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When Officials Don't Know What They Don't Know:

Dunning-Kruger Effect in the Case of Green Budgeting for Local Government

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***Abstract*— This paper extends the key findings of Kruger and Dunning (1999) showing that people who are unskilled in a given domain tend to be unaware of their lack of skills; to government circle that is supposed to be filled by professionals. This paper compares individual government officials' self-assessment of their offices' ability in performing certain tasks related to green budgeting, to their responses to questions that implicitly assess their actual ability to perform such tasks. Consistent with Kruger and Dunning (1999), individuals who have sufficient knowledge and expertise in a given domain tend to have more accurate self-assessment when they are asked to rate their own expertise, and vice versa. This paper also discusses the theoretical underpinning of how compensation structure is related to Dunning-Kruger effect on policy design and how tying the outcome with compensation can increase the learning.**

Keywords—Dunning-Kruger effect, green budgeting, government officials

JEL Codes— D86, H10, J30, J45, M52

"The fool doth think he is wise, but the wise man knows himself to be a fool"

—Shakespeare

I. INTRODUCTION

Are *all* government officials, who often deal with uncertainties and ambiguities, better in knowing the limits of their own understanding than average people? Or do they, just like people they serve, tend to overestimate their own level of knowledge *when* they actually do not know as much?

The propensity to overestimate level of knowledge in the field that one does not actually master or to underestimate the level of knowledge in the field that one actually masters is known as Dunning-Kruger effect in the field of psychology. While this specific cognitive bias has only been scientifically scrutinized since the introduction of seminal paper of Kruger and Dunning [8], philosophers throughout centuries have recognized that poor performers tend to overestimate their ability, and vice versa.

Although explanations and empirical tests on Dunning-Kruger effect are well-established, most of the existing literatures tend to focus on people who are non-professionals, i.e. non-experts whose livings do not predicate on mastering knowledge in a given field. This might be driven by assumption that professionals have to gain sufficient knowledge in a given field in order to obtain their job in the first place and get paid to perform their duties. One of experiment from Kruger and Dunning [8] which showed that logical training can improve metacognitive skills can be interpreted as (supposedly) positive relationship between education and relevant work experience; this also supposed makes people more aware of their own level of knowledge.

Indeed, concern about meta-ignorance in professional setting has already been aired in other fields, although government circle has never been explicitly researched before. In the field of academic research, where professional researchers tend to self-regulate, Regehr and Eva [14] and Huang [7] noted that reliance on self-assessment among researchers to assess the limits of their own knowledge and skills, a group that is supposed to be experts, may need to be reconsidered. Both argued that even experts as humans can still suffer from cognitive biases, including Dunning-Kruger effect.

Eva et al. [5] and Regehr and Eva [14] noted that while the increased pace of new medical researches and knowledge requires medical professionals to better assess the area of knowledge that they should learn more, many medical professionals' self-assessment correlate poorly with their actual knowledge. Huang [7] argued that the existence of Dunning-Kruger effect among academic researchers and peer-reviewers creates some sort of echo chamber, in which they suppress their own ignorance by relying on their existing knowledge and rejecting alternative or competing hypotheses in face of new evidences, and ultimately stifles diversity of ideas. This, in turn, strengthen the suggestion that professionals, rather than being group of people who are all capable of self-criticism, can be just as prone to meta-ignorance.

This suspicion about the existence of meta-ignorance among less knowledgeable individuals in government circle was further prompted by observations on civil servants at subnational level in Indonesia. As part of LPEM's grant from Millennium Challenge Account Indonesia (part of Millennium Challenge Corporation), various efforts have been conducted to increase capacity, including but not limited to trainings and technical assistances, on green budgeting for local government, both at province and municipal (city/regency) levels for almost two years. Before the training sessions were commenced, it was found that many province-level and/or regency-level officials said that they were aware of climate change issues and green budgeting, and blamed on limited funds for lack of actions in mitigating climate change to (i) absence of regulatory mandate from Ministry of Internal Affairs, (ii) lack

of willingness from elected Governors/Mayors/Regents and Regional House of Representatives, and (iii) lack of fund due to other, more urgent priorities. However, when training sessions commenced, it became apparent that those same officials did not actually possess enough relevant knowledge to understand and implement green budgeting, such as ability to reasonably assign monetary value to non-monetary goods like CO_2 emission reduction.

This disconnection between officials' perceived abilities and their actual abilities is puzzling, particularly as local governments have been mandated by law to prepare Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK) since 2011. Given all aspects of local government affected by RAD-GRK, local civil servants should have learned enough to accurately rate their own knowledge about the subject matter. Furthermore, an experiment in Kruger and Dunning [8] showed that logical training improves metacognitive skills, and that senior civil servants tend to be better educated and far more experienced than general population; those officials are supposed to be even less prone to Dunning-Kruger effect.

With these underlying issues in mind, this study is designed as a preliminary research and stepping stone for further studies on meta-ignorance in government circle, particularly when there is no clearly defined quantitative measurement for knowledge evaluation available. To that end, the first part of this paper is devoted to discussion of existing literatures on Dunning-Kruger effect and metacognition. The next part of this paper discusses the methodology, key findings of the research, and limitation of this study. The last section discusses the policy implication of meta-ignorance for public service delivery in general and for green budgeting in particular. Specifically, this paper is interested in exploring incentives, if any, that can be implemented to encourage government officials to improve their metacognitive skills.

II. Theoretical Framework and Literature Review

A. Concept of Metacognition and Dunning-Kruger Effect

To understand the cognitive mechanism behind why people who are less competent tend to overestimate their ability, understanding the concept of metacognition is first needed. The term metacognition is defined simply as the cognition about cognition or a second-order cognition; thoughts about thoughts, knowledge about knowledge, or reflection about actions [12]. A basic, non-technical example about metacognition is one's knowledge or awareness about one's level of knowledge in a given field (e.g. "I am aware that I know very little about the concept of metacognition", or "I do not know that I only know so little about psychology").

John H. Flavell, who coined the term metacognition, divided it into two parts: metacognitive knowledge and metacognitive experience. Flavell [6] defined metacognitive knowledge as "one's stored knowledge or beliefs about oneself and others as cognitive agents, about tasks, about actions or strategies, and about how all these interact to affect the outcomes of any sort of intellectual enterprise", and metacognitive experience/regulation as "conscious cognitive or affective experiences that occur during the enterprise and concern any aspect of it—often, how well it is going".

