Regulatory Competition and Rules/Principles Based Regulation

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Abstract

This paper analyses how regulatory competition affects principles based and rules based systems of regulation. Competition between regulators creates the possibility of regulatory arbitrage that generates a race to the bottom by regulators that is socially harmful. We derive the welfare effects of such competition and the regulatory response to these effects, in particular, regulatory harmonisation. We find however that regulators can adopt harmful regulatory harmonisation. These effects can make coordination efforts in developing global regulation socially desirable. We demonstrate, moreover, that corporate lobbying is not always harmful: it can both encourage and discourage socially desirable regulation.

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1 Introduction

This paper analyses how competition between regulatory jurisdictions affects principles based and rules based systems of regulation. These systems are well known in the areas of financial and accounting regulation but to our knowledge there is little research on the effects of regulatory competition. The model consists of two regulators regulating their own jurisdictions, with firms migrating between the jurisdictions to maximise profits. Regulation is socially beneficial but costly for firms to comply with, so even when regulators maximise the welfare within their jurisdiction they face a trade off between regulating firms sufficiently robustly and driving business away.

The financial crisis in 2007-08 highlights the need for a analysis of this problem. Some commentators have asserted, for instance, that a "London loophole" with regulation based on vague principles could attract financial business.[1] In parallel to the debate about financial regulation questions have also been raised about accounting regulation, in particular whether accounting reporting has reflected the underlying economic reality in many financial institutions.[2] UK's financial regulatory framework from the late 1990s and early 2000s and the International Accounting Standards (IAS)/International Financial Reporting Standards (IFRS) represent examples of principles based systems of regulation. Federal reserve's financial regulatory system in the US and the US Generally Accepted Accounting Principles (GAAP) are examples closer to rules based systems. The lack of analysis of regulatory competition in this context motivates our research. Our main finding is that regulatory competition leads to a race to the bottom effect because of the threat of regulatory arbitrage. Regulatory harmonisation can prevent regulatory arbitrage and is chosen in

[1] AIG is a prime example, see for instance Financial Times, 29 July 2012: *Finance: London's precarious position.* Since then the UK has indicates a greater reliance on rules as a means of strengthening regulation, see Financial Times 13 December 2010: *Sants signals shift to rule-based regulation.*

[2] A discussion of principles based accounting standards can be found in Carmona and Trombetta (2007).

equilibrium. However, we can have “bad” harmonisation to the wrong system or “good” harmonisation to the right system. If the regulators are otherwise indifferent in autarky, the wrong system is the principles based system and the right system is the rules based system. Regulatory competition can therefore lead to complicated and counterintuitive effects that should be taken into account when developing and coordinate global regulation.

In the area of financial regulation a key objective for regulators is to protect the society from systemic corporate failures in the financial system. In the area of accounting regulation an objective is to protect the society from harmful misreporting of financial information. Corporate failures can threaten the financial system, and misreporting can lead to social losses for third parties basing their decisions on misleading information. Therefore, it is in the interest of society that regulation can minimise the social costs of such events. The principles based and the rules based accounting systems are workhorses that form the basis for regulation. Regulatory competition is perceived a problem because it leads to a race to the bottom effect that weakens regulatory oversight. This is not a given, and indeed some believe that regulatory competition can strengthen standards. The Goldman Sachs (2009) report on financial regulation argues for instance that the development of financial centers such as Singapore and London is in part built on strong regulation.

The following outlines our understanding of the key features of the two systems. A principles based system is specific about the regulatory outcomes. The firms must document to the regulator how their actions achieve these outcomes. There is no ambiguity about the outcomes of regulation but some ambiguity about the regulatory process and whether the firms’ actions are sufficient to achieve the outcomes because it is the firms themselves that provide the documentation for compliance. The process is therefore imperfect and leads to regulatory failures. In contrast, a rules based system is specific about the regulatory process. The firms are regulated according to a specific set of rules and the regulator decides what set of rules best achieves the regulatory objectives. There is no ambiguity about the regulatory process but some ambiguity about whether the outcomes are met, leading to regulatory failures. The failures are different in nature in the two systems, which make the analysis non-trivial.

Our analysis is based on two crucial assumptions. First, the regulators are independent and there are limits to their powers. The regulator cannot implement both a principles based and a rules based system at the same time, so some ambiguity associated with regulation will always remain. The regulators are unable to pre-commit to regulation that ex ante would be jointly welfare maximising since ex post they independently may want to deviate from such commitment in order to attract business from each other. Second, the firms have full discretion in choosing their regulator. By relocations, reorganisations, or simply changing the regulations by which they operate, firms can decide which regulatory jurisdiction they belong to. Such action, labelled regulatory arbitrage, can reduce the cost of regulation for firms and creates in effect a competitive environment for the regulator. Desai (2009) argues, for instance, that factors linked to regulation can explain the structure of global firms. Regulatory arbitrage is often subject to negative press coverage, but why it should necessarily be harmful is unclear. This view is reflected in the Goldman Sachs' report (2009) on regulation. Therefore, we need to look at regulatory competition in an equilibrium model where the incentives for regulatory arbitrage and the regulators' welfare concerns are both recognized. In a study of tax-havens, for instance, Desai et al (2005) find that the commonly held assertion that tax-havens divert economic activity from nearby non-havens is not consistent with data, which illustrates that issues of this kind can be more complex than intuition tells us. The fact that we use an equilibrium model implies that the socially harmful effects of regulatory competition can be felt even if regulatory arbitrage activity does actually not take place in equilibrium. Optimal regulation does not necessarily prevent regulatory arbitrage, and conversely, the fact that regulatory arbitrage takes place does not necessarily imply that regulation is not optimal.[3]

As an extension we also study lobbying activity. Within the context of our model lobbying activity would never sway the regulators' choices so any costs spent on lobbying is of course wasted. It is nonetheless of interest to investigate what direction such lobbying would take should it be undertaken. We assume that any lobbying would be paid for by corporate profits. The natural measure for the direction of lobbying is therefore the changes to regulation that would increase the total profits made by corporations. In autarky corporate lobbying will always be directed away from the principles based systems and towards the rules based systems (if the regulators are otherwise indifferent between systems). Under regulatory competition corporate profits are maximal under regulatory diversity so the corporate sector will in general be resistant to efforts to harmonise regulation, which is always an equilibrium. This can enhance or reduce welfare depending on whether the regulators choose to harmonise in a "good" way or a "bad" way.

There is little in terms of directly related literature in this area. Related is Morrison and White's (2009) paper on the use of capital requirements under regulatory arbitrage. They analyse the regulation of firms that are known to be systemic whereas in contrast in our model the regulator does not have precise knowledge of this. Dell'Ariccia and Marquez (2006) study the benefits of a super-regulator, whereas we study the effects of competition between several regulators. The issue of rules versus standards in the field of accounting regulation have been addressed by Dye and Sunder (2001) and Benston et al. (2006). Our paper presents an equilibrium model to study rules versus principles, in contrast to these papers. Kydland and Prescott (1977) argue that the inflexible nature of rules can create a commitment effect. Rules have no commitment value in our model. The regulators can change the rules, or even switch to principles

[3]The view that regulatory arbitrage is harmful in itself is for instance expressed clearly in Moshirian (2011).

based regulation, if this is in their interest. An empirical study that finds evidence of regulatory arbitrage is Houston, Lin and Ma (2009).

The paper proceeds as follows. In Section 2 we describe the model and derive the optimal autarky level of regulation; which we extend this into a two-jurisdiction model in Section 3; in Section 4 we analyse corporate lobbying and also extend the analysis into competition between mixed systems of regulation. Section 5 concludes.

2 Model and Autarky Equilibrium

We consider a population of infinitesimal firms within each regulatory jurisdiction. Each firm produces private net profits V and some firms produce additionally social costs E (an externality). The firms are characterised by two parameters x and y, described below, and a choice variable d which indicates whether the firm complies with a set of regulations. The x value refers to "observables" related to the firms. In the context of financial regulation, the observables consist of hard facts about the firm's assets and liabilities, information about the firm's loan quality, and information about the firm's linkages to other firms in the financial system. In the context of accounting regulation, the observables consist of raw accounting information, historical costs of assets as well as market values of assets similar to those owned by the firm, depreciation schedules, and inventories. The observables may be used by the regulator to formulate regulation.

The y value refers to the degree to which the firm is "systemic". We represents this by a simple threshold value θ such that if y is less than θ it produces a social externality E, if it is greater than θ it does not. In the context of financial regulation a systemic firm is one that carries some risk to the financial system that represents a social cost. Examples of systemic costs in financial regulation are linkages between the firm and other firms in the financial system. A corporate failure can in this case have a larger social costs than just the cost to the firm's investors. An example of a systemic cost in accounting regulation is a firm that produces misleading information via its financial statements. This information may be the basis of decisions made by individuals other than the firm's own investors, which leads to social costs. If y has a high value the hidden risks are small and third parties can rely on the financial statements of the firm, but if y has low value the hidden risks are large and the financial statements are misleading.

The social cost can in either case be prevented by effective regulation that the firm complies with. For financial regulation the regulator may impose capital requirements, and for accounting regulation this may regulate the way that financial statements are produced to increase their reliability. Such compliance is costly for the firm but can be valuable to the society. Specifically, we assume that

$$V(d|x,y) = \begin{cases} V^* & \text{if } d = \text{no compliance} \\ V^* - \varphi & \text{if } d = \text{compliance} \end{cases}$$

The cost of compliance with regulation is φ and the parameters x and y do not enter directly into the value functions. The social cost function E takes the form,

$$E(d|x,y) = \begin{cases} E^* > 0 & \text{if } d = \text{no compliance and } y < \theta \\ 0 & \text{if } d = \text{compliance or } y \geq \theta \end{cases}$$

For $y < \theta$ the firm is systemic and for $y \geq \theta$ the firm is non-systemic. The model is stripped down to its simplest form by assuming that the corporate value V depends on no other factor than compliance to regulation, and the social cost E depends on no other factors than whether the firm is systemic and the firm complies to regulation. Other factors are likely to influence both quantities but it serves our purpose to assume these away in order to focus on the issue of regulation.

As mentioned compliance with effective regulation reduces the social costs. We assume $V^* > E^* > \varphi$ so that it is optimal to regulate (rather than shut down) a systemic firm and the gains from regulation always exceed the costs. From this setup it is easy to see that for the firm the optimal decision is not to comply with regulation whether it is systemic or not, whereas for the regulator is optimal to make the systemic firms comply. Each firm is located at a point (x, y) on the space $[0, 1] \times [0, 1]$, and the firms are distributed with uniform measure on this space within each jurisdiction. The x parameter is observable, whereas the y variable is hidden.

