Regulatory Capture and Economic Integration

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Abstract

In this paper we analyse the effects of joint multi-level decision-making in an economic union on regulatory outcomes produced under lobbying. We show that under certain conditions supranational decision-making leads to regulatory outcomes that raise national welfare.

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Introduction

The problem of producers' interests being overrepresented in the process of regulatory decision-making has frequently been noted. The concern is that regulatory authorities (RAs), set up to correct some real or perceived market failure, end up making decisions that differ from those that would maximise national welfare. Instead the RA seems to be at least partly "captured" by industry lobbies, and to place undue weight on the interests of producers to the detriment of those of consumers. Since producers are usually the group that is best informed on industry concerns and characteristics, it would be difficult to deny them access to the RA. Undue influence is then a likely if not unavoidable outcome.

In this paper we consider two members of an economic union, and ask whether shifting a regulatory decision from the national (RA) to the Union (supra-national regulatory authority – SA) level will alleviate the problem of regulatory capture. Of course a regulation made by the SA will impose a common standard on both members, whereas national standards would reflect differing national characteristics. While national lobby groups may not have direct access to the SA, it seems reasonable that the national RAs will have such access, and this will provide indirect access for national lobbies. Even so we are able to illustrate circumstances in which the common outcome chosen by the SA is closer to the national welfare maximising outcome than that chosen by the RA.

The attention devoted here to the way special interests affect policy formation is not new to the economic literature. In the fundamental contributions by Grossman and Helpman (GH 1994, 1995), policy outcomes result from the interactions between a policy-maker and the organised segments of society. We adopt this kind of analytical framework here reflecting the view that policies in modern democratic societies are better modelled as results of compromises between contrasting interests, rather than decisions made by monolithic entities.

The question of how a final policy outcome is affected by the specific institutional set-up in an economic union has attracted interest from political scientists, especially with reference to the European Union (Greenwood, 2003; Aspinwall and Greenwood, 1998; Grande, 1996). It is therefore striking that this issue has attracted so little attention on the part of political economists.

Two issues are addressed in what follows. The first refers to lobbying effectiveness in a joint decision-making system relative to the case of fully independent national policy-making. Specifically we attempt to offer a formal representation of Grande's 'paradox of weakness', i.e. the idea that public actors lose part of their autonomy because of the integration into a joint decision-making system but exactly for the same reason they also gain larger autonomy from private interest groups (Grande, 1996). According to the author, obligations and commitments produced by joint decision-making might strengthen the bargaining position of public actors vis-à-vis special interest groups, thus giving rise to the paradox.[1] To the best of our knowledge there have been no other attempts to formally model this paradox.

The second issue is to identify the possible determinants of the paradox. Based on our theoretical framework we can distinguish two channels through which joint decision-making affects lobbying effectiveness. These are the aggregation of heterogeneous national preferences at supranational level and the institutional details of joint decision-making. Our model makes it possible to analyse

[1] Grande's idea is rooted in theories of international negotiations, where it was already well-known that '..the power to constrain an adversary may depend on the power to bind oneself..' and that '..in bargaining, weakness is often strength, freedom may be freedom to capitulate, and to burn bridges behind one may suffice to undo an opponent..' (Schelling, 1960, p. 22).

separately the conditions under which the paradox is generated through these two different channels.

The structure of the paper is as follows. Section 1 introduces the analytical framework. Here we describe the micro-structure of the model, as well as its political-economy structure, for the case of national decision-making in a closed economy. The case of supranational decision-making in an economic union is analysed in Section 2. In Section 3 we interpret the results with specific reference to the paradox of weakness. In this sense we are particularly interested in analysing for how large a subset of the parameter space the paradox arises as an equilibrium outcome of the model. Section 4 concludes.

1. The analytical framework

1.1 The micro-structure of the model

We begin by setting up the model in the closed economy. On the supply side, we assume that each unit of industry specific capital (K) when combined with labour can produce one unit of output. The "quality" of that unit (λ) is positively related to the number of workers employed in its production. If w is the wage, the unit cost function is

$$c(w,\lambda)=\frac{w\lambda^2}{2} \tag{1}$$

which is increasing in the wage and increasing and convex in quality. We assume a perfectly competitive market structure so that the wage and output price are taken as given by individual producers. Beyond some minimum level ($\underline{\lambda}$), quality is an unobservable product characteristic prior to purchase. The market is characterized by many small firms each producing an output indistinguishable from its competitors. Since producing higher quality is costly and higher quality cannot be identified by consumers, each firm has an incentive to set its quality at the minimum level. Given this, we assume that in the absence of regulatory intervention, the market equilibrium involves sales at the minimum quality only.

On the demand side, we assume "representative" price-taking individuals in each country with identical preferences in terms quantity consumed (X^D) and quality such that:

$$u(X^D,\lambda)=\lambda\left(DX^D-\frac{(X^D)^2}{2}\right) \tag{2}$$

This implies a demand function

$$X^D(p,\lambda)=D-\frac{p}{\lambda} \tag{3}$$

The quantity demanded falls as the quality-adjusted price p/λ increases. The total profits of the owner-producers are given by:

$$\pi(\lambda)=K[p-c(w,\lambda)]=K\left[p-\frac{w\lambda^2}{2}\right] \tag{4}$$

1.2 The regulatory structure of the model

The regulator (RA) sets a *minimum* quality level that producers must comply with in order to be able to sell in the market. Although it is formally a minimum, there will be no incentive for any

individual producer to choose a higher level, so that the RA is in fact setting the quality level in the market. We assume that the level of λ emerges from a political game between the RA and special interest groups of the type considered by GH (1994, 1995). Consumers are not organised because of the strong incentive to free-ride within a large group. Producers are assumed to be sufficiently small in number to overcome the collective-action problem (even though large enough to be consistent with the assumption of perfect competition). Producers offer policy-contingent contributions, $C(\lambda)$, to the RA so as to maximise their net return:[2]

$$\pi(\lambda) - C(\lambda) \tag{5}$$

The RA values contributions from the lobbies, but also the aggregate welfare, W, including both organised and unorganised segments of society. Its objective function is:

$$C(\lambda) + aW(\lambda) \tag{6}$$

where $a>0$ measures the RA's sensitivity to aggregate welfare relative to contributions. Aggregate welfare $W(\lambda)$ is defined here as the sum of producers' profit $\pi(\lambda)$ and consumer surplus $s(\lambda) = u(X^D, \lambda) - pX^D$.

We adopt the same equilibrium concept used by GH that applies the theoretical framework developed by Bernheim and Whinston (BW 1986) for first-price menu auctions.[3] The (autarky) equilibrium standard, λ^A , chosen by the national RA is identified by the following two conditions:

$$\max_{\lambda} \left[C(\lambda) + aW(\lambda) \right] \tag{7}$$

$$\max_{\lambda} \left[\left(C(\lambda) + aW(\lambda) \right) + \left(\pi(\lambda) - C(\lambda) \right) \right] \tag{8}$$

As explained in GH (1994, 1995),[4] condition (7) ensures that the equilibrium standard is chosen by the RA to maximize its own welfare given the lobby's contribution schedule. To identify the equilibrium this condition needs to be complemented by condition (8) requiring maximization of the joint welfare of the RA and the lobby. If condition (8) were not to hold, there would be an incentive for the lobby to change its contribution schedule in a way to make the RA choose the jointly optimal standard. As a result, there cannot be an equilibrium where condition (7) is satisfied but condition (8) is not.

