Policy uncertainty, the Afforestation Grant Scheme, and the Emissions Trading Scheme

draft draft draft

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Abstract
Between 2008 and 2012 New Zealand land owners could be paid money for planting new forests under the Afforestation Grant Scheme (AGS). This grant scheme was introduced despite the fact that New Zealand already had an Emissions Trading Scheme (ETS) that rewarded forest owners with carbon credits as their forests grew. Many justifications have been proposed for such a scheme, the most prominent is that a grant scheme allows land owners to plant despite large establishment costs, however these have typically not been scrutinised using a formal model. In a simple model we show that policy uncertainty can provide a justification for a grant scheme even when a trading scheme exists. Furthermore, we can look at other reasons for a grant scheme and see if they make sense within our framework. For example, we show that establishment costs do not justify a grant in and of themselves. But, they can justify such a scheme in certain circumstances. We then use data on the population of AGS proposals, where we observe acceptances, rejections, as well as the tender rate, the proposed forest species, and several other characteristics of the proposals to look at various aspects of the grants implementation.

JEL codes
Type codes

Keywords
Policy uncertainty, emissions trading, forestry grant schemes

1. Introduction

Between 2008 and 2012 New Zealand land owners could be paid money for planting new forests under the Afforestation Grant Scheme (AGS). This grant scheme was introduced despite the fact that New Zealand already had an Emissions Trading Scheme (ETS) that rewarded forest owners with carbon credits as their forests grew. Many justifications have been proposed for such a scheme, the most prominent is that a grant scheme allows land owners to plant despite large establishment costs, however these have typically not been scrutinised using a formal model. In a simple model we show that policy uncertainty can provide a justification for a grant scheme even when a trading scheme exists. Furthermore, we can look at other reasons for a grant scheme and see if they make sense within our framework. For example, we show that establishment costs do not justify a grant in and of themselves. But, they can justify such a scheme in certain circumstances. We then use data on the population of AGS proposals, where we observe acceptances, rejections, as well as the tender rate, the proposed forest species, and several other characteristics of the proposals to look at various aspects of the grant's implementation.[1] Due to the small amount of data, and the fact that there is potentially double selection (all applicants self-select and approved applicants are then selected by officials) we are hesitant to draw strong causal conclusion. However a graphical inspection of the data is not inconsistent with several sensible economic hypotheses.

Our model is close to a model developed in Rodrik (1991). In our model forestry has a private benefit and a public benefit. We consider the decision problem facing a social planner and a land manager when a trading scheme is introduced which internalises the public benefit of forestry. The key difference between the problem that the social planner faces and the problem that the land manager faces is that the later faces policy uncertainty. In particular, they expect that at some future date there is a non-zero probability that the trading scheme will be removed forever. We show that in such a scenario, a trading scheme results in an inefficiently low amount of afforestation.

Looking at the data we see...

The rest of the paper is structured as follows. In section 2 we develop a simple model to look at how policy uncertainty can justify a grant in addition to a trading scheme. This material is of a general nature; it is not specific to the AGS. In section 3 we give a brief overview of the AGS. Section 4 contains some data analysis on the AGS. Section 5 concludes.

[1] Our data is from MAF and is parcel level as opposed to proposal level. At the moment we cannot exactly replicate official proposal level results. Thus our data analysis is only tentative at this stage.

2. The model

2.1. Problem formulation

Let's get right into the theoretical framework.[2]

- Let r be the total return to forestry.
- Let τ_0 be the social return to forestry (the part not captured by the land owner when there is no ETS).
- Thus, $r-\tau_0$ is the private return to forestry.
- Let r^* be the private return on the outside option for rural land.
- Assume that under the ETS land managers get all the social benefit of forestry so that the private return is r.
- Let κ be the cost of converting from the outside use into forestry.
- Let η be the cost of converting from forestry back to the outside option.
- Assume the land manager is a risk neutral expected utility maximizer.