The systems of regulation is distinguished mainly by how the regulator determines which firms are systemic. Broadly speaking, the regulator may formulate general principles that are not linked to the firm's observables but where the firm makes its own case for its compliance with the objectives of regulation. This is called principles based regulation. The regulator may use specific rules for compliance based on the firm's observables. This is called rules based regulation. The two systems are described below, but to illustrate the distinction consider the example of Northern Rock that was bailed out to protect depositors by the UK government in 2008 after a bank run. The reliance on short term funding to a long-term mortgage exposure represented a weakness that posed a systemic risk but the assessment by UK's regulator prior to the financial crisis was that the social risk was small. This assessment, which turned out to be incorrect, was largely based on judgements (principles) rather than on specific rules. These judgements do of course not imply that the regulator is not using available information, only that the way in which the information is used is general and non-specific. From accounting regulation we find the example of Enron that was able to hide liabilities from its accounts which enabled it to continue trading and attract capital to a failing business until its collapse in 2001. The misreporting was not exposed due to Enron's apparent compliance with a rules-based accounting system. In this case, an approach based on general judgements may have uncovered the hidden liabilities, but the rigidity of the rules-based accounting system prevented such judgements from being made. Both are examples of regulatory failures, but we can see that they are different in nature. In the first example the failure was caused by the inability of a principles based judgement to be accurate, whereas in the second example the failure was caused by the prescriptive nature of the rules that allowed the firm to hide its liabilities from the outside world. The systems are described in more detail below.

2.1 Principles Based Systems

In a principles based system of financial regulation the firms submit a report to the regulator about its true type, denoted $\hat{y}$, on which regulation is based. We assume that if the report is true, $\hat{y} = y$, it is free of cost and if it is false, $\hat{y} \neq y$, it has a cost $\gamma > 0$ to the firm. In a principles based system of accounting regulation the firm can submit an economically correct financial statement $\hat{y} = y$ free of cost, or a false one $\hat{y} \neq y$ at a cost γ. In either case, $\hat{y}$ and y must not be too different, specifically $\hat{y} \in [y, y + \epsilon]$ where ϵ represents the maximum distance between $\hat{y} - y$. We assume $\varphi > \gamma$ so that the firm submits a false report if the alternative is to incur the compliance costs φ. The regulator's strength of regulation is a and the firm incurs compliance cost of regulation if $\hat{y} < \theta + a$. The maximisation program for the firm can then be written as a function of $\hat{y}$ and d:

$$\max_{d,\hat{y}} V(d|x, y) - \mathbb{I}(\hat{y} > y)\gamma$$

subject to $d \in \{\text{compliance}, \text{no compliance}\}$ and $\hat{y} \in [y, y+\epsilon]$. It is easy to see that the optimal solution for the firm is the following:

y-value	Optimal d	Optimal $\hat{y}$	Corporate profits
$y \geq \theta + a$	no compliance	y	V^*
$y < \theta - (\epsilon - a)$	compliance	y	$V^* - \varphi$
$\theta - (\epsilon - a) \leq y < \theta + a$	no compliance	$\theta + a$	$V^* - \gamma$

In the first case the firm is non-systemic and submits a true report, so the corporate profits equal $\bar{V}$. In the second case the firm is systemic and also submits a true report because submitting a false report would make no difference other than the firm would have to pay the costs of misrepresentation of its type. The profits are $\bar{V} - \varphi$. In the third case the firm is able to cheat the regulation by misreporting its type y. Submitting a true report leads to compliance costs $\varphi > \gamma$. The corporate profits are $\bar{V} - \gamma$.

The parameter a is a choice variable for the regulator and is set such that the total welfare of regulation is maximised. Using the solution for the individual firms outlined above, the problem for the regulator can be stated as maximising a social welfare function $\Pi_S(a)$

$$\max_a \Pi_S(a) = \int_0^{\theta+a-\epsilon} (V^* - \varphi) dy + \int_{\theta+a-\epsilon}^{\theta+a} (V^* - \gamma - \mathbb{I}(y < \theta) E^*) dy + \int_{\theta+a}^{1} V^* dy$$

The first term is the corporate profits for the systemic firms that comply with regulation, the third term is the corporate profits for the non-systemic firms that do not comply, and the middle term is the corporate profits for the firms (some systemic and some non-systemic) that engage in misreporting, less the social cost function for the firms that are truly systemic. The parameter a indicates how strongly the regulator formulates its principles. If $a = 0$ then the regulation is maximally weak and all the firms submitting

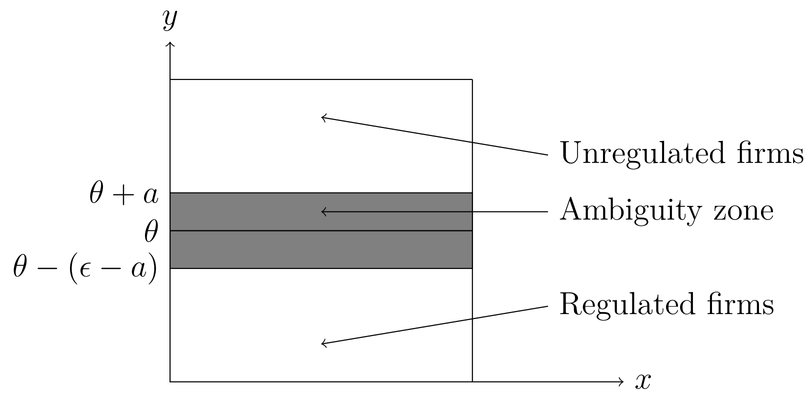

Figure 1: Cost of principles based regulation.

false reports are systemic. If $a = \epsilon$ the regulation is maximally strong and all the firms submitting false reports are non-systemic. In between there are both systemic and non-systemic firms submitting false reports. The parameter ϵ, $0 < \epsilon < \min(\theta, 1 - \theta)$ indicates the size of the ambiguity zone. The upper bound on ϵ is imposed because it simplifies the analysis, but this restriction implies no loss of generality. We can interpret the parameter ϵ as the regulator's general ability to formulate sharp principles. If $\epsilon \to 0$ the ability to formulate sharp principles becomes perfect and the regulator can impose regulation with no ambiguity costs. Figure 1 illustrates principles based regulation, and shows the firms in the (x, y) plane, as well as the cut-off points $\theta + a$ and $\theta - (\epsilon - a)$.

2.2 Rules Based Systems

In a rules based system the regulator collects information about x and estimates the firm's compliance threshold $\hat{\theta}(x)$. We can interpret $\hat{\theta}(x)$ as the regulator's estimate of the underlying parameter θ. The firm responds to this target by choosing whether to comply, realising that ex post there are large penalties for non-compliance if $y < \hat{\theta}(x)$. Their maximisation program is, therefore,

$$\max_d V(d|x,y) - \mathbb{I}(\hat{\theta}(x) > y \text{ and } d = \text{no compliance})M$$

where M is a large cost associated with non-compliance when the firm's true type does not exceed the target $\hat{\theta}(x)$. For instance, suppose the target $\hat{\theta}(x)$ represents capital requirements based on the observed quality of the firm's loan portfolio, and y may represents a hidden corporate culture parameter. If the firm's type is $y \geq \hat{\theta}$ the firm meets its target and the corporate profits equal V^*. The social surplus depends on how y compares to the actual θ-value, so if $y < \theta$ the social surplus is $V^* - E^*$ and if $y \geq \theta$ the social surplus is V^*. If the firm's type is $y < \hat{\theta}$ the firm needs to comply to avoid the ex post penalty M. If the firm off-loads bad loans to reduce the target requirement $\hat{\theta}(x)$ to the point where $y \geq \hat{\theta}(x)$, the corporate profits are $V^* - \varphi$. The social surplus is in this case $V^* - \varphi$ regardless of the firm's true type y. Given that M is large, the firm's optimal actions is given in the following table.

y-value	Optimal d	Corporate profits
$y \geq \hat{\theta}(x)$	no compliance	V^*
$y < \hat{\theta}(x)$	compliance	$V^* - \varphi$

The use of observables to meter regulation creates errors: sometimes the regulation is stronger than it should be (when $\hat{\theta}(x) > \theta$) and sometimes it is weaker (when $\hat{\theta}(x) < \theta$). Suppose $\hat{\theta}(x)$ is declining in x: we arrange the firms such that regulation is the strongest for the smallest x-values and the weakest for the highest x-values. Since the x value is not used for any other purpose in our model this represents no loss of generality, but we need to assume that the ordering is made after the regulator decides on regulation.[4] We

[4]Since the firms are distributed uniformly on the (x, y)-plane it will always be the case that $\mathbb{P}(y \leq a|x_1) = \mathbb{P}(y \leq a|x_2)$ for

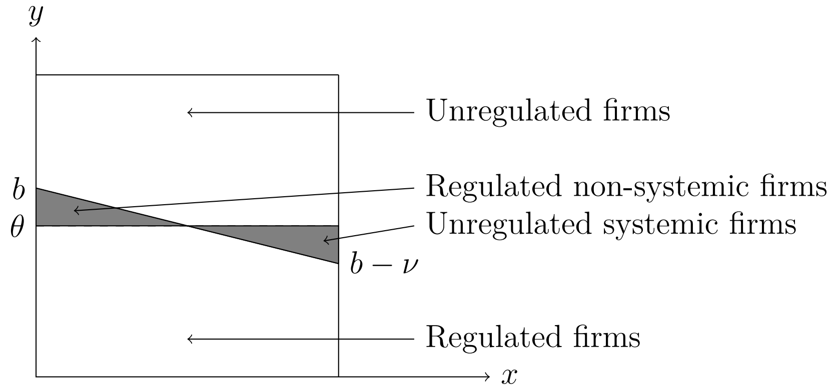

Figure 2: Cost of rules based regulation.

assume the ordering results in regulation that takes the linear form $\hat{\theta}(x) = b - \nu x$, with the parameter b being a choice variable for the regulator and the exogenous parameter ν, $0 < \nu < \min(\theta, 1-\theta)$ representing the errors that arise from this type of regulation. Whereas the ordering is without loss of generality, the linear form suggested is restrictive, but it allows a transparent and tractable analysis. Large values of ν yield large errors and in the limit as $\nu \to 0$ the errors vanish altogether. The bounds on ν is imposed for the same reasons as we impose bounds on ϵ for the principles based systems: this simplifies the analysis. If $b > \theta + \nu$ all firms classified as non-systemic will truly be non-systemic and the regulator will always optimally lower b, and if $b < \theta$ all firms classified as systemic will truly be systemic and the regulator will always optimally increase b. Therefore, $b \in [\theta, \theta + \nu]$ represents the strength of the rules. The problem for

all $a \in [0,1]$ and any $x_1 \neq x_2$. The rules dictate a relationship $\tilde{\hat{\theta}} = \theta + \tilde{\eta}$ where η is an estimation error, and our assumption is that the x variable is ordered ex post on the estimation error η. It will therefore be the case that $\mathbb{P}(y \leq \hat{\theta}(x)|x_1) \neq \mathbb{P}(y \leq \hat{\theta}(x)|x_2)$, suggesting that the regulator can soften its regulation when $\hat{\theta}(x)$ is relatively large and strengthen its rules when $\hat{\theta}(x)$ is relatively small. It is essential to the model that the regulator cannot observe the ordering before designing the rules. Since $\mathbb{E}\tilde{\hat{\theta}} = \theta + \mathbb{E}\tilde{\eta}$, which is independent of x, it would be more appropriate for the regulator to make the comparison of $\mathbb{P}(y \leq \mathbb{E}(\tilde{\hat{\theta}})|x_1)$ with $\mathbb{P}(y \leq \mathbb{E}(\tilde{\hat{\theta}})|x_2)$ for any pair x_1 and x_2. These are, of course, equal.

