A Multiprincipal, Multitask Model of Interest Group Competition: An Application to Land Reform Politics in Brazil

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Abstract

Abstract. This paper adapts the model developed by Dixit (1996) to analyze the case of interest group competition over land reform politics in Brazil. The model presents some important advances over earlier seminal economic models of interest group competition in the literature, such as Peltzman (1976), Becker (1983) and Denzau and Munger (1986) in that it considers that government agencies respond to multiple principals each one of which has an interest over a different task performed by the agency, and all of these relationships suffer from information asymmetries. The upshot of this situation is that not only does the asymmetric information push the final outcome away from the first-best and towards a second-best, the standard result in single principal, single task models, but in addition the multprincipal, multitask nature of the relationships lead to a third-best situation. Such third-best outcomes imply that we should expect to see low-powered incentives, a fact commonly observed in the actual organization of government.

In the model the government and its land reform agency are the agent, while the principals are the landless peasants (MST) and the general group of voters. Each principal is interested in a specific task performed by the government and effort put towards one of the tasks implies less effort available for the other tasks. The principals do not observe effort but they do observe the outcome in each of the two task dimensions. The model is first solved under complete information, to establish the first-best solution, and subsequently it is solved assuming cooperation amongst principals, to establish the second-best solution. It is then solved with non-united principals and the third-best solution is characterized. This solution is used to portray the case of land reform politics in Brazil by allowing the landless peasants to possess a higher level of information than the voters. By casting the land reform debate in terms of the number of settlement projects established by the government, rather than a measure of actual emancipated and self-sustaining families achieved, the better-organized groups are able to influence policy towards their own preferences.

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Section 1 – Introduction

Government policy almost always implies distribution of wealth amongst groups in society. Pareto optimal improvements tend to be quickly exhausted since they are generally realized as soon as they are perceived. Even if policies are decided so as to favor public interest, they will favor some groups and harm others. Interest groups realize this and consequently do not wait passively as policies are decided and implemented, rather they vie actively to influence the outcome towards their own interest. Given that the public interest hypothesis is generally more of a convenient abstraction for normative theories, and that governments can better be modeled through positive theories that assume vote-maximizing politicians, there are even more reasons to expect interest group competition to be pervasive and to be an important determinant of observed outcomes.

Early seminal models such as Stigler (1970), Peltzman (1976), Becker (1983) and Denzau and Munger (1986) provided powerful instruments to analyze interest group competition and its effect on policies, however they had some important limitations (Viscusi et al 1997, Chap.10). The most severe limitation is the fact that these models do not allow for asymmetric information between the politicians, who decide on policies so as to maximize their chances of reelection, and the bureaucracy, which implements those policies. Whereas those early models, which focus on the demand for regulation, assume that there is no principal agent slack between the politicians and the bureaucracy, this is typically not the case in actual governments, which has lead to an entire literature focusing on opening up the black box of the supply of regulation.[2] The multiprincipal, multitask model in this paper allow asymmetric information to be incorporated into the analysis while still maintaining the important insights of the early models of interest group competition. In addition the multiprincipal multitask model explicitly allows us to portray a situation with several principals and several tasks. Most social, economic and political relations are multiprincipal and multitask in nature, so economic analysis must strive to incorporate this explicitly in order to be better able to explain observed outcomes. The Peltzman (1976) model has the legislator/regulator choosing how small to make the beneficiary group and how large to make the taxed group, so in a way it does

[2] Weingast, B. R. and M. J. Moran (1983), McCubbins, R. Noll and B.R. Weingast (1987, 1989).

have several principals. But in the multiprincipal multitask model we can have each principal give different incentives for each task and thus get closer to the actual interactions that happen in the real world. Also we can model the effect of different rules and institutions, like forbidding certain principals to give incentives for certain tasks, and thus analyze specific situation and suggest policy recommendations.

Land reform in Brazil provides an excellent case study to analyze interest group competition. For Since the early 1960s there have been attempts by the government to implement a land reform and reduce what is still one of the most concentrated land ownership structures in the world. Until the mid 1980's the land reform efforts were based mainly on programs that tried to settle landless peasants in idle land public land. Given the failure of these programs to affect the distribution of land ownership, in 1985 the government instituted a new program where for the first time the main instrument was expropriation of private land.[3] This new mode of land reform also proved to be unable to cause much change in the concentration of land ownership, mostly because the landowners where able to politically block the program from being implemented at the necessary pace. It was only in the 1990s when the MST (Landless Peasant Movement) started their campaigns of invading private land as a means to force INCRA, the governmental land reform agency, to expropriate the land in their favor that things started to change. The MST tactics turned out to be remarkably successful, and by the end of that decade they had become one of the most effective interest groups in the country.

Alston, Libecap and Mueller (1999, 2000) analyzed the issue of land invasions and land reform in Brazil through a game theory model that captured the interaction between landless peasants, landowners and INCRA. The purpose of this paper is to focus not on the invasion and expropriation decisions, but on how the MST as an interest group was able to so successfully affect land reform policy. Why is it that the entire land reform issue in Brazil since the early 1990s has been discussed in terms of the number of families that are settled, when in actual fact this is a very poor, if not misleading, proxy of how much land reform is actually getting done? It should have been rather obvious to

[3] For a detailed description of land reform in Brazil and the issue of property rights, conflict and land use, see Alston, L.J., G. Libecap and B. Mueller, 1999, **Titles, Conflict, and Land Use: the Development of Property Rights and Land Reform on the Brazilian Amazon Frontier**, Ann Arbor, Michigan University Press.

any reasonably knowledgeable person who examined the outcomes of the land reform program that a lot of resources were being used and that the results being achieved could not justify those costs. Because of turnover, abandonments, incentives for rent-seekers, conflicts, litigation costs, rent dissipation, and other problems arising from a land reform program based on expropriation and settlements, the land reform is clearly very wasteful and has little to show in compensation. An interesting illustration of this is the following paragraph from INCRA (2000):

> "… the very success, in quantitative terms, of the land reform program in Brazil in the past four years has made the program financially and administratively unfeasible. On the one hand the demand for the PROCERA credits have increased exponentially; on the other INCRA does not have the structure to keep taking care of the 414 thousand families that are settled and to keep increasing this number with new settlements."

