Political Institutions and the Design of Environmental Policy in a Federal System with Asymmetric Information

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SUMMARY

Policy debates on trade and the environment frequently refer to a need for countries linked by trade to co-ordinate, or even harmonise, their purely domestic environmental policies. Underlying this argument is a concern that national governments will not fully internalise environmental externalities. Conventional trade models suggest this concern is unwarranted and harmonisation may be damaging. In this paper I consider two possible bases for this concern - strategic trade and political economy considerations - and assess the implications for the design of policy and political institutions to achieve co-ordination. A model which links these two factors suggests a possible rationale for harmonisation of environmental policies, even when countries differ significantly with respect to environmental damage costs.

Key words: Environmental policy, International trade, Harmonisation, Asymmetric information, Political economy, Special interests, Restricting government discretion.

JEL: F1, H7, Q2

NON TECHNICAL SUMMARY

It is well-known that there is a need to co-ordinate the environmental policies of different countries when dealing with transboundary or global environmental problems, where activities in one country have environmental effects in other countries. But recent debates on trade and the environment refer to a need for countries linked by trade to co-ordinate their environmental policies even for entirely local pollution problems. Indeed the suggestion is often made that there is a need to harmonise domestic environmental policies across countries. Industrialists often argue that harmonisation is desirable to provide a 'level playing field' for trade. Environmentalists argue that harmonisation is necessary to prevent 'environmental dumping', i.e. that governments may not set environmental policies which fully reflect environmental damage caused by productive activities because they engage in policy competition whereby they weaken their environmental regulations in order to give a competitive advantage to domestic producers.

In conventional economic models of competitive international markets and governments which are concerned with the welfare of all members of society, there is no reason to believe governments will engage in 'environmental dumping'. Moreover even if some governments did not fully internalise environmental damage costs, policy reforms would not have to be co-ordinated. In any case, harmonisation would be undesirable if there are genuine differences between countries. To give some basis for international environmental policy, it is necessary to depart from the conventional economic model and I consider a number of such departures, together with their implications for policy and institutions. I work within a framework where any co-ordination is achieved by a supra-national government agency, e.g. in the form of a federal government.

I begin with a case where some countries are large enough to affect world prices, national governments have not fully corrected environmental market failures, but they do not seek to manipulate world prices. This provides a justification for co-ordination of policy reforms, and in a special model this can be considered a form of harmonisation. However to consider appropriate institutions to achieve co-ordination one needs to consider why national governments have not fully corrected market failures.

The first case I consider is a strategic trade model, where in some markets there are significant economies of scale, so only a few firms

supply the world market. Individual national governments may then have incentives to set weak environmental policies (a ‘race towards the bottom’). While this provides a rationale for co-ordination of the domestic environmental policies of states, this is unlikely to require harmonisation. A policy of requiring countries to meet ‘minimum standards, in setting environmental policies may also face difficulties. I then show that if the federal government is poorly informed about

environmental damage costs in individual states, this may require setting environmental policies in states with different damage costs which are more similar than would be the case with full information, but this does not amount to harmonisation of environmental policies.

I next examine political economy models of how governments may set their environmental and trade policies when governments take account of the welfare of only some special interest groups within society, rather than considering the welfare of all groups. This leads to an analysis of political institutions for limiting the discretion of governments subject to the influence of special interests, while recognising that governments have access to information not available to voters. In the context of the particular model employed, the relevant restriction of government discretion implies harmonisation of environmental policies, and I assess the incentives for restricting government discretion at both the federal and state levels.

POLITICAL INSTITUTIONS AND THE DESIGN OF ENVIRONMENTAL POLICY IN A FEDERAL SYSTEM WITH ASYMMETRIC INFORMATION

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ABSTRACT

Policy debates on trade and the environment frequently refer to a need for countries linked by trade to co-ordinate, or even harmonise, their purely domestic environmental policies. Underlying this argument is a concern that national governments will not fully internalise environmental externalities. Conventional trade models suggest this concern is unwarranted and harmonisation may be damaging. In this paper I consider two possible bases for this concern - strategic trade and political economy considerations - and assess the implications for the design of policy and political institutions to achieve co-ordination. A model which links these two factors suggests a possible rationale for harmonisation of environmental policies, even when countries differ significantly with respect to environmental damage costs.

Keywords: Environmental policy, international trade, harmonisation, asymmetric information, political economy, special interests, restricting government discretion.

JEL Classification: F1, H7, Q2

NON-TECHNICAL ABSTRACT

It is well-known that there is a need to coordinate the environmental policies of different countries when dealing with transboundary or global environmental problems, where activities in one country have environmental effects in other countries. But recent debates on trade and the environment refer to a need for countries linked by trade to co-ordinate their environmental policies even for entirely local pollution problems.Indeed the suggestion is often made that there is aneed to harmonise domestic environmental policies across countries. Industrialists often argue that harmonisation is desirable to provide a 'level playing field' for trade. Environmentalists argue that harmonisation is necessary to prevent 'environmental dumping', i.e. that governments may not set environmental policies which fully reflect environmental damage caused by productive activities because they engage in policy competition whereby they weaken their environmental regulations in order to give a competitive advantage to domestic producers.

In conventional economic models of competitive international markets and governments which are concerned with the welfare of all members of society, there is no reason to believe governments will engage in 'environmental dumping'. Moreover even if some governments did not fully internalise environmental damage costs, policy reforms would not have to be co-ordinated. In any case, harmonisation would be undesirable if there are genuine differences between countries. To give some basis for international environmental policy, it is necessary to depart from the conventional economic model and I consider a number of such departures, together with their implications for policy and institutions. I work within a framework where any co-ordination is achieved by a supra-national government agency, e.g. in the form of a federal government.

I begin with a case where some countries are large enough to affect world prices, national governments have not fully corrected environmental market failures, but they do not seek to manipulate world prices. This provides a justification for co-ordination of policy reforms, and in a special model this can be considered a form of harmonisation. However to consider appropriate institutions to achieve co-ordination one needs to consider why national governments have not fully corrected market failures.

The first case I consider is a strategic trade model, where in some markets there are significant economies of scale, so only a few frims supply the world market. Individual national governments may then have incentives to set weak environmental policies (a 'race towards the bottom'). While this provides a rationale for co-ordination of the domestic environmental policies of states, this is unlikely to require harmonisation. A policy of requiring countries to meet 'minimum standards, in setting environmental poicies may also face diffculties. I then show that if the federal government is poorly informed about environmental damage costs in individual states, this may require setting environmental policies in states with different damage costs which are more similar than would be the case with full information, but this does not amount to harmonisation of environmental policies.

I next examine political economy models of how governments may set their environmental and trade policies when governments take account of the welfare of only some special interest groups within society, rather than considering the welfare of all groups. This leads to an analysis of political institutions for limiting the discretion of governments subject to the influence of special interests, while recognising that governments have access to information not available to voters. In the context of the particular model employed, the relevant restriction of government discretion implies harmonisation of environmental policies, and I assess the incentives for restricting government discretion at both the federal and state levels.