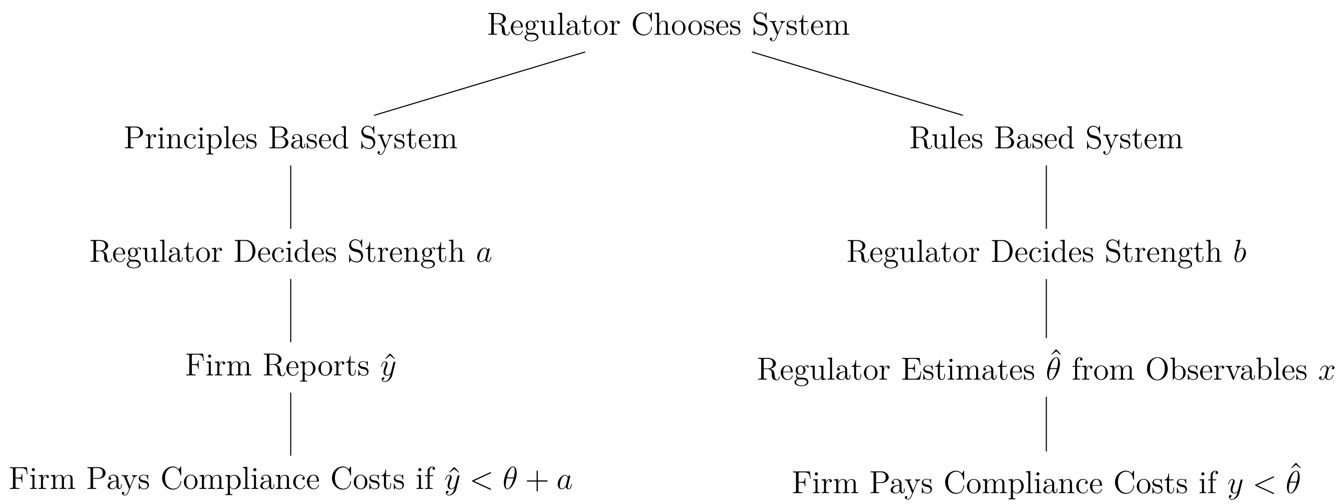

Figure 3: Structure of Model

the regulator can be formulated as maximising the social welfare function $\Pi_S(b)$:

$$\begin{aligned}\max_b \Pi_S(b) = &\int_0^{\frac{b-\theta}{\nu}} \left(\int_0^{b-\nu x} (V^* - \varphi) dy + \int_{b-\nu x}^1 V^* dy \right) dx \\ &+ \int_{\frac{b-\theta}{\nu}}^1 \left(\int_0^{b-\nu x} (V^* - \varphi) dy + \int_{b-\nu x}^{\theta} (V^* - E^*) dy + \int_{\theta}^1 V^* dy \right) dx\end{aligned}$$

The first term represents the cases where the regulator imposes rules that are too strong and firms that are non-systemic must comply, i.e. where $\hat{\theta}(x) = b - \nu x \geq \theta$; and the second term represents the cases where the regulator imposes rules that are too weak and firms that are systemic do not have to comply, i.e. where $\hat{\theta}(x) = b - \nu x < \theta$. The optimal choice of b balances the type I and type II errors in classification. Figure 2 illustrates the rules based system of regulation.

2.3 Model Outline

The full structure of the model can be illustrated in Figure 3. The regulator chooses one system of regulation. The principles based system gives the firm some discretion in documenting its own compliance to the regulatory regime, but in return the regulator can "raise the bar" to a higher level $\theta + a$ by strengthening the regulation. In a rules based system appears the regulator decides the "bar" $\hat{\theta}(x)$ where the regulator can choose the parameter b to obtain the optimal strength to balance the risk of over-regulation against the risk of under-regulation. We assume that $V^* > E^* \gg \varphi > \gamma$, so that the various costs of regulation are dwarfed by the corporate profits and the social welfare gains from regulation.

We should note that our model is a static one which ignores dynamic effects. First, in rules based systems of regulation the firm's observables are the basis for the firm's regulatory treatment. This leads to incentives for the firms to change their observables (the parameter x in the model outline) in order that they obtain more lenient regulatory treatment. Even if this is not a concern, a rules based system may become "stale" and gradually lose its functional role. Second, in principles based systems of regulation there are important learning effects where the firms "wise up to" convincing the regulator how their business is in compliance with regulation. Over time, therefore, the ambiguity cost (the parameter γ in the model outline) is likely to decrease. Third, in principles based systems of regulation the firms have an incentive to make innovations in the compliance process to drive down the compliance cost of regulation. The latter point has often been put forward as a key advantage of principles based regulation (see e.g. Financial Services Authority's (2007) report on principles based regulation). All effects of this kind are ignored in our model. However, allowing such effects would typically lead to a regulatory response in subsequent periods, leading to further adjustments by the firms, leading to further regulatory responses, etc. Ultimately a steady state is likely to be reached. Our model could therefore be interpreted as a more complicated dynamic model that has reach such a steady state.

2.4 Optimal Regulation in Autarky

The social welfare function to be maximised for a regulator operating a principles based regime is $\Pi_S(a)$, given as follows:

$$\begin{aligned}\max_a \Pi_S(a) &= \int_0^{\theta-(\epsilon-a)} (V^* - \varphi)dy + \int_{\theta-(\epsilon-a)}^{\theta} (V^* - E^* - \gamma)dy + \int_{\theta}^{\theta+a} (V^* - \gamma)dy + \int_{\theta+a}^{1} V^* dy \\ &= V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)(\epsilon - a) \end{aligned} \tag{4}$$

The expression aggregates welfare over the region $0 \leq y < \theta - (\epsilon - a)$ where systemic firms comply with regulation; over the region $\theta - (\epsilon - a) \leq y < \theta$ where systemic firms incur ambiguity costs and the society incurs the social cost of the externality E^*; over the region $\theta \leq y < \theta + a$ where non-systemic firms incur ambiguity costs; and finally over the region $\theta + a \leq y \leq 1$ where non-systemic firms are unregulated.

Proposition 1 (Principles Based Regulation in Autarky): *A regulator operating a principles based system regulates with maximum strength $a^* = \epsilon$ in autarky.*

The economic intuition behind Proposition 1 is as follows. Since the firms in the ambiguity zone $\theta - (\epsilon - a) \leq y < \theta + a$ will incur ambiguity costs regardless, the real trade off for the regulator is whether it is more profitable to involve a non-systemic firm in regulation than a systemic firm, ignoring the ambiguity costs. The effect of involving an additional non-systemic firm into the ambiguity zone is zero, since there is no change to the corporate profits and since the ambiguity costs incurred by this firm is offset by the ambiguity costs saved by another firm exiting the ambiguity zone. The systemic firm exiting the ambiguity zone will however contribute $E^* - \varphi$ to welfare, since there is a welfare gain of E^* but a net change to corporate profits of φ which is the corporate cost of complying with regulation. The welfare at the optimal regulation is $\Pi_S(\epsilon) = V^* - \varphi\theta - \gamma\epsilon$. As $\epsilon \to 0$ we find $\Pi_S(\epsilon) = V^* - \varphi\theta$ so the cost of imperfect regulation is $\gamma\epsilon$.

The social welfare function for a regulator operating a rules based system is $\Pi_S(b)$, given as follows:

$$\begin{aligned}
\Pi_S(b) = &\int_0^{\frac{b-\theta}{\nu}} \left(\int_0^{b-\nu x} (V^* - \varphi) dy + \int_{b-\nu x}^1 V^* dy \right) dx \\
&+ \int_{\frac{b-\theta}{\nu}}^1 \left(\int_0^{b-\nu x} (V^* - \varphi) dy + \int_{b-\nu x}^{\theta} (V^* - E^*) dy + \int_{\theta}^1 V^* dy \right) dx \\
&= V^* - E^*\theta - \frac{(E^* - \varphi)\nu}{2} + (E^* - \varphi)b - \frac{E^*}{2} \frac{(b-\theta)^2}{\nu}
\end{aligned} \tag{5}$$

In the x-dimension, there is a cut-off point $\bar{x} = \frac{b-\theta}{\nu}$ where the rules apply exactly such that the non-systemic firms of type $\bar{x}$ are unregulated (i.e. $y \geq b - \bar{x}\nu = b - \frac{b-\theta}{\nu}\nu = b - b + \theta = \theta$) and the systemic firms are regulated (i.e. $y < b - \bar{x}\nu = \theta$). We aggregate welfare, therefore, in the region where $0 \leq x < \bar{x}$ first, where the firms for which $0 \leq y < b - x\nu$ are the regulated systemic and non-systemic firms and the firms for which $b - x\nu \leq y \leq 1$ are unregulated. Then we aggregate welfare in the region where $\bar{x} \leq x \leq 1$, where the firms for which $0 \leq y < b - \nu x$ are the regulated systemic firms, the firms for which $b - x\nu \leq y < \theta$ are the unregulated systemic firms, and the firms for which $\theta \leq y \leq 1$ are the unregulated non-systemic firms.

