function is shaped in the linear form, the optimal report should be either zero or the full amount of the received income.

The Figure 4.5 shows the comparison between the optimal report and average actual report in treatment 1, for each combination values of treatment variables. The y axis represents the average reported income in the monetary unit, and the x axis represents the randomly generated combinations of each round. All combinations are sorted first by the probability of audit, followed by the sanction rate and tax rate.

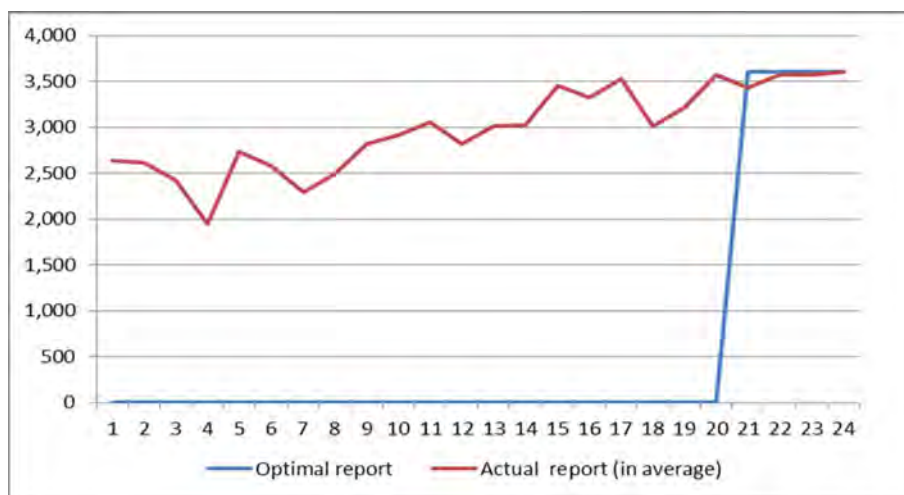
Figure 4.5
Optimal and actual report in treatment 1



Seventeen out of twenty-four combinations yielded the optimal report of zero amount, while the rest combinations suggested a full income report. However, the average reports in each round during the experiment were higher than zero (when the optimal decision indicated a zero report) and less than the full income (when the optimal decision suggested a complete report). Although the average actual reports did not fit the optimal prediction, the pattern went along with the optimal report. It can be seen from the figure that the highest actual reports were made when the combination values suggested reporting the whole income.

The comparison between the optimal and actual report in treatment 2 is illustrated in Figure 4.6. The combination of treatment variables' values is ordered by the probability of audit, followed by sanction rate, tax rate, and reward rate. Twenty out of twenty-four combinations imply that the optimal report is zero. Similar to the result of treatment 1, the average reported in the treatment 2 were also higher than zero. The figure also suggests that the pattern of the actual report in average follows the tendency of the optimal decision. The optimal report and the actual report were converged at the combination point that provided the highest payoff by reporting the true amount of the received income.

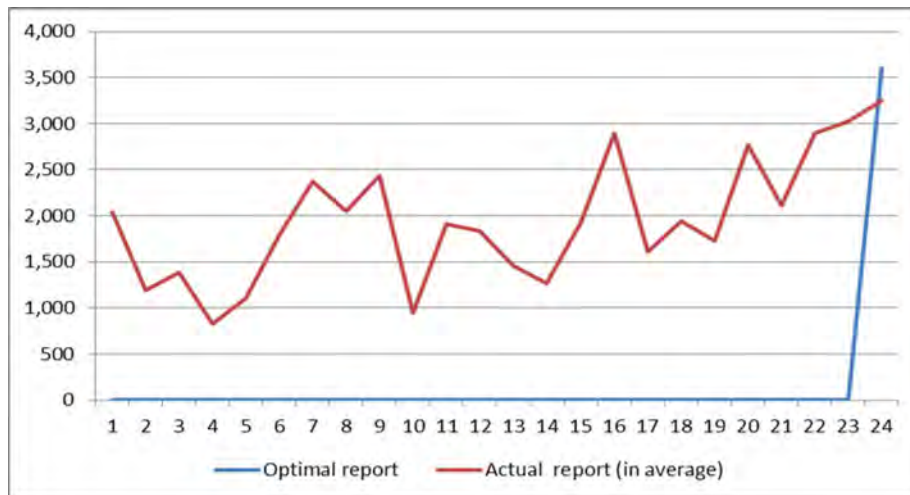
Figure 4.6
Optimal and actual report in treatment 2



The arbitrarily generated combination of treatment variables' values in treatment 3 is ordered by the probability of audit, followed by sanction rate, tax rate, and bribe rate. Only one out of twenty-four combinations suggests

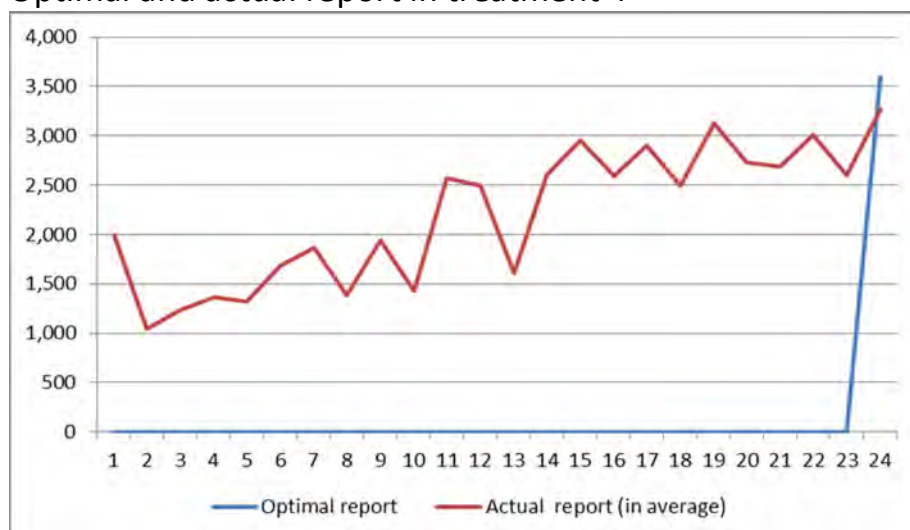
that maximum payoff will be obtained by submitting the full report. However, as demonstrated in the Figure 4.7, the average reported incomes were higher than zero but less than the complete amount of the received income.

Figure 4.7
Optimal and actual report in treatment 3



The combination of treatment variables' values in treatment 3 is ordered by the probability of audit, followed by sanction rate, tax rate, bribe rate, and financial reward rate. Similar to the treatment 3, only one of all combinations indicates a maximum payoff by reporting the whole amount of received income.

Figure 4.8
Optimal and actual report in treatment 4

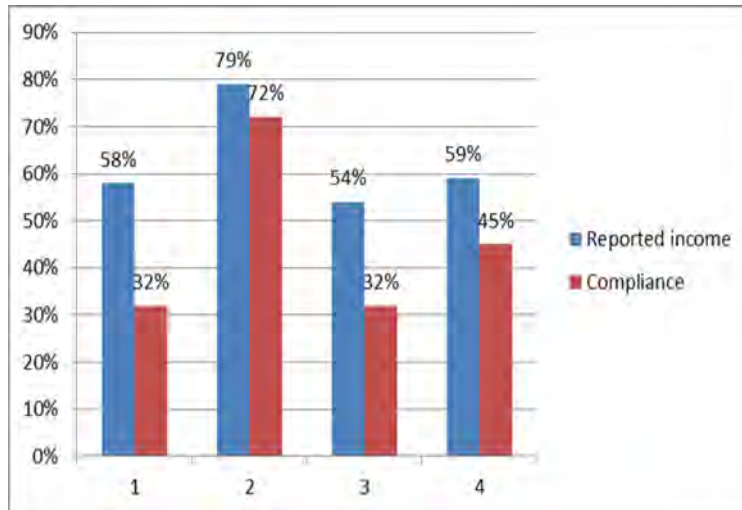


Although almost all combinations suggested the optimal value of zero report (only one combination implied the opposite), again the average actual reports were higher than zero. The trend of the actual report in treatment 4 also followed the pattern of the optimal report; in fact, the highest actual report was made when the optimal decision was submitting the true report.

4.5.2 Comparison of compliance behaviour among treatments

Compliance behaviour was measured by the average percentage of reported income and the percentage of complying decision during the experiment. In treatment 1, the mean of reported income was 58%, indicating that the subjects only reported 58% of their received income. The percentage of complying decision was 32%, meaning that only 32% of total observations were submitting the accurate report. When the reward was introduced in treatment 2, mean reported income increased to 80% and compliance increased to 72%. Under the circumstance where bribery did not exist, the introduction of reward was clearly inclined to increase the complying decision.