1. Introduction

Much of the analysis of international environmental policy is concerned with the issue of transboundary pollution where there is a well known need to co-ordinate the environmental policies of national governments who might ignore the damage caused to other countries by domestically generated pollution. In this paper I focus on the case where pollution is not transboundary, and consider whether the fact that countries are linked through trade provides a need to co-ordinate the purely domestic environmental policies of nation states, and if so what political institutions might be needed to achieve such co-ordination.

Environmentalists have frequently challenged economists' belief in the benefits of trade liberalisation because of its impact on the environment[1]. One concern is that the expansion of production, consumption and transport of goods that might accompany trade liberalisation might increase global pollution[2] . Even if that were true, provided each country correctly internalises the externalities from its domestic pollution, and there are no other market distortions, the standard results about the benefits of trade liberalisation apply. However this raises the concern that countries may not fully internalise environmental externalities, and indeed that in a competitive world environment countries will have incentives not to fully internalise external costs in order to give domestic firms a competitive advantage, expressed by terms such as "environmental dumping", or "race to the bottom". In a standard small open economy a government which seeks to maximise welfare would have no *incentive* not to fully internalise external costs. It is this concern that underlies the belief that there is a need to co-ordinate and even harmonise purely domestic environmental policies.

Now in the benchmark model of a small open-economy with a welfare maximising government it is well known that the national government would wish to pursue free trade and full internalisation of externalities. Even if, for some reason, some national governments did not pursue such policies, policy reform in one such country does not have to be co-ordinated with policy reforms in other such countries. Moreover if countries are different in terms of endowments of environmental resources, tastes for a good environment or technology harmonisation of environmental policies would be undesirable because it would prevent the operation of environmental comparative advantage[3].

To provide any basis for international environmental policy it will be necessary to depart from the simple benchmark model, and in the rest of this paper I do so in a number of ways. In section 2 I consider some models where countries are large, governments do not seek to exploit terms of trade, but for unspecified reasons do not fully correct environmental market failures. A standard second-best argument says that environmental reform in one country may have damaging effects on other countries, so

[1] See, for example, the debate between Bhagwati and Daly (1993).

[2] Copeland and Taylor (1994, 1997) provide theoretical analysis of how differences in factor endowments and incomes between countries determine whether trade liberalisation leads to lower or higher global pollution. Empirical analysis can be found in Grossman and Krueger (1993).

[3] See Ulph (1997a) for a survey of the literature on trade and environment where these standard results are presented. Krugman (1997) emphasises that gains from trade arguments are individually rational for each country, they do not depend on what other countries do.

this would provide a rationale for co-ordination of environmental policy reforms. In the specific models I review, this can be characterised by a form of harmonisation, but I suggest this does not overturn the usual presumption against harmonisation. Moreover to say something about appropriate institutions for co-ordination it is necessary to know why market failures are not fully internalised.

In sections 3 and 4 of this paper I will consider two different classes of models where governments may have incentives for environmental dumping: (a) for strategic trade reasons; (b) because government objectives are not maximisation of welfare but are influenced by special interest groups. The first case again provides a rationale for co-ordination of environmental policy reforms, but I show that both harmonisation and a policy of 'minimum standards', designed to 'ratchet up' environmental policies can reduce welfare in some countries. In the second case, I argue that the influence of special interest groups on domestic environmental policies does not of itself provide a need for international co-ordination of domestic environmental policy reforms, but rather there may be a need for institutions to 'tie the hands' of governments to overcome such influence, and I consider one possible mechanism in section 5. However the influence of special interest groups may also arise in circumstances where there is a need for co-ordination of environmental policies, in which case co-ordination must be analysed in the framework of political economy models.

This leaves the question of what political institutions may be needed to bring about international co-ordination of domestic environmental policies. One might consider three possible political institutions. The first is to allow individual governments to take action against countries who they believe are using lax environmental standards, for example by reforming GATT articles to allow the use of countervailing tariffs against environmental dumping. There are many reasons for opposing this approach[4], and I shall not pursue it. A second possible political institution is the use of International Environmental Agreements (IEAs) to co-ordinate environmental policies of national governments in the same way that is proposed for transboundary pollution. However that raises the important issue of the incentives for individual nations to join such an agreement, and since that has been explored exhaustively elsewhere[5] I do not wish to pursue this approach here. I shall therefore concentrate on a third political institution which is to posit the existence of some supra-national governmental agency which can be given the power to determine environmental policies of national governments. For concreteness I shall refer to this as a federal system, and talk about the federal government and state governments, but the analysis applies to systems which are not formally federal, such as the European Union. I shall require that any policy reform proposed by the federal government would be accepted by both state governments, i.e. it represents a Pareto improvement.

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[4] The reasons include: it is governments not firms that are doing the dumping; the difficulty of one country establishing the "right" environmental standard for another country; if the reasons for governments not fully internalising externalities lie in strategic trade reasons or the influence of special interest groups why should it be believed that allowing these governments to take countervailing action will achieve joint welfare maximisation. See for example Rauscher (1997) Chapter 9.

[5] See for example the papers by Carraro and Siniscalco (1997), Ecchia and Mariotti (1997) in this session; Tulkens (1997) is a useful attempt to reconcile different approaches to analysing incentives to join agreements.

An obvious question will be whether to delegate domestic environmental policy to the state or federal level (the 'subsidiarity question'). The usual presumption is that domestic environmental problems should be tackled at the lowest level, because of superior information, so I believe it is important to conduct the analysis on the basis of asymmetric information between the different levels of government. In section 3 I show that such asymmetries of information do not overturn the need for co-ordination at the federal level, but can lead to setting environmental policies for countries with different damage costs which are more similar than would be the case with full information, but this does not amount to harmonisation. Where there is political influence and a need for co-ordination I shall also show that it will be better to allow the federal government to set environmental policies. A more interesting question will be whether to 'tie the hands' of the federal government. For the models I shall consider such limitation of discretion would amount to endorsing harmonisation of environmental policies across countries. I take up this issue in section 5 of this paper.

2. A Simple Second-Best Argument

For reasons given in the introduction, in this section I consider some models where countries are 'large', governments do not seek to influence the terms of trade, but, for unspecified reasons, have not fully internalised environmental externalities and ask what this implies about policies such as harmonisation. I draw on two recent papers by Larry Karp and colleagues[6]. There are two countries (North and South) which each have a stock of a renewable resource, and the cost of extracting the renewable resource is decreasing function of the existing stock of the resource. The renewable resource is used solely as an intermediate input, along with another input, whose supply is fixed, to the production of two other goods, which differ in the intensity of their use of the renewable resource. The only market failure arises from imperfect property rights in the renewable resource[7], with the degree of market failure captured by the number of producers of the renewable resource which can vary from 1 (full property rights) to ∞ (pure open access). Imperfect property rights distorts the extraction of the resource, which affects the stock of the resource, and hence the cost of producing the resource and the relative costs of the two goods. The countries are identical except for initial stocks of the resource and the degree of market failure, with South having poorer property rights than North. Trade in the two goods and the resource takes place in competitive markets, but the countries are large enough that changes in exports by one country will influence the terms of trade, although governments make no attempt to influence the terms of trade. In the absence of market failure trade is driven by differences in the stock of the renewable resource, with the country with the greater stock of the renewable resource exporting the resource and the good which makes intensive use of the resource. With market failure, trade is driven by the *apparent* stocks of the resource which is neatly captured by actual stocks multiplied by a parameter which is increasing in the degree of market failure.