Proposition 2 (Rules Based Regulation in Autarky): *A regulator operating a rules based system* *should regulate with intermediate strength* $b^* = \theta + \nu\left(1 - \frac{\varphi}{E^*}\right)$ *in autarky.*

The intuition for Proposition 2 is also straightforward. The regulator incurs costs associated with excessive regulation since the firms incur compliance costs φ, and costs associated with under regulation since the firms operate with externalities E^*. The optimal regulation balances these costs, where the trade off depends on the ratio of the relative costs $\frac{\varphi}{E^*}$. The numerator is the operational loss that stems from the regulatory burden, and the denominator the welfare gain that stems from preventing the production of externalities (by assumption this ratio is always less than 1). When the operational loss increases relative to the welfare gain we expect the regulator to relax the strength of regulation, which is reflected in the optimality condition in Proposition 2. The welfare under optimal regulation is $\Pi_S\left(\theta + \nu\left(1 - \frac{\varphi}{E^*}\right)\right) = V^* - \varphi\theta - \left(1 - \frac{\varphi}{E^*}\right)\frac{\varphi\nu}{2}$. As $\nu \to 0$ the welfare approaches $\Pi_S\left(\theta + \nu\left(1 - \frac{\varphi}{E^*}\right)\right) \to V^* - \varphi\theta$, so the cost of imperfect regulation is $\left(1 - \frac{\varphi}{E^*}\right)\frac{\varphi\nu}{2}$. The regulator will choose the system of regulation that yields the highest welfare. Indifference between systems is determined by the following condition.

Proposition 3 (Regulatory Indifference in Autarky): *The regulators are indifferent between a principles based system and a rules based system when* $\frac{\epsilon}{\nu} = \frac{\varphi}{2\gamma}\left(1 - \frac{\varphi}{E^*}\right)$.

The loss due to imperfect regulation is $\gamma\epsilon$ in a principles based system. The condition outlined in Proposition 3 makes the losses due to imperfect regulation the same in the two systems. The analysis that follows looks at the effects of competition from the reference point that the two systems of regulation in autarky are equally good at delivering welfare. This assumption is purely a reference point for the analysis and not a statement of empirical plausibility, as the objective in this paper is to analyse the effects that regulatory competition has on the two systems, not to analyse the systems themselves. We adopt this assumption for the remaining parts of the paper.

3 Regulatory Competition

Consider two jurisdictions i and j which are identical. The regulators operate a principles based regulatory systems described by $\epsilon > 0$, or a rules based regulatory systems described by $\nu > 0$. If a firm in jurisdiction i is unregulated with value V^* it will never relocate to the other jurisdiction j since the value is the same or less. If a firm in jurisdiction i incurs ambiguity costs with value $V^* - \gamma$ it will relocate to j if and only if it becomes unregulated there with value V^*. If a firm in jurisdiction i is regulated with value $V^* - \varphi$ it will relocate to j if and only if it becomes unregulated with value V^* or if it incurs ambiguity costs with value $V^* - \gamma$. The situations where there is relocation generate regulatory arbitrage.

When relocation happens and the firm is systemic the private profits travel in full, but we assume some of the externality may be left behind in the jurisdiction of origin and some travels to the new jurisdiction. The split between the old regulator i and the new regulator j is $((1-\delta)E^*, \delta E^*)$, where $\delta \in [0,1]$ denotes the fraction of E^* that travels to the new jurisdiction. An example motivating δ less than one is the insurer AIG which incurred some of its largest losses in London but received bailout money from the US although the US regulator was unable to control the London operations of the AIG arm. The relocation of pats of AIG to London is an example of regulatory arbitrage that did not completely remove the systemic risk that AIG represented to the US regulator. Although intuitively an important parameter δ has surprisingly limited impact on the qualitative results generated in this paper. In the extreme case that $\delta = 0$ the systemic ties to the home jurisdiction remains completely intact after the relocation, and if $\delta = 1$ there are no systemic ties to the jurisdiction of origin. The assumption that $\delta = 1$ is natural for accounting regulation. The full welfare effects of relocation is laid out in the following table, which shows the welfare impact of a relocation of a firm from the jurisdiction of origin i to the jurisdiction of destination j.

Firm type	Status in i	Status in j	Effect on i	Effect on j
Non-systemic	Regulated	Grey zone	$\varphi - V^*$	$V^* - \gamma$
Non-systemic	Regulated	Unregulated	$\varphi - V^*$	$V*$
Non-systemic	Grey zone	Unregulated	$\gamma - V^*$	V^*
Systemic	Regulated	Grey zone	$\varphi - V^* - (1-\delta)E^*$	$V^* - \gamma - \delta E^*$
Systemic	Regulated	Unregulated	$\varphi - V^* - (1-\delta)E^*$	$V^* - \delta E^*$
Systemic	Grey zone	Unregulated	$\gamma - V^* + \delta E^*$	$V^* - \delta E^*$

Here "Regulated" status means the firm is regulated (regardless of system), "Grey zone" status means the firm is the ambiguity zone (in a principles based system), and "Unregulated" status means the firm is unregulated (regardless of system). The welfare in each jurisdiction can be written as the autarky welfare plus the welfare implications of the relocation activity of the firms.

3.1 Competition Within Systems

First consider competition between two regulators using principles based systems. We derive the welfare function for regulator i, a function of regulator i's own decision a_i, and contingent on regulator j's decision

a_j, as follows.

$$\Pi_S^i(a_i) = V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)(\epsilon - a_i)$$
$$+ \mathbb{I}(a_i < a_j)\left(\int_{\theta+a_i}^{\theta+a_j} V^* dy + \int_{\theta-(\epsilon-a_i)}^{\theta-(\epsilon-a_j)} (V^* - \gamma - \delta E^*) dy\right)$$
$$+ \mathbb{I}(a_i \geq a_j)\left(\int_{\theta+a_j}^{\theta+a_i} (\gamma - V^*) dy + \int_{\theta-(\epsilon-a_j)}^{\theta-(\epsilon-a_i)} (\varphi - V^* - (1-\delta)E^*) dy\right) \tag{6}$$

Here we use the indicator function $\mathbb{I}(\text{condition}) = 1$ if the condition is true and 0 if it is false. We find the following result.

Proposition 4 (Principles Based Harmonisation): *The optimal principles based regulation for competing regulators is to regulate with minimum strength $a_i^* = a_j^* = 0$.*

The intuition is as follows. Assume that one regulator is regulating with greater strength than the other. There is then an outflow of non-systemic firms at the top end of the ambiguity region of the strongest regulator, and by lowering the strength or regulation the regulator can prevent these. There is also an outflow of systemic firms below the lower end of the ambiguity region of the strongest regulator. This outflow leads to a welfare loss for this regulator on two accounts. First, the jurisdiction loses corporate profits because the firm relocates to the other jurisdiction. Second, the relocation of a firm to an ambiguity region in their new jurisdiction leads to a situation where the externality will be produced, and because of the ties with the home jurisdiction the externality will also be felt here. By lowering the strength of regulation the regulator can also prevent these losses. Surprisingly, it is also optimal to lower the strength of regulation even if the regulator is already the weakest regulator. In this case there is an inflow by non-systemic firms at the top end that is profitable for the regulator, and there is an inflow of systemic firms at the lower end that is also profitable. These profits will increase as the regulator lowers the strength of regulation and the net effect is so strong that it dominates the autarky effect. In total, therefore, the regulator will always lower the strength of regulation. A regulator operating a principles based system in autarky will regulate with maximum strength, therefore, whereas two regulators operating principles based system in competition will regulate with minimum strength. This result demonstrates clearly the race to the bottom effect of competitive regulation.

Next, consider rules based regulation. The welfare function for regulator i as a function of b_i and contingent on b_j can be written as follows.

$$\begin{aligned}
\Pi_S^i(b_i) &= V^* - E^*\theta - \frac{(E^* - \varphi)\nu}{2} + (E^* - \varphi)b_i - \frac{E^*}{2}\frac{(b_i-\theta)^2}{\nu} \\
&+ \mathbb{I}(b_i < b_j)\left(\int_0^{\frac{b_i-\theta}{\nu}} \int_{b_i-\nu x}^{b_j-\nu x} V^* dy dx + \int_{\frac{b_i-\theta}{\nu}}^{\frac{b_j-\theta}{\nu}} \left(\int_\theta^{b_j-\nu x} V^* dy + \int_{b_i-\nu x}^{\theta} (V^* - \delta E^*) dy\right) dx \right.\\
&\left. + \int_{\frac{b_j-\theta}{\nu}}^{1} \int_{b_i-\nu x}^{b_j-\nu x} (V^* - \delta E^*) dy dx \right)\\
&+ \mathbb{I}(b_i \geq b_j)\left(\int_0^{\frac{b_j-\theta}{\nu}} \int_{b_j-\nu x}^{b_i-\nu x} (\varphi - V^*) dy dx \right.\\
&+ \int_{\frac{b_j-\theta}{\nu}}^{\frac{b_i-\theta}{\nu}} \left(\int_\theta^{b_i-\nu x} (\varphi - V^*) dy + \int_{b_j-\nu x}^{\theta} (\varphi - V^* - (1-\delta)E^*) dy\right) dx\\
&\left. + \int_{\frac{b_i-\theta}{\nu}}^{1} \int_{b_j-\nu x}^{b_i-\nu x} (\varphi - V^* - (1-\delta)E^*) dy dx \right)
\end{aligned} \tag{7}$$

We find the following result.

Proposition 5 (Rules Based Harmonisation): *There are two cases.*

A: If $(1+\delta)E^* < V^* + \varphi$ then $b_i^* = b_j^* = \theta$ is the unique equilibrium;

B: If $(1+\delta)E^* \geq V^* + \varphi$ then there exist a continuum of equilibria where $b_i^* = b_j^* \in [\theta, \theta + \nu\left(1 - \frac{V^*+\varphi}{(1+\delta)E^*}\right)$.

Regulation is always weaker than in autarky, such that $b_i^* = b_j^* < \theta + \nu\left(1 - \frac{\varphi}{E^*}\right)$, and where there are multiple equilibria the welfare is increasing in the strength of regulation so the regulators have an incentive to collude at the maximum strength equilibrium point.

Using the expressions in (7) we can work out the marginal welfare in b_i, taking b_j as given. It is possible that the marginal welfare is positive at $b_i = \theta$ but it will always be falling. It will however always be the case that the marginal welfare is negative for $b_i \geq b_j$. Therefore, an equilibrium point is reached for Case A if $\left.\frac{d\Pi_S^i}{db_i}\right|_{b_i<b_j}$ is equal to zero or strictly positive, since the cut off point where b_i goes through b_j will lead to a change in the marginal welfare from weakly positive to negative. For Case B this will never happen and b_i and b_j must both be minimal.