Despite all of this the land reform issue has been reduced to a question of how many families were being settled. This paper suggests that the reason why this happened was that the MST was successful in creating this situation. They were able to cast the whole land reform issue in terms of number of settled families and not on how many families were transformed into sustainable producers. In addition it would have to be that the government would prefer (or be forced) to go along with this than to try to oppose it. The multiprincipal, multitask model in this paper analyzes this situation by having a well-organized interest group as one of the principals, and a more diffuse and heterogeneous group as the other. The equilibrium conditions allow us to express the incentives each principal would give for each of the two tasks, settlements and emancipation, as functions of the level of observability of that task and of the level of substitutability or complementarity of each task. This is used to show how a better organized interest group is able to successfully pull policy towards their preferred position by affecting how the other groups perceive the outcomes.

Section 2 - A Multiprincipal, Multitask Model of Land Reform in Brazil[4]

The Model

In this model we assume that there is no principal-agent slack between the government and the land reform agency INCRA, and concentrate instead on the relationship between voters/interest groups and government/INCRA. There are two groups of principals. The first, M, is made up of organized groups representing landless peasants, such as the MST (Movimento Sem Terra), and the second, V, is made up of the voters in general who also have preferences regarding how a land reform should be done. The general purpose of INCRA is to implement a land reform within the government's current land reform policy. This is based on obtaining land, through purchase or expropriation, and establishing settlement projects where families of landless peasants are given land, credit, infrastructure and technical assistance, with the final objective that they should eventually become emancipated productive small farmers.

Because of the way that the land reform program in Brazil has evolved, we model INCRA's actions as consisting of efforts placed in two basic tasks, settlement and emancipation.[5] Settlement consists in simply placing families on plots of land in settlement projects. The government typically announces how many families it plans to settle each year and these targets are then used by society (media, interest groups, voters, etc.) as parameters to judge if the land reform project is actually being pursued.[6] By tacit agreement a family is counted as being settled as soon as it is given a plot of land. Typically, however, the probability of a settled family actually remaining on the land and becoming true rural producers is very small. The number of emancipated settlement projects is shockingly low.[7] A large fraction of those families that are initially beneficiaries of settlement projects abandon, exchange or sell their rights and move elsewhere. Besides the high level of turnover there also typically occurs a process of

[4] This section is an application of the model by Dixit (1996, pg. 157-171) to the case of land reform in Brazil. Dixit's model is a combination of the multitask model of Holmström and Milgrom (1991) and the multiprincipal model of Bernheim and Whinston (1986).

[5] Another way of putting this would be to consider one task, implementing a land reform, consisting of two dimensions, settlement and emancipation.

[6] The targets of the first term of the Fernando Henrique Cardoso government were (in number of settled families): 1995 - 40,000, 1996 – 60,000, 1997 – 80,000, 1998 – 100,000. Despite some challenges by the MST it is accepted that these targets were in fact reached.

[7] See Incra (2000).

consolidation where, through the sale of the land by the beneficiaries, the ownership of the land re-concentrates in the hands of a small number of persons. Therefore, a large number of families settled by INCRA does not translate necessarily into an effective redistribution of land ownership, which is the final objective of land reform.

Emancipation naturally presupposes settlement of families on the land, but it involves the entire follow-through to ensure that the families eventually become able to subsist without the direct assistance of INCRA. Any effort placed towards emancipation implies the opportunity cost of not being able to use those resources to settle additional families. Furthermore, the choice of which families to settle and the way in which this is done has direct implications for the probability of that family being emancipated. For example, by settling families with no rural experience INCRA may reduce the cost of settlement, however, this will have the effect of increasing the cost of emancipation. Therefore settling and emancipation will be taken to be substitute activities in what follows. Efforts placed by INCRA towards settling and emancipation will be denoted by t^s and t^e, respectively, so that the total effort vector is

$\mathbf{t}' = \left| \mathbf{t}^s \quad \mathbf{t}^e \right|$ (where prime denotes a transpose).

In general the principals do not observe the level of effort placed by INCRA in each task, instead they observe the outcome of that effort. The vector of outcomes, or alternatively a vector of information signals, is modeled as

$$\mathbf{x} = \mathbf{t} + \boldsymbol{\varepsilon} \qquad or$$

$$\begin{vmatrix} x^s \\ x^e \end{vmatrix} = \begin{vmatrix} t^s \\ t^e \end{vmatrix} + \begin{vmatrix} e^s \\ e^e \end{vmatrix} \qquad (1)$$

where $e \sim N(0, \Omega)$.

Both of the principals benefit (or are harmed is x is negative) from the outcomes that arise from INCRA's efforts. The benefit of each principal can be written as

$$\textit{benefit to interest groups} = \left| b_M^s \quad b_M^e \right| \begin{vmatrix} x^s \\ x^e \end{vmatrix} = \mathbf{b_M}'\mathbf{x} \qquad (2)$$

$$\textit{benefit to voters} = \left| b_V^s \quad b_V^e \right| \begin{vmatrix} x^s \\ x^e \end{vmatrix} = \mathbf{b_V}'\mathbf{x} \qquad (3)$$

where b_i^j is the benefit of outcome *j* to principal *i*, and the prime denotes a transposed vector. The aggregate benefit to all principals is the sum of the individual benefits and will be written as ***b'x***.