Lai [11], further refined the constituent elements of metacognition that were proposed by Flavell [6] by incorporating insights researches that followed Flavell [6]. Lai (2011) categorized the components of metacognition into cognitive knowledge and cognitive regulation. He summarized cognitive knowledge; it was broadly defined as knowledge about one's own knowledge [13, 17], others' [6] and about epistemological understanding in general [9][1]. Cognitive regulation is also broadly defined as perception or experience of cognition that serves as "quality control" [6] and process of planning, monitoring, and evaluating cognition [2, 13, 16, 17, 20][2].

It may become apparent by now that ability to know the limit of one's own knowledge (cognitive knowledge) and ability to create strategy to widen one's horizon is important to gain new knowledge. Researchers have linked metacognition to intelligence; Sternberg [19] even considered metacognition, which enables someone to appropriately allocate cognitive resources for learning, as central to intelligence. Within the context of knowledge acquisition, it can be inferred that when someone has vast knowledge about certain field, he or she tends to know better and more accurately about the extent of available knowledge and limit of his current knowledge, what concepts he should learn to gain more knowledge, and how to do so. In some cases, people with vast knowledge may even underestimate their own knowledge and capabilities, fallen prey to false-consensus effect [15][3]. Conversely, without sufficient knowledge about related field and sufficient humility to admit ignorance, people may tend to overestimate their knowledge on a given field.

This very phenomenon is what constitutes Dunning-Kruger effect; people with low level of knowledge tend to overestimate their ability in that field precisely because they are not actually familiar with the field in question. People who do not know what they do not know tend to think that they almost know all there is to know. The good news is that, as aforementioned, deficit in metacognitive skills (and metacognitive skills in general) is not a permanent condition; training and feedbacks can improve metacognitive skills, i.e. better ability to know the extent and limit of one's own knowledge or competence.

However, as pointed out by Kruger and Dunning [8], if trainings and feedbacks improve metacognitive skills, and that life experience should have demonstrated that they are ignorant and/or unskilled, why do people with less knowledge or competence still fail to realize their shortcomings? Kruger and

[1] Cognitive knowledge can be expressed by the ability to accurately respond to question such as "Do I know this?"

[2] Cognitive regulation can be defined by how individual monitor, assess and make strategy to improve their knowledge. This can be expressed by questions such as "How am I doing now? What should I do to improve my skills or knowledge?"

[3] False consensus effect in this context refers to perception among people who are knowledgeable and/or top performer to falsely assume that since they are performing so well (perhaps effortlessly), they assume that their peers should also perform as well as them. This issue is also discussed in Kruger and Dunning [8].

Dunning [8] suggested that (i) people who are not competent seldom receive feedbacks, (ii) some tasks and/or settings preclude people from receiving feedbacks of their shortcomings and why they are not performing well, (iii) even if people receive feedbacks that point to their lack of knowledge or skills, they may attribute it to other factors [1, 18], and (iv) less competent individuals are less able to take advantage of feedback via social comparison[4].

This paper suggests an alternative explanation, particularly in the case of government officials: government officials may not recognize their own shortcomings and try to improve their knowledge or skills because they are not incentivized to do so. It should be noted that government's meta-ignorance can be costly for society at large. Take, for example, the case of 2008 Global Financial Crisis that was originated in United States. Failure of regulators to realize how little they know about then-unknown adverse impacts of unchecked financial innovations made them put too much faith in market's self-regulation, which led to near-total collapse of global financial market following the demise of Lehman Brothers in 2018. This is despite the fact that the source of crisis increased in delinquency of U.S. subprime mortgages, was not actually large enough to cause crisis in such a global scale by itself.

B. Why Remaining Blissfully Ignorant of One's Ignorance Can Be Rational

If the cost of overestimating level of knowledge and competence and the benefit of continuous learning are huge, as mentioned above, and if private incentives of individual government officials are perfectly aligned with social interest, government officials will be incentivized to remain vigilant of the "unknown-unknown" by accumulating more knowledge. However, in many cases, there is a principal-agent issue in the problem of government officials' meta-ignorance; while mistake is costly for taxpayer, private cost for government officials are negligible. Likewise, officials do not receive pecuniary compensation for good services that can only be made possible by accumulating sufficient knowledge. Under these conditions, incentive for government officials to be aware of the extent and limit of their knowledge is negligible, which makes them less likely to learn more. Conversely, the drive to learn more can be inferred as the sign that the officials are aware of the limit of their knowledge.

This paper incorporates insights from contract theory by utilizing basic framework à la Laffont and Martimort [10] and Delfgaauw and Dur [3] to explain why government officials with low level of prior knowledge tend to learn less and those with more prior knowledge tend to learn more. Assuming that government is the representation of the people at large[5], acts as principal and individual officials as its agents. Government provides benefit for society to the value of $S\left(\sum_{t=1}^{T}(1+\delta)^{t-T}q_{i,t}\right)$, which can be simplified to $S(\cdot)_{i,t}$. Stripped to its essence, the work of government is to mobilize officials to use their knowledge and expertise to provide services to general public, so that social value of government services $S(\cdot)_{i,t}$ depends on officials' accumulated knowledge ($\sum_{t=1}^{T}(1+\delta)^{t-T}q_{i,t}$). Social benefit is assumed to follow $S'(\cdot)_{i,t} > 0$, $S''(\cdot)_{i,t} < 0$, and $S(0) = 0$.

Accumulation of knowledge by government officials affects the quality of public services $S(\cdot)_{i,t}$ through (i) reduction of expected social cost from the possibility of avoidable, costly mistakes and (ii) improved quality of government services delivery. To illustrate the two, here is the example of public planning within the context of waste management. Knowledge about increased risks of disease outbreak and flooding from allowing households to dump their waste into the river allows officials to take preventive measures, such as by routinely collecting household wastes and promoting private-operated recycling center to reduce the cost. Additionally, preventive better waste management system reduces environmental nuisance and improve public satisfaction from better water quality.

Officials derive benefit from wage (w) and utility from their contribution to public benefit through their works, which can be represented by $\gamma_{i,t}S(\cdot)_{i,t}$, $\gamma_i = f\left(\sum_{t=1}^{T-1}(1+\delta)^{t-T}q_{i,t}\right), \gamma_{i,t} \in [0,1]$ where $\gamma_{i,t}$ is defined as the relationship between officials' ex-ante knowledge of a given subject and utility derived from their works $S(q_{i,t})$. The concept of $\gamma_{i,t}$ can be demonstrated using the previous hypothetical example about waste management. If the hypothetical official is not aware of the risks associated with dumping household waste into the river (no prior knowledge on the subject of waste treatment, $\sum_{t=1}^{T-1}(1+\delta)^{t-T}q_{i,t} = 0$), s/he will put little to no value ($\gamma = 0$) on learning waste management best practice. S/he will also have no problem with continuous dumping of household waste into the river or letting the community operate open landfill in densely-populated area, thus risking disease outbreak, flooding and reduction in overall environmental quality.