There is a race to the bottom effect with rules based competition as well, which applies in particular to case A, which arises if the externality E^* is sufficiently small or the parameter describing the transfer of the externality to the new jurisdiction, δ, is sufficiently small. This is characteristic of a situation where the cost of attracting new business to a jurisdiction through lowering the strength of regulation is relatively small, either because the relocating firm does not pose a great threat to welfare, or because the relocating firm leaves the systemic risk behind in the home jurisdiction. If these conditions do not hold the race to the bottom may be mitigated, as illustrated by case B. This is a case where δ matters, but the effect is that it becomes more likely that there exist equilibria in addition to the equilibrium where both regulators regulate with minimum strength rules, the greater the value of δ (i.e. the greater fraction of the externality relocates with the firm). This plays no role for the comparison of welfare, as set out in the following result.

Proposition 6 (Optimal Regulatory Harmonisation): *If the regulators are otherwise indifferent between systems in autarky, rules based regulatory harmonisation produces greater welfare than principles based regulatory harmonisation.*

The intuition is linked to the fact that a switch from autarky to competition has a dramatic impact for the principles based systems. The regulator's choice in a principles based system is binary: whether to include a non-systemic firm in the ambiguity zone or a systemic firm. In autarky, the regulator always prefers to include a non-systemic firm so that no firm produces the externality E^* in equilibrium. Faced with regulatory competition from another regulator applying a principles based system the regulator prefers to include a systemic firm, so that all firms in the ambiguity zone produces the externality E^*, regardless of what the other regulator does. The cost of the race to the bottom is felt very severely under principles based regulation. Under rules based regulation the cost of the externality enters the decision problem for the regulator such that the cost of under regulation, i.e. the cost of allowing the externality E^* to be produced, is balanced against the cost of over regulation. i.e. the cost of the change in operations $\varphi = V^* - \bar{V}$. This choice is not binary, but rather a trade-off between the mass of firms on the margin being over regulated against the mass of firms being under regulated. Faced with regulatory competition the mass of firms on the margin being over regulated will decrease since they have an option to migrate into another jurisdiction, but the welfare loss is felt less severely since not all firms produce externalities in autarky, and not all firms are able to produce externalities under regulatory competition. The regulator will in therefore even in autarky incur some costs linked to under regulation. The race to the bottom will lead to greater costs of under regulation but this is only one component.

There are two things that stand out from the analysis in this section. The first is the race to the bottom effect that is in play regardless of which system is used. In general this tends to lower welfare, so it is a relevant concern that measures are taken to prevent the problem of regulatory arbitrage. International coordination of financial regulation is an obvious potential fix to this problem. The second is that the regulators can reduce the effect of the race to the bottom by choosing a rules based system instead of a principles based system. Therefore, in order that principles based regulation is the optimal system for regulators it needs to do more than just compete in autarky – it needs to be better than a rules based systems in autarky to compensate for the welfare loss associated with regulatory competition.

3.2 Competition Between Systems

The analysis so far has assumed that a regulator applying a principles based system of regulation will always face competition from another regulator also applying a principles based system, and a regulatory applying a rules based system of regulation will always face competition from another regulator also applying a rules based system. To complete the picture, therefore, we extend the analysis in this section to the case where a principles based system competes with a rules based system. This case turns out to be messier than the previous cases but the following result is relatively clean, however. This illustrates that the race to the bottom effect of regulatory competition carries over to the case of competition between systems.

Proposition 7 (Regulatory Diversity): *If E^* is sufficiently small relative to V^*, specifically $(1+\delta)E^* < V^*$, the weakest form of regulation $a^* = 0$ and $b^* = \theta$ is always an equilibrium.*

The condition outlined in Case A of Proposition 5 is similar to the condition outlined in Proposition 7, and it has the same effect. In Case A of Proposition 5, if the externalities are small the cost of weak regulation with rules is low, so in equilibrium the regulator choose to set the strength b minimal. Exactly the same reasoning is behind the condition in Proposition 7. For the principles based regulator minimum strength is always optimal whenever the competing regulator chooses minimum strength rules. Unlike the case of competition within systems, there is always some regulatory arbitrage taking place in equilibrium. Firms, therefore, relocate from one jurisdiction to another in equilibrium and the welfare effects of these relocations depend closely on the model parameters. Whether such regulatory arbitrage is harmful to welfare is an issue that needs to be investigated further. Since the regulators cannot commit to any regulatory action we need to allow for the possibility that they can choose to harmonise their regulation, i.e. they may choose the same regime. We find the following result.

Proposition 8 (Equilibrium Regulation): *Assume the regulators are indifferent between systems in autarky, and also assume that in any equilibrium the weakest form of regulation, i.e. that* $a^* = 0$ *and* $b^* = \theta$*, is played (*$(1+\delta)E^* < V^*$ *is sufficient for this assumption).*

If $\epsilon \geq \nu$ *then (i)* $\frac{\epsilon}{\nu} \geq \kappa_2$ *and we get principles based harmonisation; (ii)* $\kappa_1 \leq \frac{\epsilon}{\nu} \leq \kappa_2$ *and we get principles based or rules based harmonisation (either is an equilibrium); or (iii)* $\frac{\epsilon}{\nu} \leq \kappa_1$ *and we get rules based harmonisation. The total welfare for principles based harmonisation is less than the total welfare for regulatory diversity, which in turn is less that the total welfare for rules based harmonisation. If* $\epsilon < \nu$ *we always get rules based harmonisation. The total welfare for rules based harmonisation is greater than the* *total welfare for regulatory diversity. The numbers* $1 \leq \kappa_1 < \kappa_2$ *are given by the following.*

$$\kappa_1 = \frac{V^* - \delta E^*}{V^* - \delta E^* - \gamma} \tag{8.a}$$

$$\kappa_2 = \frac{V^* - \left(\frac{1}{2} + \delta\right) E^* + \frac{\varphi}{2} - \gamma}{V^* - (1+\delta)E^* + \varphi - 2\gamma} \tag{8.b}$$

The condition in that the regulators are indifferent between systems in autarky implies that they would do better to harmonise to a rules based system than to a principles based system if this were their only choice. However, because they can choose regulation independently, regulation by principles may be welfare optimal whether the other regulator uses principles or rules. Proposition 8 shows that we always get regulatory harmonisation, but when $\epsilon \geq \nu$ the wrong type of harmonisation may be the only equilibrium and in this case regulatory diversity can actually be desirable. When $\nu \geq \epsilon$ we get the right type of harmonisation and regulatory diversity can here be harmful.

For this result the parameter δ matters. We can confirm that $\frac{d\kappa_1}{d\delta}$, $\frac{d\kappa_2}{d\delta}$ are both positive, so the threshold values increase as δ increases. Such an increase reduces the number of instances where harmful principles based harmonisation is chosen, keeping all other parameters the same.

The relative magnitudes of ϵ and ν will not have impact on the inherent desirability of the principles and rules based systems of regulation directly, since we assume that the systems are equally efficient in autarky (other parameters cancel out the changes to ϵ and ν). But it is nonetheless interesting that in equilibrium harmonisation to rules based systems is an equilibrium for ϵ is small relative to ν. In this case the ambiguity region under principles based regulation is also small and the ability to write regulatory rules that separate the systemic firms from the non-systemic firms is relatively weak. This effect appears counter intuitive but can be understood in the context of the constraint that the regulators are indifferent in autarky. Rules based harmonisation becomes equilibrium if it is optimal to choose rules regardless of what the other regulator does. If we start from a situation where the regulators operate regulatory diversity, the effect of a reduction in φ is an increase in the welfare for both the principles based and the rules based regulator because regulation becomes cheaper. Because ν increases, however, there will also be an inflow of new business to the rules based regulator at the expense of the principles based regulator. Therefore, there is a loss of welfare for the principles based regulator and a gain of welfare for the rules based regulator that can be attributed to regulatory arbitrage activity. For large values of ν therefore, it becomes less attractive to play principles based regulation. This is the main intuition explaining why we get rules based regulation even if the ability to write effective rules may not be very high compared to the ability to formulate sharp principles. The same intuition is in play explaining why we get principles based harmonisation. The cases where this happens are characterised by large values of ϵ relative to ν, and principles based regulation becomes attractive because the large ambiguity area is an important means of attracting business from other jurisdictions.

4 Lobbying

In this section we extend the analysis to look at the issue of corporate lobbying. Note that if the regulators are truly welfare maximisers the resources spent on lobbying will never lead to changes to regulation that reduce welfare. Since lobbying is an empirical fact it is nonetheless of interest to investigate in which direction regulation should take in order to increase the corporate profits.[5] It is unclear a priori which system the corporate sector would prefer, but this is a question that can be addressed in our framework.

[5] In 2007, for instance, a group of financial firms argued that the US financial regulation should make a switch to a principles based form of regulation.

Since lobbying would be paid for by corporate profits, a measure of lobbying direction would be the structure of regulation that generates the greatest corporate profits. Denote corporate profits by $\Pi(a)$ in a principles based system when the regulator chooses strength a, and $\Pi(b)$ in a rules based system when the regulator chooses strength b.

4.1 Lobbying in Autarky

The corporate profits under a principles based regime can be written as

$$\begin{aligned}\Pi(a) &= \int_0^{\theta-(\epsilon-a)} (V^* - \varphi)dy + \int_{\theta-(\epsilon-a)}^{\theta+a} (V^- \gamma)dy + \int_{\theta+a}^{1} V^* dy \\ &= V^* - \varphi\theta + (\varphi - \gamma)\epsilon - \varphi a \qquad (9)\end{aligned}$$

The corporate profits under a rules based regime can be written as

$$\begin{aligned}\Pi(b) &= \int_0^{\frac{b-\theta}{\nu}} \left(\int_0^{b-\nu x} (V^* - \varphi)dy + \int_{b-\nu x}^{1} V^* dy\right) dx + \int_{\frac{b-\theta}{\nu}}^{1} \left(\int_0^{b-\nu x} (V^* - \varphi)dy + \int_{b-\nu x}^{1} V^* dy\right) dx \\ &= V^* + \varphi\frac{\nu}{2} - \varphi b \qquad (10)\end{aligned}$$

We find the following result.