Following Dixit (1996) we will first assume a benchmark case where the principals observe the level of effort chosen by INCRA and additionally are able to act cooperatively so as to reach the first best solution. Subsequently we will relax the principal's capacity to observe the level of effort, but retain their capacity to act together. Finally we will relax this later assumption and assume the principals to act non-cooperatively. This will allow us to compare the effect of each assumption on the optimal level of effort and the pay-offs to each actor.

Full information, united principals and observable effort

In order to establish the pay-offs to the government/INCRA we need to define what is its motivation. We assume that the government's efforts in pursuing both tasks are rewarded with political support from each of the principals. The total level of political support received is taken to be the sum of the support from each principal, that is, the scalar $p = p_M + p_V$. Because they are acting together we do not need to disaggregate the support received from each principal and treat is simply as *p*. Offering political support imposes on the principals an opportunity cost so we can treat *p* in monetary terms. That is, *p* can be thought of as the amount of resources that the government would need to purchase through advertising and campaigning an equivalent amount of support.

The cost to the government of incurring the effort in both of the tasks is modeled as the following quadratic function

$$\frac{1}{2}\,\mathbf{t'Ct} \qquad where \qquad \mathbf{C} = \begin{vmatrix} \mathbf{c}_{ss} & \mathbf{c}_{se} \\ \mathbf{c}_{es} & \mathbf{c}_{ee} \end{vmatrix} \qquad (4)$$

That is, the total cost of effort to the government is $\frac{1}{2}(t^s)^2 c_{ss} + t^s t^e c_{se} + \frac{1}{2}(t^e)^2 c_{ee}$, where the matrix ***C*** is assumed positive definite. If the terms $c_{se} = c_{es}$ are positive there will be a substitution amongst types of effort, so that an increase in t^e will imply a decrease in t^s, and vice-versa. If these terms are negative the types of effort will be

complementary. It can be shown that if $\boldsymbol{C}$ is positive definite then $\boldsymbol{C}^{-1}$ will have negative off-diagonal terms.[8]

The pay-off to the government is thus

$$w = p - \frac{1}{2}\mathbf{t}'\mathbf{Ct} \qquad (5)$$

With this we can obtain the government's utility, which is assumed to have the following constant risk-aversion form:

$$u(w) = -exp(-rw) \text{ or } -exp(-r(p - \frac{1}{2}\mathbf{t'Ct})) \qquad (6)$$

where r is the risk-aversion coefficient. Note that the government will maximize $p - \frac{1}{2}\mathbf{t'Ct}$, which is the income equivalent of its utility.

The expected return to the principals acting together is their benefit minus the value of the political support they bestow the government:

$$E[\mathbf{b'x} - p] = E[\mathbf{b'(t+e)} - p] = \mathbf{b't} - p \qquad (7)$$

The total surplus is therefore the sum of the agents and the principal's net benefit:

$$\mathbf{b't} - p + p - \frac{1}{2}\mathbf{t'Ct} = \mathbf{b't} - \frac{1}{2}\mathbf{t'Ct} \qquad (8)$$

Note that the level of political support disappears, so we assume that p is high enough for the agent to stay in the game. The level of effort will be chosen so as to maximize this function, giving the following first-order condition:

$$b - Ct = 0 \qquad (9)$$

Thus the first-best level of effort is:

[8] This may not be true when the dimension of the matrix is larger than 2.

$$\mathbf{t} = \mathbf{C}^{-1}\mathbf{b} \qquad (10)$$

or

$$\begin{vmatrix} t^s \\ t^e \end{vmatrix} = \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} b^s \\ b^e \end{vmatrix}$$

or

$$t^s = k_{ss}b^s + k_{se}b^e \qquad (11)$$

$$t^e = k_{es}b^s + k_{ee}b^e \qquad (12)$$

where the *k*'s are the elements of $\boldsymbol{C}^{-1}$. Note that given the assumption that $\boldsymbol{C}$ is positive definite, k_{ss} and k_{ee} are positive, while k_{se} and k_{es} are negative. Thus, an increase in b^s leads to an increased effort in settling and a decreased effort in emancipation, and an increase in b^e leads to an increased effort in emancipation and a decreased effort in settling.

<u>The effect of asymmetrical information with multiple tasks - United principals and unobservable effort</u>

Because effort is no longer observable contracts between the principals and the government must be made contingent on **x** and no longer on **t**. Following Dixit (1996) and Holmstöm and Milgrom (1991) we use a linear reward scheme to stipulate the government's pay-offs given outcomes **x**. That is, given the observed outcomes **x**, the united principals provide to the government political support that has the following monetary equivalent:

$$\mathbf{á'x} + b \qquad (13)$$

or $\quad \begin{vmatrix} a^s & a^e \end{vmatrix} \begin{vmatrix} x^s \\ x^e \end{vmatrix} + b$

Thus the government's utility is now

$$-exp(-r(a'x + b - \frac{1}{2}\mathbf{t'Ct})) \qquad (14)$$

which can be shown to equal[9]

[9] This transformation of the government's expected utility function, from outcomes to effort, uses the standard formula of the expectation of the exponential of a normally distributed variable.

$$-exp(-r\mathbf{a}'\mathbf{t} + \frac{1}{2}r^2\mathbf{a}'\Omega\mathbf{a} - r\mathbf{b} + \frac{1}{2}r\mathbf{t}'\mathbf{C}\mathbf{t}) \qquad (15)$$