When maximizing (7) and (8) with respect to λ we can see that in equilibrium:

$$\frac{d\pi}{d\lambda} = \frac{dC}{d\lambda} \tag{9}$$

As stressed in GH (1994), result (9) shows that the lobby's contribution schedule is locally truthful around λ^A. Moreover, as argued by GH based on BW's work, we can choose to restrict ourselves to truthful contribution schedules, i.e. schedules that reflect the lobby's true preferences also away from the equilibrium, and to focus on truthful Nash equilibria (NE) among all possible NE.[5] This

[2] We assume, as in GH (1995), that producers capture a negligible fraction of consumer surplus (which can therefore be excluded from producers' objective function (5)).

[3] The structure of a first-price menu auction is applicable to this framework. Special interest groups represent the bidders that name a vector ('menu') of contributions, where each specific contribution level refers to a possible policy outcome chosen by the RA (the auctioneer). Lobbying groups then stick to their announced contributions ('first price') when paying the bid to the RA after the policy-setting stage.

[4] We refer to GH's work for a more detailed explanation of the equilibrium concept.

[5] One of the justifications for focussing on truthful NE provided by BW (1986) and used in GH (1994) rests on the proof that truthful NE are the only coalition-proof NE in first-price menu auctions (coalition-proof NE are defined by BW(1984) as NE where there exists no coalition of bidders that has an incentive to arrange a stable deviation from the equilibrium when non-binding communication between the bidders is possible).

implies that the optimum quality identified by conditions (7) and (8) can also be derived by maximizing[6]

$$G = \pi(\lambda) + aW(\lambda) = (1+a)\pi(\lambda) + as(\lambda) \tag{10}$$

The solution of the model using conditions (7) and (8) leads to the following first-order condition:

$$(1+a)\frac{d\pi}{d\lambda} = -a\frac{ds}{d\lambda} \tag{11}$$

In equilibrium the weighted gain for a social group induced by a marginal change in quality needs to be equal to the weighted loss for the other social group.

Equating demand from (3) with supply $X^S = K$, gives the equilibrium autarky price:

$$p^A = \lambda(D - K) \tag{12}$$

which is increasing in product quality. We then have

$$\pi(\lambda) = \lambda K\left[D - K - \frac{w\lambda}{2}\right] \quad \text{and} \quad s(\lambda) = \frac{\lambda K^2}{2} \tag{13}$$

This in turn gives us

$$\frac{d\pi}{d\lambda} = K(D - K - w\lambda) \quad \text{and} \quad \frac{ds}{d\lambda} = \frac{K^2}{2} \tag{14}$$

Substituting in (11) we have

$$(1+a)[K(D - K - w\lambda)] = -a\frac{K^2}{2} \tag{15}$$

On the supply side, an increase in quality raises production costs (cost effect for firms), while on the demand side utility and demand increase with quality (consumer confidence effect). These two can be seen as the direct effects of an increase in quality. Indirect effects are then triggered by the increase in the equilibrium price associated with a quality increase. This price effect will obviously be positive for producers and negative for consumers. From (14) we see that consumer surplus is always increasing in λ, showing that the positive confidence effect of quality always dominates the negative price effect for consumers. Given this, *in equilibrium* we must have that producers' profit is decreasing in λ (i.e. in equilibrium the negative production cost effect of quality dominates the positive price effect for producers). The equilibrium is such that consumers prefer a higher standard, whereas producers would opt for a lower standard.

From (15) we derive the equilibrium quality level:

$$\lambda^A = \frac{D - K}{w} + A\frac{K}{2w} \tag{16}$$

where $A \equiv a/1+a$. The equilibrium quality standard is increasing in market size (D) and in the relative weight attached to consumers' versus producers' interests (A). When D increases, we know from (14) that the marginal loss for producers in equilibrium becomes smaller (thanks to the increase in the price due to greater demand) and this leads, ceteris paribus, to higher optimal quality. As consumers prefer a higher standard in equilibrium, a larger relative weight A assigned by the RA to consumers' interests ceteris paribus raises optimal safety. Equilibrium quality is decreasing in supply (K) and the cost of quality (w). A larger w translates into a larger loss for producers in equilibrium, thus lower optimal quality. The impact of an increase in K is more complex in that it raises both the marginal gain for consumers in (14) (through increased utility and lower price due to larger supply and consumption), as well as the marginal loss for producers in (14) (through lower price and larger supply). Thus, the reduction in optimal quality associated with

[6] For the proof see footnote 7 in GH (1994).

an increase in K is due to the increase in the marginal loss for producers dominating the increase in the marginal gain for consumers.
This solution can also be used to illustrate two extreme cases. First, where the RA is only concerned with aggregate welfare maximisation (i.e. $A \to 1$), in which case

$$\lambda_W^A \to \frac{2D-K}{2w} > \lambda^A \tag{17}$$

Lobbying indeed leads to a policy outcome favouring special interests against the general interest. In the second case the regulator is only concerned with contributions from the lobby group (i.e. $A \to 0$). Then

$$\lambda_L^A \to \frac{D-K}{w} < \lambda^A \tag{18}$$

This is the quality standard that maximises profits. We assume that $\lambda_L^A > \underline{\lambda}$, so that both producers and consumers support the establishment of a regulator, in principle.

2. The model for an economic union with lobbying

In this Section we consider the case of an economic union between two countries (1 and 2). We assume that the minimum quality is optimally set at supranational level for the whole integrated area. In this sense, our model describes more a situation of centralisation of the policy area under examination rather than simple policy coordination. We do not specify the details of the regulatory process at supranational level, but simply assume the existence of a supranational authority (SA) that is analogous, in terms of objectives, to the national RAs. Thus, the SA's objective function includes what we call 'political support' from national RAs, $S_j(\lambda)$ with j = 1,2, as well as aggregate welfare in the economic union and can be formulated as follows:

$$\sum_{j=1}^{2} S_j(\lambda) + b\sum_{j=1}^{2} W_j(\lambda) \tag{19}$$

where $b \geq 0$ measures the SA's sensitivity to aggregate welfare, and $W_j(\lambda)$ is aggregate welfare in country j, defined as before. It is reasonable to assume that RAs are able to exert pressure on the SA and also that the SA cares about RAs' support because of the institutional linkages characterising a multi-level decision-making system. With regard to the general well-being in the union, we can think of a SA that reports to an elected body.

In this framework $S_j(\lambda)$ represents RA j's support schedule aimed at influencing supranational decision-making. We define RA j's objective function as follows:

$$C_j(\lambda) + aW_j(\lambda) - S_j(\lambda) \tag{20}$$

Thus, RAs maximize contributions received from the domestic lobbies plus national welfare net of support offered to the SA. We assume that the special interest group within each country lobbies only its national RA, not the other country's RA, nor the SA.[7] Therefore, pressure exerted by special interest groups is mediated by national RAs at supranational level. The lobbies' objective function is still defined as in (5).