Proposition 9 (Lobbying in Autarky): *Corporate profits are always increasing when the strength of regulation is weakened in autarky. If the regulator calibrates regulation to maximise welfare, and if the regulator is indifferent between systems, the corporate profits are greater under a rules based system than under a principles based system.*

The first part follows essentially because regulation is costly for the firms so the weaker the regulation the greater the corporate profits. In a principles based system the regulator always finds it optimal to increase the strength of regulation, since the cost of including a non-systemic firm in the ambiguity zone is zero and the benefit of excluding a systemic firm is that the firm stops producing the externality net of compliance costs. For the corporate sector the trade off is negative. The cost of including a non-systemic firm in the ambiguity zone is zero, and the cost of excluding a systemic is that the firm incurs compliance costs. In a rules based systems the regulator faces a trade-off between making non-systemic firms incur compliance costs, and stopping systemic firms producing the externality. For the firms there is no benefit to stronger regulation so again this trade off is always negative. The intuition for the second part is as follows. The welfare is the sum of the corporate profits and the welfare losses associated with regulatory failures. If the sum of the two are identical so the regulators are indifferent, the firms would prefer the rules based systems because a part of the welfare losses associated with regulatory failures, the the ambiguity cost (represented by the parameter γ in our model), is paid for by corporate profits. In a rules based system the cost of the regulatory failures is borne by society.

4.2 Lobbying within Systems

The corporate profits under competition between two principles based systems can be written as (using the convention that the home jurisdiction is i and the foreign jurisdiction is j) a function of a_i taking a_j

as given:

$$
\begin{aligned}
\Pi(a_i) &= V^* - \varphi\theta + (\varphi - \gamma)\epsilon - \varphi a_i + \mathbb{I}(a_i < a_j)\left(\int_{\theta+a_i}^{\theta+a_j} V^* dy + \int_{\theta-(\epsilon-a_i)}^{\theta-(\epsilon-a_j)} (V^* - \gamma)dy\right) \\
&+ \mathbb{I}(a_i \geq a_j)\left(\int_{\theta+a_j}^{\theta+a_i} (\gamma - V^*)dy + \int_{\theta-(\epsilon-a_j)}^{\theta-(\epsilon-a_i)} (\varphi - V^*)dy\right) \\
&= V^* - \varphi\theta + (\varphi - \gamma)\epsilon - \varphi a_i + \mathbb{I}(a_i < a_j)(2V^*(a_j - a_i) - \gamma(a_j - a_i)) \\
&+ \mathbb{I}(a_i \geq a_j)(2V^*(a_j - a_i) - (\gamma + \varphi)(a_j - a_i)) \qquad (11)
\end{aligned}
$$

Similarly, the corporate profits under competition between two rules based systems can be written as (using the same convention as above) a function of b_i taking b_j as given:

$$
\begin{aligned}
\Pi(b_i) &= V^* + \varphi\frac{\nu}{2} - \varphi b_i + \mathbb{I}(b_i < b_j)\left(\int_0^1 \int_{b_i-\nu x}^{b_j-\nu x} V^* dydx\right) + \mathbb{I}(b_i \geq b_j)\left(\int_0^1 \int_{b_j-\nu x}^{b_i-\nu x} (\varphi - V^*)dydx\right) \\
&= V^* + \varphi\frac{\nu}{2} - \varphi b_i + \mathbb{I}(b_i < b_j)V^*(b_j - b_i) + \mathbb{I}(b_i \geq b_j)(\varphi - V^*)(b_i - b_j) \qquad (12)
\end{aligned}
$$

We find, therefore, the following result.

Proposition 10 (Lobbying within Systems): *Corporate profits are always increasing when the strength of regulation is weakened. If the regulators play a competitive equilibrium and if they would have been indifferent between systems in autarky, there exists an $\bar{\gamma} \in (0, \varphi)$ such that the corporate sector prefer a principles based system if $\gamma < \bar{\gamma}$. The prefer a rules based system if $\gamma > \bar{\gamma}$ and $(1 + \delta)E^* \leq V^* + \theta$. In all other situations the answer depends in part on which equilibrium is played when the regulators compete in rules based systems.*

The prime determinant of corporate lobbying is the ambiguity cost γ. It is not difficult to understand why γ should play this role as this cost is borne by the firms. The regulation is already at minimal strength owing to the race to the bottom effect, so a minimum number of firms incur compliance cost, hence the relative size of the ambiguity cost is key. As mentioned in the introduction we saw several instances of powerful corporate groups lobbying for principles based systems of financial regulation in the run-up to the crisis in 2007-08. The perception of the ambiguity costs in such systems may therefore have been that they were cheap, which can be socially harmful in industries where the systemic externality is large (Proposition 6).

4.3 Lobbying for Regulatory Diversity

In this subsection we look at the corporate profits when the two regulators regulate with different systems. We know that this is never an equilibrium within the context of the model when the regulators are indifferent between systems in autarky, so this case is of interest mainly for reference. Our main finding can be summarised as follows.

Proposition 11 (Regulatory Diversity): *Assume that in autarky the regulators are indifferent between systems, and also assume that the weakest form of regulation* $a^* = 0$ *and* $b^* = \theta$ *is always played in equilibrium. Total corporate profits are always maximal with regulatory diversity so lobbying efforts are likely to be directed away from regulatory harmonisation.*

Corporations can always do better with access to diverse systems of regulation than when the regulators harmonise regulation. The intuition is that regulatory diversity gives corporations the option to switch regulator to one that gives them more lenient treatment. Lobbying efforts directed towards regulatory diversity is not necessarily at odds with improving welfare as the regulators may prefer harmful regulatory harmonisation. However, if the regulators chooses welfare maximal harmonisation in equilibrium such lobbying is of course not helpful. The parameter δ does not influence the direction of corporate lobbying. This is intuitive as the corporate sector is unaffected by this parameter.

5 Conclusions

The paper analyses the relative strength and weaknesses of principles based and rules based regulatory systems under regulatory competition. We find that regulatory competition leads to a harmful race to the bottom effect, driven by the possibility of regulatory arbitrage. In equilibrium the regulators will however choose to harmonise their regulation, but surprisingly such harmonisation can also be harmful because the regulators choose to harmonise to the "wrong" system. The welfare losses with principles based harmonisation are greater than with rules based harmonisation. This effect arises from a dramatic shift in the strength of regulation in the principles based systems, from maximum strength in autarky to minimum strength under competition. International coordination of regulation can therefore play an important role even if individual regulators care about welfare maximisation within their jurisdictions.

We also study lobbying activity. In the rules based systems the regulator writes the "rule-book" and the firms comply, whereas in the principles based systems the firms are more involved with regulation in the sense they need to document how their decisions are consistent with the outcomes of regulation. In autarky, therefore, the corporate sector prefers rules based system if the regulator is otherwise indifferent between systems. However, under competition the corporate sector prefers regulatory diversity. If the regulators choose harmful regulatory harmonisation such lobbying activity can be helpful. If the ambiguity cost of principles based regulation is high (the parameter γ) lobbying can be directed towards rules based harmonisation if the alternative is principles based harmonisation. Such lobbying efforts are also likely to improve welfare. We find therefore that both the corporate sector, as well as international efforts to coordinate regulation, can play important roles in shaping regulation. Our results are derived using the crucial assumption that the regulators would be indifferent between systems in autarky which of course is violated if one system is inherently superior to the other. We do not address this important issue in this paper but refer the reader to Dye and Sunder (2001) and Benston et al. (2006) who analyse the inherent costs and benefits of rules based and principles based regulation.

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Appendix A: Overview of Notation

x	Firm's observable type
y	Firm's true type
θ	Parameter that separates the systemic firms ($y < \theta$) from the non-systemic ones ($y \geq \theta$)
V^*	Firm profits produced by unregulated firms
E^*	Social cost (externality) produced by unregulated firms
θ	Cutoff between systemic ($y < \theta$) and non-systemic ($y \geq \theta$) firms
a	Strength of principles based regulation
b	Strength of rules based regulation
ϵ	Parameter describing the lack of precision for a principles based system
ν	Parameter describing the ability to write effective rules for a rules based system
δ	Parameter describing the links between a relocating firm and its home jurisdiction
φ	Cost of complying with regulation
γ	Cost of avoiding compliance to a principles based system
$\Pi_S(a)$	Social welfare for a regulator operating a principles based system with strength a
$\Pi_S(b)$	Social welfare for a regulator operating a rules based system with strength b
$\Pi(a)$	Corporate profits under a principles based system with strength a
$\Pi(b)$	Corporate profits under a rules based system with strength b

Appendix B: Proofs

Proof of Proposition 1: The marginal welfare in a is always positive, $\frac{d}{da}\Pi_S(a) = E^* - \varphi > 0$. $\square$

Proof of Proposition 2: The first order condition for welfare maximization is $\frac{d}{db}\Pi_S(b) = (E^* - \varphi) - E^* \frac{b-\theta}{\nu} = 0$, which implies the result. Minimum strength regulation is $b = \theta$ and maximum strength is $b = \theta + \nu$, so the optimal regulation is in the intermediate range between the two. □

Proof of Proposition 3: The welfare under optimal principles based regulation is $\Pi_S(a^*) = V^* - \varphi\theta - \gamma\epsilon$ and the welfare under optimal rules based regulation is $\Pi_S(b^*) = V^* - \varphi\theta - \frac{\nu\varphi}{2}\left(1 - \frac{\varphi}{E^*}\right)$. Equalling the two and solving with respect to ϵ yields the result. □

Proof of Proposition 4: Take the marginal welfare in the regulator's own action a_i and we find $\frac{d}{da_i}\Pi^i_S(a_i) = (E^* - \varphi) - \mathbb{I}(a_i < a_j)(2V^* - \gamma - \delta E^*) - \mathbb{I}(a_i \geq a_j)(2V^* - \gamma - \varphi + (1-\delta)E^*)$, where $\mathbb{I}$ are indicator functions. If $a_i < a_j$ this expression equals $(1+\delta)E^* - 2V^* - \varphi + \gamma$ which is negative for all $\delta \in (0,1]$, and if $a_i \geq a_j$ this expression equals $\delta E^* - 2V^* + \gamma$ which also is negative for all $\delta \in (0,1]$. □

Proof of Proposition 5: We can work out the marginal welfare from the expressions in (4):

$$\frac{d}{db_i}\Pi^i_S(b_i) = \begin{cases} (1+\delta)E^*\left(1 - \frac{b_i - \theta}{\nu}\right) - (V^* + \varphi) & \text{for } b_i < b_j \\ \delta E^*\left(1 - \frac{b_i - \theta}{\nu}\right) - V^* & \text{for } b_i \geq b_j \end{cases} \tag{B.1}$$