We consider the decision of a land-owner, who is initially *not* in forestry, *after* the policy is introduced. The decision--maker has two choices. If they remain in the outside option they get r^* for all time. This yields a net present benefit of

$$V_0 = \int_0^{\infty} r^* e^{-\rho t} dt = \frac{r^*}{\rho} \tag{1}$$

If instead they convert to forestry then the expected value net present benefit is

$$V_1 = \int_0^{\infty} r e^{-\rho t} dt - \kappa - \pi \int_R^{\infty} [r - \max\{r-\tau_0, r^* - \rho\eta\}] e^{-\rho t} dt. \tag{2}$$

The first term in (2) is the net present value of the stream of returns of r for all time. To achieve this return κ must be paid for conversion costs today. Furthermore with probability π the land-owner's return will be reduced by the difference between the post-policy return to forstry, and the best alternative after a policy reversal. This involves either remaining in forestry at the pre-policy return, or swapping back to the outside option which incurs an exit cost of η which has been annualised as $\rho\eta$. This is captured by the third term in (2).

[2] As mentioned above much of this work draws on ideas from Rodrik (1991).

How will the amount of afforestation differ when there is no policy uncertainty versus when there is policy uncertainty? To answer this we solve the decision problem for the condition which determines when land will be afforested in each case.

2.2. Social planner

Suppose the social planner knows that there will be no policy reversal – i.e., if land-owners have $\pi > 0$ then this is only due to the governments lack of credible commitment. For this problem we set $\pi = 0$. Furthermore for this first case we assume no carbon price uncertainty. Hence we do not explicity account for carbon prices at all. Thus the net present benefit from conversion is

$$V_1^{sp} = \int_0^{\infty} re^{-\rho t} dt - \kappa.$$

Evaluating the integral we see that

$$V_1^{sp} = \frac{r}{\rho} - \kappa \tag{3}$$

The social planner will choose conversion if

$$V_1^{sp} \geq V_0.$$

Substituting and simplifying we see the condition for conversion is

$$\frac{r}{\rho} - \kappa \geq \frac{r^*}{\rho}.$$

Conversion occurs when the net present social value of forestry less conversion costs is no less than the net present value of the outside land use.

Furthermore, assuming that there is some land which is marginal in the sense that $r - \tau_0 = r^*$ then for this kind of land we get

$$\kappa \leq \frac{\tau_0}{\rho}.$$

For marginal land, conversion occurs if the present value of social return to forestry is greater than or equal to conversion costs. Simply put, in this situation the social planner obtains the efficient solution.

2.3. Land manager

Suppose first that the annual return in forestry after policy-reversal is greater than the annual return of the outside option less the annualised cost of exit $(r - \tau_0 > r^* - \rho\eta)$. Then (2) evaluates to

$$V_1^{lm} = \frac{r}{\rho} - \kappa - \frac{\pi\tau_0 e^{-\rho R}}{\rho}. \qquad (4)$$

Comparing (4) to (3) we see that

$$V_1^{lm} = V_1^{sp} - \frac{\pi\tau_0 e^{-\rho R}}{\rho}.$$

Thus $V_1^{sp} \geq V_1^{lm}$ and because afforestation is increasing in its return[3] this implies less afforestation than optimal.

If the annual return in forestry after policy-reversal is less than the annual return in the outside use, then there will be exit. In this case (2) becomes

$$V_1^{lm} = \frac{r}{\rho} - \kappa - \frac{\pi[r - (r^* - \rho\eta)]e^{-\rho R}}{\rho}. \qquad (5)$$

This is the net present value of afforestation less conversion costs adjusted by the expected value of the loss from policy reversal, relative to no policy reversal.

Regrouping the terms in (5) and comparing it to (3), we see that

$$V_1^{lm} = V_1^{sp} - \frac{\pi\{[r - r^*] + \rho\eta)\}e^{-\rho R}}{\rho}.$$

The term in square brackets is the difference between returns when the forestry subsidy was on and returns in the alternative land use. The second term is the value of sunk capital. These are clearly both nonnegative; if the first term was not nonnegative, then there would never have been an incentive to switch to forestry in the first place! Thus it is clear once again that $V_1^{sp} \geq V_1^{lm}$ and so there is too little afforestation.

If we consider marginal land where $r^* = r - \tau_0$, then the difference becomes

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[3] We have not yet made this formal, however the idea is simple. There is a distribution of land qualities. For land of any quality there will be conversion if the expected return to forestry exceeds the expected return in the outside use there is conversion (this relies on our assumption that the land manager is risk neutral, however the results are not qualitatively changed even if we assume risk aversion). Now because the social planner's expected return is never smaller then the land manager's expected return the social planner will convert any parcel that the land manager would and may even convert some extra parcels.

$$\frac{\pi(\tau_0 + \rho\eta)e^{-\rho R}}{\rho}.$$

This is also necessarily positive, so that we will have too little planting.