KSZ derive a number of results for both the short-run (fixed stocks) and long-run (stocks evolve to a long-run steady-state, which may not be unique): (i) trade can be inefficient in both volume and direction; (ii) in the short-run trade either increases aggregate extraction of the resource or leaves it unaffected; (iii) in the long-run under both trade and autarky there can be steady-states with both high and low stocks of the resource; with trade the steady-state is either autarkic or has inefficient direction of trade; (iv) in the short-run trade improves the welfare of the country importing the resource intensive good, but can lower the welfare of the country exporting the resource intensive good if it has sufficiently weak property rights; a large difference in property rights reduces aggregate welfare; (v) in the long-run there are parameter values for which trade and autarky are equivalent, both countries lose from trade, both countries gain from trade, or the South loses, the North gains, and aggregate welfare is reduced. KSZ are careful to note that these results do not provide a justification for trade distortions but rather for reducing the environmental distortions that lead to excessive use of environmental resources.

[6] Karp, Sacheti and Zhao (1997) (KSZ) and Karp, Zhao and Sacheti (1997), (KZS); their papers are an extension of a model by Chichilnisky (1994); see also Brander and Taylor (1996) for a related paper.

[7] There is also a failure because owners of the renewable resource act myopically, which affects the dynamics of the model. However this is not essential for the main points made in KSZ and KZS.

The question then arises as to how environmental distortions should be reduced. Standard second-best theory tells us that improving property rights in one country may not be a Pareto improvement. In this model the key point is that it is not just the absolute distortions in property rights that matters, but the relative distortions. KZS show that in the short run improving property rights in the country which already has the better property rights (hence widening the difference in property right regimes) reduces aggregate welfare by increasing resource extraction by the country with the weaker property rights. On the other hand, *either upward or downward* harmonisation of property rights regimes in the two countries raises aggregate welfare. In the long-run upward harmonisation makes it more likely that the long-run dynamics will lead to a steady-state with high resource stocks.

While these results are interesting they do not contradict economists' general arguments against harmonisation. For in the KSZ model the difference in market failure or property rights is the only difference between countries, and it is easy to characterise absolute and relative degrees of market failure. If there are more fundamental differences between countries (e.g. tastes or technology), while the general theory of the second best will still imply that a reduction in market failure in one country may reduce welfare in another country, so that some co-ordination of policy reforms is required, it is not at all clear that this can be usefully defined in terms of harmonisation of absolute or even relative degrees of market failure[8]. Moreover, the KSZ analysis tells us nothing about what institutions might be needed to bring about the appropriate co-ordination of policy reforms, because that depends on why market failure has not been fully corrected. The next two sections consider different reasons why national governments may not want to fully correct market failures.

[8] Clearly first-best policy requires free trade and complete internalisation of externalities in both countries, but I do not believe that this just defines harmonisation as achievement of the first-best.

3. Strategic Trade .

In this section I consider imperfectly competitive markets for some traded goods[9]. If markets are imperfectly competitive, and governments cannot use trade instruments, then governments will have incentives to manipulate their environmental policies to gain a strategic trade advantage and this will sometimes mean that governments will engage in environmental dumping, though this is by no means a general result[10]. The rationale is that national governments try to shift profits towards their domestic producers by setting weak environmental policies[11].

Assuming that environmental dumping does occur, what are the implications for policy and political institutions? To fix ideas I shall use a simple model by Ulph (19977b,c). There are two firms producing a homogenous product, each located in a separate state (country) in which there are no consumers so all production is exported to a third set of countries. Production of the good causes pollution but firms can abate, though abatement costs are strictly convex. Any unabated pollution causes damage but only to the state in which the firm is located, and the states have strictly convex damage cost functions. The states and firms are identical except for damage costs, which can differ in the two states by a multiplicative parameter. The governments of the two states can use either emission limits or emission taxes as their policy instruments, and there is a two-stage game in which state governments first set their policy instruments and firms then choose output[12]. In setting their policy instruments the governments of the two states can either act independently (a non-cooperative equilibrium) or they can act cooperatively, which is equivalent to a federal government setting the policy instruments for the two states to maximise the sum of the welfare of the two countries[13]. Figure 1 shows the iso-welfare contours, government reaction functions, non-cooperative and cooperative equilibria for the cases where the policy instruments are emission limits and emission taxes. As can be seen emission limits are strategic substitutes (reaction functions slope down) while emission taxes are strategic complements (reaction functions slope up)[14]. In both cases environmental dumping

[9] Of course another departure from the small economy case is to assume that firms act perfectly competitively but countries have market power. If countries cannot use trade instruments then they may distort their environmental policy from the simple first-best rule as a proxy for imposing the optimal trade tax. As Rauscher (1994) has shown this will usually involve net exporters setting environmental policies tougher than the first-best rule, and net importers setting policies which are laxer than first-best.

[10]Results depend upon the form of market competition (e.g. Bertrand or Cournot), whether producers are also able to make strategic investments in capital or R&D, general equilibrium effects amongst others. See Rauscher (1997) Chapter 6 and Ulph (1997a) for surveys of the available results.

[11] It should be noted that there are two different definitions of environmental dumping in the literature. The first is that national governments acting non-cooperatively set environmental policies which are weaker than the simple first-best rule (e.g. emission taxes below marginal damage costs); the second is that national governments acting non-cooperatively set environmental policies which are weaker than those they would set acting cooperatively. In the model I shall present environmental dumping occurs in both senses, but this is not always so. The second definition is more robust than the first

[12] The results would be the same if there was Cournot rather than Bertrand competition.

[13] For reasons discussed below this maximisation should be subject to the condition that neither country is worse off than in the non-cooperative equilibrium.

[14] The intuition is as follows. If state 2's environmental policy is tightened this will cut the output of firm 2 and raise the output of firm 1. Suppose state 1's environmental policy is unchanged. Then if

takes place in the sense that if the states act non-cooperatively they both set environmental policies which are laxer than they would set if they acted cooperatively[15].

Figure 1 shows a situation where state 1 has lower damage costs than state 2, so for both the non-cooperative and cooperative equilibria environmental policy is less stringent in country 1 than country 2. Consider now policy reforms from the non-cooperative equilibrium, where I suppose that for any such reform to be *feasible* it must be a Pareto improvement over the non-cooperative equilibrium[16] . As noted in Ulph (1997b, c) two immediate implications follow from Figure 1. First, no policy which involves harmonisation of environmental policy in the two countries is feasible[17]. Second, if emission limits are the policy instrument, then a policy of "minimum standards", i.e. imposing an upper limit on the emission limits state governments can set, would not be feasible; the reason is that as state 1 is forced to reduce its emission limits from the non-cooperative level, state 2 would be able to increase its emission limits, moving along state 2's reaction function in the section AB. This clearly makes state 1 worse off than in the non-cooperative equilibrium. By contrast, with emission taxes, requiring state 1 to raise its emission tax would cause state 2 to also raise its emission tax, and at least in the range AB this would yield a Pareto improvement over the non-cooperative equilibrium[18].