Figure 4.9
Compliance behavior of subjects by treatment



Treatment 3 and 4 were set to simulate the situation where bribery practice existed, and bribe rate was added as a treatment variable. The complying decision under treatment 3, where there was no reward for compliance and subjects are given the choice to bribe, was slightly lower than the compliance behaviour in treatment 1, which had the same treatments but without the bribery. The mean of reported income was lower (54%) while the percentage of compliance was equal (32%). When the reward was introduced under treatment 4, the mean reported income increased to 59% while the percentage of compliance increased to 45%. It indicated that under the bribery setting, the introduction of reward only vaguely increased the reported income. On the other hand, it increased the complying decision in a more considerable size (although it is still lower than the compliance when bribery was prevented).

Comparing the compliance behaviour under the absence and the presence of bribery reveals the fact that when a financial reward was unavailable, the complying decision of the subjects was similar. When the financial reward was introduced, subjects in the different bribery settings acted differently. The introduction of the financial reward increased the level of compliance of subjects when bribery was absent. However, when the cheating subjects were allowed to bribe, the positive impact of financial reward was reduced.

At this stage, it is still unknown whether the difference of complying decision among different treatments was indeed significant, or it was simply due to random chance. Therefore, it was necessary to conduct the mean-difference t-test. The t-test examines the probability that the difference between the

two means is caused by chance. If the difference is statistically significant, it is safe to say that the difference across groups is not caused by random chance.

Prior to the t-test, the equality of variance between paired groups should be tested. The Bartlett's test was used to test if two treatment groups have equal variances. It is a chi-square statistic with (k-1) degrees of freedom, where k is the number of categories in the independent variable. It tests the null hypothesis that the variance of compared groups is equal. If the chi-square is statistically significant, the variances across groups are unequal. Therefore, Welch's t-test should be used to test the mean-difference instead of Student's t-test (Sawilowsky, 2002).

Table 4.5
Test of mean-difference of reported income

Group	t-test
1 and 2	-10.13** (0.00)
1 and 3	0.51 (0.13)
2 and 4	9.43** (0.00)
3 and 4	-1.94 (0.06)

Note: * significant at 5% significance level
 ** significant at 1% significance level
 Value in the bracket is P-value

Table 4.5 shows the difference of mean of reported income and percentage of compliance among all treatment groups. The difference of reported income between treatment 1 and 2 were significant, so was the difference between treatment 2 and 4. On the contrary, the difference of reported income between treatment 1 and 3 was not significant, and neither was the difference between the treatment 3 and 4.

Table 4.6
 Test of mean-difference of percentage of compliance

Group	t-test
1 and 2	-15.73** (0.00)
1 and 3	0.23 (0.81)
2 and 4	10.30** (0.00)
3 and 4	-5.19** (0.00)

Note: * significant at 5% significance level
 ** significant at 1% significance level
 Value in the bracket is P-value

The results of mean-difference test on the percentage of compliance are presented in the Table 4.6. The difference of the complying decision due to the implementation of financial reward was significant, under the absence and the presence of bribery practice (treatment 1 against 2, and treatment 3 against 4). The difference between the treatments with the financial reward before and after the introduction of bribery (treatment 2 and 4) was also significant. On the other hand, the complying decision of subjects in the absence and the presence of bribery were not significantly different before and after the introduction of financial reward.

4.5.3 Determinants of compliance behaviour

This study models the compliance behaviour as a function of treatment variables such as the tax rate, sanction rate, reward rate, bribe rate, probability of audit, and risk. The compliance is approached using two proxies. The first proxy of compliance was reported income. The use of reported income was expected to give the information regarding the degree of compliance, where a bigger amount of reported income is assumed to indicate higher compliance level. The second proxy of compliance used in this experiment was complying decision. Complying in this research was interpreted as the action where the subjects reported the actual received income. It could provide information regarding absolute compliance, which

was consisted of only two dichotomous values, cheating or complying. Subjects were only considered complying if they reported the full amount of received income.

Reported income was regressed on determinant variables using the panel data regression approach. The first step in the analysis is choosing a preferable method between the random effect and the fixed effect approach. The Hausman test is used to test whether the unique errors are correlated with the independent variables. The Hausman test on the regression models revealed that the null hypothesis, from which the errors were uncorrelated, was not rejected. Therefore, the random effect was more preferable than the alternative fixed effect. The econometric results are presented in the table below.

Table 4.7
Determinants of reported income

Determinant of reported income	Treatment 1 (R ² : 0.18)	Treatment 2 (R ² : 0.11)	Treatment 3 (R ² : 0.17)	Treatment 4 (R ² : 0.15)
Tax rate	0.03 (0.47)	0.03 (0.47)	-0.37** (0.00)	-0.15** (0.00)
Sanction rate	0.09* (0.03)	0.02 (0.67)	0.10* (0.02)	0.11** (0.01)
Financial reward rate	n.a	-0.04 (0.39)	n.a	0.07 (0.12)
Bribe rate	n.a	n.a	0.15** (0.00)	0.10* (0.03)
Audit probability	0.51** (0.00)	0.41** (0.00)	0.37** (0.00)	0.53** (0.00)
Risk	-0.02 (0.69)	0.00 (0.99)	-0.02 (0.69)	-0.04 (0.40)

Note: * significant at 5% significance level

** significant at 1% significance level

The value in the bracket is P-value

The coefficients in the table represent the percentage of change in reported income as one unit change in determinant variables. During all treatments, the risk characteristic of subjects does not have a significant impact on their

decision in deciding the amount of reported income, although the sign of the coefficient is correct. The signs of the risk coefficient show that the reported income will be lower for the more risk-seeking subjects.

In treatment 1, the determinant variables that significantly affect the reported income during the experiment are sanction rate and audit probability. Those variables are significant at 5% and 1% significance level respectively. One unit change in sanction rate will increase the reported income by 9% of the actual income. Audit probability demonstrates a greater impact on reported income, where one unit change will lead to 51% increase in reported income. On the other hand, the tax rate is not affecting the decision of subjects in reporting their income.

The only significant determinant in treatment 2 is the audit probability (significant at 1% significance level), implying that one unit change in probability of the audit will increase the reported income by 41% of the received income. Other variables do not significantly affect the decision of subjects. The financial reward rate, the additional instrument to enhance the compliance, is also insignificant.

The impact of the tax rate in treatment 3 and 4, where the bribery practice is introduced into the experiment, is significant at 1% level of significance. In the treatment 3, one unit increase in the tax rate will reduce the reported income by 37%. When the financial reward is introduced into treatment 4, the size of reduction due to one unit increase in the tax rate falls to 15% of actual income. Sanction rate and audit probability show the significant influence on the decision of subjects in treatment 3 and 4. Both variables are significant at 1% significance level. One unit increase in the sanction rate lead to 10% increase of reported income in treatment 3 and 11% increase in treatment 4, while one unit increase in audit probability raises the reported income by 37% in treatment 3 and 53% in treatment 4.

Bribe rate, the additional determinant variable of compliance under the presence of bribery, also shows the significant impact on reported income at 1% and 5% level of significance in treatment 3 and 4 respectively. One unit increase in the bribe rate raises the report in the treatment 3 by 15% of the actual income.

In treatment 4, the rise in the bribe rate is 10% of the actual income. The results indicate that the probability of audit has the most important role in determining reported income of subjects in all treatments. It is constantly significant at 1% significance level across all treatment groups. Sanction rate is also significant in all the treatment groups, except in treatment 2 where

the financial reward is offered to subjects who have proven to submit the true amount of received income. Tax rate, which does not have a statistically significant effect on reported income in treatment 1 and 2, has a negative impact on reported income when bribery is practiced in treatment 3 and 4 at 1% level of significance. The coefficient, which indicates the size of the impact, is bigger than the coefficient of the sanction rate. Bribe rate, as an addition to the conventional determinant of compliance, is significant under the presence of bribery. However, the financial reward rate as another alternative determinant of compliance is not significant in any treatment group; both in the absence and the presence of bribery.

Since the impact of financial reward is the topic of interest in this study, it is necessary to see whether the availability of financial reward (as opposed to the size of the reward) will make a difference in the reported income. Therefore, financial reward is translated into the dummy variable consisting of binary values. Zero value represents the condition without the financial reward, and 1 if the financial reward is available. The financial reward dummy is regressed on reported income, together with other controlled variables.

Table 4.8

Determinants of reported income with financial reward dummy

Determinant of reported income	Treatment without bribery (R ² : 0.21)	Treatment with bribery (R ² : 0.17)
Tax rate	0.02 (0.33)	-0.25** (0.00)
Sanction rate	0.07** (0.00)	0.12** (0.00)
Bribe rate	n.a	0.13** (0.00)
Probability of audit	0.46** (0.00)	0.44** (0.00)
Risk	-0.01 (0.79)	-0.03 (0.36)
Reward dummy	0.22** (0.00)	0.04 (0.49)

Note: * significant at 5% significance level

** significant at 1% significance level

The value in the bracket is P-value

The result presented in Table 4.8 show that financial reward dummy is statistically significant in influencing the reported income when bribery is not practiced. The introduction of the financial reward will increase the reported income under the absence of bribery by 22% of the received income. The significance of the financial reward dummy might explain why the financial reward rate does not affect the reported income in treatment 2. Subjects are more motivated by the presence of financial reward instead of the size of the reward. Provided that the reward is available, they will be more compliant regardless the amount of the reward. However, when the bribery practice is introduced, financial reward becomes insignificant. It indicates that the introduction of financial reward for compliance is only effective in affecting the reported income in the absence of bribery.