2.4. A grant can theoretically solve the problem of policy uncertainty

Suppose we had a grant instead of a trading scheme. Then the land owner only receives the private return to forestry, however, she receives an upfront cash grant for afforestation. If the grant is equal to the net present value of the social return to forestry then we get an efficient solution. It is trivial to see this. The net present value of the social return to forestry is

$$\frac{\tau_0}{\rho}.$$

Annualising this, adding it to the private return to forestry, and noticing that with a grant there is no policy uncertainty, we see that the land manager's private return to forestry is

$$V_1^{lm} = \frac{r}{\rho} - \kappa,$$

which is exactly equal to the social planners return to forestry. The problem, which we leave unresolved for now, is to figure out how the social planner can determin the net present value of the social return to forestry.

2.5. Establishment costs do not justify a grant on their own

In its review of the AGS MAF says that the "AGS would be solely to promote carbon sequestration by providing money up-front for those (mainly smaller growers) with cash flow difficulties. It would be administered entirely through the public pool, by fixed grant (not tender), and be available in full regardless of income from other schemes for non-carbon environmental services. It would be limited to areas 5-300 hectares in extent, because very small areas are expensive to administer compared to the small benefit they provide, and because tree growers with larger areas can normally overcome cash flow difficulties by other means." Ministry of Agriculture and Forestry, 2011.

Suppose we had no policy uncertainty, but in all other respects the model was as described in subsection 2.1. Clearly the problem for the social planner and the land manager are equal and there is no inefficiency. This is true whatever we choose for the size of establishment costs. This is not to say that establishment costs cannot contribute towards a justification for a grant scheme. However such a justification would necessarily involve other problems such as policy uncertainty or particular problems in financial markets.

3. A description of the Afforestation Grant Scheme

In this section we describe New Zealand's Afforestation Grant Scheme (AGS). A fuller description of the scheme, as it was implemented, is provided by Ministry of Agriculture and Forestry, 2010; we draw heavily on that resource in what follows. Another useful resource on details of the scheme is provided by Ministry of Agriculture and Forestry, 2011. The AGS was created to encourage the establishment of new forests to increase green house gas absorption in New Zealand. It was designed to provide a simpler option than the ETS for land owners to increase their returns from forestry by rewarding them for carbon sequestration. As well as the main goal of increasing afforestation, the AGS had several subsidiary goals. These included reducing soil erosion, improving water quality, and improving biodiversity. It aimed to achieve its goals at least cost and least risk to the government.

The AGS worked as follows. The government set aside a substantial amount of money to fund grants for people who planted new forests. Land owners were encouraged to apply. If a land owner's application was successful then she would be offered a contract. The contract would last for 10 years. The land owner would be required to plant and maintain a forest to certain specified standards. The carbon credits earned on the forest for the duration of the contract would be given to the government. In return, once establishment to minimum standards was verified, the government would pay the land owner a cash grant. The land owner could not enter other government forest subsidy programs for the 10 year duration of the AGS contract. However after the 10 year contract expired they were free to enter the ETS or apply for another government forest program, the Permanent Forest Sink Initiative (PFSI). The minimum forest standards were as follows. During the first four years the forest needed to achieve a minimum stocking of 750 stems per hectare[4] and be free of significant weed competition. For the remainder of the contract the forest had to achieve at least 500 stems per hectare.

Funding was divided between two pools; a public pool and a Regional Council pool.[5] The public pool funding was allocated by a tender system. Each year land owners were able to

[4] In fact, applications with a stocking rate of 500-749 stems per hectare were considered, however they were not eligible for a discount tender due to soil erosion benefits.
[5] In this draft we focus on the public pool, which allocated funding using a tender system. Later we will include work on the Regional Council pool.