Why should one be concerned with policy reforms such as harmonisation or minimum standards when the federal government could just implement the cooperative solution? One answer might be that, as noted in the introduction, the analysis so far misses the usual presumption that local environmental problems are best tackled at the local level because of the superior information held locally. This suggests it would be more appropriate to assume that information about damage costs of each state is known only to the government of that state[19]. Might it then be possible to justify policies such as

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emission limits are the policy instrument, the extra pollution associated with the extra output in state 1 must all be abated; this is inefficient - some of the extra pollution can be emitted, so state 1 environmental policy is *relaxed*; on the other hand if emission taxes are the policy instrument then all the extra pollution associated with the extra output in state 1 will be emitted, and this is inefficient, some of it should be abated, so environmental policy in state 1 should be *toughened.*

[15] It also takes place in the narrower sense that non-cooperative environmental policies are laxer than the simple first-best rule, while cooperative policies are tougher than the simple first-best rule. The reason for the latter is that when the two governments cooperate they not only wish to fully internalise the externalities but also wish to move total industry output closer to the monopoly level, and this requires setting environmental policies tougher than first-best. Clearly a cooperative equilibrium which involved states which consume the product would want a less stringent set of environmental policies.

[16] This amounts to assuming that any state has veto power over environmental policy proposed by a federal government.

[17] Clearly this result depends on the difference in abatement costs of the two states, but as Ulph (1997b) shows, using a special case of this model where profit and cost functions are quadratic, countries only need to differ by 50% in damage costs for harmonisation not to be feasible.

[18] Kanbur, Keen and van Wijnbergen (1995) used a model of NAFTA involving mobile capital to show that harmonisation would be infeasible if countries were sufficiently different; but for their model emission limits are strategic complements, so they showed that a minimum standards policy could provide a feasible policy reform.

[19] Clearly scientific information about environmental problems may not be private; but damage costs also depend on willingness-to-pay for a cleaner environment, and it seems plausible that state

harmonisation and minimum standards on the grounds that they would not require information on damage costs in individual states? To answer this Ulph (1997 b, c) analysed the non-cooperative and cooperative equilibria using standard techniques for handling asymmetric information[20], but under the assumption that the damage cost parameter of each state can take one of only two values (high or low). I showed that in general it will not be possible for the federal government to implement the full information cooperative equilibrium shown in Figure 1. In particular, for the case where one state has high damage costs and the other low the environmental policies of the two states will be more similar than in the full information case. The reason is that in the full information case, efficiency requires the federal government to allocate a lot of output to the state with lower social costs of production, so the high damage cost state gets low market share and low profits. To overcome the incentive for the high damage cost country to pretend to have low damage costs it is necessary for the federal government to give the two states a more equal share of the market, and hence more equal environmental policies. But in general this falls well short of harmonisation, and as I have shown, for emission limits, a minimum standards policy is not even feasible. Despite asymmetric information, both states are better off when environmental policy is set at the federal rather than the state level[21].

To summarise, the analysis presented here suggests that when state governments have incentives to manipulate their environmental policies then domestic environmental policy should be set at the federal level, even if the federal government is not well informed about key parameters in each state, such as damage costs. The federal government can design policies to overcome this lack of information, and this will not imply policies such as harmonisation or minimum standards. However this analysis may be misleading since to understand the way in which state governments might manipulate their environmental policies for strategic trade reasons, the federal government would need to know a lot about the nature of market competition.

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governments may be better informed about such tastes than a federal government, particularly if tastes are revealed informally rather than through a cost-benefit analysis, say.

[20] The non-cooperative equilibrium is modelled as a Bayesian-Nash equilibrium and the cooperative equilibrium is a mechanism design problem with Bayesian implementation.

[21] Bigano (1997) extends the analysis of Ulph (1997b) to allow for some consumers to be located in the two producing states and for transboundary pollution. He shows that the main qualitative results are unaffected. The only substantive difference is that with transboundary pollution the incentive compatibility constraints may be different. The reason is that the social costs of production in one state are now a weighted average of the damage costs in the two states, with the weights being the proportion of pollution emitted that ends up in the two states. This means that states have incentives to understate their damage costs to the extent that this affects their own social costs of production, but to overstate their damage costs to the extent that this raises the social costs of their rival. When emissions by both firms fall equally on the two states, Bigano shows that states always tell the truth.

4. Political Economy Models

An alternative explanation of why governments may not fully internalise externalities is that they do not maximise welfare but rather maximise a utility function which may include social welfare but may also reflect the influence of special interest groups. In this section I shall briefly review the main contributions I am aware of that have tried to apply such political economy models to the issue of trade and the environment.

Frederikson (1997a) extends the model of trade protection developed by Grossman and Helpman (1994) to analyse environmental issues. He considers a small open economy with two industries, one polluting and one not, where pollution is again entirely domestic. The only policy instrument available to the government is an emission tax. There are two interest groups - an environmental group which represents all those who are damaged by damaged by pollution, and a group which owns an industry-specific factor used in the production of the polluting industry, and which earns all the profits earned by this industry; the environmental group favours a high emission tax, the industry group a low emission tax. The two pressure groups offer an incumbent government a schedule of contributions as a function of the emission tax. The incumbent government chooses the emission tax to maximise a utility function which consists of social welfare plus financial contributions made by the two groups[22]. In the absence of any lobbying the government would set the emission tax equal to marginal damage cost. With lobbying the political equilibrium emission tax is:

$$t^p = \frac{t^*}{1-\gamma(1-\varepsilon)} \quad \text{where } \gamma = \frac{1-\alpha}{1+\omega}, \quad 0 \le \gamma \le 1$$

where t^* is the simple-first-best emission tax, α the proportion of the population which has joined a lobby group whether the environmental or the industry group, ε is the absolute value of the inverse elasticity of pollution with respect to the emission tax, and ω is the weight the government attaches to social welfare[23]. It is clear that the political tax will be above or below the first-best tax as ε is below or above 1. The emission tax will be an increasing (decreasing) function of γ if ε is below (above) 1. Note that if all members of society belong to one or the other pressure group (α =1) then the political tax equals the simple first-best tax, so the effects of the two lobby-groups cancel out, a general result of the Grossman and Helpman model; the rationale is that the weighted sum of the utilities of the lobby groups is essentially the same as the social welfare function . Frederikson extends this model to allow for pollution abatement, with the government setting an abatement subsidy, which is assumed not to be the subject of lobbying. He shows that an increase in the pollution subsidy can lead to an increase in pollution because of a political economy effect whereby an increased subsidy allows firms to produce more output without producing more pollution; but this increases the incentive for the industry group to lobby for a reduced emission tax, and this may offset the effect of the increased abatement subsidy. Frederikson (1997b) uses this analysis as a possible explanation of empirical research has largely failed to find significant effects of environmental policy on trade (see, for example, van Beers and van den Bergh (1997)).

[22] Financial contributions are used by the government to fight the next election.

[23] It would appear that the political tax does not depend on the proportion of the population in each lobby group, but in Frederikson's simple model the first-best tax is just equal to the share of the population in the environment group.