Individual knowledge of a given subject is assumed to decay over time, which in this paper is reflected by the term δ. Knowledge decay happens naturally through memory loss of any given knowledge over extended period of time. Ability to recollect information from texts that were read 10 years ago, for example, is lower than from texts read just yesterday. Information that was acquired from distant past is also less useful than, which further contributes to effective decay of knowledge over time. The term δ is close to the concept of depreciation, but instead of depreciation of physical capital stock, δ represents depreciation of stock of knowledge; this phenomenon is also more popularly known as half-life of knowledge.

Acquiring knowledge is also private-costly, with individual officials paying for both fixed[6] (F) and variable cost (θ) of

[4] In the words of Kruger and Dunning [8], less competent individuals are less able to spot competence when they see it compared to their more competent counterparts, so that watching behavior do not make their estimate of their own ability is incorrect

[5] The study also simplifies the model by assuming that government office's incentive is aligned with community at large, i.e. what government office wants is what the community want.

[6] This fixed cost is also known as status quo utility level, i.e. reservation utility level in the form of outside opportunity that can be obtained outside this transaction.

knowledge acquisition. Individual officials also face different variable costs of acquiring knowledge; highly productive officials (denoted by superscript H) can learn easily and face lower cost of learning than less productive officials (denoted by superscript L), thus implying $\theta_H < \theta_L$. This implies that the cost structure for individual officials equals to:

$$C(q, \theta_H) = \theta_H q_{H,t} \quad (2.1a)$$

$$C(q, \theta_L) = \theta_L q_{L,t} \quad (2.1b)$$

Payoff and utility function for officials type i is represented by following function:

$$U_{i,t} = w_{i,t} + \gamma_i S(\cdot)_{i,t} - \theta_i q_{i,t} \quad (2.2)$$

Before entering a contract, officials (agents) are assumed to have ex-ante knowledge of their own type. The government (principal) also has knowledge about general distribution of each type of worker, but cannot assess the type of each individual worker. The problem faced by the principal is, therefore, to maximize the following program, subject to participation and incentive constraints of both highly productive and less productive officials:

$$\max(p\big(S(\cdot)_{H,t} - w_H\big) + (1-p)\big(S(\cdot)_{H,t} - w_L\big)) \quad (2.3)$$

In the first-best world, government as principal can offer contract that yields zero utility for each agent ($w_{i,t} = \theta_i q_{i,t} - \gamma_{i,t} S(\cdot)_{i,t}$) in order to achieve its own best possible utility. The complication to this first-best scenario arises from inability of government as principal to correctly assess the type of each individual worker and incentive constraint of highly productive worker. As highly productive officials have lower learning cost than less productive officials, they can gain positive utility by mimicking less productive worker; by definition, if government can offer less productive workers a contract of $w_L - \theta_L q_{L,t} + \gamma_L S(\cdot)_{L,t} = 0$, highly productive worker can take that contract and have utility of $(\theta_L - \theta_H) q_{L,t} + (\gamma_{H,t} - \gamma_{L,t}) S(\cdot)_{H,t} > 0$. Thus, if the government as principal wants highly productive officials to elicit the private information regarding their true type, the contract offered to them have to satisfy the incentive constraint as outlined in (2.4), which can be re-written as (2.5) or (2.6)

$$w_{H,t} + \gamma_{H,t} S(\cdot)_{H,t} - \theta_H q_{H,t} \geq w_{L,t} + \gamma_{H,t} S(\cdot)_{L,t} - \theta_H q_{L,t} \quad (2.4)$$

$$U_{H,t} \geq U_{L,t} + (\theta_L - \theta_H) q_{L,t} + (\gamma_{H,t} - \gamma_{L,t}) S(\cdot)_{L,t} \quad (2.5a)$$

$$U_{H,t} \geq U_L + \Delta\theta q_{L,t} + \Delta\gamma_t S(\cdot)_{L,t} \quad (2.5b)$$

$$w_{H,t} - w_{L,t} \geq \theta_H\big(q_{H,t} - q_{L,t}\big) - \gamma_{H,t}(S(\cdot)_{H,t} - S(\cdot)_{L,t}) \quad (2.6a)$$

$$\Delta w_t \geq \theta_H \Delta q_t - \gamma_{H,t} \Delta S(\cdot)_t \quad (2.6b)$$

The reverse, however, can be safely ignored. As the cost of carrying out the contract for less productive officials is higher than for highly productive officials, the contract offered to highly productive official is unappealing to less productive officials. This condition has two implications. First, if a menu of contracts can satisfy less productive officials' participation constraint ($U_{L,t} \geq 0$), that menu will always strictly satisfy highly productive agent's participation constraint. The constraints for principal's optimization can therefore be simplified to less productive officials' participation constraint and highly productive officials' incentive constraint (Laffont and Martimort, Chapter 2).

Rewriting highly productive officials' incentive constraint (6) and less productive officials' participation constraint into principal's problem in (4) allows having outputs as the problem's only choice variable:

$$\max(p\big(S(\cdot)_{H,t} - \theta_H q_{H,t} + \gamma_{H,t} S(\cdot)_{H,t}\big) + (1-p)\big(S(\cdot)_{L,t} - \theta_L q_{L,t} + \gamma_{L,t} S(\cdot)_{L,t}\big) - p\big(\Delta\theta q_{L,t} + \Delta\gamma_t S(\cdot)_{L,t}\big)) \quad (2.7)$$

Maximization of principal's utility with respect to amount of knowledge learned by officials at period T ($q_{i,T}$) yields:

$$S'(\cdot)_{H,T} = \frac{1}{1+\gamma_H}\theta_H < \theta_H \quad (2.8)$$

$$S'(\cdot)_{L,T} = \frac{(1-p)\theta_L + p\Delta\theta}{(1-p)(1+\gamma_{L,T}) - p\Delta\gamma_T} > \theta_L \quad (2.9)$$

(2.8) and (2.9) show that the second-best, incentive-feasible menu of contracts entails upward distortion of output for highly productive officials and downward distortion of output for less productive workers when compared to first-best output, consistent with Delfgaauw and Dur [3]. At this point, a special case is where less productive workers have zero prior knowledge, so that $\gamma_{L,T} = 0$. This brings (2.9) to:

$$S'(\cdot)_{L,T} = \frac{(1-p)\theta_L + p\Delta\theta}{1-p(1+\gamma_{H,T})} \quad (2.10)$$

(2.10) represents further downward distortion in output that happens if less productive officials, due to lack of knowledge, do not appreciate the social benefit created by accumulating more knowledge and do not derive any intrinsic utility from their own work. Using another example, officials that have little to no knowledge about the link between human activities climate change may not see the intrinsic benefit of learning more on subjects like climate change mitigation or adaptation. Less productive officials will therefore only commit to learn the bare minimum level required by their respective job description (only meeting the participation constraint). This notion is supported by Regehr and Eva [14] suggesting that even if people are aware of their shortcomings, they may avoid learning if it takes more energy and commitment than they are willing to expend.