submit applications for a grant to plant a new forest.[6] Applications provided details on the land proposed for new forestry, including potential environmental benefits from planting. Applications also included a tender rate in dollars per hectare. Tenders were ordered from smallest to largest. They were then adjusted depending on the number of extra environmental benefits a land proposal would achieve; this was done very crudely, a proposal which achieved on extra environmental benefit had its tender adjusted down by 10 per cent, for two benefits it was adjusted down by 20 per cent, if a proposal improved soil erosion, water quality, and biodiversity it was adjusted down by 30 per cent. Applicants with the lowest adjusted tender rates were offered grants until the year's funding was exhausted. While adjusted tender rates determined who was offered a grant, the actual grant offer was based on the unadjusted tender. The public pool also calculates a maximum grant rate. This is supposed to reflect the rate of carbon sequestration and the risk to the government from owning carbon credits. It was calculated as the net present value of the stream of carbon credits obtained from radiata pine assuming the current carbon price and a 12 per cent discount rate. In theory if in any given year there were insufficient tenders below this rate then not all funding would be exhausted. This has never occurred in practice.

4. Data analysis

We obtained the data on the population of applicants to the public pool until mid 2011.[7] In this section we take a qualitative look at the data. Clearly selection issues are a problem. Given this, we do not attempt to identify causality in any sense. Instead we argue that the data are consistent with certain hypotheses that make economic sense.

In Figure 1 we show the proportion of new planting, as estimated by the National Exotic Forestry Description (NEFD), which was planted under the AGS.[8] The total amount of new planting estimated by the NEFD is small by historical standards.[9] Overall AGS planting makes more than one half of total new planting. Ideally we would like to know if the AGS is causing new planting. The problem is that we cannot tell if the land would have been planted anyway. However, the fact that more than half of the estimated new planting is under the AGS is not inconsistent with the fact that the grant could be inducing more planting.

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[6] Initially there were two rounds for applications each year; however from 2009 this was reduced so there was only one round per year.

[7] Our data is from MAF and is parcel level as opposed to proposal level. At the moment we cannot exactly replicate official proposal level results. Thus our data analysis is only tentative at this stage.

[8] For this graph we use planting numbers from MAF's official review of the AGS as opposed to our own data set.

[9] Between 1970 and the early 2000s NEFD reports that new planting typically exceeded 20,000 Ha per year. In 2009 and 2010 NEFD estimate around 5,000 Ha of new planting per year.

In Figure 2 and Figure 3 we look at the distribution of tender rates to the public pool. Figure 2 shows the distribution of tenders across time. It appears to us that there is significant learning over time. In particular, in each sequential year the distribution of tenders appears to get more compressed and looks to bunch closer to the highest grant rate of the previous year. This is suggestive of the fact that the government may have paid too much for the forests. If this were the case then we should expect efficiency losses through the government budget constraint as taxes are not raised lump sum.

Figure 3 shows the distribution of tenders for the North and South Islands of New Zealand separately. In later work we plan to investigate more closely spatial differences in the distribution of tenders. The idea behind this graph is that the ETS treats forests differently based on where they are located; for example the look-up tables differ by Wood Supply Region. On the other hand, the AGS does not take into account these spatial differences. Tenders are evaluated on the tender rate, environmental co-benefits, and minimum forest standards. As such we look to see whether or not there is a difference in tender rates between the distribution of tenders in the North Island and the South Island; forests in North Island Wood Supply Regions sequester more carbon according to the look-up tables. The mean of the distributions are similar and so is their spread. It could be that strategic behaviour or the value of non-forestry uses are more important for driving tender rates.

5. Conclusion

New Zealand has an emissions trading scheme that rewards forest owners for sequestering carbon. Despite this, it also has a range of other policy instruments to encourage afforestation. One such instrument is the Afforestation Grant Scheme. In this paper we developed a simple model to show how a grant scheme could be justified in the presence of a trading scheme that faced policy uncertainty. We also discussed the implications of this model for a commonly used justification for the grant scheme, namely establishment costs. In our model, establishment costs alone cannot justify a grant scheme. This does not imply that establishment costs can never justify such a scheme, but in our model other things must also change too.

We have data on the population of applications to the public pool of the Afforestation Grant Scheme. So far we have only started to look at this data. The distribution of tender rates over time is suggestive of learning effects which could reduce the efficiency of a grant scheme. At the moment this paper is only in its early drafts. In the future we will look to do more with this unique data set.