The model of Hillman and Ursprung (1992, 1994) differs from Frederikson in a number of respects. First, while there are again two sectors with one polluting industry, instead of a small open economy the polluting industry is characterised by imperfect competition between firms in two countries, so there is an interaction between the lobbying activities in the two countries. Second, the only policy instrument available to the government is a tariff on imports. Third the model of political competition is one of electoral competition in which there are two parties who, at the first stage, announce their policy platforms. The probability of a party being elected depends on total campaign contributions from lobby groups. There are three lobby groups, one representing the industry-specific factor owned by domestic producers, another representing the industry-specific factor owned by foreign exporters, and a third an environmental group. They choose their contributions in a second-stage game to maximise expected utility taking account of how their contributions affect the probability of election. Pollution is again domestic, and may be caused by either domestic consumption or domestic production, and the environmental group may be concerned only about domestic pollution or about total pollution in the two countries ('supergreens').

The focus in this model is not so much on the level of the policy instrument, since it turns out that the political parties will optimally select extreme positions, one taking a free trade stance (zero import tax) and the other a protectionist stance with the import tariff set to prohibit imports; rather the focus is on which party the environmentalists will support, and what this implies for contributions. If pollution is caused by consumption, then since domestic consumption is decreasing in the import tariff both greens and supergreens will support the protectionist party. However if pollution depends on domestic production, this will depend on what happens to tariffs in both countries, being lowest if the foreign country prohibits imports but the domestic country allows imports. This leads to a prisoner's dilemma for green parties in which support for free trade is a dominant strategy, but green parties in both countries would be better off if both backed protection. The problem arises because of lack of cooperation between green lobby groups in different countries. Supergreens would always support protectionist parties. These models provide some support for the view that there is an alliance of interests between environmentalists and domestic industry lobby groups in their dislike of free trade.

A limitation of both approaches is that it is assumed that there is only one policy instrument on which political competition operates. Rauscher (1997) uses a model similar to Frederikson, but in which pollution can be caused by both production and consumption, and in which the government can set an emission tax, consumption taxes, which can differ between domestic and foreign goods, and environmental quality standards, which again can be applied differentially to domestic and foreign goods. He studies the support which different instruments will get from industrial and environmental lobbying groups, and shows that with many instruments there can be some surprising implications; for example, industry groups may be happy to lobby for tight emission controls if that increases the demand for industry-specific capital for abatement purposes and if the effect on costs can be mitigated by a reduction in consumption tax.

While these results are interesting, the models have been used in a solely positive vein to predict how different interest groups might support different policy packages and how in turn this will move trade or environment policy away from what would be predicted with welfare maximising governments. The focus of this paper is on what this tells about the nature of environmental policy reform, whether it is necessary to have international co-ordination of environmental policy reform, and the political institutions to achieve co-ordination. As noted in section 1, if, as in the Frederikson model, all countries are small open economies, then any move to welfare maximising policies in one country can be considered independently from other countries, but if countries are large or trade is imperfectly competitive, as in Hillman and Ursprung, then the analysis of sections 2 and 3 applies and it will be generally desirable to co-ordinate these reforms. This raises the question of fruitful interactions between these two sets of models - e.g. how far lobbying by environmentalists might over come environmental dumping.

A more important issue concerns the nature of the political institutions involved, particularly in the framework adopted for this paper of a federal government. The issue arises most starkly if there is no real co-ordination role for the federal government; are we to assume that the federal government is better able to pursue welfare maximisation than state governments? If state governments are subject to pressures from special interest groups, is this not also true of federal governments, and if so how are the processes of either elections or lobbying at the different levels of government linked? In the absence of an argument as to why federal governments may be less prone to political pressure groups, then the fact that state governments may not fully internalise their environmental externalities does not provide any argument for environmental policy to be handled at the federal level. Instead one should consider other methods of limiting the influence of pressure groups at the individual state level.

However if there is also a co-ordination role for a federal government, then the fact that both state and federal governments may be influenced by pressure groups adds an additional dimension to the question of whether to set domestic environmental policy at the state or federal level. Further, if it is possible to limit political influence at the state level, can this also be done at the federal level, and how does the decision whether or not to limit political influence at the state level relate to the same decision at the federal level? I consider these issues in the next section.

5. Limiting Political Discrimination.

An analysis of why it may be desirable to limit political influence on government environmental policy is set out in a recent paper by Boyer and Laffont (1996). They consider a government regulating a firm with unknown cost of abatement. Optimal environmental regulation under asymmetric information has to leave the firm with an information rent[24] and this rent will be higher the tighter is the environmental regulation. This information rent has a social cost, whose true value will only become known to the government in power. However the government in power will represent the interests of the majority of the population. This may consist either of people who have shares in the regulated firm, and so the government will act with a social cost of

[24] See Lewis (1996) for an excellent survey of environmental regulation with asymmetric information.

the firm's rent which is below the true social cost, or of people who do not have shares in the firm, in which case the government acts as if the social cost of funds is higher than its true value. Paradoxically this means that governments representing the interests of shareholders will impose tougher environmental regulation than governments representing the interests of non-shareholders.

Boyer and Laffont consider the following choice, which can be thought of as taking place at some constitutional stage. The first choice is *political discrimination* which means allowing governments which come in to power to set environmental policy using their knowledge of the true value of the social cost of funds, but then acting in a way which is biased on either side of that true value[25]; the second choice is *social pooling* which means "tying the hands" of any incoming government by requiring it to implement the environmental policy which would maximise social welfare using the expected value of the true social cost of funds. The choice between the two is made on the basis of *ex ante* expected welfare, where expectations are across both the possible values of the true social cost of funds and the types of governments which might come into power; I denote the expected welfare levels by *EWSP* (*Expected Welfare Social Pooling*) and *EWPD* (*Expected Welfare Political Discrimination*). The outcome is summarised in Fig. 2 which shows on the vertical axis the variance of the true social cost of funds, denoted $V(\delta)$, and on the horizontal axis the variance in the bias which governments representing different majorities would apply to the true social cost of funds, denoted $V(\gamma)$. Boyer and Laffont show that there is an upward sloping curve $V(\delta)=F[V(\gamma)]$, for simplicity shown as linear, such that for values of the variances along this curve society would be indifferent between social pooling and political discrimination, *EWSP=EWPD.* For variances above this curve society would prefer political discrimination, *EWPD > EWSP*, since the high variance in the social cost of funds makes it important to allow governments to benefit from learning its true value. For varainces lying below this curve society would prefer social pooling, *EWSP > EWPD*, since the high variance in biases used by different governments makes it important to limit their discretionary powers.

Ulph (1997d) extends the Boyer and Laffont analysis to the case of a federal structure, by combining it with the model of strategic trade developed in Ulph (1997b, c) presented in section 3. Unlike Boyer and Laffont, there is no asymmetry of information between the state government and the firm whose pollution it has to regulate; the asymmetry of information is that it is assumed that only the state governments know the true damage costs of their states, and they only learn this information when they get elected. The difference from the Ulph (1997b, c) model is that when a government comes into power it maximises a utility function reflecting the interests of those who elected it rather than maximising social welfare. Depending on whether the government has been elected representing the interests of environmentalists or of the shareholders of the firm, the government may give too much or too little weight to environmental damages compared to the weight they have in social welfare. There is an equal chance of electing each type of government, and the outcomes of elections in each state and at

[25] Boyer and Laffont call this "sophisticated" environmental policy making.

the federal level are independent of each other[26]. The outcome of these elections is public knowledge.