The marginal welfare is decreasing in b_i, $\frac{d^2\Pi^i_S(b_i)}{db_i^2} < 0$, and it is always negative for $b_i \geq b_j$, $\left.\frac{d\Pi^i_S(b_i)}{db_i}\right|_{b_i \geq b_j} < 0$. Therefore, the regulator has never an incentive to regulate with greater strength than its opponent. If the marginal utility is always negative, which happens if the condition for Case A is satisfied, the only equilibrium is the corner solution $b_i^* = b_j^* = \theta$. If the marginal utility is positive for some $b_i < b_j$, the marginal utility will change sign from positive to negative as b_i runs through the barrier b_j. Therefore, for given such b_j, $b_i = b_j$ is the best response, and this constitutes an equilibrium. This is possible for all $b_j \in \left(\theta, \theta + \nu\left(1 - \frac{V^* + \varphi}{(1+\delta)E^*}\right)\right)$, and this proves Case B. Finally, since all equilibria are of the type $b_i = b_j = b$, the welfare is given by the autarky welfare $\Pi_S(b)$ which is increasing for all $b < \theta + \nu\left(1 - \frac{\varphi}{E^*}\right)$. We can easily see that $\frac{\varphi}{E^*} < \frac{V^* + \varphi}{(1+\delta)E^*}$ so it follows that the welfare is increasing in the strength of regulation. □

Proof of Proposition 6: It suffices to compare the welfare under principles based regulation (where $a_i^* = a_j^* = 0$) with that under rules based regulation for the worst case (where $b_i^* = b_j^* = \theta$). The welfare under principles based regulation is $\Pi_0 = V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)\epsilon$. The welfare under rules based regulation for the worst case is $\Pi_0 + \Delta_1 = V^* - E^*\theta - \frac{(E^*-\varphi)\nu}{2} + (E^* - \varphi)\theta$, so $\Delta_1 = \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right)$. It suffices to show that $\Delta_1 > 0$. We find $\Delta_1 > 0 \Leftrightarrow (\gamma + (E^* - \varphi))\epsilon > (E^* - \varphi)\frac{\nu}{2} \Leftrightarrow (\gamma + (E^* - \varphi))\frac{\nu}{2}\frac{\varphi}{\gamma}\left(1 - \frac{\varphi}{E^*}\right) > (E^* - \varphi)\frac{\nu}{2}$, where the latter expression comes from the assumption that the regulators are indifferent between systems in autarky, or $\epsilon = \frac{\nu}{2}\frac{\varphi}{\gamma}\left(1 - \frac{\varphi}{E^*}\right)$. Eliminating terms are rearranging the latter expression, we find $(\gamma + (E^* - \varphi))\frac{\nu}{2}\frac{\varphi}{\gamma}\left(1 - \frac{\varphi}{E^*}\right) > (E^* - \varphi)\frac{\nu}{2} \Leftrightarrow E^* > \varphi$, which is always true since E^* is much greater than φ. $\square$

Proof of Proposition 7: It suffices to show that $\frac{d}{da}\Pi_S(a) \leq 0$ for all a conditional on $b = \theta$, and $\frac{d}{db}\Pi_S(b) \leq 0$ for all b conditional on $a = 0$.

Consider first $\Pi_S(a)$ conditional on $b = \theta$. We can write the regulator's welfare function as the autarky welfare plus the welfare effects that arise from regulatory arbitrage, and we find

$$
\begin{aligned}
\Pi_S(a) = {} & V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)(\epsilon - a) \\
& + \mathbb{I}(\epsilon - a \geq \nu)\int_0^1 \left(\int_\theta^{\theta+a}(\gamma - V^*)dy + \int_{\theta-\nu x}^{\theta}(\gamma - V^* + \delta E^*)dy + \int_{\theta-\epsilon+a}^{\theta-\nu x}(V^* - \gamma - \delta E^*)dy\right)dx \\
& + \mathbb{I}(\epsilon - a < \nu)\int_0^{\frac{\epsilon}{\nu}} \left(\int_{\theta-\epsilon+a}^{\theta-\nu x}(V^* - \gamma - \delta E^*)dy + \int_{\theta-\nu x}^{\theta}(\gamma - V^* + \delta E^*)dy + \int_\theta^{\theta+a}(\gamma - V^*)dy\right)dx \\
& + \mathbb{I}(\epsilon - a < \nu)\int_{\frac{\epsilon}{\nu}}^1 \left(\int_{\theta-\nu x}^{\theta-\epsilon+a}(\varphi - V^* - (1-\delta)E^*)dy + \int_{\theta-\epsilon+a}^{\theta}(\gamma - V^* + \delta E^*)dy + \int_\theta^{\theta+a}(\gamma - V^*)dy\right)dx \\
= {} & V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)(\epsilon - a) \\
& + \mathbb{I}(\epsilon - a \geq \nu)\left((2\gamma - 2V^* + \delta E^*)a + \text{terms that do not depend on } a\right) \\
& + \mathbb{I}(\epsilon - a < \nu)\left((\varphi - V^* - E^*)a - (\varphi - 2\gamma + V^* - (1+\delta)E^*)\frac{(\epsilon - a)^2}{2\nu} + \text{terms that do not depend on } a\right)
\end{aligned}
\tag{B.2}
$$

For case one, we find $\frac{d}{da}\Pi_S(a) = (E^* - \varphi) + \mathbb{I}(\epsilon - a \geq \nu)(2\gamma - 2V^* + \delta E^*) + \mathbb{I}(\epsilon - a < \nu)\left((\varphi - V^* - E^*) - (\varphi - 2\gamma + V^* - (1+\delta)E^*)\frac{\epsilon - a}{\nu}\right)$ which by inspection is negative so $a^* = 0$.

Now turn to $\Pi_S(b)$ conditional on $a = 0$. Using a similar approach we find

$$
\begin{aligned}
\Pi_S(b) = V^* - E^*\theta - (E^* - \varphi)\frac{\nu}{2} + (E^* - \varphi)b - E^*\frac{(b-\theta)^2}{2\nu} \\
&+ \mathbb{I}(\theta - \epsilon \le b - \nu)\left(\int_0^{\frac{b-\theta}{\nu}} \int_\theta^{b-\nu x} (\varphi - V^*)dydx + \int_{\frac{b-\theta}{\nu}}^1 \int_{b-\nu x}^\theta (V^* - \delta E^*)dydx \right. \\
&\left. + \int_0^{\frac{b-\theta}{\nu}} \int_{\theta-\epsilon}^\theta (\varphi - V^* - (1-\delta)E^*)dydx + \int_0^1 \int_{\theta-\epsilon}^{b-\nu x} (\varphi - V^* - (1-\delta)E^*)dydx \right) \\
&+ \mathbb{I}(\theta - \epsilon > b - \nu)\left(\int_0^{\frac{b-\theta}{\nu}} \int_\theta^{b-\nu x} (\varphi - V^*)dydx + \int_{\frac{b-\theta}{\nu}}^1 \int_{b-\nu x}^\theta (V^* - \delta E^*)dydx \right. \\
&\left. + \int_0^{\frac{b-\theta}{\nu}} \int_{\theta-\epsilon}^\theta (\varphi - V^* - (1-\delta)E^*)dydx + \int_{\frac{b-\theta}{\nu}}^{\frac{b-\theta+\epsilon}{\nu}} \int_{\theta-\epsilon}^{b-\nu x} (\varphi - V^* - (1-\delta)E^*)dydx \right) \\
&= V^* - E^*\theta - (E^* - \varphi)\frac{\nu}{2} + (E^* - \varphi)b - E^*\frac{(b-\theta)^2}{2\nu} \\
&+ \mathbb{I}(\theta - \epsilon \le b - \nu)\left((\varphi - 2V^* - (1-2\delta)E^*)b + (V^* + (1-2\delta)E^*)\frac{(b-\theta)^2}{2\nu} + \text{terms that do not depend on } b\right) \\
&+ \mathbb{I}(\theta - \epsilon > b - \nu)\left(-(V^* - \delta E^*)b + 2(\varphi - V^* - (1-\delta)E^*)\frac{\epsilon}{\nu}b + (\varphi - V^* - E^*)\frac{(b-\theta)^2}{2\nu} \right. \\
&\left. - (\varphi - V^* - (1-\delta)E^*)\frac{(b-\theta+\epsilon)^2}{2\nu} + \text{terms that do not depend on } b\right)
\end{aligned}
\tag{B.3}
$$

The derivative $\frac{d\Pi_S(b)}{db} = E^* - \varphi - E^*\frac{b-\theta}{\nu} + \mathbb{I}(\theta - \epsilon \le b - \nu)\left(\varphi - 2V^* - E^* + 2\delta E^* + (V^* + E^* - 2\delta E^*)\frac{b-\theta}{\nu}\right) + \mathbb{I}(\theta - \epsilon > b - \nu)\left(-V^* + \delta E^* + (\varphi - V^* - E^* + \delta E^*)\frac{\epsilon}{\nu} - \delta E^*\frac{b-\theta}{\nu}\right)$. For $\theta - \epsilon \le b - \nu$ the expression is negative, which can be confirmed by checking the maximum value $b = \theta + \nu$, where the derivative equals $-V^*$, and the minimum value $b = \theta$, where the derivative is $-2V^* + 2\delta E^*$. Both values are negative and since the derivative is linear in b all intermediate values must also be negative. For $\theta - \epsilon > b - \nu$ we find that the derivative equals $E^*\left(1 - \frac{\epsilon}{\nu}\right) - \varphi\left(1 - \frac{\epsilon}{\nu}\right) - V^*\left(1 + \frac{\epsilon}{\nu}\right) + \delta E^*\left(1 + \frac{\epsilon}{\nu}\right) - (1+\delta)E^*\frac{b-\theta}{\nu}$. This expression is decreasing in b so it suffices to check at the point where b is minimal, or $b = \theta$. The derivative is here negative if $(1+\delta)E^* - V^* - \varphi < (V^* - \delta E^*)\frac{2\epsilon}{\nu - \epsilon}$. The right hand side is positive but can become arbitrarily close to zero, so if $(1+\delta)E^* - V^*$ is negative the left hand side is always negative. □