We now characterise the equilibrium in this scenario of joint decision-making, where we have two tiers of interactions, one between the SA and national RAs and the other between each national RA and its domestic lobby. Following the line of argument employed in Section 1.2, we can show that, under the assumption of (globally) truthful political support schedules, the upper tier involves the SA solving the following maximization problem:

[7] In our theoretical framework the assumption of no lobbying at supranational level is not restrictive. We can prove that allowing for direct lobbying on the SA would not change the results.

$$\max_{\lambda}\left[\sum_{j=1}^{2} C_j(\lambda)+(a+b)\sum_{j=1}^{2} W_j(\lambda)\right] \tag{21}$$

The SA behaves as if it is maximizing the sum of contributions paid by the lobbies to their respective national RAs plus aggregate welfare, with the latter weighted by (*a*+*b*) (i.e. the sum of the weights attached to aggregate welfare respectively by the national RAs and the SA). Although the lobbies' contributions are paid at national level, the consequences for the regulatory outcome are the same as if they were paid directly to the SA. Since we focus on truthful contribution schedules, it is possible to show that the optimal standard is derived by the SA maximizing the following social-welfare function:[8]

$$G^{SA}=\sum_{j=1}^{2}\pi_j(\lambda)+(a+b)\sum_{j=1}^{2} W_j(\lambda)=(1+a+b)\sum_{j=1}^{2}\pi_j(\lambda)+(a+b)\sum_{j=1}^{2} s_j(\lambda) \tag{22}$$

A comparison of (22) with (10) shows that the weights attached to producers' and consumers' welfare differ from the case of national decision-making. Specifically, the relative weight attached to consumers' interests increases from A in case of national decision-making to $[a+b]/[1+a+b]\equiv B$ in case of supranational decision-making. The FOC in this context of supranational decision-making is:

$$(1+a+b)\sum_{j=1}^{2}\frac{d\pi_j}{d\lambda}=-(a+b)\sum_{j=1}^{2}\frac{ds_j}{d\lambda} \tag{23}$$

In equilibrium the weighted marginal gain for the social group that benefits from an increase in quality must be equal to the weighted marginal loss for the other social group.

As we will show below, supranational decision-making *with identical countries* leads to an equilibrium standard that differs from that obtained in case of national decision-making only if the SA directly cares about aggregate welfare (i.e. $b\neq 0$). If the introduction of a supranational level of decision-making does not alter the relative weight assigned to special interests versus general interest in policy-setting and the two countries in the union are perfectly symmetric, the two channels through which we expect supranational policy-making to affect the policy outcome (i.e. the institutional specificities of the supranational level of decision-making and the aggregation of heterogeneous national preferences) are fully neutralised.

The two economies can be made asymmetric in demand, supply or regulatory welfare. Here we introduce cross-country differences in parameter D in the specification of the utility function (2). Given that D is the intercept of demand function (3), the country with the larger D will have a demand curve that lies above that of the other country for any common λ. We assume $D_1-D_2\equiv\Delta>0$ and that the two countries are identical in every other respect.

The equilibrium price, p^U, is determined by equalising total demand to total supply in the union (at a common quality level):

$$D_1-\frac{p^U}{\lambda}+D_2-\frac{p^U}{\lambda}=2K \tag{24}$$

This leads to

$$p^U=\lambda\left(\frac{D_1+D_2}{2}-K\right) \tag{25}$$

which is (12) with the average intercept replacing the national intercept. A positive autarky price in each market ($D_j>K$) implies a positive price here. For positive sales in the smaller market in this equilibrium we require that

[8] For the proof we refer again to footnote 7 in GH (1994).

$$\Delta < 2K \tag{26}$$

This imposes an upper bound on the demand asymmetry.

Substituting (25) into profits and consumer surplus and differentiating, gives us

$$\frac{d\pi_j}{d\lambda} = K\left(\frac{D_1 + D_2}{2} - K - w\lambda\right) \qquad \text{and} \qquad \frac{ds_j}{d\lambda} = \frac{\left(D_j - D_k + 2K\right)^2}{8} \qquad j \neq k \tag{27}$$

We can now rewrite FOC (23) using (27):

$$(1 + a + b)\left[2K\left(\frac{D_1 + D_2}{2} - K - w\lambda\right)\right] = -(a + b)\left[\frac{(D_1 - D_2 + 2K)^2 + (D_2 - D_1 + 2K)^2}{8}\right] \tag{28}$$

We can again conclude that in equilibrium consumers *in both countries* would gain from a marginal increase in safety, whereas producers *in both countries* would lose. Stated in a slightly different way, the equilibrium is such that the confidence effect of quality dominates the price effect for consumers, whereas the production cost effect dominates the price effect for producers.

The equilibrium quality standard set by the supranational authority is:

$$\lambda^U = \frac{D_1 + D_2 - 2K}{2w} + B\frac{K}{2w} + B\frac{\Delta^2}{8wK} \tag{29}$$

The first two terms in (29) correspond to the solution if the two countries were identical (with $D = [D_1 + D_2]/2$). The final term, which is positive, indicates that the SA will choose a higher common standard the greater the demand asymmetry between them. The equilibrium quality standard is increasing in the average demand parameter ($[D_1 + D_2]/2$), the absolute difference in demand ($|D_1 - D_2|$) and the weights put on aggregate welfare at either tier (*a*,*b*). It is decreasing in the supply parameters (*K* and *w*). With one exception, these outcomes follow the corresponding arguments for the closed economy. The exception is the effect of an increase in demand dispersion. That this is positive follows from

$$\frac{ds_1}{d\lambda} + \frac{ds_2}{d\lambda} = \frac{\Delta^2 + 4K^2}{4} \tag{30}$$

which implies that an increase in demand dispersion raises the marginal benefit to consumers from a quality increase.

Again we can compare the equilibrium outcome with that which would be obtained in the two extreme cases. If the SA is concerned only with aggregate welfare, then we have

$$\lambda_W^U = \frac{D_1 + D_2 - K}{2w} + \frac{\Delta^2}{8wK} > \lambda^U \tag{31}$$

While if the SA is only concerned with lobbyists' contributions, we have

$$\lambda_L^U = \frac{D_1 + D_2 - 2K}{2w} < \lambda^U \tag{32}$$

3. National-supranational biases in policy outcomes and the paradox of weakness

In this Section we investigate the possibility, envisaged by Grande (1996), that public actors losing their autonomy because of the integration in a joint decision-making system at the same time gain autonomy from special interest groups. This logic highlights what Grande calls the 'paradox of weakness', in that national governments would be able to gain more freedom from special interests

(i.e. more actual decision-making power) by tying their hands (thus becoming formally weaker) in a system of joint policy-making. The paradox would be generated by the ties and commitments characterising a joint decision-making system, which can be used by public actors to strengthen their bargaining position vis-à-vis special interest groups. In his article (specifically focussed on the case of the European Union) Grande identifies more precisely what factors, typical of a joint multi-level decision-making system, might give rise to the paradox. The fact that in such a system public actors depend on the preferences and resources of other actors is considered as one of the possible sources of the paradox. According to the author, such dependence might lead to the extreme case of enabling public actors to reject demands raised by lobbying groups. Another possible source of the paradox is identified by Grande in the change in access conditions to public decision-making for special interest groups induced by the creation of a joint decision-making system. In this sense, the author refers specifically to institutional details of supranational decision-making (like the closure of certain stages of the decision-making process to external forces)[9] that might reduce the influence of lobbying groups on policy-setting.