If domestic environmental policy is determined at the state level, then under *political discrimination* for each of the four possible configurations of types of the two state governments, and each of the four possible configurations of damage costs in the two countries, there is Bayesian-Nash equilibrium set of emission limits. Taking expectations across all possible configurations of government types and damage costs, one calculates *ex ante expected social welfare with political discrimination at the state level* (*EWPDS*). This is a decreasing function of the variance of the weights different governments attach to environmental damage costs, $V(\gamma)$, (it is assumed that the expected weight is 1, the weight in social welfare). For low values of average damage costs it is also a *decreasing function* of the variance of damage costs[27], $V(\delta)$, while for high average damage costs it is an *increasing* function of the variance of damage costs. Put simply, the reason is that at low average damage costs, as the variance of costs increases market shares for the high cost firm do not fall very sharply in a Cournot equilibrium and so the loss of profits from raising the cost of the high cost firm outweigh the increase in profits from reducing costs of the low cost firm, causing total profits and welfare to fall. With high average damage costs, increasing the variance of damage costs leads to a sharper fall in market share for the high cost firm, so that total industry profits and welfare rise as the variance of damage costs increases. For plausible parameter values, i.e. where environmental damage costs in the absence of any environmental policy are less than 50% of gross welfare, *EWPDS* is a decreasing function of the variance of damage costs.

Under *social pooling* state governments are mandated to implement the environmental policy which would maximise social welfare, taking as given the environmental policy of the rival government; since this must be chosen before the level of damage costs are known, this policy must be set on the basis of *expected* damage costs. Since this is known for both countries, there is a simple Nash equilibrium set of emission limits which must be implemented in each country regardless of the type of government or the actual *ex post* level of damage costs. This yields *ex ante expected social welfare under social pooling at the state level* (*EWSPS*), which depends only on the expected level of damage costs, and not on either of the variances. Note the crucial point that under social pooling both governments will be mandated to implement the *same* environmental policy, i.e. there will be harmonisation; this is because policy is based on expected damage costs, which are assumed to be the same for both countries, rather than on *ex post* damage costs which could be different in the two countries. The comparison between *EWPDS* and *EWSPS* is shown in Fig. 3a for the case where *EWPDS* is a decreasing function of the variance of damage costs. Clearly political discrimination will be preferred to social pooling for low values of both variances, while social pooling will be preferred for high values of both variances.

[26] It is straightforward to introduce a link between the outcome of state elections and the federal election.

[27] Note that variances are assumed to be bounded to ensure that the minimum weight attached to environmental damage and the minimum damage cost parameter are non-negative. In Figure 3 the variances are really the coefficient of variation and are expressed as proportions of the mean, with values between 0 and 1.

Setting environmental policy at the state level will still result in governments setting environmental policies laxer than they would if they co-operated, so there is role for co-ordination at the federal level. Under *political discrimination* there will now be eight possible configurations of types of government at the state and federal levels; for each configuration, as in section 3 the federal government solves a Bayesian mechanism design problem using monetary transfers and appropriate emission limits to get the state governments to reveal their private information about damage costs. Note that the appropriate *participation constraints* are that the state governments must have at least as high a level of expected *utility* as they would have had in non-cooperative equilibrium when environmental policy is set at the state level. Taking expectations across all possible configurations of government types and damage costs, one calculates *ex ante expected social welfare under political discrimination at the federal* level, *EWPDF*, and this is an *increasing* function of the variance of damage costs, and a *decreasing* function of the variance of government types. The reason why *EWPDF* is always an increasing function of the variance of damage costs, is that in a co-operative equilibrium more production will be switched to the low cost firm as the variance rises compared to what happens with a non-cooperative equilibrium, and high cost firms are compensated in part by monetary transfers. Under *social pooling*, again the federal government is mandated to set emission limits to maximise the sum of welfare in the two states, using the *expected* value damage costs in the two countries. This implies that the level of emission limits will be set the *same* in both countries, and independent of the type of government at state or federal level or of the *ex post* damages in each state. So social pooling again leads to harmonisation of environmental policies. One then calculates *expected welfare under social pooling at the federal level, EWSPF*, The choice between social pooling and political discrimination at the federal level is shown in Fig 3b, so that, as in the Boyer and Laffont model, social pooling will be preferred when the variance of government types, $V(\gamma)$, is high relative to the variance of damage costs, $V(\delta)$.

There are two other comparisons to note. First, there is the question of whether policy should be set at the federal or state level. Under social pooling, since the cooperative and non-cooperative equilibria are calculated on the basis that both states have expected damage costs, it is obvious that the cooperative equilibrium must result in higher welfare than the non-cooperative equilibrium. For political discrimination it is less obvious that setting policy at the federal level is appropriate, because, as noted above, for a given configuration of government types, the participation constraint on the federal government is that each state government must have at least as high expected *utility* as it would have had at the non-cooperative equilibrium, but this does not guarantee that expected *welfare* is higher in cooperative equilibrium than at the non-cooperative equilibrium; and for some configurations of government types expected welfare for one state may be lower at the cooperative equilibrium than at the non-cooperative equilibrium. However this occurs infrequently and when expectations are taken across all configurations of government types it turns out that for political discrimination ex ante expected welfare is always higher when policy is set at the federal level than at the state level. Second, one can ask how the choice between social pooling and political discrimination compares when policy is set at the state or federal level. The situation is shown in Fig 3c, which brings together Fig 3a and Fig 3b. In region I (32% of parameter space) political discrimination is preferred at both federal and state level, while the opposite is true in region IV (16% of parameter space); in

region II (48% of parameters space) social pooling is preferred at the federal but not the state level, and the reverse is true in region III (4 % of parameter space). What is striking is that region II is the largest region of parameter space, and certainly much larger than region III; what this means is that where the choice of institutional structure differs between state and federal level, it is most likely to be in the form of wishing to tie government's hands at the federal level but not at the state level. The rationale is that political discrimination at the federal level requires the federal government to give up resources to solve an informational asymmetry, which state governments are not required to do.

To summarise, the introduction of political economy models of government behaviour raises the issue of political institutions which might limit the influence of special interest groups. I have considered one such mechanism - tying the governments hands through some constitutional process, which removes the bias imparted by pressure groups, but also means that policy is not based on information which will become available to governments in power, and this gives a trade-off in deciding whether or not to limit political discretion. In the context of a model where there are strategic incentives for environmental dumping, tying the hands of governments implies harmonisation of policies across countries which are *ex ante* identical but could be quite different *ex post*. I have shown that it is more likely that one will want to tie the hands of governments when policy is made at the federal rather than the state level.

6. Conclusions.

In this paper I have analysed two possible reasons why governments may fail to internalise purely domestic environmental costs - strategic trade and political economy considerations. While the former factor requires co-ordination of environmental policies, the latter, by itself, may not. With strategic trade, co-ordination does not require harmonisation of environmental policies even if supra-national authorities lack important information about individual countries. The interaction between these two factors generates interesting issues. For the simple model considered here, co-ordination of policies at a supra-national level is desirable in welfare terms even if there is both asymmetric information and political biases at both the national and supra-national level. However, whatever level policy is set at, it may be desirable to limit the scope for political discrimination, and, in the context of this paper, that implies harmonisation of environmental policies. For a significant set of parameter values such harmonisation would be desirable when policy is set at a supra-national level, but is undesirable when it is set at the national level. I believe there is much fruitful work still to be done on the interaction of political economy and strategic trade models of environmental policy.