The second proxy of compliance used in this experiment was the complying decision. Compliance was defined as the action where the subjects reported the true amount of the received income. Complying decision as a binary variable was regressed on determinant variables using the Panel Logistic Regression approach. The regression results are presented in the Table 4.9 below.

Table 4.9
Determinants of complying decision

Determinant of complying	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Tax rate	0.96 (0.91)	1.46 (0.37)	0.04** (0.00)	0.26** (0.00)
Sanction rate	2.59** (0.01)	1.26 (0.63)	3.73** (0.00)	2.72** (0.00)
Reward rate	n.a	0.79 (0.62)	n.a	1.66 (0.13)
Bribe rate	n.a	n.a	6.39** (0.00)	1.96* (0.05)
Probability of audit	19.56** (0.00)	42.44** (0.00)	20.48** (0.00)	27.41** (0.00)
Risk	0.85 (0.77)	1.25 (0.65)	1.34 (0.59)	0.75 (0.44)

Note: * significant at 5% significance level
 ** significant at 1% significance level
 The value in the bracket is P-value

The values in Table 4.9 represent the odds ratio that the subjects are compliant due to one unit increase in the explanatory variables. In general, the results almost similar to the regression that used reported income as the proxy of compliance. In treatment 1, two determinants affected the compliant behaviour significantly. Sanction rate and probability of audit, both are significant at 1% significance level, present the positive impact on the odd that subject will report the true amount of income. One unit increase in the sanction rate will increase the odds that subjects are being compliant by a factor of 2.59. On the other words, the odds of being compliant due to one unit increase in sanction rate is 159 % higher than without the increase. At the same time, one unit increase in probability of audit increases the odds of submitting the true report by a factor of 19.56.

The only significant determinant in treatment 2 is the probability of the audit, which is significant at 1% at the level of significance. One unit increase in probability of audit enhances the odds of the subjects complying by a factor of 42.44. In the treatment 3, sanction rate, probability of audit, and bribe rate significantly increase the compliance. On the other hand, the tax rate is found to have the opposite impact. All of those variables are significant at 1% significance level. One unit increase in sanction rate, probability of audit, and bribe rate will lead to the increase in the odds of complying by a factor of 3.73, 20.48, and 6.39 respectively. On the other hand, the odds of complying due to one unit increase in tax rate is 0.04, indicating that the increase in tax rate lead to the decrease in tendency to comply. To put it differently, the odds of cheating is 96% higher with one unit increase in tax rate.

Similar results are found in treatment 4. Excluding the financial reward rate and risk attitude, other determinant variables affect the odds of the subjects being compliant significantly. One unit increase in sanction rate, bribe rate, and probability of audit enhance the odds of subjects to be compliant by a factor 2.72, 1.96, and 27.41. The odds of complying due to one unit increase in the tax rate is 0.26, suggesting that the odds of cheating is 74% higher as sanction rate increase by one unit.

Since the size of the financial reward rate is found insignificantly in affecting the compliance tendency of the subjects, this study intends to examine whether the availability of financial reward significantly influences the compliance behaviour. Therefore, financial reward is translated into the dummy variable, with 0 representing the condition without the financial

reward and 1 if the financial reward is available. The financial reward dummy is regressed on compliance decision, together with other controlled variables. The results are presented below.

Table 4.10
Determinants of complying decision with financial reward dummy

Determinants of compliance	Treatment without bribery	Treatment with bribery
Tax rate	1.03 (0.89)	0.12** (0.00)
Sanction rate	1.92** (0.01)	3.67** (0.00)
Bribe rate	n.a	3.22** (0.00)
Probability of audit	29.02** (0.00)	22.66** (0.00)
Risk	1.06 (0.87)	0.90 (0.74)
Reward dummy	23.46** (0.00)	2.67* (0.05)

Note: * significant at 5% significance level

** significant at 1% significance level

The value in the bracket is P-value

The results confirm the previous findings of regression on reported income. The financial reward dummy is significantly affecting the odds of complying. The odds that subjects submit the true report under the absence of bribery is 23.46, indicating that the odds of complying is 2,246% higher when the financial reward is available. In the presence of bribery, the availability of financial reward increases the odds of complying by a factor of 2.67. Those results indicate that the availability of financial reward will augment the tendency to comply, even in the situation where bribery is prevailing.

4.6. DISCUSSION

The main focus of this study is to observe the compliance behaviour, indicated by the size of the submitted report. The amount of income in the experiment (indicating the firms' benefit associated with the emission) is fixed, assuming for the sake of simplicity that the polluting firms do not have the opportunity to adjust their production process.

The comparison of optimal and actual reported income shows that subjects in average do not completely choose optimal choice, although the pattern of reported income follows the prediction of the optimal decision. Although most optimal decisions require subjects to report zero amounts, the reports in average are higher than zero. It indicates that subjects are also inclined toward obeying the regulation of tax payment. However, the deviation from the optimal decision is as well applied in the case where the optimal report should be the full amount of income. On average, the report is less than the received income. These results may suggest that the subjects are not going through the necessary calculations to devise the optimal decision, nevertheless, the fact that subjects still pay the tax when the optimal decision should be a complete evasion is consistent with the findings of Torgler (2002) that taxpayers may also be driven by moral rules and sentiments. Economic motive drives the subjects to be inclined toward underreporting the income, but the moral sentiment prevented them from totally avoiding the tax.

The compliance in this experiment was approached using reported income and compliance decision. Reported income could provide information regarding the degree of compliance, where the higher amount of income reported by subjects indicating a higher compliance. Compliance decision is a particular case of the reported income when the report is identical to the received income. The compliance decision is converted into binary variable, with the value of one if the reported income is correct and zero if the report is less than the actual income.

In the absence of bribery, the amount of reported income and the incident of compliance are higher after financial reward for compliance is available. The test of mean-difference confirms that the difference before and after the application of reward is significant. It implies that the introduction of a reward can increase the compliance, by both increasing the reported amount and the complying decisions. However, the application of a financial reward fails to increase the reported income in the presence of bribery, while the occurrences of complying decision only slightly increase. It

demonstrates that the positive impact of financial reward is crowded out by the presence of bribery.

Without the availability of financial reward, compliance behaviour of the subjects before and after the inclusion of bribery practice is not different statistically. The reported income under the presence of bribery is indeed lower by 4%, however, the mean-difference t-test fails to confirm that the difference is significant. This result is in contrast to the study by Chander and Wilde (1992) and Bilotkach (2006), which find underreporting increases with the presence of corrupted tax official. The reason for this might be that subjects are strongly driven by economic motive to minimize the loss of income, whether or not the bribery is practiced. This finding is consistent with the research of Purohit (2007), which indicates that the extreme unwillingness of taxpayers to comply with the law is common in many middle-income countries.

The panel analysis reveals that the tax rate does not affect the compliance in the absence of bribery. This result is in line with the findings of Baldry (1987), Porcano (1988), and Beck, et al. (1991). However, tax rate shows a significant negative impact on compliance under the presence of bribery, thus, confirming the finding of Friedland et al (1978) and Almet et al (1992) that higher tax rates significantly lessen the tax compliance. The argument for this ambiguity could be that the tax elasticity of the reported income increases under the presence of bribery. The subjects find that the cost of the sanction could be evaded all the time by paying the bribe, which is less than the amount of the sanction. When the tax rate increases, subjects directly respond by decreasing their report. When the financial reward is introduced into the setting with bribery practice, the negative impact of the tax rate is lesser than the impact without financial reward.

The regression results show that the effect of audit probability on compliance is more considerable than the effect of sanction rate. The values of coefficients indicate that the impact of audit probability is greater than the impact of sanction rate in all treatments. This result is in line with the finding of Friedland (1982) that audit intensity affects the compliance stronger than the severity of fine.

The availability of financial reward significantly increases the compliance when the bribery is prevented. Once bribery is practiced, the availability of financial reward only significantly induces the tendency to comply but does not increase the reported income in general. Moreover, the tendency to comply due to financial reward is lower. It indicates that only subjects who

are inclined toward compliance will be encouraged to submit the true report by the presence of the reward. On the other hand, the rest of the subjects will not be affected by the reward if the gain of cheating is more compelling. Since the bribery provides them with lower costs of evasion, they will continue to underreport the income. Therefore, the application of financial reward is not able to augment the reported income in the presence of bribery.

Incorporating the bribe rate as a determinant variable of tax compliance is a correct choice. The bribe rate significantly affects the compliance of subjects. Subjects perceived the bribe rate as the price of evading the punishment. A lower the bribe rate indicates that the price for evading the punishment of cheating decreases, thus, subjects are encouraged to lower their compliance. Accordingly, the increase in bribe rate tends to increase the tax compliance.