Our objective is to analyse whether the paradox of weakness can emerge as an equilibrium outcome in our model of joint decision-making, thereby providing formal representation to the paradox that Grande stated in qualitative terms. As usual when formalising an abstract concept, our theoretical model involves significant simplification relative to the potential richness of Grande's analysis. For instance, in our model we do not specify the institutional details of the decision-making process at supranational level. The multi-level nature of the joint decision-making system is reflected in the offer for policy-contingent support made by national RAs to the SA. Apart from support offered by the RAs based on national interests, we assume that the SA may also value the aggregate welfare of the union. This could be because the SA is answerable to a directly elected body. Despite the inevitable simplifications, the model allows us to consider both factors identified by Grande as possible sources of the paradox of weakness. Firstly, by introducing asymmetry between countries we are able to consider the case where the paradox arises because of the need to conduct a policy synthesis starting from heterogeneous national preferences (the dependence on other actors' preferences mentioned by Grande). Secondly, we are able to capture the idea of the paradox as being generated by the non-accessibility of some supranational bodies to special interest groups. We do this in two ways - we restrict direct lobbying activity to the national authorities, and by allowing the SA to care directly about aggregate welfare (i.e. $b > 0$), we raise the relative weight on aggregate welfare in the objective function. As we saw above, the former is not a source of the paradox in that the outcome would be the same if we allowed producer groups to directly lobby the SA. But a positive value of b can be a source of the paradox as we shall see.

As a first step, we need to make Grande's concept of the paradox of weakness 'operational'. We consider both a broad and a strict (in the sense that the former encompasses the latter) version of the paradox. For the broader definition, we can think of the paradox of weakness as occurring where the equilibrium quality standard set at supranational level is higher than the national standard for *at least* one of the two countries. Above we showed that lobbying leads to a lower equilibrium standard than that maximising consumer welfare. We can then say that national regulation is 'constrained' by supranational decision-making if the outcome is further away from the wishes of the lobby group and more in line with consumer interests. But this interpretation of the paradox has

[9] For temporary closure of the decision-making process Grande means that (with specific reference to the European Union): '..there are instances in which the negotiations between the various public actors dominate and the negotiation process is not only inaccessible to interest groups, companies and associations, it is not even transparent for them. The Council meetings are the most obvious instances of such a closure. […] If national representatives have not been 'captured' in advance by national interest groups aiming to obstruct a proposal, the complex process of bargaining and the complicated trade-offs behind the closed doors of a Council meeting may trigger inherent political dynamics which the interest groups can neither anticipate nor influence..' (Grande, 1996, p. 331).

the shortcoming that it fails to take into account whether the standard set by the SA is in fact relatively more in line with the general interest. The idea of the paradox of weakness is reflected more accurately by a situation where at least for one of the two countries the common standard imposed by the SA is not just higher than what would be chosen nationally under lobbying but also closer to the safety level that the national government would choose under aggregate welfare maximization (thus showing larger freedom to pursue the general interest).

To investigate the paradox under the broader definition, we define the bias in policy outcomes generated by supranational versus national decision-making, as the difference between the standard set by the SA and those set by the RAs. Given the demand differences, this bias will be country-specific. It turns out to be convenient to investigate the alternative, tighter definition by analysing the difference between two 'gaps' - the gap between the actual standard set by the SA and that maximizing national welfare; and the gap between the latter and that actually chosen by the national regulator. By studying the sign of the difference between these two gaps we can see whether the standard set by the SA is closer than that chosen by the national government to the level maximizing national aggregate welfare.

To identify different sources of the paradox, we consider three different scenarios. First, where countries differ in their demand parameters and the SA does not directly care about aggregate welfare ($\Delta > 0, b = 0$). Second, where countries are identical and the SA cares about aggregate welfare ($\Delta = 0, b > 0$). Finally, where demands differ and the SA directly cares about aggregate welfare ($\Delta > 0, b > 0$). For each scenario we will start by analysing the case for the paradox based on the broader definition and then move to the tighter definition to see how our conclusions change.

We define γ_j as the bias in policy outcomes for country j (with j = 1,2):

$$\gamma_j = \lambda^U - \lambda_j^A \tag{33}$$

Note that with (33) we are comparing policy outcomes produced under different institutional arrangements (a supranational versus a purely national decision-making system), as well as under two extreme situations in terms of cross-country economic linkages (a perfectly functioning common market for goods versus the case of two closed economies). Behind this way of proceeding is the assumption that economic integration has gone hand in hand with institutional integration (i.e. economic interdependence between countries is matched by political interdependence). This clearly simplifies the analysis in the sense that all economic interests coexisting in a specific jurisdiction are 'internalised' in policy-setting independently of the specific jurisdiction we consider (either national or supranational).

3.1 Demand asymmetry and no direct SA welfare concern ($\Delta > 0, b = 0$)

By setting b = 0 in equation (29) and reformulating (16) with a country-specific parameter D_j, we obtain:

$$\lambda_0^U = \frac{\lambda_1^A + \lambda_2^A}{2} + A\frac{\Delta^2}{8wK} \tag{34}$$

$$\gamma_1^0 = -\frac{\Delta}{2w} + A\frac{\Delta^2}{8wK} < 0 \tag{35}$$[10]

[10] The negative sign is implied by (26), the condition for positive sales in the smaller market.

$$\gamma_2^0 = \frac{\Delta}{2w} + A\frac{\Delta^2}{8wK} > 0 \tag{36}$$

Note that the sum of the biases is non-negative and their signs reflect the fact that

$$\lambda_2^A < \lambda_0^U < \lambda_1^A \tag{37}$$

The policy outcome set at supranational level is the result of a compromise between different national preferences. As a consequence, the country characterised by a preference for a lower standard (2 in this case) ends up being constrained by supranational decision-making (i.e. it faces a higher standard than that chosen by its national regulator). Thus, based on our broader definition, the paradox always arises in equilibrium, and is generated here by the aggregation of different national preferences. If countries were fully symmetric ($\Delta = 0$), both biases would be zero. In this sense, Grande's idea that the paradox might result from the dependence on other actors' preferences typical of a multi-level joint decision-making system is substantiated by our theoretical model.