The second-best, incentive-compatible contracts as shown by (2.8) and (2.9) also highlight the problem with existing remuneration scheme offered by government to its officials. Ideally, highly productive officials should be demanded to focus their energy on gaining more knowledge and learning new, more innovative approaches to government's day-to-day problems and thus rewarded accordingly. However, by offering identical wage for both types of officials, as the case today, highly productive workers will only learn more to the extent of their perceived utility from learning more, which may or may not amount too much. Under the current condition, highly productive officials are willing to accept identical wages while learning more than less productive officials by

$$\Delta q = \frac{\gamma_{H,T}(S(\cdot)_{H,T} - S(\cdot)^*_{L,T})}{\theta_H} \quad (2.11)$$

Viewed from another perspective, offering contracts with similar wage as in (2.11) is akin to purely appealing to altruistic motive when it comes to pushing highly productive officials to learn more. Compare (2.11) to the difference in quantity of learning between highly productive and less productive workers under second-best, incentive-compatible contracts (i.e., when paid sufficiently more):

$$\Delta q^* = \frac{(w^*_{H,T} - w^*_{L,T}) + \gamma_{H,T}(S(\cdot)^*_{H,T} - S(\cdot)^*_{L,T})}{\theta_H} \quad (2.12)$$

In summary, (2.10) shows that particularly for less productive officials, inability to appreciate the social benefit of acquiring more knowledge—something that allows them to derive intrinsic utility from the subjects they learn—will reduce the amount of knowledge they are willing to learn. The conclusion is similar to what is predicted by Dunning-Kruger effect, where people who know less tend to think that what they already know covers almost everything to know, thus reducing the incentive to learn. The more sanguine aspect from (2.9) is that as officials start to accumulate more knowledge, they are also more appreciative of the benefit of acquiring more knowledge, particularly the limitation of their own knowledge; thus increasing the amount of knowledge they acquire with same level of wage. This means that incentivizing officials to learn may, in the long run, increase their accumulated level of knowledge in that subject and allows them to accurately assess their level of knowledge (i.e. by realizing that there is always more to learn).

III. METHODOLOGY

A. Data

Data for this research are sourced from LPEM FEB UI's Survey on Readiness of Local Government for Implementation of Green Budgeting. The survey was aimed at senior civil servants in local government offices (*Satuan Kerja Perangkat Daerah*/SKPD) who are in charge of climate-change related issues and/or formulation of contribution of local office in Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK). Respondents should be either Heads of Local Office (*Kepala SKPD*), Secretaries of Local Office (*Sekretaris SKPD*, equivalent to Secretary-General in title), Division Heads (Kepala Bidang), or Subdivision Heads (Kepala Sub-Bidang), mentioned according to the level of seniority. Respondents are composed of 138 local offices in 4 provinces and 13 regencies in Indonesia.

B. Method

The survey was designed to reflect self-assessments on various aspects of readiness to implement green budgeting. Several questions were designed as pairs of "reference question" and three "test questions". Reference question is self-assessment on the ability to conduct certain activities, with responses rated on an ordinal scale of 1-4. Test questions are binary response (yes/no) questions, the responses of which reflect subset of knowledge that are inquired in Reference Question. The aim of this design is to test the consistency of self-assessment that is reported in reference questions and the response, i.e. whether claiming to knowledge that is reported in reference question is warranted.

There are four pairs of Reference Question which then are compared to aggregate of its three respective questions. To do so, the binary responses to Test Questions will be transformed into 1-4 scale that is used for Reference Questions. Starting with score of 1, and add score of 1 for each "yes" answer to binary response question. With 3 Test Questions to be compared to each Reference Question, the minimum score for the aggregated Test Questions is 1 (i.e. when the response to every test question is "no" and maximum score is 4 (i.e. when the response to every test question is "yes"), identical with the ordinal scale employed by Reference Question. The list of Reference Questions and Test Questions is provided in the appendix.

Even as the question purportedly tries to assess the competence of the whole local office not the competence of the individual respondent in conducting certain activities, the construction of the questions will reveal the extent of knowledge about concepts that are subject of inquiry in reference questions. For example, in order to accurately assess the ability of local office to prepare RAD-GRK document in Reference Question 1, respondent should know the processes of drafting and preparing RAD-GRK, which includes but is not limited to coordination meeting on RAD-GRK with other local offices (Test Question 1), providing necessary data (Test Question 2), and actually preparing RAD-GRK document (Test Question 3). Accurate metacognitive knowledge should result in consistent result between Reference Questions and their respective Test Questions (i.e. difference between the score of Reference Question and aggregated Test Questions is zero or close to zero).

To detect whether Dunning-Kruger effect is present within the government circle, the study tested the hypothesis of whether the average of self-assessed responses to Reference Questions is equal to aggregate of response to the respective Test Questions (using simple t-test), and plotted the results into scatterplot. Ordered probit regression was then performed to detect the source of overestimation in self-assessment on selected aspects of green budgeting readiness asked on Reference Questions.