The numerical impact of tax scheme on reported income could be simulated with the equation $R = 0.53\rho - 0.15t + 0.11s + 0.10b$ ¹³, Where R , ρ , t , s , b indicate the reported emission, probability of audit, tax rate, sanction rate, and bribe rate respectively. Applying the values of parameters used in this experiment, and keeping the bribe rate constant, the proposed experimental tax scheme would be to set the probability of audit at 80% (meaning that the capacity of audit is able to cover 80% of the reports submitted by polluting firms), tax rate at 5% of reported emission denominated in monetary unit, sanction rate at 180% of unpaid tax. This scenario yields the reported emission amount to 55% of actual emission. Relaxing the assumption of constant bribe rate, the impact of emission tax scheme could be simulated with more modest values. Let the tax rate is set at 0.01%, probability of audit at 60%, sanction rate at 150%, and bribe rate assumed to be set by officials at 50% of the sanction, the reported emission would be 48% from actual emission.

The impact of emission tax scheme on complying decision could be simulated with the equation $R = 27.41\rho + 0.26t + 2.72s + 1.96b$ ¹⁴. Similar with the previous equation, the proposed experimental scheme would be to set the probability of audit at 80%, tax rate at 5%, and sanction rate at 180% while keeping the bribe rate constant. This simulation yields the odds of being compliant at a factor of 26.95. It indicates that the odds of complying is 2,595 % higher than the odds without the scheme instruments. Setting

¹³ Derived from the results of treatment 4 as presented in the Table 4.7.

¹⁴ Derived from the results of treatment 4 as presented in the Table 4.9.

the tax rate at 0.01%, probability of audit at 60%, sanction rate at 150%, and bribe rate at 50%, yields the odds of being compliant by a factor of 21.51.

Those two simulations do not include financial reward rate since the effect is not significant. However, while it has no impact on reported emission, the availability of financial reward (despite its value) is able to increase the odds of complying by the factor of 23.46.

Evidently, the values of instruments in the two simulations are hypothetical. The main message is that the reported emission would be maximal if the tax and financial reward are set at the lowest rate as possible, while probability rate and sanction rate are at the highest possible level. However, it should be noted that setting the sanction at a higher rate might stimulate more pervasive bribery. Therefore, the bribe rate should also be induced to be high, so that the cost of evading the sanction is severe.

4.7. CONCLUSION AND POLICY RECOMMENDATION

The study finds that the presence of bribery does not reduce the compliance much. Although bribery is fully prevented, the compliance behaviour is not much different. This finding confirms the fact that the nature of tax compliance behaviour in Indonesia is still low, regardless of the existence of bribery.

However, bribery disrupts the effectiveness of emission tax schemes and enforcement policies. It augments the negative consequence of tax on the compliance, by encouraging aggressive tax evasion as the tax rate increases. This condition raises more restriction for the MoF in deciding the tax scheme, since the tax rate should be maintained at a low level. Bribery also reduces the positive impact of financial reward on compliance, which is able to enhance the compliance (despite the value of the reward) before the bribery becomes prevalent. On the other hand, the introduction of financial reward can encourage the tendency to comply under the presence of bribery, although the impact is not as strong as that without bribery.

Based on the findings in this study, the proposed emission tax schemes under the presence of bribery would be a combination of low tax rate and low financial reward. Considering that the audit probability and sanction have significant and strong impacts on the compliance, a high audit and severe sanction are also compulsory. Since the bribe rate also has a significant impact on the compliance decision, the enforcement policies

directed toward corrupt tax official that increase in the cost of the bribe and eventually lead to higher compliance are recommended.

Chapter 5

CONCLUSION

This dissertation is intended to provide the clue regarding the optimal emission tax design under imperfect monitoring and the presence of bribery, motivated by the case of Indonesia. The emission tax scheme in this study is depicted as the outcome of strategic interplay among the Ministry of Finance (MoF), tax officials, and the polluting firms. This study is expected to contribute to environmental policy and tax compliance literature, particularly by examining the role of financial reward on emission tax compliance under the presence of bribery and incorporating the cost of bribe explicitly as a determinant of compliance.

This study employs game theoretical and experimental methods, the practical approaches to examine and to predict the performance of policy designs when the required empirical data is unavailable. Game theoretical method is particularly useful to analyze the strategic interaction in which the outcome of a party's choices depends on the decision of others. The experimental approach is employed to compensate for the weaknesses of the theoretical method, which relies heavily on the assumption that the economic agents are fully rational and driven by the benefit maximization motive. This approach can fill the gap between actual economic behavior and the prediction of the theoretical model.

Prior to theoretical and experimental analysis, this study firstly describes the problems of taxation in Indonesia. Results of the in-depth interview confirm the presence of firms' noncompliance and tax officials' corruption in Indonesia. The interview also reveals the inability of the monitoring mechanism to observe tax compliance of firms and to prevent corruption practice among tax officials. In addition, the findings of in-depth interview suggest the alternative way to enforce the compliance. Instead of relying on the sanction, the interview suggests enforcing the compliance with the provision of financial reward to the firms with accurate tax reports and the officials who can reveal the noncompliance behavior of the firms. Another conclusion that could be drawn from the interview findings is the necessity for emission tax, although the measures against tax evasion should be taken.

The theoretical study is intended to formulate the optimal emission tax scheme with costly monitoring under the presence of bribery. This process

firstly requires the observation of optimal decision of the polluting firms and tax officials. The polluting firms choose an optimal level of reported emission, given the emission tax scheme announced by the MoF and the cost of bribe demanded by the corrupt tax official. The corrupt officials decide the rate of bribe to extract from the firms that submit inaccurate report, given the mixture of enforcement policy set by the MoF.

The theoretical results indicate that optimal reported emission of polluting firms is decreasing with the tax rate and increasing with sanction, audit probability, financial reward for compliance, and bribe cost. When bribery becomes prevalent, the optimal reported emission of polluting firms is lower than that without bribery. The availability of financial reward raises the size of the optimal report, although the incremental report becomes smaller once the bribery takes place. However, the presence of financial reward can mitigate the adverse impact of emission tax rate on reported emission.

The highest impact on reported emission under the presence of bribery is demonstrated by the cost of the bribe. The magnitude of change in reported emission due to the change in bribe rate is higher than the change triggered by other determinants. The second highest impact is due to the sanction. The impact of the sanction is superior to financial reward in increasing the report when the gap between the optimal reported emission and the actual emission is wide.

Contrary to the optimal behavior of a polluting firm, the optimal behavior of a tax official in deciding the bribe rate is more affected by the financial reward than the penalty. This difference is due to the different mechanism of reward disbursement between the polluting firms and tax officials. The theoretical model set that compliant firms may only receive the reward after the accuracy of their reports is confirmed. However, the theoretical model allows the officials who can identify the violation against compliance to propose for financial reward directly by submitting the report to the MoF. On the other hand, the penalty for the corrupt officials is only imposed after their corrupt attitude is proved through inspection process.

The optimal policy for the MoF is formulated under assumption that the implementation of each instrument in the emission tax scheme is costly, and thus the formulation of the policy should consider the benefit and the incurred costs of each instrument. Based on the observation on optimal behaviour of the polluting firms and tax officials, theoretical study proposes that the optimal emission tax schemes would be a mixture of low tax rate with high sanction rate and low financial reward for polluting firms, in

combination with high financial reward for tax officials who are able to discover the evasion and moderate penalty for the corrupt tax officials.

The main focus of the experimental study is to predict the compliance behavior of the firms, given various emission tax schemes under different bribery settings. In particular, the experiment intends to observe the impact of financial reward on compliance behavior in the bribery setting. In the case of Indonesia, descriptive analysis on the experiment results find that the level of compliance is identical before and after bribery becomes prevalent. However, bribery restricts the effectiveness of the emission tax scheme and enforcement instruments. It augments the negative consequence of tax on compliance, by encouraging aggressive tax evasion as the tax rate increases. Bribery also curbs the positive impact of financial reward, which enhances compliance significantly before bribery takes place. Nevertheless, the introduction of financial reward encourages the compliance tendency in the presence of bribery, although the impact is not as strong as it is without bribery. The experimental study also finds that audit probability and sanction have a significantly positive impact on compliance.

In general, the results of the experimental study are in line with the theoretical results, except for the impact of financial reward. The theoretical study assumes that firms will act optimally to maximize their profit, on the other hand, the experimental study assumes that firms also act on ethical consideration aside from profit maximization behaviour. The experimental firms, who consider that cheating is ethically wrong, are more encouraged to comply when the reward is available. However, the bribery creates a condition where the benefit of evasion is more appealing than the benefit of compliance, and thus the financial reward loses its deterrence power.

Combining the findings of both theoretical and experimental studies, the proposed emission tax schemes under the presence of bribery would be a combination of low tax rate, low financial reward for compliant polluting firms, accompanied with a high sanction for evasion. Financial reward would be best to set at a low level since theoretical findings show that the impact of the reward on compliance is lower than the impact of the sanction. Furthermore, experimental results suggest that the important determinant of compliance in the absence of bribery is simply the availability of the reward, regardless the value, while the reward hardly affects the compliance behaviour in the presence of bribery. Therefore, it will be optimal for the MoF to design a financial reward rate at low level lower than the sanction rate. Since the bribe also contributes a significant impact on compliance

decision, the enforcement policies directed toward corrupting tax officials that eventually lead to the increase in the cost of bribe is recommended. Theoretical findings indicate that the optimal deterrence policy to ensure the performance of tax officials under costly monitoring would be a high financial reward for revealing the tax evasion and a lower penalty for taking the bribe. This recommendation also supported by the finding of in-depth interview, which reveals that the bribery in taxation is systemic. Consequently, the detection and prosecution of the officials engaging in bribery would be difficult and costly. Therefore, the penalty that entails the detection of bribery would be less appealing than the reward, which does not require a prior costly inspection.