We now apply our stricter definition of the paradox. For this to be satisfied we need the SA standard to be closer to the domestic welfare maximising standard than is the autarky standard (i.e. $\left|\lambda_{jW}^A - \lambda_0^U\right| < \left|\lambda_{jW}^A - \lambda_j^A\right|$). We know that $\lambda_{jW}^A > \lambda_j^A$. A positive bias ($\lambda_0^U - \lambda_j^A > 0$) is therefore a necessary, but not sufficient condition for the paradox to arise under this definition, since it could be that λ_0^U "overshoots" λ_{jW}^A by a large margin. There are two cases to consider. The first is where $\lambda_{jW}^A > \lambda_0^U$. In this case, we can conclude that the more stringent definition of the paradox is satisfied. The second is where $\lambda_{jW}^A < \lambda_0^U$, and we have to consider the relative extent of the overshoot. The simplest way to consider these cases is to look at the sign of the difference between the two gaps discussed above – i.e.:

$$\mu_j = \left[\lambda_0^U - \lambda_{jW}^A\right] - \left[\lambda_{jW}^A - \lambda_j^A\right] \tag{38}$$

We know that the second term is positive from (17), while the sign of the first term is ambiguous. But from the discussion above we can conclude that the paradox holds whenever μ_j has a negative sign. Since only country 2 can be constrained under this more stringent definition, we focus on it.

We begin by considering the first term in (38). Using (29) (with *b* set to zero) and (17) we have:

$$\lambda_0^U - \lambda_{2W}^A = \frac{\Delta - K}{2w} + A\left[\frac{K}{2w} + \frac{\Delta^2}{8wK}\right] \tag{39}$$

The first term in (38) cannot be unambiguously signed given that Δ can be either smaller or larger than *K*, but we can use (39) to derive:

$$\lambda_0^U - \lambda_{2W}^A < 0 \Leftrightarrow A < \frac{4K\left[K - \Delta\right]}{4K^2 + \Delta^2} \equiv \bar{A}_2 \tag{40}$$

We therefore need to consider both cases when studying the sign of (39), as done in Table 1.[11]

[11] In Table 1 we consider the fact that, based on restriction (26), 2*K* is the maximum value that can be taken by Δ.

Table 1 – Case with Δ > 0 and *b* = 0: policy outcomes

Case No.	*Degree of cross-country asymmetry*	*Conditions*		*Policy outcomes*
i.a	relatively low	$0 < \Delta < K$	$0 \le A < \bar{A}_2$	$\lambda_0^U < \lambda_{2W}^A$
i.b			$A \ge \bar{A}_2$	$\lambda_0^U \ge \lambda_{2W}^A$
ii	relatively high	$K \le \Delta < 2K$		$\lambda_0^U \ge \lambda_{2W}^A$

Both the degree of asymmetry between countries as well as the relative weight attached to aggregate welfare by national regulators are important in determining the relative positions of λ_0^U and λ_{2W}^A. It is quite straightforward to understand why this is the case. If the countries are identical, then $\lambda_0^U = \lambda_2^A < \lambda_{2W}^A$. For small differences in market size (and relatively small values of *A*) this inequality continues to hold, other things equal. But the larger the degree of country asymmetry, the greater the difference in national standards, and therefore the greater the likelihood that λ_0^U is above the national standards of the smaller market. Similarly the higher the weight attached to aggregate welfare, the closer the national standard to that which maximises welfare. This implies that ceteris paribus it becomes less likely to have safety set by the SA lying below that maximizing aggregate welfare in country 2.

Now that we have a clearer idea about what factors affect the distance between safety set by the SA under lobbying and safety maximizing aggregate welfare in country 2, we can study the sign of the full expression in (38) to draw conclusions on the paradox of weakness. First, we need to rewrite (38) in its explicit form by substituting the expressions for the different optimal safety levels taken from (16), (17) and (29), obtaining:

$$\mu_2 = \frac{\Delta - 2K}{2w} + A\left[\frac{K}{w} + \frac{\Delta^2}{8wK}\right] \tag{41}$$

Here the first term is negative and the second positive. The sign of (41) is determined by:

$$\mu_2 < 0 \Leftrightarrow A < \frac{4K[2K - \Delta]}{8K^2 + \Delta^2} \equiv \hat{A}_2 \tag{42}$$

Given (26) we know that threshold $\hat{A}_2$ is positive. It is also straightforward to show that $\bar{A}_2 < \hat{A}_2$, which allows us to directly employ the results from Table 1 as in Table 2.

Table 2 shows that, under our tighter definition, the paradox arises only in two cases, (I.a) and (I.b), if differences between countries are relatively small. When cross-country asymmetry gets relatively large, the paradox holds only in one case, (II.a). We can see that in all these cases the paradox arises only for relatively small values of *A*. These results are explained by the same forces as in Table 1. As expected the paradox is a much less universal outcome under the stricter definition. When national governments care relatively more about aggregate welfare, the paradox does not arise in equilibrium, independently of the degree of cross-country asymmetry. For a relatively large *A* the standard under lobbying is closer to the standard maximizing aggregate welfare, so that the need to

compromise with different national preferences within the union pushes λ_0^U too far away from λ_{2W}^A for the paradox to hold.

Table 2 – Case with $\Delta > 0$ and $b = 0$ under stricter definition of the paradox

Case No.	*Degree of cross-country asymmetry*	*Conditions*		*Relative position of* λ_0^U *and* λ_{2W}^A	*Sign of* μ_2	*Paradox of weakness holding (under stricter def.)*
I.a	relatively low	$0 < \Delta < K$	$0 \le A < \bar{A}_2$	$\lambda_0^U < \lambda_{2W}^A$	–	yes
I.b			$\bar{A}_2 \le A < \hat{A}_2$	$\lambda_0^U \ge \lambda_{2W}^A$	–	yes
I.c			$A \ge \hat{A}_2$	$\lambda_0^U > \lambda_{2W}^A$	+ / 0	no
II.a	relatively high	$K \le \Delta < 2K$	$A < \hat{A}_2$	$\lambda_0^U \ge \lambda_{2W}^A$	–	yes
II.b			$A \ge \hat{A}_2$	$\lambda_0^U > \lambda_{2W}^A$	+ / 0	no

Thresholds $\bar{A}_2$ and $\hat{A}_2$ are both functions of the demand asymmetry, with properties as follows:

$$\frac{\partial \bar{A}_2}{\partial \Delta} < 0; \quad \frac{\partial \hat{A}_2}{\partial \Delta} < 0$$