As above, the government will maximize the income equivalent of its utility, which is[10]:

$$z = \boldsymbol{\alpha}'\mathbf{t} - \frac{1}{2}r\boldsymbol{\alpha}'\Sigma\boldsymbol{\alpha} + b - \frac{1}{2}\mathbf{t}'\mathbf{C}\mathbf{t} \qquad (16)$$

The government will thus choose its levels of effort to maximize this expression, which yields the following first order condition:

$$\mathbf{t} = \mathbf{C}^{-1}\boldsymbol{\alpha} \qquad (17)$$

or

$$\begin{vmatrix} t^s \\ t^e \end{vmatrix} = \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a^s \\ a^e \end{vmatrix} \quad or$$

$$t^s = k_{ss}a^s + k_{se}a^e \qquad (18)$$

$$t^e = k_{es}a^s + k_{ee}a^e \qquad (19)$$

Note that a^s and a^e are the value of the marginal support given by the principals to effort from the government. Once again, since k_{ss} and k_{ee} are positive, and k_{se} and k_{es} are negative, an increase in α^s leads to an increased effort in settling and a decreased effort in emancipation, and an increase in α^e leads to an increased effort in emancipation and a decreased effort in settling.

By substituting (17) into (16) we get the government's optimal certainty-equivalent income:

$$z = \frac{1}{2}\boldsymbol{\alpha}'\mathbf{C}\boldsymbol{\alpha} - \frac{1}{2}r\boldsymbol{\alpha}'\Sigma\boldsymbol{\alpha} + b \qquad (18)$$

The net benefit of the principals is the expected value of their total benefit minus the value of the support they give the government:

$$E[\mathbf{b}'\mathbf{x} - \boldsymbol{\alpha}'\mathbf{x} - b] = (\mathbf{b} - \boldsymbol{\alpha})'E[\mathbf{x}] - b = (\mathbf{b} - \boldsymbol{\alpha})'\mathbf{t} - b \qquad (20)$$

In order to get the joint surplus of the united principals and the government we can add (18) and (20):

[10] This is actually the value of the amount of support that would make the government indifferent to what he would receive given the result of the uncertain outcome. It is thus the government's certainty-equivalent payoff.

$$\mathbf{b't} - \frac{1}{2} r\,\mathbf{á'Ùá} + b - \frac{1}{2}\mathbf{t'Ct} = \mathbf{b'C^{-1}á} - \frac{1}{2}\mathbf{á}(r\mathbf{Ù} + \mathbf{C^{-1}})\mathbf{á} \qquad (21)$$

This expression can be maximized with respect to $\boldsymbol{a}$ to obtain the following first order condition:

$$\mathbf{b} = (\mathbf{I} + r\mathbf{CÙ})\mathbf{á} \qquad (22)$$

Writing this in extended form we have:[11]

$$b^s = a^s + r(c_{ss}w_{ss}a^s + c_{se}w_{ee}a^e) \qquad (23)$$

$$b^e = a^e + r(c_{es}w_{ss}a^s + c_{ee}w_{ee}a^e) \qquad (24)$$

Since both the *c*'s and the *w*'s are positive, and assuming that the principals will not want negative effort, so that the α's are all positive, it must be that $b^s > \alpha^s$ and $b^e > a^e$. Consequently, comparing (11) and (12) to (18) and (19) it turns out that the government optimally chooses less effort when effort is not observable than in the first best situation where it is. This is the standard second-best story where, as a result of the moral hazard arising from the information asymmetry, less effort is realized in both tasks and the resulting level of land reform achieved is less than the efficient level. Note that if the agent is not risk averse (r=0) then $b^s = a^s$ and $b^e = a^e$, and the result is the same as the first-best. This result says that incentives in the case of asymmetrical information are more low-powered than in the full-information case, which is due to the fact that the in the second-best case there is a sharing of risk between the principals and the government.

Equations (23) and (24) allow us to derive some results related to the different level of observability of each task by making assumptions about the relative level of some parameters. Recall that the relationship between effort and outcomes is $x^s = t^s + e^s$ and $x^e = t^e + e^e$, and that the *w*'s are the variance of each of the errors. Therefore, the higher the level of *w*, the more difficult it is to infer effort from outcomes. In the limit *w* is zero and effort is perfectly observable. Let us suppose a case where the number of settled families is directly observable so that $w_{ss} = 0$. Then equations (23) and (24) become:

$$b^s = a^s + rc_{se}w_{ee}a^e \qquad (25)$$

$$b^e = a^e + rc_{ee}w_{ee}a^e \qquad (26)$$

Note additionally, that c_{ee} and c_{se} determine the impact of the level of each type of effort on the marginal cost to the government of each type of effort.[12] If it is the case that the marginal cost of t^e is more affected by the level of t^e than it is by the level of t^s, this means that c_{ee} is greater than c_{se}. Under these circumstances the distance between b^s and a^s is smaller than the distance between b^e and a^e. Since the distance between these parameters measures the distance of the first-best to the second-best solution for each task, this means that the government's incentives for settling are more high-powered than they are for emancipation. This occurs because in this example t^s is perfectly observable whereas t^e is not. More generally neither type of effort would be perfectly observable, but that which is more observable than the other will be produced at a level closer to its full information level.

We argue that in Brazil it is easier to infer the government's dedication towards settling than it is towards emancipation. Measuring settlement effort requires mostly counting the number of families currently on settlement projects, or counting the number of expropriated farms. This has been done frequently in the past, by INCRA itself, by the MST and also by third parties, such as the 1996 census coordinated by the Universidade de Brasilia and several surveys done by the media. On the other hand measuring efforts towards emancipation is more difficult. Emancipation is a slow process that occurs though time and there are less good proxies that can be used. If this is the case, the model presented here presents an explanation as to why the government has pursued a land reform program that seems so wasteful and so doomed to failure in the long term. This conclusion will hold even after we have allowed the principals to not act cooperatively. As we will see in the next section, this will allow us to reach some even more interesting conclusion concerning the type of land reform pursued in Brazil.