APPENDICES

Appendix A: List of Respondents

Table A.1

List of Respondents

No.	Agency	Position
1	Indonesian Employers Association	Head of Indonesian Employers Association
2	Tax Advisor	Head of Tax Consultant Company
3	Tax Audit and Investigation Office, Ministry of Finance	Director of Tax Audit and Investigation Office
4	Internal Compliance and Human Resource Transformation, Ministry of Finance	Head of Internal Compliance and Human Resource Transformation, Ministry of Finance
5	Indonesia Corruption Watch	Senior staff of Indonesia Corruption Watch
6	Fiscal Policy Office, Ministry of Finance	Senior staff of Fiscal Policy Office, Ministry of Finance
7	Expert in Environmental Economics	Diponegoro University professor
8	Expert in Public Economics and Taxation	Diponegoro University professor
9	Expert in Industrial Economics	Diponegoro University professor
10	Expert in Public Economics	Diponegoro University researcher

Appendix B: Risk Profile Questionnaire

B.1 Risk questionnaire

Please complete the questionnaire by ticking one option for each question. There is no right or wrong answer; you can choose the option that suits your preference best.

1. Which of the following best describes your attitude to financial risk?
 - a) A very low risk taker
 - b) A low risk taker
 - c) An average risk taker
 - d) A high risk taker
 - e) A very high risk taker

2. If my investment value decreases more than 10% over a short period of time, I would sell the remaining of my investment.
 - a) Strongly agree
 - b) Agree
 - c) Neutral
 - d) Disagree
 - e) Strongly disagree

3. I am willing to accept more risk and experience more uncertainty to possibly achieve higher returns.
 - a) Strongly agree
 - b) Agree
 - c) Neutral
 - d) Disagree
 - e) Strongly disagree

4. If my investment value decreases more than 10% over a short period of time, I would invest more fund since I can tolerate short term losses in expectation of future gain.
 - a) Strongly agree
 - b) Agree
 - c) Neutral
 - d) Disagree
 - e) Strongly disagree

5. My main concern is security, keeping my money safe is more important than earning higher returns.

- a) Strongly agree
- b) Agree
- c) Neutral
- d) Disagree
- e) Strongly disagree

B.2 Risk scoring

1. Score for each option in the questions

Question	Option	Point
1	a)	1
	b)	2
	c)	3
	d)	4
	e)	5
2	a)	1
	b)	2
	c)	3
	d)	4
	e)	5
3	a)	5
	b)	4
	c)	3
	d)	2
	e)	1
4	a)	5
	b)	4
	c)	3
	d)	2
	e)	1
5	a)	1
	b)	2
	c)	3
	d)	4
	e)	5

2. Risk classification

a. Aggressive (22-25 point)

A high risk taker, who is aiming to pursue potentially greater returns. His/her choices carry with them a higher level of risk. Security is secondary to the potential for gain accumulation.

- b. Moderately aggressive (18-21 point)
A risk taker, who is prepared to accept higher volatility and moderate risks in order to accumulate profit. Her/his combination of business choices will be similar to those of balanced businessman, but more aggressive actions are included.
- c. Balanced (14-17 point)
A risk neutral, who requires diversified business choices to balance the expected gain and potential loss. A well calculated risky action will be acceptable for them to achieve good returns.
- d. Moderately conservative (10-13 point)
A risk averse, who is seeking better than basic returns, but risk must be low. Typically a businessman seeking to protect the wealth that has been accumulated, she/he may be prepared to carefully consider less aggressive business actions.
- e. Conservative (6-9 point)
A very risk averse, which requires that risk must be very low. She/he is willing to accept lower returns to protect her/his capital.

Appendix C: Experiment Instruction

C.1 Instruction of the Treatment 1

You are about to participate in an economic experiment. The experiment is taking form in a game. You can make considerable amount of money depend on the actions you take. The game will consist of 24 rounds. You are not allowed to communicate with other participants once the game is started.

You will receive a real income indicated in Indonesian Rupiah every round, written in *the income card*. In each round, you are required to report the amount of income that you receive in that particular round. You have to write the amount of income that you intend to report in *the reported income card*. We will draw the tax from the money that you have received. The tax is calculated as a certain percentage of your reported income; therefore, the sizes of the tax that will be deducted from your income every round is depend on your report. Due to the limitation of time and number of research assistants in this experiment, we cannot check whether all of you are reporting the amount of money honestly. We are only able to audit a certain number of the report in each round. If your report is audited and the amount of the report is less than the real income, you will get the sanction for cheating. The sanction is calculated as a percentage of the unpaid tax.

The percentage of the tax, the number of the reports that will be audited, and the percentage of the sanction will be announced in the *announcement card* in each round. The amount of money that will be deducted from your income as the sanction will be informed to you in *the sanction card*.

A calculator is available to assist you with your decision. I would like to emphasize that the anonymity of your decision is guaranteed. Your decision is confidential and will not be known to others. When the experiment is started, you are only represented by the number, which is randomly picked up. You will receive your money after the experiment by showing your card to the financial assistant.

C.2 Instruction of the Treatment 2

You are about to participate in an economic experiment. The experiment is taking form in a game. You can make considerable amount of money depend on the actions you take. The game will consist of 24 rounds. You are not allowed to communicate with other participants once the game is started.

You will receive a real income indicated in Indonesian Rupiah every round, written in *the income card*. In each round, you are required to report the amount of income that you receive in that particular round. You have to write the amount of income that you intend to report in *the reported income card*. We will draw the tax from the money that you have received. The tax is calculated as a certain percentage of your reported income; therefore, the sizes of the tax that will be deducted from your income every round is depend on your report. Due to the limitation of time and number of research assistants in this experiment, we cannot check whether all of you are reporting the amount of money honestly. We are only able to audit a certain number of the report in each round. If your report is audited and the amount of the report is less than the real income, you will get sanction for cheating. The sanction is calculated as a percentage of the unpaid tax. However, if your report is found to be accurate, you will get reward for compliance. The reward is calculated as a percentage of the tax payment.

The percentage of the tax, the number of the reports that will be audited, the percentage of the sanction, and the percentage of the reward will be announced in the *announcement card* in each round. The amount of money that will be deducted from your income as the sanction will be informed to you in *the sanction card*, while the amount of money that will be added to your income as the reward will be announced in *the reward card*.

A calculator is available to assist you with your decision. I would like to emphasize that the anonymity of your decision is guaranteed. Your decision is confidential and will not be known to others. When the experiment is started, you are only represented by the number, which is randomly picked up. You will receive your money after the experiment by showing your card to the financial assistant.

C.3 Instruction of the Treatment 3

You are about to participate in an economic experiment. The experiment is taking form in a game. You can make considerable amount of money depend on the actions you take. The game will consist of 24 rounds. You are not allowed to communicate with other participants once the game is started.

You will receive a real income indicated in Indonesian Rupiah every round, written in *the income card*. In each round, you are required to report the amount of income that you receive in that particular round. You have to write the amount of income that you intend to report in *the reported income*

card. We will draw the tax from the money that you have received. The tax is calculated as a certain percentage of your reported income; therefore, the sizes of the tax that will be deducted from your income every round is depend on your report. Due to the limitation of time and number of research assistants in this experiment, we cannot check whether all of you are reporting the amount of money honestly. We are only able to audit a certain number of the report in each round. If your report is audited and the amount of the report is less than the real income, you will get sanction for cheating. The sanction is calculated as a percentage of the unpaid tax. However, you may avoid the sanction by agreeing to pay the bribe. The bribe is calculated as a percentage of sanction.

The percentage of the tax, the number of the reports that will be audited, the percentage of the sanction, and the percentage of the bribe will be announced in the *announcement card* in each round. The amount of money that will be deducted from your income as the sanction, as well as the amount of bribe that you may pay to escape the sanction, will be informed to you in *the sanction card*.

A calculator is available to assist you with your decision. I would like to emphasize that the anonymity of your decision is guaranteed. Your decision is confidential and will not be known to others. When the experiment is started, you are only represented by the number, which is randomly picked up. You will receive your money after the experiment by showing your card to the financial assistant.

C.4 Instruction of the Treatment 4

You are about to participate in an economic experiment. The experiment is taking form in a game. You can make considerable amount of money depend on the actions you take. The game will consist of 24 rounds. You are not allowed to communicate with other participants once the game is started.