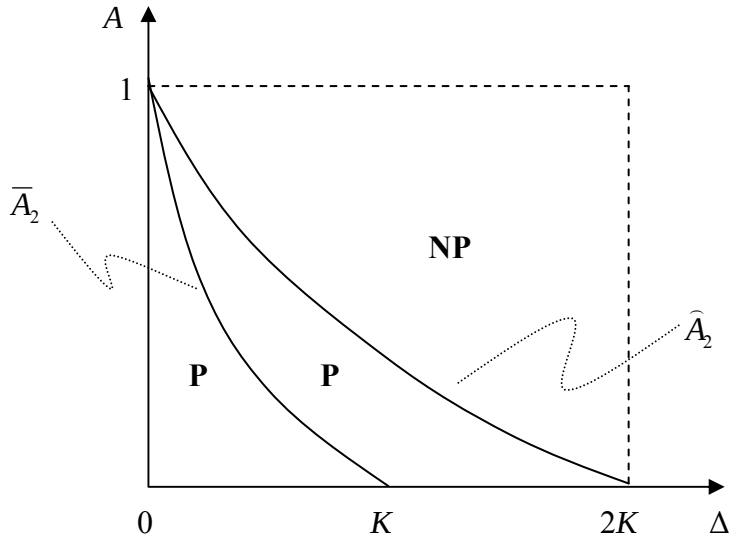
which allows us to conclude that the larger the degree of cross-country asymmetry, the less likely the paradox of weakness becomes under our more stringent definition. Considering the limits:

$$\lim_{\Delta \to 0^+} \bar{A}_2 = 1; \ \lim_{\Delta \to 0^+} \hat{A}_2 = 1; \ \lim_{\Delta \to K^-} \bar{A}_2 = 0; \ \lim_{\Delta \to K^-} \hat{A}_2 = \frac{4}{9}; \ \lim_{\Delta \to K^+} \hat{A}_2 = \frac{4}{9}; \ \lim_{\Delta \to 2K^-} \hat{A}_2 = 0$$

As the asymmetry becomes vanishingly small, the paradox becomes the only possible equilibrium outcome. But as the asymmetry approaches its maximum (while maintaining positive sales in both markets in equilibrium), no paradox arises. For the intermediate level of asymmetry ($\Delta = K$), cases (II.a) and (II.b) are both possible and the paradox arises only if $A < 4/9$.

The results from Table 2 are shown in Figure 1. The combinations of demand asymmetry and weight on consumers' versus producers' interests for which the paradox holds under the more stringent definition are labelled as P, while the combinations over which it does not are labelled NP. Figure 1 clearly indicates that the likelihood of the paradox as an equilibrium outcome is decreasing in the degree of asymmetry between countries and the weight attached to aggregate welfare. It also shows how much more restrictive the tighter definition of the paradox is, since the paradox occurs over the whole area under the looser definition (based on (37)).

Figure 1 – The paradox of weakness with Δ > 0 and *b* = 0 under the stricter definition



Based on what has been said so far, we can conclude that this second stricter definition also substantiates Grande's idea that the paradox of weakness might be generated by the dependence on other actors' preferences typical of a joint decision-making system. The crucial difference relative to the broader definition is that here the paradox is no longer a general outcome of the model with asymmetric countries and $b = 0$. When the asymmetry between countries gets relatively large, the paradox becomes much less likely in equilibrium. We can therefore conclude that heterogeneity of preferences is one of the sources of the paradox in our theoretical set-up under this definition, but the paradox here becomes more likely if the degree of asymmetry is restrained within certain bounds.

3.2 Identical countries and direct SA welfare concern ($\Delta = 0, b > 0$)

In this Section we briefly examine the case where countries are fully symmetric and the SA takes direct account of aggregate welfare (i.e. $b > 0$). As before we begin with the broader definition and define the bias in policy outcomes, which is the same for both countries in this symmetric case, as:

$$\phi = \lambda_S^U - \lambda^A \tag{43}$$

Using (29) and (16), and defining $B \equiv [a+b]/[1+a+b] \geq A$, we have

$$\phi = [B - A]\frac{K}{2w} > 0 \tag{44}$$

In this context both domestic regulators are constrained by supranational decision-making. Thus, based on our simpler operational definition, the paradox of weakness always arises in equilibrium. Since λ^A is also the standard set by a SA not directly concerned about aggregate welfare (when $b = 0$) in an economic union where both countries are identical, bias (44) directly reflects the degree of concern by the SA. Given that b derives from institutional details of supranational decision-making, we can conclude that institutional arrangements are to be included among the possible determinants of the paradox. More specifically, if we interpret $b>0$ as reflecting the temporary closure of the decision-making process to private interest groups, our model supports Grande's idea that this feature of multi-level joint decision-making systems represents one of the possible determinants of the paradox.

We now repeat the analysis for the same scenario but using the more stringent definition of the paradox. We can easily show that this leads to the same conclusion, since in this case:

$$\lambda_S^U - \lambda_W^A = [B-1]\frac{K}{2w} < 0 \tag{45}$$

The standard set by the SA is lower than that maximising national aggregate welfare, but converges to the latter as $B \to 1$. Combining (43), (44) and (45) we have:

$$\lambda^A < \lambda_S^U < \lambda_W^A \tag{46}$$

The standard set by the SA is closer to the aggregate welfare maximising standard than that set by the national regulators. Thus, as with the broader definition, the paradox always holds under the more stringent definition with identical countries and *b*>0.

3.3 Demand asymmetry and direct SA welfare concern ($\Delta > 0, b > 0$)

In this Section we finally turn to the case with both asymmetric countries and *b*>0. As before we start with the broader definition of the paradox. We define the bias in policy outcomes for country *j* as:

$$\eta_j = \lambda^U - \lambda_j^A \tag{47}$$

Substituting (29) and (16) in (47), we obtain:

$$\eta_1 = -\frac{\Delta}{2w} + A\frac{\Delta^2}{8wK} + [B-A]\frac{4K^2+\Delta^2}{8wK} \tag{48}$$

$$\eta_2 = \frac{\Delta}{2w} + A\frac{\Delta^2}{8wK} + [B-A]\frac{4K^2+\Delta^2}{8wK} > 0 \tag{49}$$

As in the case where $b = 0$, the biases have a positive sum, and the bias for country 2 is always positive. But now the bias for country 1 could also be positive if *B* is large enough. Using (48) we can establish that:

$$\eta_1 > 0 \Leftrightarrow B - A > \frac{\Delta[4K - A\Delta]}{4K^2+\Delta^2} \equiv \underline{B}_1 > 0 \tag{50}$$

[12]

Here *B*-*A* represents the additional weight on aggregate welfare that arises as a result of the SA's preferences (as $B = A$ if the SA is not directly concerned with aggregate welfare). We observe that $\underline{B}_1$ is decreasing in *A*, and that a positive bias for country 1 is not possible if the national regulator puts too high a weight on aggregate welfare, as proved by the following result derived from (50):

$$A + \underline{B}_1 < B \le 1 \Leftrightarrow A \le \frac{4K^2 - \Delta[4K - \Delta]}{4K^2} \equiv \overline{A}_1 < 1 \tag{51}$$

The analysis of the sign of the biases for both countries is summarized in Table 3.

[12] The threshold is positively signed since $\Delta < 2K$, based on restriction (26).