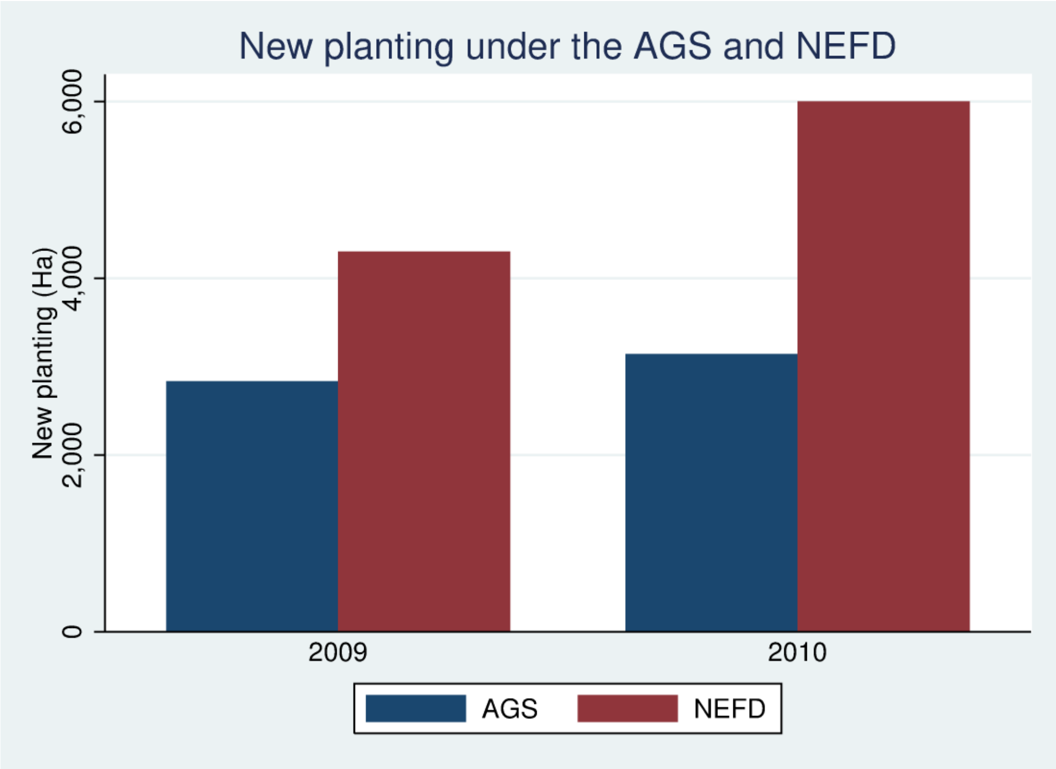

Figure 1: AGS afforestation vs NEFD afforestation

Notes: The blue bars gives actual AGS planting in 2009 and 2010, while the red bars give NEFD estimates of new planting. *Sources:* NEFD (2011), Ministry of Agriculture and Forestry (2011).