You will receive a real income indicated in Indonesian Rupiah every round, written in *the income card*. In each round, you are required to report the amount of income that you receive in that particular round. You have to write the amount of income that you intend to report in *the reported income card*. We will draw the tax from the money that you have received. The tax is calculated as a certain percentage of your reported income; therefore, the sizes of the tax that will be deducted from your income every round is depend on your report. Due to the limitation of time and number of

research assistants in this experiment, we cannot check whether all of you are reporting the amount of money honestly. We are only able to audit a certain number of the report in each round. If your report is audited and the amount of the report is less than the real income, you will get sanction for cheating. The sanction is calculated as a percentage of the unpaid tax. However, you may avoid the sanction by agreeing to pay the bribe. The bribe is calculated as a percentage of sanction. On the other hand, you will get reward for compliance if your report is found to be accurate. The reward is calculated as a percentage of the tax payment.

The percentage of the tax, the number of the reports that will be audited, the percentage of the sanction, the percentage of the bribe, and the percentage of the reward will be announced in the *announcement card* in each round. The amount of money that will be deducted from your income as the sanction, as well as the amount of bribe that you may pay to escape the sanction, will be informed to you in *the sanction card*. The amount of money that will be added to your income as the reward will be announced in *the reward card*.

A calculator is available to assist you with your decision. I would like to emphasize that the anonymity of your decision is guaranteed. Your decision is confidential and will not be known to others. When the experiment is started, you are only represented by the number, which is randomly picked up. You will receive your money after the experiment by showing your card to the financial assistant.

Appendix D: Experiment Instruments

Figure D.1

Announcement card in treatment 1

<u>Announcement card</u>	
Tax rate	X % of reported income
Sanction rate	X % of unpaid tax
Audit probability	X person of total participant

Figure D.2

Announcement card in treatment 2

<u>Announcement card</u>	
Tax rate	X % of reported income
Reward rate	X % of paid tax
Sanction rate	X % of unpaid tax
Audit probability	X person of total participant

Figure D.3

Announcement card in treatment 3

<u>Announcement card</u>	
Tax rate	X % of reported income
Sanction rate	X % of unpaid tax
Bribe rate	X % of sanction amount
Audit probability	X person of total participant

Figure D.4
Announcement card in treatment 4

<u>Announcement card</u>	
Tax rate	X % of reported income
Reward rate	X % of paid tax
Sanction rate	X % of unpaid tax
Bribe rate	X % of sanction amount
Audit probability	X person of total participant

Figure D.5
Income card

<u>Income card</u>
In this round you are entitled to
..... IDR

Figure D.6
Reported income card

<u>Reported income card</u>
The amount of money that you intend to report:
..... IDR
(Your reported amount will be the basis for the tax payment that will be deducted from your income)

Figure D.7

Sanction card in treatment 1 and 2

Sanction card
You have to pay the sanction for cheating:

..... **IDR**

Figure D.8

Sanction card in treatment 3 and 4

Sanction card
You have to pay the sanction for cheating:

xxxx IDR (1)

Or pay the bribe:

xxxx IDR (2)

(thick one of the two options)

Figure D.9

Reward card

Reward card
You get the reward for reporting your income accurately:

xxxx IDR

Appendix E: Preceding Test for Mean-Difference Test and Panel Data Analysis

Table E.1

The results of Variance Equality Test: reported income

Treatments	Bartlett's Chi2
1 and 2	5.84** (0.02)
1 and 3	0.28 (0.60)
2 and 4	15.45** (0.00)
3 and 4	4.12* (0.04)

Note: * significant at 5% significance level
 ** significant at 1% significance level
 Value in the bracket is P-value

Table E.2

The results of Variance Equality Test: percentage of accurate reports

Treatments	Bartlett's Chi2
1 and 2	1.12 (0.29)
1 and 3	0.02 (0.90)
2 and 4	7.13** (0.01)
3 and 4	2.99 (0.08)

Note: * significant at 5% significance level
 ** significant at 1% significance level
 Value in the bracket is P-value

Table E.3

The results of Hausmann Test: determinant of reported income

Treatments	chi2 (3)	Prob>c hi2
Treatment 1	0.02	0.9994
Treatment 2	0.00	1.0000
Treatment 3	-0.00	-
Treatment 4	1.94	0.9249

Table E.4

The results of Hausmann Test: determinant of compliance decision

Treatments	chi2 (3) 15	Prob>c hi2
Treatment 1	-0.62	-
Treatment 2	-0.53	-
Treatment 3	-0.23	-
Treatment 4	-0.48	-

¹⁵ Most empirical and theoretical literature dismisses the problem of negative values for estimated variance, and suggests replacing the negative variance by zero value (Magazzini and Calzolari, 2010).

References

- ALLINGHAM, M.G. and SANDMO, A. (1972) Income tax evasion: A theoretical analysis. *Journal of Public Economics*, vol.1, pp. 323-338.
- ALM, J. (1998) Tax Compliance and Administration, Working Paper, University of Colorado, Boulder.
- ALM, J. (2011) Testing Behavioral Public Economics Theories in the Laboratory. *Tulane Economics Working Paper Series 1102*.
- ALM, J., JACKSON, B.R. and McKEE, M. (1992a) Estimating the Determinants of Taxpayer Compliance with Experimental Data. *National Tax Journal*, vol. 45, pp. 107-114.
- ALM, J., JACKSON, B.R. and McKEE, M. (1992b) Deterrence and Beyond: toward a Kinder, Gentler IRS. In: SLEMROD, J. (ed) *Why People Pay Taxes: Tax Compliance and Enforcement*, pp. 311-329. Michigan: University of Michigan Press.
- ALM, J., SANCHEZ, I. and de JUAN, A. (1995) Economic and Noneconomic Factors in Tax Compliance. *Kyklos*, vol.48, pp. 3-18.
- ANTARANEWS (2007) "The Potential Revenue of Environmental Tax Reach 4 Trillion IDR Annually", 21 May [online]. Available at: <http://www.antaranews.com/print/1179742544/potensi-pajak-lingkungan-capai-rp4-triliuntahun> (Accessed at 10 November 2010).
- BALDRY, J.C. (1987) The Enforcement of Income Tax Laws: Efficiency Implications. *Economic Record*, vol. 60(169), pp. 156-159.
- BAZART, C. and PICKHARDT, M. (2010) Fighting Income Tax Evasion with Positive Rewards: Experimental Evidence. *LAMETA Working Papers*, no. 09-01.
- BECK, P., DAVIS, J. and JUNG, W. (1991) Uncertainty and Taxpayer Aggressiveness: Experimental Evidence. *The Accounting Review*, vol. 66(14), pp. 535-558.
- BECKER, G.S. (1968) Crime and Punishment: An Economic Approach. *The Journal of Political Economy*. Vol. 76 (2), pp. 169-217.
- BILOTKACH (2006) A Tax Evasion – Bribery Game: Experimental Evidence from Ukraine. *The European Journal of Comparative Economics*, vol.3, pp. 31-49.

- BLACKWELL, C. (2007) A Meta-Analysis of Tax Compliance Experiments. *International Studies Program, Working Paper 07-24*.
- BONTEMS, P. and BOURGEON, J. (2005) *Optimal Environmental Taxation and Enforcement Policy*. *European Economic Review*, vol. 49(2), pp. 409-435.
- BOYCE, B. and NEALE, P. (2006) *INTERVIEWS: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input*. Pathfinder Internasional [online]. Available at [http://www.esf-agentschap.be/uploadedFiles/Voor ESF promotoren/Zelfevaluatie ESF-project/me tool series indepth interviews.pdf](http://www.esf-agentschap.be/uploadedFiles/Voor_ESF_promotoren/Zelfevaluatie_ESF-project/me_tool_series_indepth_interviews.pdf) (Accessed February 3, 2009).
- BRANDTS, J. and CHARNESS, G. (2004) Do Labour Market Conditions Affect Gift Ex-change? Some Experimental Evidence. *Economic Journal*, vol. 114(497), 684-708.
- CERTAINTY FINANCIAL (2009) *Superannuation Risk Profile Questionnaire* [online]. Available at: <http://www.certainty.com.au/pdfs/toolbox/AMP%20Risk%20Profiler%20Oct%2009.pdf>. (Accessed January 16, 2010).
- CHANDER, P. and WILDE, L. (1992) Corruption in Tax Administration. *Journal of Public Economics*, vol.49, 333-349.
- COMMON, M. and STAGL, S. (2005) *Ecological Economics: An Introduction*. Cambridge: Cambridge University Press.
- CREW, M.A. and PARKER, D. (ed.), 2006, *International Handbook on Economic Regulation*. Cheltenham: Edward Elgar Publishing Ltd.
- CROPPER, M.L. and OATES, W.E. (1992) Environmental Economics: A Survey. *Journal of Economic Literature*, vol. 30(2), pp. 675-740.
- DAMANIA, R. (2002) Environmental Control with Corrupt Bureaucrats. *Environment and Development Economics*, vol.7(3), pp. 407-427.
- DAMANIA, R., FREDRIKSSON, P. G. and LIST, J. A. (2003) Trade Liberalization, Corruption, and Environmental Policy Formulation: Theory and Evidence. *Journal of Environmental Economics and Management*, vol. 46(3), pp: 490-512.
- DASGUPTA, S., Laplante, B., Mamingi, N. and Wang, H. (2001) Inspections Pollution Prices, and Environmental Performance: Evidence from China. *Ecological Economics*, vol.36, pp.487-498.