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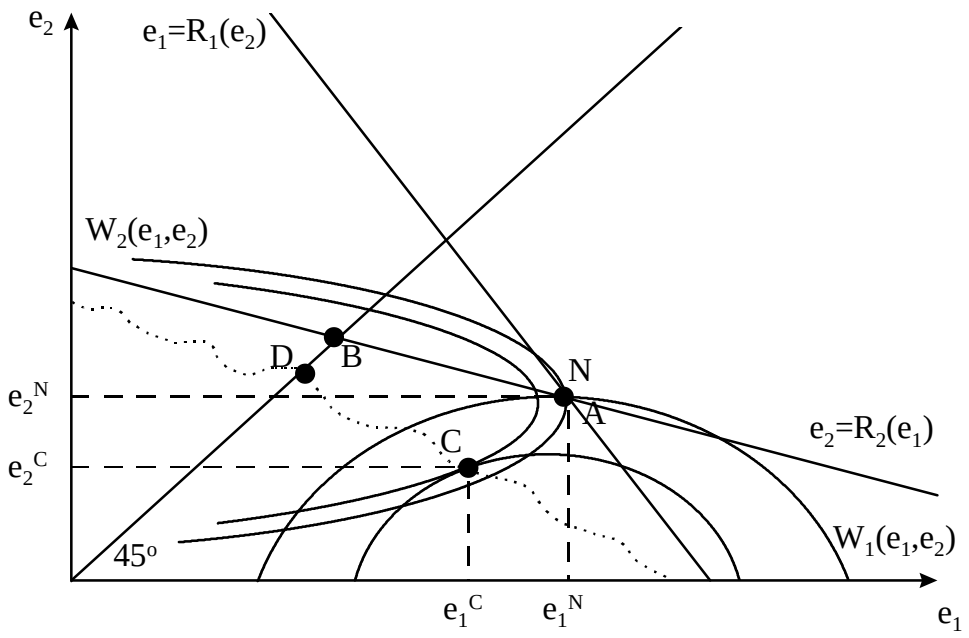