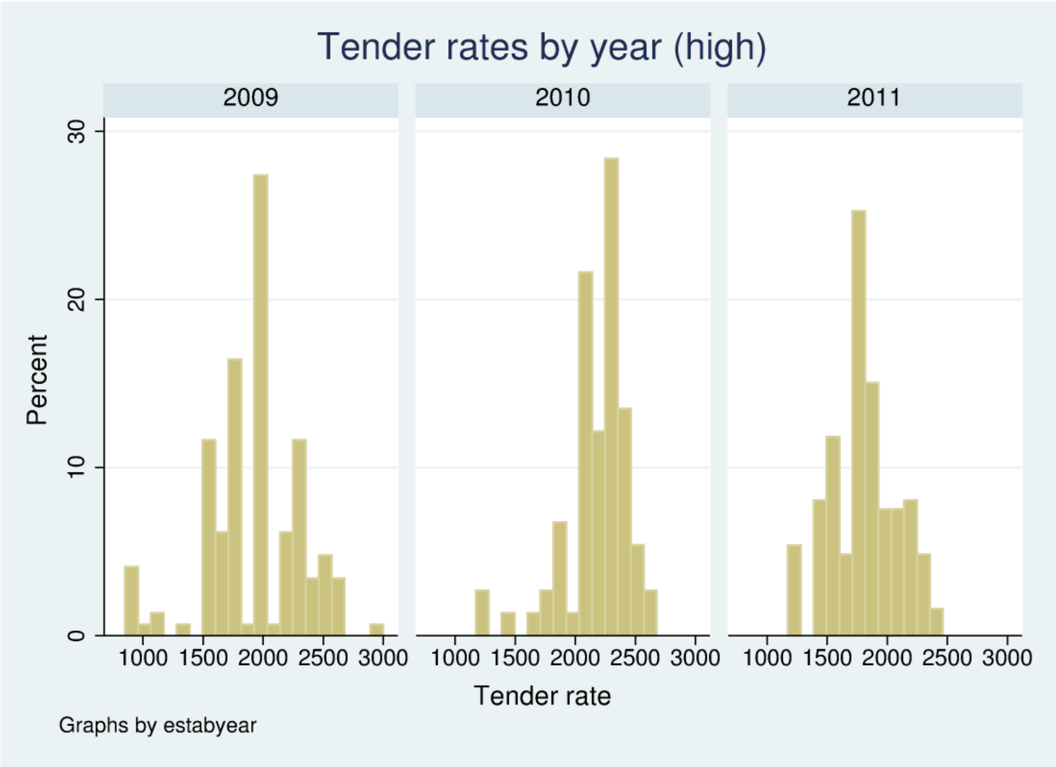

Figure 2: AGS yearly tender rates (public pool high sequestration category)

Notes: The unit of observation is an AGS parcel as opposed to a proposal. *Source:* Authors' own calculations.

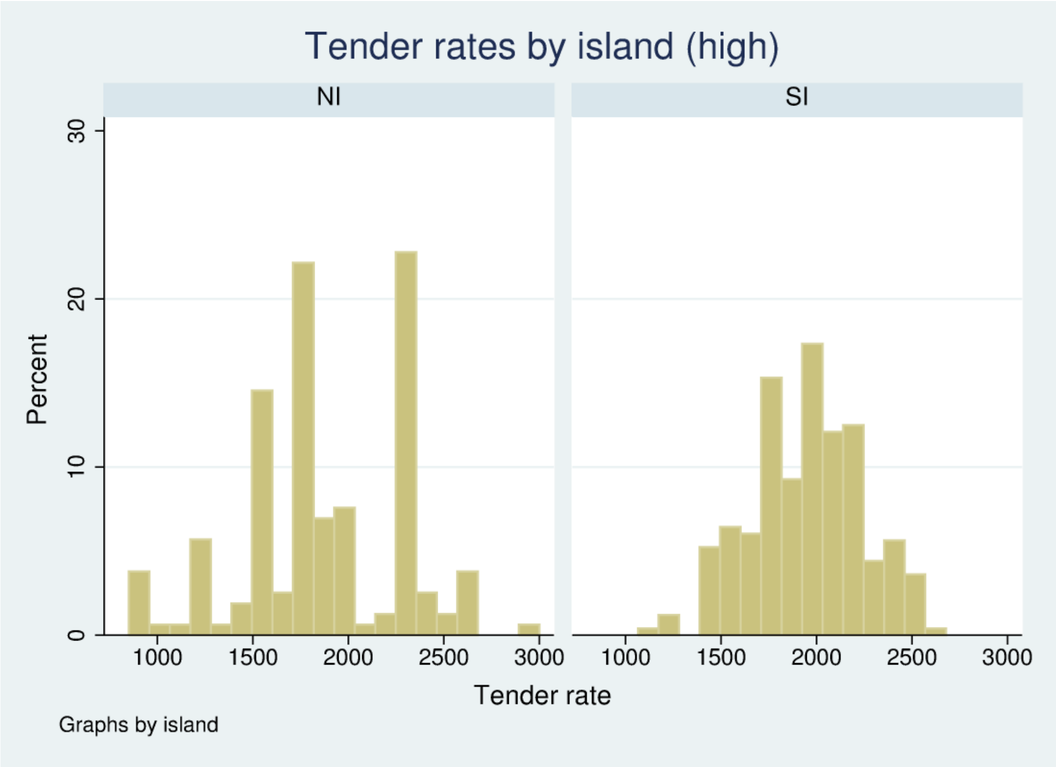

Figure 3: AGS tender rates by island (public pool high sequestration category)
Notes: The unit of observation is an AGS parcel as opposed to a proposal. *Source:* Authors' own calculations.

Several references need to be added. In particular I must reference MAF 2010, 2011 and NEFD 2011.

References

Rodrik, Dani. 1991. "Policy Uncertainty and Private Investment in Developing Countries", *Journal of Development Economics,* 36:2, pp. 229-42.