Furthermore, to assess possible factors that are likely to affect officials to be self-confident, both responses to every Reference Questions and Test Questions were regressed by various probable causes with ordered probit model, focusing the result on probability of someone to score 3 on the scale of 1-4. The regressions follow the following model:

$$question = f(d_{Pemprov}, d_{Jambi}, d_{NTB}, d_{NTT}, d_{Bappeda}, d_{Kehut}, d_{LH}, Grad, Postgrad) \quad (3.1)$$

Where:

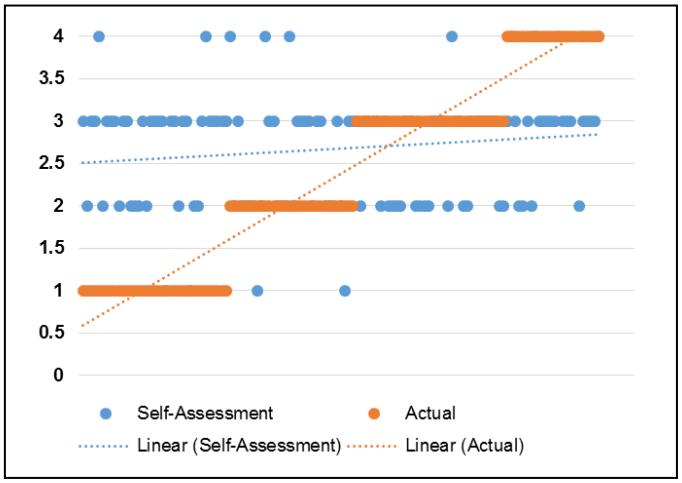
- $d_{Pemprov}$: Dummy variable of Provincial Government (1= Provincial government)
- d_{Jambi} : Dummy variable of Jambi (1= within Jambi border)
- d_{NTB} : Dummy variable of NTB (1= within NTB border)
- d_{NTT} : Dummy variable of Jambi (1= within NTT border)

- $d_{Bappeda}$: Dummy variable of Bappeda (1= official from Office of Planning/Bappeda)
- d_{Kehut} : Dummy variable of Dinas Kehutanan (1= official from Office of Forestry/Dishut)
- d_{LH} : Dummy variable of BLHD (1= official from Regional Environmental Agency)
- Grad : Proportion of employees with at least bachelor/S1 degree
- Postgrad: Proportion of employees with at least graduate/S2 degree

IV. Results and Discussions

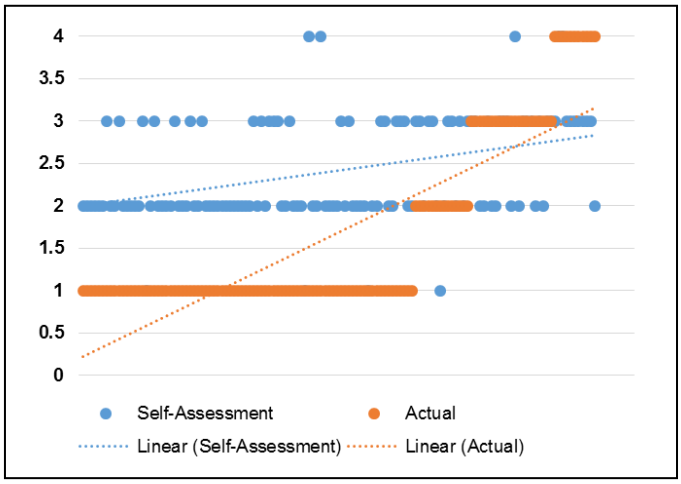
The study compared the response for reference questions which serve as respondent's self-assessment, and their respective questions which serve as respondent's actual knowledge. It was illustrated this by plotting respondent's actual knowledge against respondent's self-assessment in one scatterplot.

Figure 1: Response to statement "this local office is able to prepare the Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK) document"



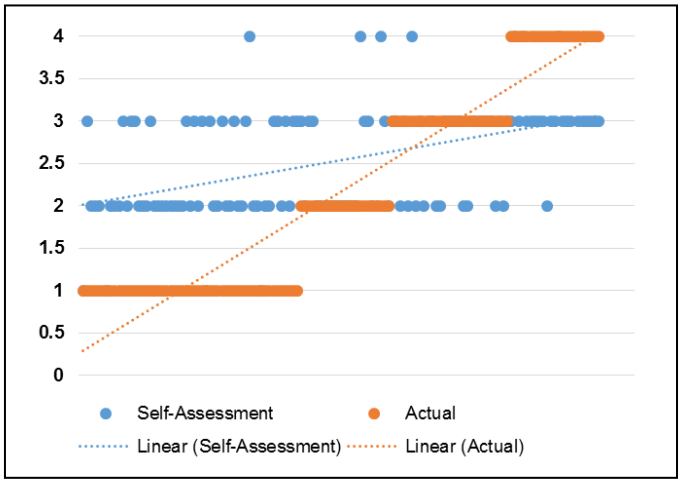
The comparison between self-assessment and actual result (derived from its three constituent Test Questions) for Reference Question 1 were analyzed. Overall, self-assessment for Reference Question 1 ($\bar{x}$ = 2.6769) is higher than the actual result ($\bar{x}$ = 2.3615), t(129) = 3.0436, p<0.01. The relationship between self-assessment and actual result is weakly positive and statistically insignificant, with r_s = 0.1210, p = 0.1704

Figure 2: Response to statement "this local office is able to calculate level of emissions and emission reduction from mitigation activities in every sector that are under the purview of local office"



The analysis of comparison between self-assessment and actual result (derived from its three constituent Test Questions) for Reference Question 2 shows that overall, self-assessment for Reference Question 2 ($\bar{x}$ = 2.4253) is higher than the actual result ($\bar{x}$ = 1.7537), t(133) = 7.7587, p<0.01. The relationship between self-assessment and actual result is moderately positive and statistically significant, with r_s = 0.4241, p = 0.0000. It should be noted that difference between stated ability to calculate level of emissions and actual ability (whether they have done so in the past) are more pronounced than in other Reference Questions. This can be explained by the fact that most respondents have little awareness that activities related to their field can emit greenhouse gas emissions.

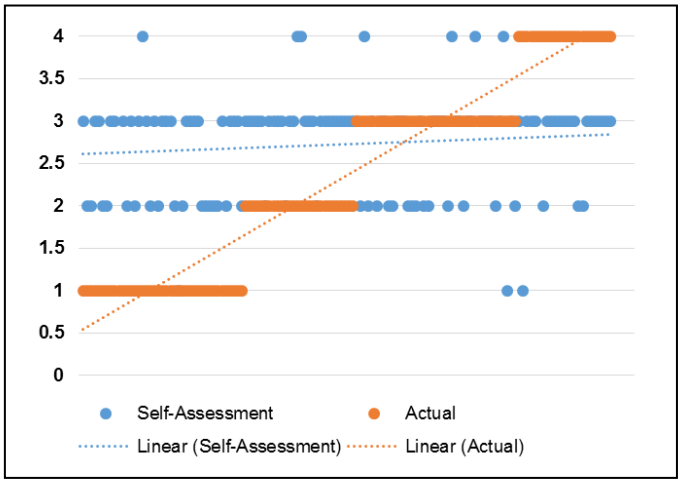
Figure 3: Response to statement "this local office is able to prepare the Monitoring, Evaluation, and Reporting of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK) document"