Figure 1a: Non-Cooperative and Cooperative Equilibria with Emission Limits

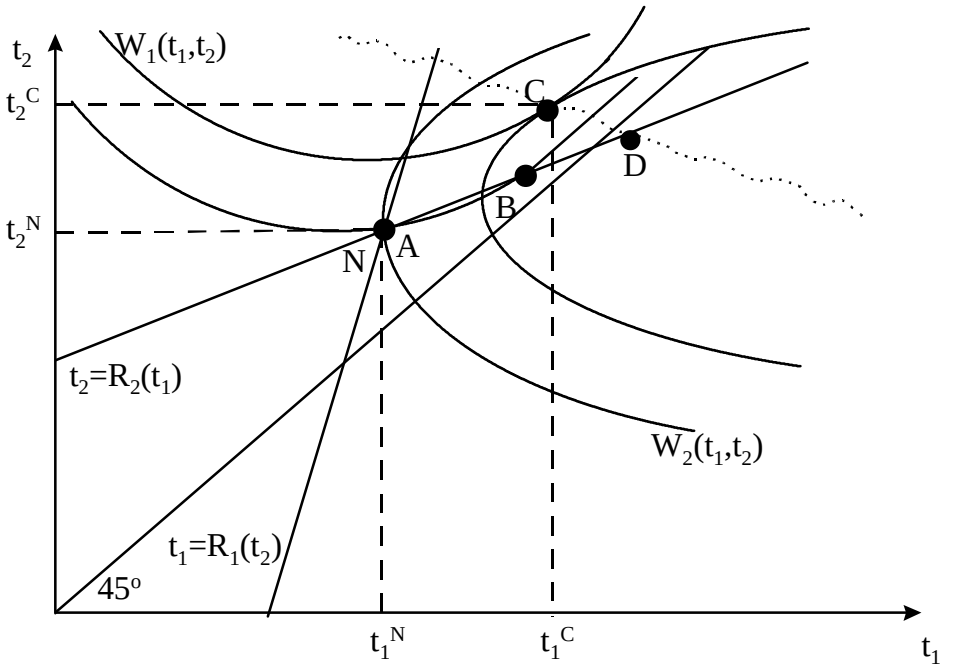

Figure 1b: Non-Cooperative and Cooperative Equilibria with Emission Taxes

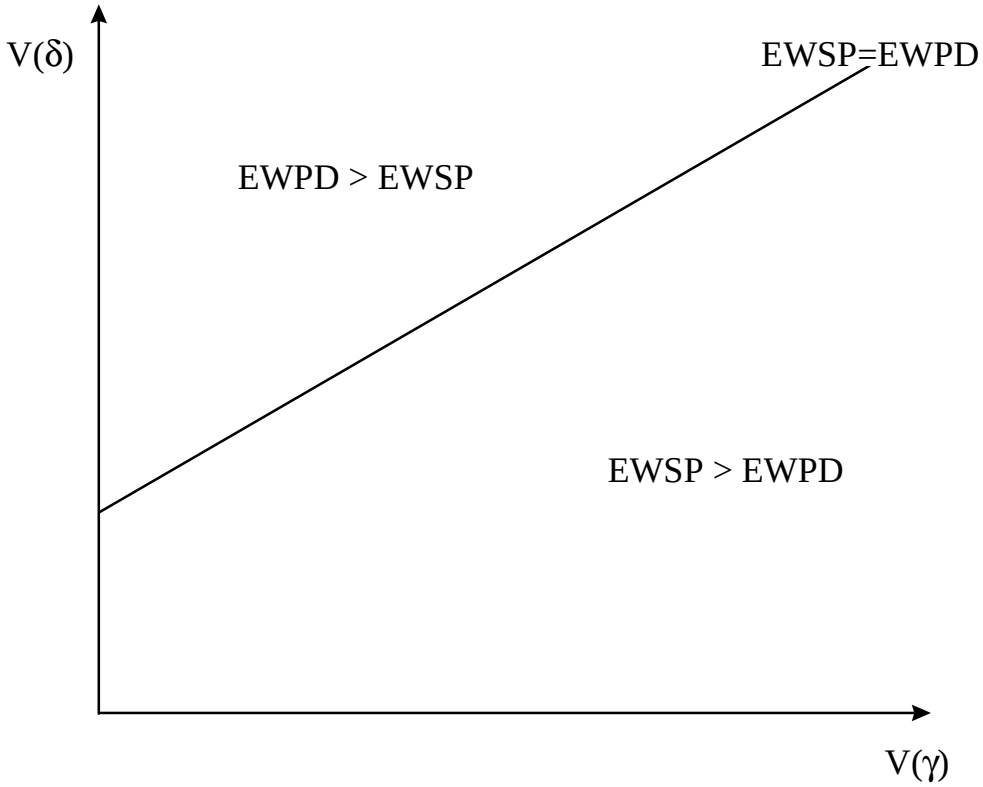

Figure 2: Expected Welfare With Political Discrimination and Social Pooling

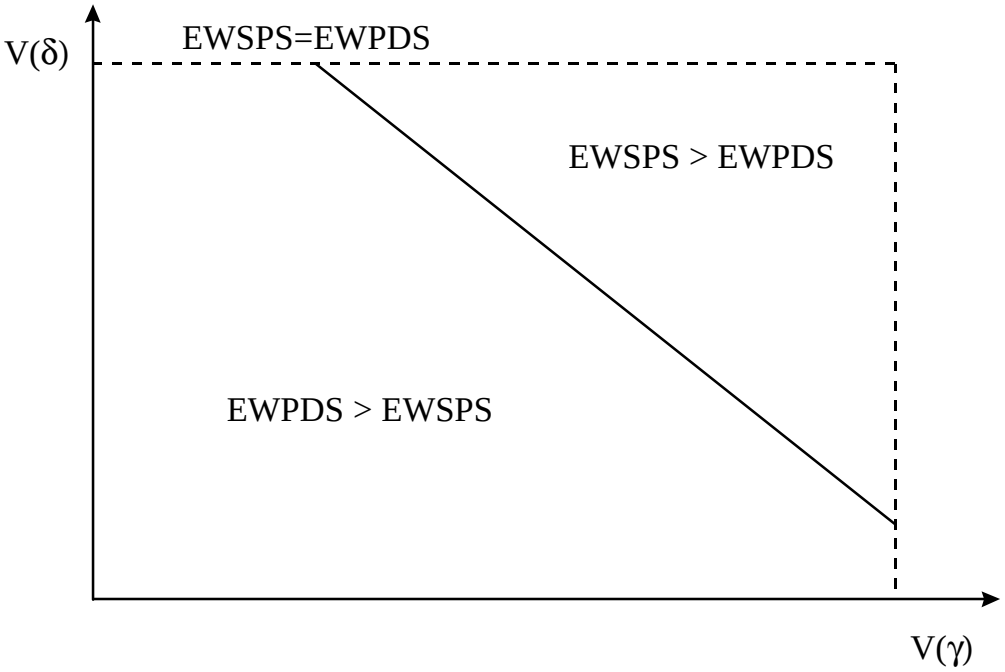

Figure 3a: Political Discrimination vs Social Pooling at State Level

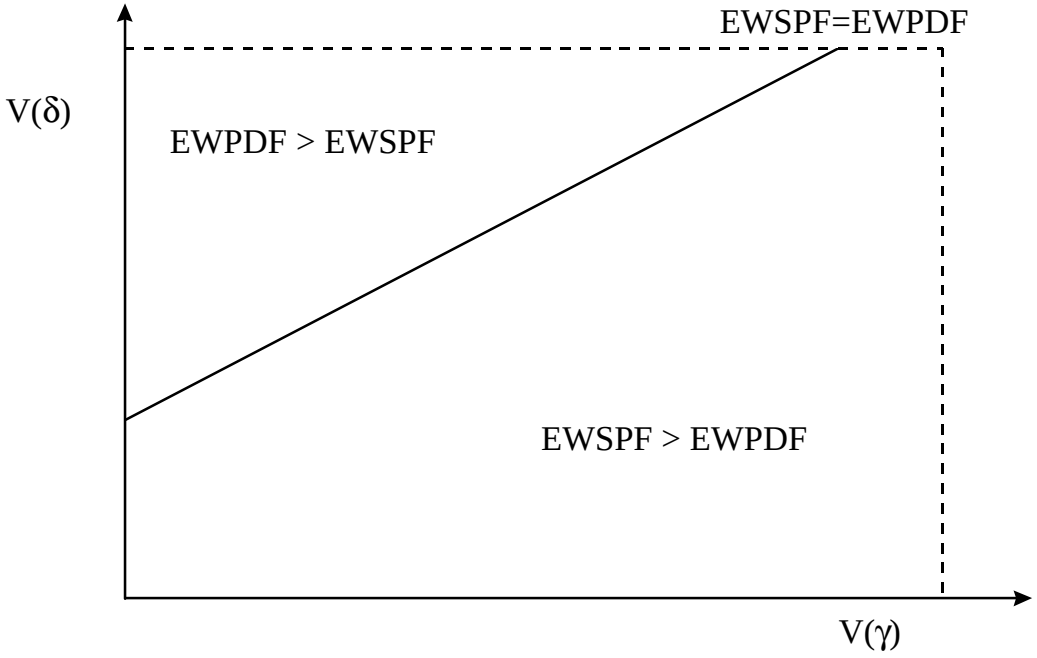

Figure 3b: Political Discrimination vs Social Pooling at Federal Level

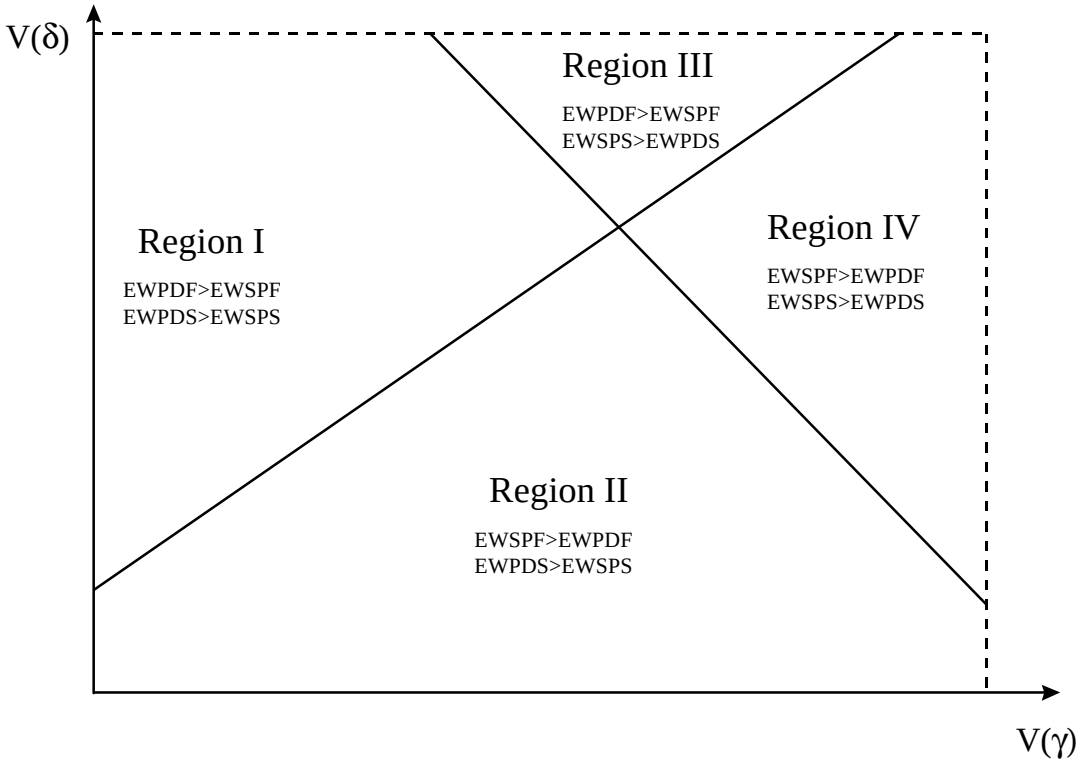

Figure 3c: Political Discrimination vs Social Pooling at State and Federal Levels