Table 3 – Case with $\Delta > 0$ and $b > 0$ under looser definition of the paradox

Case No.	*Conditions*		*Policy outcomes*	*Type of bias*	*Paradox of weakness holding (under looser def.)*
I.a	$0 \le A < \overline{A}_1$	$0 \le B - A \le \underline{B}_1$	$\lambda_2^A < \lambda^U \le \lambda_1^A$	oppositely biased RAs	Yes (for country 2)
I.b		$B - A > \underline{B}_1$	$\lambda_2^A < \lambda_1^A < \lambda^U$	like-biased RAs	Yes (for countries 1 & 2)
II	$A \ge \overline{A}_1$		$\lambda_2^A < \lambda^U < \lambda_1^A$	oppositely biased RAs	Yes (for country 2)

When $b = 0$ (i.e. $B = A$) the standard set by the SA always lies between the standards chosen by the two national regulators. Borrowing terminology from GH (2001) we can say that in this case the equilibrium is always characterised by 'oppositely biased national RAs', in the sense that one would set a lower standard and the other a higher standard than that chosen by the SA. This implies that only one RA is constrained in equilibrium. From Table 3 we can see that $b>0$ (i.e $B > A$) allows a new scenario, where the two RAs are 'like-biased' and as a result they are both constrained by supranational decision-making. But this case can only occur if both RAs attach a sufficiently low weight to aggregate welfare ($A < \overline{A}_1$), leaving scope for the SA to attach a relatively large weight to it ($B > \underline{B}_1$). We can conclude that in this case with $\Delta>0$ and $b>0$ the paradox of weakness always arises in equilibrium (based on our broader definition) and is generated by the aggregation of heterogeneous national preferences, as well as by the SA's additional concern for aggregate welfare.

We can also investigate the effects of demand asymmetry on the thresholds in Table 3. We would expect an increase in Δ to enlarge the area over which we get oppositely biased RAs, because greater heterogeneity leads to a larger spread between the two national standards, thus making it more likely that the equilibrium safety chosen by the SA lies between them. Indeed, using (26) it is straightforward to show that $\partial \overline{A}_1 / \partial \Delta < 0$, which increases the parameter space of case (II) (implying oppositely biased RAs). The effects on $\underline{B}_1$ are a little more complicated since

$$sign \frac{\partial \underline{B}_1}{\partial \Delta} = sign\left[4K^2 - \Delta^2 - 2AK\Delta \right] \tag{52}$$

which depends on the size of A and Δ. Clearly the sign is positive when $A = 0$ (given that $2K > \Delta$), and one can show that the sign is also positive when $A = \overline{A}_1$,[13] which allows us to conclude the $\underline{B}_1$ is increasing in Δ over the relevant range. An increase in demand asymmetry therefore increases the range for which there are oppositely biased governments over the interval $0 \le A < \overline{A}_1$. We conclude that a larger degree of demand asymmetry unambiguously raises the likelihood of oppositely biased RAs and reduces that of like-biased RAs.

We now turn to the more stringent definition of the paradox. As explained above, a necessary but not sufficient condition for the paradox to arise under this stricter definition is that the supranational standard is higher than the national standard. While this condition allowed us to focus exclusively on the smaller country when $b = 0$, both countries must be considered when $b > 0$. We begin with country 2. The analogous of expression (38) for this case is:

[13] When $A = \overline{A}_1$, the RHS of (52) becomes $[2K - \Delta][4K^2 + \Delta^2] / 2K > 0$.

$$\varphi_2 = \left[\lambda^U - \lambda_{2W}^A\right] - \left[\lambda_{2W}^A - \lambda_2^A\right] \tag{53}$$

The paradox arises under the stricter definition whenever $\varphi_2 < 0$. By substituting the explicit expressions for the optimal standards from (16), (17) and (29), we can rewrite φ_2 as follows:

$$\varphi_2 = \frac{\Delta - 2K}{2w} + A\frac{8K^2 + \Delta^2}{8wK} + [B - A]\frac{4K^2 + \Delta^2}{8wK} \tag{54}$$

The first term is negative, while the other two are positive. For this country the paradox requires that the demand asymmetry and the weights on aggregate welfare are not too large. More precisely, with regard to the weights on aggregate welfare we have that

$$\varphi_2 < 0 \Leftrightarrow B - A < \frac{4K[2K - \Delta] - A[8K^2 + \Delta^2]}{4K^2 + \Delta^2} = \overline{B}_2 \tag{55}$$

From (55), observing (42), we can see that

$$\overline{B}_2 > 0 \Leftrightarrow A < \frac{4K[2K - \Delta]}{8K^2 + \Delta^2} \equiv \widehat{A}_2 < 1 \tag{56}$$

If $A > \widehat{A}_2$, the paradox cannot hold for country 2. Given that $A < \widehat{A}_2$, the paradox will not hold if $B > A + \overline{B}_2$.

With regard to the degree of asymmetry, we can show that

$$\Delta > 2K\frac{-1 + \sqrt{1 + 2A(1 - A)}}{A} \equiv \Delta_2 \Rightarrow \varphi_2 > 0 \tag{57}$$[14]

Since $\Delta_2 < 2K$ we know that there is a subset of relatively high values of Δ satisfying restriction (26) such that the paradox never arises in equilibrium. These findings are summarized in Table 4.

Table 4 – Case with Δ > 0 and *b* > 0: country 2 under stricter def. of the paradox

Case No.	*Degree of cross-country asymmetry*	*Conditions*		*Paradox of weakness holding for country 2 (under stricter def.)*
i.a	relatively low	$0 < \Delta < \Delta_2$	$0 \le B - A < \overline{B}_2$	yes
i.b			$B - A \ge \overline{B}_2$	no
ii	relatively high	$\Delta_2 \le \Delta < 2K$		no

[14] This result is derived using condition (55), which allows us to determine for what values of Δ threshold $\overline{B}_2$ is negatively signed.

Under the stricter definition the paradox possibly arises in country 2 only for a relatively low degree of asymmetry and relatively low values of *B*-*A*. Thus, with regard to this country the paradox is a much less general outcome than under the broad definition.

We now analyse the case for the paradox under the stricter definition with regard to country 1. This possibility arises when we have like-biased governments in equilibrium (case (I.b) in Table 3). We proceed in steps as before. By using results (17) and (29) we have that

$$\lambda^U - \lambda_{1W}^A = -\frac{\Delta + K}{2w} + B\frac{K}{2w} + B\frac{\Delta^2}{8wK} \tag{58}$$

It is straightforward to show that $\lambda^U < \lambda_{1W}^A$. We also know that $\lambda_1^A < \lambda_{1W}^A$. So whenever $\lambda_1^A < \lambda^U$ the standard set by the SA is closer to that maximizing aggregate welfare in 1 than the standard chosen by the national regulator, and the paradox of weakness arises under the more stringent definition. Thus, the necessary and sufficient conditions for the paradox to arise in country 1 are identical under the two operational definitions, and we can use the results for country 1 presented in Table 3 also for the more stringent definition.

To draw general conclusions on the paradox for this case with asymmetric countries and *b*>0 we need to consider both countries. From Table 3, the paradox occurs in country 1 if $A < \overline{A}_1$ and $B - A > \underline{B}_1$. From Table 4, the paradox occurs in country 2 if $\Delta < \Delta_2$ and $B - A < \overline{B}_2$. To be able to analyse the case for the paradox jointly for the two countries we consider the relationships between the thresholds in Tables 3 and 4. It is straightforward to show that

$$\overline{B}_2 > \underline{B}_1 \Leftrightarrow A < \frac{K - \Delta}{K} \equiv \overline{A}_3 < 1 \tag{59}$$

where $\overline{A}_3 < 0$ if $\Delta > K$, while $\hat{A}_2 > \overline{A}_1 > \overline{A}_3$. These relationships are used to summarise the results on the paradox of weakness in Table 5.