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[11] The ω's are the elements of the error covariance matrix Ω. By assumption this matrix has off-diagonal elements equal to zero.

[12] From (4) the marginal costs of each type of effort for the government are as follow: MgCost of $t^s = t^s c_{ss} + t^e c_{se}$ and MgCost of $t^e = t^e c_{ee} + t^s c_{se}$. Recall also that the c's are positive because emancipation and settling are considered as substitute activities.

The effect of multiple principals: Non-cooperative principals and unobservable effort

In general principals do not act cooperatively, so we now derive the optimal levels of effort allowing for non-cooperative behavior in addition to asymmetrical information. In order to do this we need to find the Nash equilibrium of the game where each principal strategically takes into account the actions of the other principals. In order to do this we need the incentive scheme each principal offers to the government. The MST's incentives schemes are $a_M^s \, ' \, x^s$ and $a_M^e \, ' \, x^e$ and that of the voters are $a_V^s \, ' \, x^s$ and $a_V^e \, ' \, x^e$. The total incentive schemes for each principal are therefore $\boldsymbol{\acute{a}}_{\mathbf{M}}\mathbf{'x} + b_M$ and $\boldsymbol{\acute{a}}_{\mathbf{V}}\mathbf{'x} + b_V$, where $\boldsymbol{\acute{a}}_{\mathbf{M}}\mathbf{'} = \begin{vmatrix} a_M^s & a_M^e \end{vmatrix}$, $\boldsymbol{\acute{a}}_{\mathbf{V}}\mathbf{'} = \begin{vmatrix} a_V^s & a_V^e \end{vmatrix}$, $\mathbf{x'} = \begin{vmatrix} x^s & x^e \end{vmatrix}$. Finally the aggregate incentive scheme faced by the government is the sum of that offered by each principal and is simply $\boldsymbol{\acute{a}}\mathbf{'x} + b$, where $\boldsymbol{\acute{a}}_{\mathbf{V}} + \boldsymbol{\acute{a}}_{\mathbf{M}} = \boldsymbol{\acute{a}}$ and $b_V + b_M = b$.

The government still chooses $\boldsymbol{t} = \boldsymbol{C^{-1}a}$ and its certainty equivalent remains as in (18), $\frac{1}{2}\,\boldsymbol{\acute{a}}(\mathbf{C}^{-1} - r\dot{\mathbf{U}})\boldsymbol{\acute{a}} + b$. Writing this out in full matrix form we have:

$$\frac{1}{2}\left(\begin{vmatrix} a_V^s & a_V^e \end{vmatrix} + \begin{vmatrix} a_M^s & a_M^e \end{vmatrix}\right)\left(\begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} - r\begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix}\right)\left(\begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} + \begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix}\right) + b_V + b_M \qquad (27)$$

In order to find the Nash equilibrium of this game we follow Dixit (1996) and consider the contribution of each of the principals to the government's certainty equivalent. This will then be added to the benefit that each principal receives from the relationship with the government.[13] This total bilateral surplus will then be maximized taking the actions of the other principal as given. The result will give us the optimal incentive scheme of each principal in the Nash equilibrium.

Considering only the MST, the government would choose the following optimal level of effort:

[13] Note that even if one of the principals does not hold a relationship with the government it will still be benefited or harmed by the actions chosen by the government.

$$\begin{vmatrix} t_M^s \\ t_M^e \end{vmatrix} = \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix} \qquad (28)$$

This leads to a certainty equivalent for the government from the MST as follows:

$$\frac{1}{2} \begin{vmatrix} a_M^s & a_M^e \end{vmatrix} \left(\begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} - r \begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix} \right) \begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix} + b_M \qquad (29)$$

Subtracting this from the total certainty equivalent (27) gives the contribution of the voters to the government's surplus:

$$\begin{vmatrix} a_M^s & a_M^e \end{vmatrix} \left(\begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} - r \begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix} \right) \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} + \frac{1}{2} \begin{vmatrix} a_V^s & a_V^e \end{vmatrix} \left(\begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} - r \begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix} \right) \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} + b_V \qquad (30$$

Now we need to find the benefit of the voters from participating directly in the game. The voter's expected surplus is $\mathbf{b_V't} - \mathbf{á_V't} - b_V$, that is, its benefit minus its payment to the government. Substituting (17) in this expression and re-writing in full matrix form gives the voter's expected surplus as:

$$\left(\begin{vmatrix} b_V^s & b_V^e \end{vmatrix} - \begin{vmatrix} a_V^s & a_V^e \end{vmatrix} \right) \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \left(\begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix} + \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} \right) - b_V \qquad (31)$$

If the voters did not participate directly they would not need to provide an incentive scheme but their benefit would come from the governments actions influenced only by the MST:

$$\begin{vmatrix} b_V^s & b_V^e \end{vmatrix} \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix} \qquad (32)$$

The difference between (31) and (32) is the additional expected surplus that the voters receive from participating directly:

$$\begin{vmatrix} b_V^s & b_V^e \end{vmatrix} \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} - \begin{vmatrix} a_V^s & a_V^e \end{vmatrix} \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} - \begin{vmatrix} a_M^s & a_M^e \end{vmatrix} \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} - b_V \qquad (3$$