- DESAI, U. (ed.) (1998) *Ecological Policy and Politics in Developing Countries: Growth, Democracy and Environment*. New York: State University of New York Press.
- DOUGHERTY, C. (2006) *Introduction to Econometrics*. Oxford: Oxford University Press.
- Environmental Act No. 23/1997 on Basic Stipulations on Environmental Management. Ministry of Environment, Republic of Indonesia.
- Environmental Act No. 32/2009 on Basic Stipulations on Environmental Management. Ministry of Environment, Republic of Indonesia.
- Environmental Act No. 4/1982 on Basic Stipulations on Environmental Management. Ministry of Environment, Republic of Indonesia.
- FALK, A. and FEHR, E. (2003) Why Labour Market Experiments? *Labour Economics*, vol.10(4), pp. 399–406.
- FALKINGER, J. and WALTHER, H. (1991) Reward versus Penalties: on a New Policy against Tax Evasion. *Public Finance Quarterly*, vol.19, pp.67-79.
- FEHR, E. and FALK, A. (1999) Wage Rigidity in a Competitive Incomplete Contract Market. *Journal of Political Economy*, vol. 107(1), pp. 106–34.
- FEHR, E. and GÄCHTER, S. (2000) Fairness and Retaliation: The Economics of Reciprocity. *Journal of Economics Perspective*, vol. 14, pp. 159-189.
- FEHR, E., KIRCHSTEIGER, G. and RIEDL, A. (1993) Does Fairness Prevent Market Clearing? An Experiment Investigation. *The Quarterly Journal of Economics*, vol. 108, pp. 437-459.
- FELD, L., FREY, S. and TOGLER, B. (2006) Rewarding Honest Taxpayers? Evidence on the Impact of Reward from Field Experiments. *CREMA Working Paper*, no. 200616.
- Finance Minister Decree No. 143.1/2009 on The Third Amendment on Financial Decree No 100/2008 on Organization and Work Procedure of Ministry of Finance. Ministry of Finance, Republic of Indonesia.
- Finance minister decree No. 184/2010 on Organization and Work Procedure of the Ministry of Finance. Ministry of Finance, Republic of Indonesia.
- Finance minister decree No. 199/2007 on Tax Audit Procedure. Ministry of Finance, Republic of Indonesia.
- Finance minister decree No. 33/2007 on Ethical Code within General Directorate of Taxation. Ministry of Finance, Republic of Indonesia.

- Finance Minister Decree No. 462/2004 on Investigation Procedures within General Inspectorate of Ministry of Finance. Ministry of Finance, Republic of Indonesia.
- FOULON, J., LANOIE, P. and LAPLANTE, B. (2002) Incentives for Pollution Control: Regulation or Information? *Journal of Environmental Economics*, vol. 44, pp.169-187.
- FRIEDLAND, N. (1982) A Note on Tax Evasion as a Function of the Quality of Information about the Credibility of Threatened Fines: Some Preliminary Research. *Journal of Applied Social Psychology*, vol 12, pp. 54-59.
- FRIEDLAND, N., MAITAL, S. and RUTENBERG, A. (1978) A Simulation Study of Income Tax Evasion. *Journal of Public Economics*, vol. 10, pp. 107-116.
- FULLERTON, D., LEICESTER, A. and SMITH, S. (2008) Environmental tax. *NBER Working Paper*, No. 14197.
- GREENE, W.H. (2002) *Econometric Analysis*. New Jersey: Pearson Education, Inc.
- HACKETT, S. (2006) *Environmental and Natural Resources Economics: Theory, Policy, and the Sustainable Society*. New York: M.E. Sharpe.
- HAHN, R.W. and STAVINS, R.N. (1992) Economic Incentives for Environmental Protection: Integrating Theory and Practice. *The American Economic Review*, vol. 82(2), pp. 464-468.
- HAILPERN, S. and VISINTAINER, P.F. (2003) Odds Ratios and Logistic Regression: Further Examples of Their Use and Interpretation. *The Stata Journal*, vol.3(3), pp. 213-225.
- HAMM, J.L. (1995) *Income Level and Tax Rate as Determinants of Taxpayer Compliance: An Experimental Examination*. Unpublished thesis (PhD), Graduate Faculty of Texas Tech University.
- HANLEY, N. and FOLMER, H. (1999) *Game Theory and the Environment*. Camberley: Edward Elgar Publishing Ltd.
- HARFORD, J.D. (1978) Firm Behavior Under Imperfectly Enforceable Pollution Standards and Taxes. *Journal of Environmental Economics and Management*, vol. 5, pp. 26-43.
- HASAN, D. and PUSPITASARI, E.P. (2008) Tinjauan Terhadap Rencana Penerapan Pajak Lingkungan Sebagai Instrument Perlindungan

- Lingkungan Hidup Di Indonesia. *Mimbar Hukum*, vol. (20)3, pp. 411-588.
- HEYES, A. (2000) Making Things Stick: Enforcement and Compliance, in Hehm, D. (ed), *Environmental Policy: Objectives, Instruments, and Implementation*. Oxford: Oxford University Press.
- HORHORUW, M., KARIPPACHERIL, T.M., SUTİYONO, W. and THOMAS, T. (2012) *Transforming the Public Sector in Indonesia: Delivering Total Reformasi* [online]. Available at [http://siteresources.worldbank.org/EXTGOVANTICORR/Resources/3035863-1289428746337/Transforming Public Sector Indonesia.pdf](http://siteresources.worldbank.org/EXTGOVANTICORR/Resources/3035863-1289428746337/Transforming_Public_Sector_Indonesia.pdf) (Accessed at 20 July 2012)
- IBBOTSON ASSOCIATES (2007) *Risk Profile Questionnaire* [online]. Available at: http://www.upsecurities.com/documents/Investor_Profile.pdf. (Accessed January 16, 2010).
- KAGEL, J.H. and ROTH, A.E. (1997) *The Handbook of Experimental Economics*. Princeton: Princeton University Press.
- KAMBUAYA, B. (2011) *Socialization of Utilization Direction of Specific Allocation Fund for Environmental Sector 2012*. Bali, 23 November.
- KASTLUNGER, B., Muehlbacher, S., Kirchler, E. and Mittone, L. (2011) What Goes Around Comes Around? Experimental Evidence of the Effect of Rewards on Tax Compliance. *Public Finance Review*, vol. 39(1) pp. 150-167.
- KRAUSE, M., KROGER, S. and POTTERS, J.(2004) Inside from Experimental Economics for Market Regulation, *Tijdschrift voor Economie en Management*, vol. XLIX (2) pp.218-238.
- KIRKWOOD, B. and STERNE, J. (2003) *Essential Medical Statistics*. Oxford: Willey-Blackwell.
- KOMPAS (2008) "Environmental Tax under the Threat of Cancellation", 9 September [online]. Available at: <http://entertainment.kompas.com/read/2008/09/09/00481256> (Accessed at 10 November 2010).

- KONTAN (2008) "Environmental Tax Should Stay There", 11 September [online]. Available at: <http://nasional.kontan.co.id/news/pajak-lingkungan-harus-tetap-ada> (Accessed at 10 November 2010).
- KORAN JAKARTA (2011) "Tax Compliance is Still Low", 30 September [online]. Available at: <http://koran-jakarta.com/index.php/detail/view01/72518> (Accessed at October 9, 2011).
- LAFFONT, J.J. and MARTIMORT, D. (2002) *The Theory of Incentives: The Principal-Agent Model*. Princeton: Princeton University Pers.
- LE COQ, C. and ORZEN, H. (2006) Do Forward Markets Enhance Competition? – Experimental Evidence. *Journal of Economic Behavior and Organization*, vol. 61(3), pp. 415-431.
- MACHO-STADLER, I. and PÉREZ-CASTRILLO, D. (2006) Optimal Enforcement Policy and Firms' Emissions and Compliance With Environmental Taxes. *Journal of Environmental Economics and Management*. Vol.51, pp. 110-131.
- MINISTRY OF ENVIRONMENT (2007) *National Action Plan Addressing Climate Change*. Jakarta: Ministry of Environment, Republic of Indonesia.
- MINISTRY OF FINANCE AND AUSTRALIA INDONESIA PARTNERSHIP (2009) *Ministry of Finance Green Paper: Economic and Fiscal Policy Strategies for Climate Change Mitigation in Indonesia*. Jakarta: Ministry of Finance, Republic of Indonesia.
- MIRRLEES, J.A. (1997) Information and Incentives: The Economics of Carrots and Sticks. *Economic Journal*, vol.107(444), pp. 1311-29.
- MORGAN, J., ORZEN, H. and SEFTON, M. (2006) A laboratory Study of Advertising and Price Competition. *European Economic Review*, vol. 50(2), pp.323-347.
- MORSE, S. (2006) Is corruption bad for environmental sustainability? A cross-national analysis. *Ecology and Society*, vol.11(1) [online]. Available at URL: <http://www.ecologyandsociety.org/vol11/iss1/art22/> (Accessed at March 8, 2012).
- NORMANN, H.T. (2006) Experimental Economics for Antitrust Law and Policy. *SSRN eLibrary* [online]. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=950206 (Accessed March 6, 2009)
- NORMANN, H.T., RUFFLE, B.J. and SNYDER, C.M. (2006) Do Buyer-Size Discounts Depend on the Curvature of the Surplus Function?