The comparison between self-assessment and actual result (derived from its three constituent Test Questions) for Reference Question 3 shows that self-assessment for Reference Question 3 ($\bar{x}$ = 2.5426) is higher than the actual result ($\bar{x}$ = 2.1550), t(128) = 4.2611, p<0.01. The relationship between

self-assessment and actual result is moderately positive and statistically significant, with $r_s = 0.4523$, $p = 0.0000$

Figure 4: Response to statement "this local office is able to incorporate issues related to climate change within the planning and budgeting cycle"



The average range of the self-assessment for Reference Questions is 2.43-2.73, which is higher and has less range than the average results of actual assessment (Range 1.75-2.36). While average responses to Reference Question 1, 2, 3, or 4 are not statistically the same, with $F(539) = 6.12$, $p<0.01$, breakdown of descriptive statistics shows that responses to Reference Questions are centered around the score of 2 and 3, as seen at the Table 1 below. This also suggests that government officials also tend to rate themselves as "above average", in line with results of previous studies.

Table 1: Summary of Responses to Reference Questions (Self-Assessment)

Score	Reference Question 1		Reference Question 2		Reference Question 3		Reference Question 4	
	Freq	%	Freq	%	Freq	%	Freq	%
1	4	2.96	4	2.94	4	2.99	3	2.22
2	46	34.07	75	55.15	62	46.27	38	28.15
3	75	55.56	52	38.24	61	45.52	87	64.44
4	10	7.41	5	3.68	7	5.22	7	5.19
Total	135	100.00	136	100.00	134	100.00	135	100.00

The findings show that the overall pattern tends to be very weak (models' R^2 below 0.10) yet statistically significant. The clearest tend emerging is the respondents from Office of Environmental Affairs (Badan Lingkungan Hidup Daerah), on average, more likely underestimate their knowledge compared. This trend emerges when the marginal effects of Reference Question 1 (self-assessment) to Test Questions 1 (actual results) and Reference Question 2 to Test Questions 2 are compared. In Question 1, offices of environmental affairs are 1.97% (n.s.) more likely to score 3 on self-assessment, but 7.23% ($p < 0.10$) more likely score 3 on actual results. In Question 2, offices of environmental affairs are 6.36% (n.s.) more likely to score 3 on self-assessment, but 9.14% ($p < 0.05$) more likely score 3 on actual results. The pattern in 2 other questions is not clear and not statistically significant.

This trend of Environmental Affairs Office respondents more likely underestimate their knowledge can be attributed to the fact that offices of environmental affairs most likely have issues of climate change and green budgeting under their purview; thus making officials be more aware of steps of climate change mitigation and green budgeting, and more compliant with RAD-GRK. This awareness of issues related to green budgeting and climate change mitigation makes officials in office of environmental affairs accurately assess their knowledge of issues in questions.

Another relatively clear trend is consistently significant overestimation among government officials in Nusa Tenggara Timur, particularly when compared to other provinces. Compared to baseline province (Sulawesi Barat) in Question 1, local officials in Nusa Tenggara Timur, both province-level and regency level, are 16.43 % ($p < 0.05$) more likely to score 3 on self-assessment, but 1.16% (n.s.) less likely to score 3 on actual results. In Question 2, local officials in Nusa Tenggara Timur are 26.05 % ($p < 0.01$) more likely to score 3 on self-assessment, but only 1.10% (n.s.) more likely scores 3 on actual results. In Question 1, local officials in Nusa Tenggara Timur are 8.37 % (n.s.) more likely to score 3 on self-assessment, but 2.25% (n.s.) less likely score 3 on actual results. The same trend plays out in Question 4; local officials in Nusa Tenggara Timur are 21.96 % ($p < 0.01$) more likely to score 3 on self-assessment, but only 9.28% ($p < 0.05$) more likely score 3 on actual results.

There is no conclusive explanation as to why civil servants from local offices in Nusa Tenggara Timur tend to overestimate their ability by a wide margin, particularly compared to other provinces. The trend of overestimation of knowledge among NTT officials is likely affected by the existing environmental condition of Nusa Tenggara Timur. Different from other provinces in Indonesia, major islands in NTT, such as Sumba and Timor, have savannah climate. This naturally drier condition may induce officials and population in general to attribute adverse climate events, such as drought or flash flood, less to human activities. This may also explain why officials in NTT are less inclined to care or learn about human negative impacts on environment because they have lived with less friendly environmental conditions for a very long time.

Less apparent but equally interesting regional differences in score can be seen in relatively higher mean test score (actual ability) in Jambi and propensity of respondents in Jambi to be more accurate in measuring their readiness in aspects of green budgeting, compared to other provinces (q.v. Appendix 1). While respondents in Jambi still tend to overestimate their readiness in aspects of green budgeting, the gap between self-assessment and actual assessment tend to be much lower than in other provinces. Indeed, regression results suggest that respondents in Jambi might actually tend to slightly underestimate their abilities; in Question 1, Jambi officials are 11.53% ($p < 0.10$) more likely to score 3 on self-assessment, but 20.29% (n.s.) more likely score 3 on actual results. Likewise, in Question 4, Jambi officials are 6.01% (n.s.) more likely to score 3 on self-assessment, but 6.31% ($p < 0.10$) more likely score 3 on actual results.

The most plausible reason behind why Jambi officials tend to outperform three other provinces in terms of accurately measuring their own readiness on aspects of green budgeting is because Jambi experienced large-scale anthropogenic environmental disaster. In 2015, Jambi experienced total shutdown as forest fires, which were used to clear lands for new palm oil plantations, became uncontrollable. This months-long continuous forest fires, which prevented people in Jambi to do any activities outside homes and claim many casualties, caused deep trauma among people in Jambi, as also shown in interview with both officials and locals. This shock prompted Jambi provincial government and regency/municipal governments to dedicate significantly more attention to environment-related issues, which then explains higher awareness and knowledge of environmental issues across-the-board in Jambi.