Therefore, the total bilateral surplus that arises from the relationship of the voters with the government is the sum of (30) and (33):[14]

$$\begin{vmatrix} b_V^s & b_V^e \end{vmatrix} \begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} - r \begin{vmatrix} a_M^s & a_M^e \end{vmatrix} \begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix} \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} - \frac{1}{2} \begin{vmatrix} a_V^s & a_M^e \end{vmatrix} \left(\begin{vmatrix} k_{ss} & k_{se} \\ k_{es} & k_{ee} \end{vmatrix} - r \begin{vmatrix} w_{ss} & w_{se} \\ w_{es} & w_{ee} \end{vmatrix} \right) \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} \qquad (34)$$

This can be written out as follows:

$$(b_V^s k_{ss} + b_V^e k_{es}) a_V^s + (b_V^s k_{se} + b_V^e k_{ee}) a_V^e - r(a_M^s w_{ss} + a_M^e w_{es}) a_V^s - r(a_M^s w_{se} + a_M^e w_{ee}) a_V^e - \frac{1}{2}[((k_{ss} - r w_{ss}) a_V^s + (k_{es} - r w_{es}) a_V^e)) a_V^s + ((k_{se} - r w_{se}) a_V^s + (k_{ee} - r w_{ee}) a_V^e) a_V^e] \qquad (35)$$

The voters will maximize this function with respect to a_V^s and a_V^e taking as given the actions of the MST, that is a_M^s and a_M^e.[15] The first order conditions are:

$$\frac{\partial(35)}{\partial a_V^s} = b_V^s k_{ss} + b_V^e k_{es} - r a_M^s w_{ss} - a_V^s (k_{ss} - r w_{ss}) - a_V^e k_{es} = 0 \qquad (36)$$

$$\frac{\partial(35)}{\partial a_V^e} = b_V^s k_{se} + b_V^e k_{ee} - r a_M^e w_{ee} - a_V^e (k_{ee} - r w_{ee}) - a_V^s k_{es} = 0 \qquad (37)$$

In order to simplify this we use the following notation:

$$\mathbf{k_1} = \begin{vmatrix} k_{ss} \\ k_{es} \end{vmatrix} \quad \mathbf{k_2} = \begin{vmatrix} k_{se} \\ k_{ee} \end{vmatrix}$$

$$\mathbf{\acute{a}^s} = \mathbf{\acute{a}_V^s} + \mathbf{\acute{a}_M^s}, \quad \mathbf{\acute{a}^e} = \mathbf{\acute{a}_V^e} + \mathbf{\acute{a}_M^e}, \quad \mathbf{\acute{a}} = \mathbf{\acute{a}_V} + \mathbf{\acute{a}_M}$$

$$\mathbf{b^s} = \mathbf{b_V^s} + \mathbf{b_M^s}, \quad \mathbf{b^e} = \mathbf{b_V^e} + \mathbf{b_M^e}, \mathbf{b} = \mathbf{b_V} + \mathbf{b_M}$$

$$\mathbf{b_V} = \begin{vmatrix} b_V^s \\ b_V^e \end{vmatrix} \quad \mathbf{b_M} = \begin{vmatrix} b_M^s \\ b_M^e \end{vmatrix} \quad \mathbf{b} = \begin{vmatrix} b^s \\ b^e \end{vmatrix}$$

$$\mathbf{\acute{a}_V} = \begin{vmatrix} a_V^s \\ a_V^e \end{vmatrix} \quad \mathbf{\acute{a}_M} = \begin{vmatrix} a_M^s \\ a_M^e \end{vmatrix} \quad \mathbf{\acute{a}} = \begin{vmatrix} a^s \\ a^e \end{vmatrix}$$

The first-order conditions (36) and (37) can now be written as follows:

[14] As before $\hat{a}_V$ is set to assure the participation of the government.

[15] Remember that ω_{se} and ω_{es} are zero.

$$\mathbf{b_v'k_1} - \mathbf{á_v'k_1} - r a^s w_{ss} = 0 \qquad (38)$$

$$\mathbf{b_v'k_2} - \mathbf{á_v'k_2} - r a^e w_{ee} = 0 \qquad (39)$$

Adding (38) and (39) and solving for b_V we obtain an expression for the incentive scheme of the voters in the Nash Equilibrium:

$$\mathbf{b_V} = (\mathbf{I} + r\mathbf{ÙC})\mathbf{á_V} + r\mathbf{ÙCá_M} \qquad (40)$$

Following the same procedure from (27) to (40) for the MST gives this group's optimal incentive scheme:

$$\mathbf{b_M} = (\mathbf{I} + r\mathbf{ÙC})\mathbf{á_M} + r\mathbf{ÙCá_V} \qquad (41)$$

In order to analyze the individual incentive schemes offered by each principal to the government we will write out the two equations for each principal:

MST's optimal incentive schemes for each task:

$$a_M^s = \frac{b_M^s}{1 + r w_{ss} C_{ss}} - \frac{r w_{ss}}{1 + r w_{ss} C_{ss}} \left(C_{se} a_M^e + C_{ss} a_V^s + C_{se} a_V^e \right) \qquad (42)$$

$$a_M^e = \frac{b_M^e}{1 + r w_{ee} C_{ee}} - \frac{r w_{ee}}{1 + r w_{ee} C_{ee}} \left(C_{es} a_M^s + C_{es} a_V^s + C_{ee} a_V^e \right) \qquad (43)$$

Voter's optimal incentive scheme for each task:

$$a_V^s = \frac{b_V^s}{1 + r w_{ss} C_{ss}} - \frac{r w_{ss}}{1 + r w_{ss} C_{ss}} \left(C_{se} a_V^e + C_{ss} a_M^s + C_{se} a_M^e \right) \qquad (44)$$

$$a_V^e = \frac{b_V^e}{1 + r w_{ee} C_{ee}} - \frac{r w_{ee}}{1 + r w_{ee} C_{ee}} \left(C_{es} a_V^s + C_{ee} a_M^s + C_{es} a_M^e \right) \qquad (45)$$