- Experimental Tests of Bargaining Models. *SSRN eLibrary* [online]. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=422780 (Accessed March 6, 2009)
- O'CONNOR, D. (1994) *Managing the Environment with Rapid Industrialisation: Lessons from the East Asian Experience*. Paris: Development Centre of the Organisation for Economic Cooperation and Development.
- OLSEN, T.E. and TORSVIK, G. (1998) Collusion and Renegotiation in Hierarchies: A Case of Beneficial Corruption. *International Economic Review*, vol. 39(2), pp. 413-438.
- ORZEN, H. (2008) Counterintuitive Number Effects in Experimental Oligopolies. *Experimental Economics*, vol.11(4), pp. 390-401.
- PARGAL, S., MANI, M. and HUQ, M. (1997) Inspections and Emissions in India: Puzzling Survey Evidence on Industrial Water Pollution. *PRD Working Paper 1810*, Development Research Group, World Bank.
- PARK, C. and HYUN, J. (2003) Examining the Determinants of Tax Compliance by Experimental Data: a Case of Korea. *Journal of Policy Modeling*, vol.25, pp. 673-684.
- PARK, H.M. (2009) Comparing Group Means: T-test and One-way ANOVA Using STATA, SAS, R, and SPSS. *UITS Center for Statistical and Mathematical Computing Working Paper*.
- PBD WEALTH MANAGEMENT PTY LTD (2006) *PBD Risk Profile Questionnaire* [online]. Available at: www.pbd.com.au/PDFs/PBD%20Risk%20Profile%20Questionnaire.pdf. (Accessed January 16, 2010).
- PEACE (2007) Indonesia and Climate Change: Current Status and Policies [online]. Available at: http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf (Accessed November 7, 2008)
- PLOTT, C.R. (1982) Industrial Organization Theory and Experimental Economics. *Journal of Economic Literature*, vol.20(4), pp. 1485-1527.
- POLINSKY, A. M. and SHAVELL, S. (2000) The Economic Theory of Public Enforcement of Law. *Journal of Economic Literature*. Vol.38, pp.45-76.
- PORCANO, T.M. (1988) Correlates of Tax Evasion. *Journal of Economic Psychology*, vol. 9, pp. 47-67.

- PUNCH, K.F. (2005) *Introduction to Social Research: Quantitative and Qualitative Approaches*. London: Sage Publications Ltd.
- PUROHIT, M.C. (2007) Corruption in Tax Administration. In SHAH, A. (ed) *Performance Accountability and Combating Corruption*. The World Bank, pp. 285-301.
- REINGANUM, J.F. and WILDE, L. (1985) Income Tax Compliance in Principal-agent Framework. *Journal of Public Economics*, vol.26, pp. 1-18.
- RICHARDSON, G. (2008) The Relationship between Culture and Tax Evasion Across Countries: Additional Evidence and Extensions. *Journal of International Accounting Auditing and Taxation*, vol.17, pp. 67-78.
- ROBBINS, P. 2000. The Rotten Institution: Corruption in Natural Resource Management. *Political Geography*, vol. 19(4), pp: 423-443.
- ROSE-ACKERMAN, S. (1978) *Corruption: A Study in Political Economy*. Academic Press, Inc. New York.
- ROTH, A. E. (eds) (1987) *Laboratory Experimentation in Economics: Six Points of View*. Cambridge: Cambridge University Press.
- ROTH, A.E. (1991) Game Theory as a Part of Empirical Economics. *The Economic Journal*, vol. 101(404), pp. 107-114.
- ROTH, A.E. (2002) The Economist as Engineer: Game Theory, Experimentation, and Computation as Tools for Design Economic. *Econometrica*, vol. 70(4), pp. 1341-1378.
- ROTH, J.A., SCHOLZ, J.T. and WITTE, A.D. (eds) (1989) *Taxpayer Compliance*. Philadelphia: University of Pennsylvania Press.
- SAWILOWSKY, S.S. (2002) Fermat, Schubert, Einstein, and Behrens-Fisher: The Probable Difference Between Two Means with Different Variances. *Journal of Modern Applied Statistical Methods*, vol.1, pp. 461-472.
- SHOR, M. (2005) *Backward Induction, Dictionary of Game Theory Terms* [online]. Available at http://www.gametheory.net/dictionary/url_of_entry.html (Accessed. August 15, 2009)
- SIEBERT, H. (2008) *Economics of the Environment: Theory and Policy*. Heidelberg: Springer.
- SINAR HARAPAN (2009) "Firms Tax Compliance is Still Low", 31 January [online]. Available at:

- <http://www.sinarharapan.co.id/berita/0801/24/uang04.html> (Accessed August 16, 2010).
- SMITH, V.L. (1992) *Experimental Methods in Economics*, Inaugural Lecture at the Laboratori d'Economia Experimental, Universitat Pompeu Fabra [online]. Available at: http://www.upf.edu/leex/_pdf/history/Inaugural_Lecture.pdf (Accessed August 18, 2010)
- SMITH, V.L. (1994) Economics in the Laboratory. *The Journal of Economic Perspectives*, vol. 8(1), pp. 113-131.
- SMITH, V.L. (2003) Constructivist and Ecological Rationality in Economics. *American Economic Review*, vol. 93, pp. 465-508.
- SUARA MERDEKA (2009) "2014, carbon tax for Industry will be imposed", 10 Desember [online]. Available at: <http://m.suaramerdeka.com/index.php/read/cetak/2009/12/10/91140> (Accessed August 16, 2010).
- SUARA MERDEKA (2009) "The Corporate Tax Compliance is Investigated", 16 Juli [online]. Available at <http://suaramerdeka.com/v1/index.php/read/cetak/2009/07/16/72719/> (Accessed August 2, 2009).
- SWIERZBINSKI, J. (1994) Guilty Until Proven Innocent: Regulation with Costly and Limited Enforcement. *Journal of Environmental Economics and Management*, vol. 27(2), pp. 127-146.
- Tax Law No. 28/2007 on The Third Amendment on General Provisions and Taxation Procedures. Ministry of Finance, Republic of Indonesia.
- Tax Law No. 6/1983 on General Provisions and Taxation Procedures. Ministry of Finance, Republic of Indonesia.
- TEMPO (2004) "Business Sector Asks for Firms Tax Reduction", 16 September [online]. Available at: <http://www.tempointeraktif.com/hg/ekbis/2004/09/16/brk,20040916-32.id.html> (Accessed November 4, 2008).
- THE JAKARTA GLOBE (2009) "Indonesian Delegate Advocates Environmental Tax on Industry", 8 December [online]. Available at: <http://www.thejakartaglobe.com/nvironment/indonesian-delegate-advocates-environmental-tax-on-industry/346344> (Accessed at 10 November 2010).

- TORGLER, B. (2002) Speaking to Theorists and Searching for Facts: Tax Morale and Tax Compliance in Experiments. *Journal of Economic Surveys*, vol.16, pp. 657-683.
- TORGLER, B. (2003) Beyond Punishment: a Tax Compliance Experiment with Taxpayers in Costa Rica. *Revista de Analisis Economico*, vol.18, pp.27-56.
- TRANSPARENCY INTERNATIONAL INDONESIA (2010) *Corruption Perception Index*. Jakarta.
- TRANSPARENCY INTERNATIONAL INDONESIA (2010) *Survey of Bribery Perception Index*. Jakarta.
- UNODC (2012) *UNODC Country Programme for Indonesia, 2012-2015* [online]. Available at: http://www.unodc.org/documents/southeastasiaandpacific//indonesia/publication/Country_Programme_Indonesia.pdf. (Accessed at 10 November 2010)
- USAID (2008) *An Analysis of Opportunities for USAID Indonesia's Water and Energy Team to Incorporate Global Climate Change Activities in the Natural Resource Management and Energy Sectors* [online]. Available at: http://pdf.usaid.gov/pdf_docs/PNADS198.pdf. (Accessed at 10 November 2010)
- WEPA (2012) *Outlook on Water Environmental Management in Asia 2012* [online]. Available at: www.wepa-db.net/pdf/1203outlook/01.pdf (Accessed at 20 July 2012)
- WILSON, J.K. and DAMANIA, R. (2005) Corruption, political competition, and environmental policy. *Journal of Environmental Economics and Management*, vol. 49, pp. 516-535.
- WORLD BANK (2000) *Anticorruption in Transition: A Contribution to the Policy Debate*, World Bank. Washington.
- WORLD BANK (2009) *Investing in a More Sustainable Indonesia: Country Environmental Analysis*. Jakarta.