The comparison between Tables 3 and 5 highlights that the paradox is a much less general outcome under the narrow definition. In Table 3, where we apply the broad definition, the paradox arises over the whole parameter space. On the contrary, in Table 5 with the stricter definition we get subsets of parameter values for which the paradox is ruled out. For instance, we can see that the paradox becomes less likely for relatively high values of *A* ($A \geq \overline{A}_1$) independently of the degree of cross-country asymmetry (which is in line with the result obtained by applying the more stringent definition to the case with asymmetric countries and *b* = 0 in Table 2). We know that for relatively high values of *A* the national standard is closer to that maximizing aggregate welfare. As a result, a supranational decision-making system with its need to strike a compromise between different national interests is less likely to get the low standard country, 2, closer to aggregate welfare maximization.[15] At the same time, for relatively high values of *A* the SA standard cannot be higher than the highest national standard (that in country 1). As a consequence, the RA in 1 cannot be constrained, and the paradox cannot arise in country 1, when $A \geq \overline{A}_1$.

[15] With $A \geq \overline{A}_1$ this is possible only for a relatively low degree of cross-country asymmetry (case 3.a in Table 5) but not for higher degrees of asymmetry (see case 5 in Table 3).

In Table 5 we can see that for most subsets of the parameter space the paradox is conditional on the value taken by *B-A*. This is true for three cases (2, 3 and 4) out of five.[16] On this point the two countries have conflicting interests in the sense that the paradox arises for country 2 for a value of *B-A* below a certain threshold, whereas a value of *B-A* above a certain threshold is required for the paradox to occur in country 1. This is in line with what we would expect. A larger weight attached to aggregate welfare by the SA pushes up optimal safety at supranational level, thus making the paradox more likely for the high standard country, 1, and less likely for the low standard country, 2, under the stricter operational definition. From Table 5 we can see that there is only one case, 1, where the paradox always arises in equilibrium, corresponding to a low degree of cross-country asymmetry and low weight attached to aggregate welfare by the national RAs.

Table 5 – Case with $\Delta > 0$ and $b > 0$ under stricter definition of the paradox

Case No.	*Degree of cross-country asymmetry*	*Conditions*			*Type of bias*	*Paradox of weakness (under stricter def.)*
1.a	relatively low	$0 < \Delta < \Delta_2$	$0 \le A < \overline{A}_3$	$0 \le B - A \le \underline{B}_1$	OB	Paradox in 2
1.b				$\underline{B}_1 < B - A < \overline{B}_2$	LB	Paradox in 1 & 2
1.c				$B - A \ge \overline{B}_2$	LB	Paradox in 1
2.a			$\overline{A}_3 \le A < \overline{A}_1$	$0 \le B - A < \overline{B}_2$	OB	Paradox in 2
2.b				$\overline{B}_2 \le B - A \le \underline{B}_1$	OB	*No paradox*
2.c				$B - A > \underline{B}_1$	LB	Paradox in 1
3.a			$A \ge \overline{A}_1$	$0 \le B - A < \overline{B}_2$	OB	Paradox in 2
3.b				$B - A \ge \overline{B}_2$	OB	*No paradox*
4.a	relatively high	$\Delta_2 \le \Delta < 2K$	$0 \le A < \overline{A}_1$	$0 \le B - A \le \underline{B}_1$	OB	*No paradox*
4.b				$B - A > \underline{B}_1$	LB	Paradox in 1
5			$A \ge \overline{A}_1$		OB	*No paradox*

It is interesting to compare the results on the paradox obtained using the narrow definition for the case with $\Delta>0$ and $b=0$ with those obtained when $\Delta>0$ and $b>0$. From Table 2 we can see that in the case with asymmetric countries and $b=0$ the paradox arises (for country 2) whenever $A < \widehat{A}_2$, independently of the degree of cross-country heterogeneity. We said above that $\widehat{A}_2 > \overline{A}_1 > \overline{A}_3$. Based on this, we know from Table 5 (and conditions (55)-(56)) that with a positive b the paradox becomes relatively less likely as an equilibrium outcome of our theoretical model. We can therefore conclude that a positive b, which always generates the paradox with identical countries (see Section 3.2), weakens the case for the paradox in presence of asymmetric countries. The reason is that with $b=0$ the degree of asymmetry is the only factor that pushes optimal safety at supranational level further away from safety maximizing aggregate welfare in country 2. A positive b reinforces this effect, thus making the paradox relatively less likely in equilibrium.

[16] Only in cases 1 and 5 (Table 5) the value taken by *B-A* does not determine whether the paradox arises or not. With a low degree of asymmetry and a low value of *A* the paradox always arises under case 1. With high asymmetry and large *A* the paradox never arises under case 5.

4. Conclusions

Our aim in this paper was to illustrate circumstances under which countries in an economic union could benefit from the surrender of national sovereignty over regulatory policy to a supranational authority. If national regulatory authorities have been captured by industry lobbies, then producer interests will receive undue weight in setting regulatory standards, so that outcomes do not maximise national welfare. By shifting the decision to a supranational authority an outcome that results in higher national welfare may be obtained. This despite a common standard being set for all union members and the supranational authority being subject to lobbying by the national regulatory authorities, which continue to respond to industry interests.

Gains of this type are more likely under certain conditions. First, the more similar the two countries, the more likely one or both to gain in this way. Since the union standard is, in some sense, a compromise between the national standards, and both standards need to be raised to get closer to aggregate welfare maximisation, if the countries are too different then the less likely a rise in the higher standard and the more likely an overshoot in the other. Second, the lower the weight placed on aggregate welfare by national regulatory authorities, the higher the chance of gaining from a compromise union standard. This is because when national regulatory authorities place too low a weight on aggregate welfare, national standards are further away from those maximising welfare. This leaves scope for improvement through regulation at supranational level. Finally, it helps if the supranational authority also directly weights aggregate welfare – but not too much. Such a weighting raises the union standard, which tends to raise welfare given that both national standards are too low. But too high a weighting will preclude benefits in the country with the lower standard through overshooting. This is sometimes, but not always, compensated by the benefits occurring to the high standard country in case of high weighting. We also notice that the more similar the two countries, the stronger the possibility of gains occurring through an additional weight on aggregate welfare at supranational level. This is because with more similar countries overshooting through a supranational direct concern for welfare with regard to the low standard country becomes less likely, while gains for the high standard country become more likely.

Our theoretical model supports the case for Grande's paradox of weakness being generated in equilibrium by heterogeneous national preferences and a lower degree of accessibility of supranational bodies to special interest groups. By providing a formal representation to the paradox, we are also able to add some caveats to Grande's argument in the form of limited degree of heterogeneity, as well as limited degree of closure of supranational bodies, required for the paradox to arise.

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