Section 3 – The effect of observability on Land Reform Policy

Equations (42) to (45) can be used to analyze several aspects of the optimal behavior of the MST and voter's in this multi-principal and multi-task situation. It is possible to solve this system of four equations to get expressions for the optimal incentive of each principal for each task (a_M^s, a_M^e, a_V^s, a_V^e) in terms of the parameters (c's, ω's, b's and r). This would allow us to determine the signs and magnitudes of the incentive provided by each principal for each task. Also it would allow us to draw reaction curves for each principal's scheme for a given task against his own or another principal's optimal scheme for another task However, the expressions obtained are very long and are

only interesting if one wants to plug in specific values of the parameters. Instead we will analyze the system of equations directly to derive some of the characteristics of the relationship of the MST and the voters amongst themselves and with the government in this scenario.

The first point to note is that if the government is not risk averse then r = 0 and $a_M^s = b_M^s$, $a_M^e = b_M^e$, $a_V^s = b_V^s$ *and* $a_V^s = b_V^s$. This is the situation where the agents marginal pay-off for a given task is equal to the marginal expected output of the principal for that task, and it is equivalent to the first best solution. Thus without risk-aversion we would expect to observe only high-powered incentives.

Equations (42) to (44) can also be used to analyze the effect of different levels of observability for each of the two tasks. Suppose, as we did before, that settlement efforts of the government are easily observable but that emancipation efforts are not. In the extreme, so as to drive the point more easily, w_{ss} is zero and w_{ee} is a positive number.[16] Under these circumstances $a_M^s = b_M^s$ *and* $a_V^s = b_V^s$ while the expression for a_M^e *and* a_V^e remain those in equations (43) and (45). This means that the incentives given by each of the principals for settlement, the observable task, will be high-powered and consequently equal to the first-best level. On the other hand the incentives given by each of the principals for emancipation, the less observable task, will be low-powered, that is, the principals will offer less to the government in exchange for the marginal outcome of that task than their expected marginal benefit from that task. This result helps to explain why the land reform issue in Brazil is cast so much in terms of the number of families settled and hardly at all in terms of the number of emancipated families.

Another point that can be seen from equations (42) to (44) is that each principal cares about the optimal scheme offered by the other, even if he has no interest in the other task. Suppose for example that the MST derives no benefit from emancipation, so that $b_M^e = 0$. Equation (43) shows that even in this case the MST will want to offer an incentive for the government concerning the level of emancipation, probably a negative incentive, though this depends on the values of the parameters. This happens because

[16] Remember that outcomes are a function of the government's efforts plus a normally distributed error. The ω's are the variance of the error for each task. The more observable the outcome, the smaller the variance of the error.

although the first-term in the right-hand side disappears when $b_M^e = 0$, the second term does not.

A final point can be seen by supposing that there is no substitutability between the tasks so that $c_{se}=c_{es}=0$. This simplification allows us to obtain the sign of one principal's reaction curve to the incentive offered by the other principal for a given task. For example, setting $c_{se}=c_{es}=0$ in (43) and taking the derivative of each side with respect to a_V^s, gives us the information that $\frac{\partial a_M^s}{\partial a_V^s} = -\frac{r w_{ss}}{1 + r w_{ss}} < 0$, that is, the voter's and the MST's incentives for settlement are negatively related. The more the MST offers the government in exchange for settling, the more will be the negative incentives offered by the voters. The same analysis can be done for the other task. Furthermore, the effect of allowing for substitutability or complementarily of tasks can be analyzed by doing comparative statics. The point here is to note the way in each the multi-principal multi-task context affects the ways the actors behave.

To end this section we can add the individual benefit of each principal, (40) and (41), to get an expression for the total benefit arising from the Nash equilibrium:

$$\mathbf{b_M} + \mathbf{b_V} = \mathbf{b} = (\mathbf{I} + r\mathbf{\dot{U}C})\mathbf{\acute{a}} + r\mathbf{\dot{U}C}\mathbf{\acute{a}} = \mathbf{\acute{a}} + 2r\mathbf{\dot{U}C}\mathbf{\acute{a}} \qquad (46)$$

This equation can be compared to the total benefit that resulted when the principals were able to act cooperatively:

$$\mathbf{b} = (\mathbf{I} + r\mathbf{C\dot{U}})\mathbf{\acute{a}} \qquad (22)$$

Remembering that when $a = b$ the first-best is achieved, we can see that with non-cooperative principals a situation is reached that is even further from the first-best than with unified principals, since the r is multiplied by two.[17] This situation is therefore a third-best, characterized by apparent inefficiencies and low-powered incentives. In fact the inefficiencies are simply a direct consequence of the multi-principal multi-task nature of the problem.

Section 4 – Conclusions

[17] More generally, as shown by Dixit (1996) the total benefit equals $\mathbf{b} = (\mathbf{I} + nr\mathbf{C\dot{U}})\mathbf{\acute{a}}$, where n is the number of principals.