A surprising result comes from positive statistical relationship between proportions of undergraduate level (S1) employee to total employees (proxy of how well-educated civil servants in each local office are) and overestimation of level of knowledge among respondents. In Question 1, increase of 1 percentage point in proportion of undergraduate-level employee makes respondents 0.20% (n.s.) more likely score 3 on self-assessment, but only 0.17% ($p < 0.10$) more likely score 3 on actual results. In Question 2, increase of 1 p.p. in proportion of undergraduate-level employee makes respondents 0.40% ($p < 0.10$) more likely score 3 on self-assessment, but only 0.21% ($p < 0.05$) more likely score 3 on actual results. In Question 3, increase of 1 p.p. in proportion of undergraduate-level employee makes respondents 0.50% ($p < 0.01$) more likely score 3 on self-assessment, but only 0.14% ($p < 0.05$) more likely score 3 on actual results. Question 4 yields no statistically significant measure.

The effect is more acute when measuring the portion of postgraduate (S2 and S3) level employees to total employees and how it makes respondents more likely overestimate their knowledge and abilities. In Question 3, an increase of 1 p.p. in proportion of undergraduate-level employee makes respondents 1.04% ($p < 0.05$) more likely score 3 on self-assessment, but 0.12% (n.s.) less likely score 3 on actual results. In Question 4, an increase of 1 p.p. in proportion of undergraduate-level employee makes respondents 0.50% ($p < 0.01$) more likely score 3 on self-assessment, but only 0.14% ($p < 0.05$) more likely score 3 on actual results. Regression with respect to self-assessment responses and actual results for Question 1 and Question 2 does not yield statistically significant results.

Illusion of superiority may account the tendency of respondents to overestimate when they know their employees are better-educated. It may be the case that when senior civil servants know that their peers and subordinates are well-educated, they more likely assume that at least somebody in their offices knows about concepts related to green budgeting, even if they do not personally know about the concepts in question. However, more researches are needed to better account this phenomenon.

It should also be noted that the survey used in this study relies almost completely on self-assessment; even the Test Questions, which are supposed to measure actual skills, still rely to some degree on self-assessment, as presenting specific question in binary response format may reduce cognitive load needed to answer the questions and are not less accurate than ordinal response format [4]. The binary response format used in this survey was also designed to reveal skills even when relying on self-assessment, given that most of the questions focus more on whether the respondents (who represent their respective local offices) have done something and less on whether the respondents can do something. Furthermore, devising proper examination to assess senior local civil servants' actual performance on green budgeting, or any other government activities is also impractical; it took long duration to assess competence on certain government activities and time constraint of senior civil servants. For example, measuring ability of government officials to conduct social cost-benefit analysis, even when key data and assumptions are provided, may take hours, given the complexity of calculating social cost and social benefit. With time constraints faced by civil servants, it may be very difficult to find enough willing civil servants to have any statistically meaningful survey.

V. Policy Implications

Results of this study on green budgeting readiness give strong indication that government officials are not immune to Dunning-Kruger effect. Further analysis reveals that certain government functions such as respondents from office of environmental affairs have better metacognitive skills when it comes to concepts of green budgeting; given that they deal with climate change mitigation-related issues on daily basis. Officials from regions that have suffered from acute anthropogenic environmental disaster also tend to be more accurate in their assessment of green knowledge, suggesting that adverse events tend to promote learning. Presence of more educated workforce, paradoxically, gives illusion of superiority amongst respondents and cause respondent to overestimate their own office's ability.

This study yields three key insights from the presence of Dunning-Kruger effects in government officials circle, particularly among the less-knowledgeable. First, self-assessment and self-monitoring are grossly inadequate, which suggest that if central government wants local governments to implement green budgeting, they should create mechanism to independently assess the readiness and performance of local government. Second, good performance measurement design should be easily quantifiable and objective; targets for green budgeting for local governments cannot be vague or immeasurable. Third, large-scale adverse events tend to promote learning and more accurate self-assessment, particularly when continued ignorance is costly for decision makers.

This problem of incentives, or lack thereof, may also account for apparent lack of efforts to improve metacognitive ability among civil servants under current setting. Even people who are aware of their shortcomings may still avoid learning when such learning takes more energy and commitment than they are willing to expend. When ignorance are costly, government officials cannot afford to remain ignorant of their ignorance and shortcomings. The most important part of good

incentives for government officials to implement green budgeting (or other policies) is therefore overwhelmingly simple; name official(s) responsible for implementation of green budgeting and ensure that good performances are well-rewarded and bad performances are privately costly.

The study highlights several insights that arise from realization that less knowledgeable government officials are not better in avoiding Dunning-Kruger effect than general population:

1. **Self-assessment and self-monitoring are grossly inadequate**. Taking the RAD-GRK and green budgeting implementation for local governments as example, **measurement of ability**, performance, and readiness to implement new system **should be conducted by external parties**.
2. **Good performance measurement design needs to be easily quantifiable** (so that measurements are comparable) **and be objective.** Easily quantifiable and transparent measurement of officials' individual performance and collective departmental performance helps to incentivize officials to formulate clear and workable plan to achieve the pre-set target.
3. **Large scale adverse events tend to promote learning and more accurate self-assessment**. Adverse events, such as large-scale anthropogenic forest fire experienced by Jambi and other provinces in Sumatera, tend to promote awareness of the topics for those who are unaware and is one of the most effective way for government and individuals alike to learn and better understand the limit of one's ignorance.

Using the third insight, it is seen that good incentives should give signal to government officials that ignorance, and mistakes resulting from it, are privately costly and that good performance will be well-rewarded. The key takeaway from equation (2.6a) is that wage differential, which can take the form of expected future promotion (present value of expected incremental future income), should be tied to learning-related performance e($\theta_H(q_{H,t} - q_{L,t})$).

Additionally, as the contract offered to less productive workers, $w_L = \theta_L q_{L,t} - \gamma_L S(\cdot)_{L,t}$, suggests that less productive workers do accumulate their knowledge over time, it might not be in the best interest of government to frequently rotate officials to different functions, a common phenomenon following leadership changes. Whenever local officials are transferred to new office following change in leadership, officials will start from scratch with respect to knowledge in their new function, thus setting the γ_L to zero again. This will reduce overall efficiency of the government, as they can only expect officials to learn less for the same wage whenever they are moved to different functions.

One of the more practical suggestion with respect to green budgeting is for local offices to name officials in charge of emission reduction target, with clear risk and reward, both for ability to accurately measure CO_2 reduction (requiring knowledge of GHG emission calculation) and for ability to meet the target in time (requiring knowledge of cost-benefit analysis). Before emission reduction program is implemented, independently-conducted pre-test, training, and post-test to measure initial readiness of local offices (particularly for knowledge of GHG emission calculation and cost-benefit analysis) should be held. There should also be routine target monitoring to measure accuracy of GHG emission measurement by local offices and compare actual reduction with target reduction. Ultimately, local government as principal should fully implement the merit-based risk and reward mechanism to align the private incentives of officials with public interest.

Aligning private incentives of government officials and public interest is not only useful in the context of green budgeting, but can also be implemented in other areas of public governance. It should however always be aware that current government structure, with ineffective legislative bodies and government departments that tend to self-regulate, may present difficulties for realignment of civil servants' incentives with social interest. To reiterate the point of Regehr and Eva [14], people who are aware of their shortcomings may avoid learning when such learning takes more energy and commitment than they are willing to expend.

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APPENDIX 1: LIST OF REFERENCE QUESTIONS AND TEST QUESTIONS

Reference Question	Test Questions
1. This local office is able to prepare the Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK) document	1. Did this local office, in the last 3 years, attend dissemination seminar(s) and/or coordination meeting(s) in preparation of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
	2. Did this local office, in the last 3 years, provide necessary data for preparation of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
	3. Did this local office, in the last 3 years, prepare Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
2. This local office is able to calculate the level of emission reduction from mitigation activities in every sector that are under the purview of local office	1. Can this local office estimate the emission level from their activities?
	2. Can this local office estimate the emission level from activities of the general public?
	3. Did this local office, in the last 3 years, calculate level of emissions and changes in level of emissions?
3. This local office is able to prepare the Monitoring, Evaluation, and Reporting of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK) document	1. Did this local office, in the last 3 years, attend dissemination seminar(s) and/or coordination meeting(s) on preparation of Monitoring, Evaluation, and Reporting of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
	2. Did this local office, in the last 3 years, provide necessary data for preparation of Monitoring, Evaluation, and Reporting of Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
	3. Did this local office, in the last 3 years, prepare Regional Action Plan for Greenhouse Gas Emission Reduction (RAD-GRK)?
4. This local office is able to incorporate issues related to climate change within the planning and budgeting cycle	1. Can this local office conduct social cost-benefit analysis for their programs/activities?
	2. Can this local office assign monetary value to non-monetary cost/benefit?
	3. Can this local office assign monetary value to negative impacts of greenhouse gases emissions?

APPENDIX 2: SUMMARY STATISTICS

Provinces	Question 1		Question 2		Question 3		Question 4	
	Reference	Test	Reference	Test	Reference	Test	Reference	Test
Jambi	2.667***	2.571***	2.524***	2.024***	2.571***	2.357***	2.643***	2.476***
	(0.106)	(0.167)	(0.0978)	(0.185)	(0.114)	(0.170)	(0.0890)	(0.161)
Nusa Tenggara Barat	2.609***	2.087***	2.304***	1.478***	2.435***	1.826***	2.652***	1.870***
	(0.122)	(0.226)	(0.117)	(0.165)	(0.123)	(0.232)	(0.119)	(0.211)
Nusa Tenggara Timur	2.784***	2.216***	2.595***	1.676***	2.595***	2.027***	2.892***	2.757***
	(0.0878)	(0.182)	(0.113)	(0.174)	(0.0985)	(0.196)	(0.101)	(0.171)
Sulawesi Barat	2.524***	2.476***	2.238***	1.714***	2.619***	2.333***	2.571***	2.095***
	(0.164)	(0.235)	(0.118)	(0.250)	(0.146)	(0.279)	(0.148)	(0.248)
Observations	123	123	123	123	123	123	123	123

APPENDIX 3: ORDERED PROBIT MODEL

AVERAGE MARGINAL EFFECT (PROBABILITY TO SCORE 3 ON DEPENDENT VARIABLES)
BASELINE PROVINCE: SULAWESI BARAT

Independent Variables	Question 1		Question 2		Question 3		Question 4	
	Reference	**Test**	**Reference**	**Test**	**Reference**	**Test**	**Reference**	**Test**
D_Pemprov	0.0224	0.5731**	0.1148	0.0686**	0.0373	0.0614*	0.0319	0.0137
	(0.0561)	(0.2484)	(0.0701)	(0.0342)	(0.0664)	(0.0319)	(0.0589)	(0.0298)
D_Jambi	0.1153*	0.2029	0.1962**	0.0721*	0.0334	0.0145	0.0601	0.0631*
	(0.0660)	(0.2871)	(0.0833)	(0.0400)	(0.0786)	(0.0352)	(0.0682)	(0.0358)
D_NTB	0.0628	-0.1858	0.0944	-0.0265	-0.0111	-0.0508	0.1020	-0.0436
	(0.0741)	(0.3295)	(0.0954)	(0.0472)	(0.0887)	(0.0424)	(0.0773)	(0.0406)
D_NTT	0.1643**	-0.0116	0.2605***	0.0110	0.0837	-0.0225	0.2196***	0.0928**
	(0.0713)	(0.0377)	(0.0889)	(0.0434)	(0.0840)	(0.0386)	(0.0769)	(0.0402)
D_Bappeda	0.0655	0.0035	0.0174	0.0263	0.0025	0.0121	-0.0436	-0.0372
	(0.0803)	(0.0427)	(0.0987)	(0.0431)	(0.9321)	(0.0436)	(0.0849)	(0.0423)
D_Kehut	-0.0302	0.0560	-0.1231	-0.0007	-0.0333	0.0448	-0.1160*	-0.0206
	(0.0661)	(0.0372)	(0.0865)	(0.0431)	(0.0796)	(0.0383)	(0.0691)	(0.0360)
D_LH	0.0197	0.0723*	0.0636	0.0914**	-0.0572	0.0554	0.0865	-0.0054
	(0.0715)	(0.0382)	(0.0890)	(0.0422)	(0.0861)	(0.0391)	(0.0765)	(0.0368)
Grad	0.2021	0.1672*	0.4015*	0.2086**	0.5096***	0.1411	0.1387	-0.0514
	(0.1673)	(0.0926)	(0.2096)	(0.1051)	(0.1943)	(0.0942)	(0.1770)	(0.0893)
Postgrad	0.7254	-0.0383	0.5732	0.0401	1.0491**	-0.1205	0.7351*	0.0353
	(0.4268)	(0.2278)	(0.5198)	(0.2587)	(0.5009)	(0.2374)	(0.4413)	(0.2146)
Observations	135	131	136	134	134	131	135	134
Prob > χ^2	0.0638	0.0154	0.0034	0.0015	0.0065	0.0945	0.0334	0.0207
Pseudo-R^2	0.0604	0.0569	0.0982	0.0943	0.0877	0.0432	0.0766	0.0537

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1