The problem analyzed in this paper was not so much to explain the poor outcomes of land reform in the 1990`s, but why the government has insisted on a land reform model organized in a way that, at least with the benefit of hindsight, was obviously not going to be successful. Until recently the land reform model has been for INCRA to expropriate unproductive land from private owners and settle families of landless peasants on it through settlement projects. Therefore expropriation and settlement are complementary. As shown in Alston, Libecap and Mueller (1999, 2000), this model of land reform gave incentives for invasions and conflicts. In terms of the model in this paper the problem can be thought of with variable t^s as effort by INCRA (and the government) towards implementing this model of land reform. What has happened in the past decade is that INCRA has actually put most of its efforts on this task. The other task, emancipation, would be an alternative model of land reform, that is different from the expropriation./settlements model in the sense that it has a higher probability of transforming landless peasants into small rural producers. However this emancipation model is slower to show results and is capable of dealing with a smaller number of beneficiaries, clearly much less than settling 280,000 families in four years. What the multiprincipal, multitask model does is provide a way of explaining why one task was pursued and not the other. The reason revolves around the interest of the principals and the observability of each task.

The MST is interested in expropriation/settlement model of land reform because when INCRA settles a family this family receives subsidized credit from INCRA and they pay 2% to 3% of this credit to the MST. Additionally the more settled families the larger the MST's political base, the larger their exposure and thus their political power. Once a given number of families are settled and have received their credit, INCRA must decide how to allocate its marginal unit of effort. It can settle an additional family or it can invest in the follow-through tasks to ensure that the already settled families stay on the land and become successful producers. Assume this follow-through involves monitoring the settlement projects, providing infrastructure, technical assistance and other public goods that the MST cannot benefit directly from. Or, even if the MST can also take a slice of these follow-through services, it is a smaller slice than what it can get from the credit of a newly settled family. Thus the MST gives incentives for settlements

and against emancipation.[18] What was observed in practice was that INCRA ended up allocating practically all its effort towards settlement and very little towards emancipation. That is, it is as if we ended up in a corner solution where only one task was engaged in. That is in part what makes it difficult to think about; we look to the real world and see little emancipation going on, so it seems as if this task doesn't exist. What the multiprincipal, multitask model does is to explain why so little of it is done in practice.

The paper showed that a well organized interest group has an incentive to try to convince other more diffuse interest groups to also prefer its task rather than their own. That is, the MST by its marketing, marches, media appearances, etc. convinced the voters that what is important is that a large number of families get settled. In fact all they have to do is to convince the voters that the number of settled families is a good proxy of how much the government is doing towards emancipation. The result was shown in the model in two ways. The first was just to assume that the MST convinces the voters so that the game collapses to single-principal, single-task model whose second-best solution is better for the MST than that of the multiprincipal multitask. The second was through comparative statics that showed how the benefits of each principal changed when the level of observability of each task changed. Under the right assumptions about complementarity and substitutability of the tasks the result was that we would observe a lot of settlement getting done and little emancipation.

The idea that one interest group may try to affect another's preferences, or perceptions, is also found in Peltzman (1976). In that paper, he regulator, when deciding the level of support or opposition that each group will give in exchange for the transfers he will realize, will take into account the efforts or expenditures each group will spend in "campaign funds, lobbying, and so on, to mitigate opposition." (variable K in his model). Another interesting parallel between this model and Peltzman's is the result that in general the regulator will not give all the spoils to one side but will trade-off the support that each side will give.

[18] Note that the MST's incentives to the government are not so much in the form of actual support but rather in the form of providing more or less opposition.

An important question that arises from this analysis is why the government pursued the expropriation/settlement model of land reform when it soon became clear that it would eventually become unsustainable. Clearly the government realized what was happening but because of the pressure from the MST and voters (who are convinced by the MST to equate settlements with land reform) it could not simply stop settling and embark on another program. What it did was to carry on with the settlements to appease the MST and voters, and at the same time try to develop other ways of dealing with land reform so that they could ease off settlements and onto this new program. The changes made in the ITR (land tax) in 1996 were an attempt at this, as is currently the new Land Bank land reform (the World Bank program where landless peasants are financed to purchase land straight from the owner).[19]

Currently the land reform debate is less and less held in terms of the number of settled families. As noted in the quote in the introduction there are so many families settled today that INCRA is unable to provide all the credit that is due to these families. The MST realizes this and no longer pressures for more settlement. Their fight today is to make sure the government pays the credit it owes the families that are already settled. This is why there are few invasions currently, but the MST are still in the headlines. They are invading INCRA offices, camping out in front of government offices, closing highways, doing marches from one city to the other, etc., all tactics to force the government to keep transferring credit to them. What has happened is that recently the land reform program has changed. The expropriation/settlement program is practically defunct and we are in a transition to something new. The government was always aware that the old model was unsustainable, so as soon as it became politically feasible they changed the model.

The multiprincipal multitask model allowed us explain why the old model was engaged in by the government. The end of the model can be explained as the government changing the rules so as to achieve a more efficient (closer to first best) solution. This is in fact one of the uses to which Dixit (1996) puts his model. He shows that when there

[19] In a recent interview the Minister of Land Reform expressed his disappointment with the results from the new ITR. He stated that he now realizes that taxing the rich is not a feasible way of doing land redistribution since there are so many ways to avoid and evade taxes. The landowners were able to find

are several principals and several tasks you reach a third best solution, which is further from first best than the second best case where you have only one (or united) principal. He then shows that if you are able to change the rules (at a constitutional level and not at the level of the game itself) and restrict the principals so that each can only provide incentives to the agent for the one task they are interested in, and cannot provide negative incentives to the other tasks, then under some conditions you reach a level better than the second best. In our case this would be as if the MST could not provide negative incentives for emancipation and the voters could not provide negative incentives for settlement. This paper explained the recent changes in the land reform program as a means to impose restrictions on the incentives that the principals can provide. In the new Land Bank program the MST is unable to invade since there is no expropriation involved. No wonder the MST is strongly opposed to this program.

several ways to avoid the new stringent tax rules, like dividing their large farms amongst their sons so that each part could not be considered a latifundia.

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