Proof of Proposition 8: Assume first that $\epsilon \ge \nu$. Under principles based harmonisation the welfare levels are (using the notation introduced in the proof of Proposition 6) $\Pi_0 = V^* - \varphi\theta - \gamma\epsilon - (E^* - \varphi)\epsilon$. If both regulators switch to rules based harmonisation the welfare levels are (using (7)) $\Pi_0 + \Delta_1 = V^* - \varphi\theta - (E^* - \varphi)\frac{\nu}{2}$. Therefore, the gain Δ_1 can be calculated as

$$\Delta_1 = \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \tag{B.4}$$

which we know from Proposition 6 is positive. Under regulatory diversity, the principles based regulator earns welfare (using (B.2)) $\Pi_0 + \Delta_2$, where

$$\Delta_2 = (\gamma - V^* + \delta E^*)(\nu - \epsilon) \tag{B.5}$$

which by the assumption that $\epsilon \geq \nu$ is positive. Under regulatory diversity, the rules based regulator earns welfare (using (B.3)) $\Pi_0 + \Delta_1 + \Delta_3$, where

$$\Delta_3 = (V^* - \delta E^*)(\nu - \epsilon) - (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \tag{B.6}$$

which by the assumption that $\epsilon \geq \nu$ is negative. Therefore, we get rules based harmonisation as an equilibrium if $\Delta_1 \geq \Delta_2$ and $\Delta_1 \geq -\Delta_3$ or if $\Delta_1 \geq \Delta_2$ and $-\Delta_3 \geq \Delta_1$; we get principles based regulation as an equilibrium if $\Delta_2 \geq \Delta_1$ and $-\Delta_3 \geq \Delta_1$ or if $\Delta_1 \geq \Delta_2$ and $-\Delta_3 \geq \Delta_1$, and we get regulatory diversity as an equilibrium if $\Delta_2 \geq \Delta_1$ and $\Delta_1 \geq -\Delta_3$. We check these conditions in turn. First,

$$\begin{aligned}
-\Delta_3 \geq \Delta_1 &\Leftrightarrow (V^* - \delta E^*)(\epsilon - \nu) + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \geq \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \\
&\Leftrightarrow (V^* - \delta E^* - \gamma)\epsilon \geq (V^* - \delta E^*)\nu \\
&\Leftrightarrow \frac{\epsilon}{\nu} \geq \frac{V^* - \delta E^*}{V^* - \delta E^* - \gamma} = \kappa_1
\end{aligned} \tag{B.7}$$

The right hand side, κ_1, is strictly greater than one so does not conflict with the assumption that $\epsilon \geq \nu$. Next,

$$\begin{aligned}
\Delta_1 \geq \Delta_2 &\Leftrightarrow \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \geq (\gamma - V^* + \delta E^*)(\nu - \epsilon) \\
&\Leftrightarrow (V^* - (1+\delta)E^* + \varphi - 2\gamma)\epsilon \leq \left(V^* - \left(\frac{1}{2} + \delta\right)E^* + \frac{\varphi}{2} - \gamma\right)\nu \\
&\Leftrightarrow \frac{\epsilon}{\nu} \leq \frac{V^* - \left(\frac{1}{2} + \delta\right)E^* + \frac{\varphi}{2} - \gamma}{V^* - (1+\delta)E^* + \varphi - 2\gamma} = \kappa_2
\end{aligned} \tag{B.8}$$

The right hand side, κ_2, is also strictly greater than one so does not conflict with the assumption that $\epsilon \geq \nu$. We can, moreover, work out that $\kappa_1 < \kappa_2$:

$$\kappa_1 < \kappa_2 \Leftrightarrow \frac{V^* - \delta E^*}{V^* - \delta E^* - \gamma} < \frac{V^* - \left(\frac{1}{2} + \delta\right) E^* + \frac{\varphi}{2} - \gamma}{V^* - (1+\delta)E^* + \varphi - 2\gamma}$$
$$\Leftrightarrow -(V^* - \delta E^*)\frac{1}{2}(E^* - \varphi) < \gamma \frac{1}{2}(E^* - \varphi) + \gamma^2 \tag{B.9}$$

which is always true because the left hand side is strictly negative and the right hand side strictly positive. Therefore, the equilibrium candidates are (i) $\frac{\epsilon}{\nu} \geq \kappa_2$ and we get principles based harmonisation (here $\frac{\epsilon}{\nu} \geq \kappa_1$ by default); (ii) $\kappa_1 \leq \frac{\epsilon}{\nu} \leq \kappa_2$ and we get principles based or rules based harmonisation (either is an equilibrium); and (iii) $\frac{\epsilon}{\nu} \leq \kappa_1$ and we get rules based harmonisation (here $\frac{\epsilon}{\nu} \leq \kappa_2$ by default). Regulatory diversity is never an equilibrium as it requires $\frac{\epsilon}{\nu} \geq \kappa_2$ and $\frac{\epsilon}{\nu} \leq \kappa_1$ which is not feasible. Also, the total welfare in rules based harmonisation is greater than the total welfare for regulatory diversity as $2\Pi_0 + 2\Delta_1 \geq 2\Pi_0 + \Delta_2 + \Delta_3$, which implies $\Delta_1 \geq \Delta_2 + \Delta_3 \Leftrightarrow \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \geq (V^* - \delta E^*)(\nu - \epsilon) - (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) + (\gamma - V^* + \delta E^*)(\nu - \epsilon) \Leftrightarrow \epsilon \geq \frac{\nu}{2}$ which is always true. Moreover, the total welfare in principles based harmonisation is less than the total welfare for regulatory diversity as $2\Pi_0 \leq 2\Pi_0 + \Delta_1 + \Delta_2 + \Delta_3$, which is equivalent to $-\Delta_2 \leq \Delta_1 + \Delta_2 \Leftrightarrow (V^* - \delta E^*)(\epsilon - \nu) + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \leq \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) + (\gamma - V^* + \delta E^*)(\nu - \epsilon) \Leftrightarrow 0 \leq \gamma\nu$ which is always true.

Now consider the case where $\epsilon < \nu$. We use the same reasoning but the gains corresponding to Δ_2 and Δ_3 will now change, and we denote these by $\hat{\Delta}_2$ and $\hat{\Delta}_3$, respectively. Using (B.2) we find

$$\hat{\Delta}_2 = -(V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) - (E^* - \varphi)\frac{\nu}{2}\left(1 + \frac{\epsilon^2}{\nu^2} - 2\frac{\epsilon}{\nu}\right) + \gamma\epsilon\left(1 - \frac{\epsilon}{\nu}\right)$$
$$< 0 \tag{B.10}$$

Similarly, using (B.3) we find

$$\hat{\Delta}_3 = (V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) - (E^* - \varphi)\frac{\nu}{2}\frac{\epsilon^2}{\nu^2} \tag{B.11}$$

The quantity $\hat{\Delta}_3$ may be positive or negative. Since $\Delta_1 \geq \hat{\Delta}_2$ is always true, thre are two candidates for equilibrium. Either $\Delta_1 \geq -\hat{\Delta}_3$ and we get rules based harmonisation, or $-\hat{\Delta}_3 \geq \Delta_1$ and we get rules based or principles based harmonisation as equilibria. We find

$$\begin{aligned} \Delta_1 \geq -\hat{\Delta}_3 &\Leftrightarrow \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \geq -(V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) + (E^* - \varphi)\frac{\epsilon^2}{2\nu} \\ &\Leftrightarrow \gamma\epsilon + (E^* - \varphi)\frac{\nu}{2}\left(2\frac{\epsilon}{\nu} + \frac{\epsilon^2}{\nu^2} + 1\right) \geq -(V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) \end{aligned} \tag{B.12}$$

We can easily confirm that the inequality on the right hand side is always satisfied for $\frac{\epsilon}{\nu} \in (0,1)$, hence the only feasible equilibrium is rules based harmonisation. Rules based harmonisation yields greater total welfare than regulatory diversity for $2\Pi_0 + 2\Delta_1 \geq 2\Pi_0 + \Delta_1 + \hat{\Delta}_2 + \hat{\Delta}_3$, which is equivalent to $\Delta_1 \geq \hat{\Delta}_2 + \hat{\Delta}_3 \Leftrightarrow \gamma\epsilon + (E^* - \varphi)\left(\epsilon - \frac{\nu}{2}\right) \geq -(V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) - (E^* - \varphi)\frac{\nu}{2}\left(1 + \frac{\epsilon^2}{\nu^2} - 2\frac{\epsilon}{\nu}\right) + \gamma\epsilon\left(1 - \frac{\epsilon}{\nu}\right) + (V^* - \delta E^*)\frac{\nu}{2}\left(1 - \frac{\epsilon^2}{\nu^2}\right) - (E^* - \varphi)\frac{\nu}{2}\frac{\epsilon^2}{\nu^2} \Leftrightarrow \gamma + (E^* - \varphi) \geq 0$, which is always true. $\square$

Proof of Proposition 9: The first part is obvious as we see straight away that $\frac{d}{da}\Pi(a), \frac{d}{db}\Pi(b) < 0$. Recall that the welfare optimal regulation is $a^* = \epsilon$ under a principles based system and $b^* = \theta + \nu\left(1 - \frac{\varphi}{E^*}\right)$ under a rules based system. Therefore we find $\Pi(a^*) = V^* - \varphi\theta - \gamma\epsilon$ and $\Pi(b^*) = V^* - \varphi\theta - \varphi\frac{\nu}{2} + \frac{\varphi^2}{E^*}\nu$. Evaluating the inequality $\Pi(b^*) \geq \Pi(a^*)$ we find $V^* - \varphi\theta - \varphi\frac{\nu}{2} + \frac{\varphi^2}{E^*}\nu \geq V^* - \varphi\theta - \gamma\epsilon$ which reduces to $\epsilon \geq \frac{\varphi}{\gamma}\nu\left(\frac{1}{2} - \frac{\varphi}{E^*}\right)$. We know that when the regulator is indifferent between systems, $\epsilon = \frac{\nu}{2}\frac{\varphi}{\gamma}\left(1 - \frac{\varphi}{E^*}\right)$, therefore if $\frac{\nu}{2}\frac{\varphi}{\gamma}\left(1 - \frac{\varphi}{E^*}\right) \geq \frac{\varphi}{\gamma}\nu\left(\frac{1}{2} - \frac{\varphi}{E^*}\right)$ we are done. We see that the latter inequality reduces to $\frac{1}{2}\left(1 - \frac{\varphi}{E^*}\right) \geq \frac{1}{2} - \frac{\varphi}{E^*}$ which always holds. $\square$

Proof of Proposition 10: The first part follows directly by evaluating the marginal profits $\frac{d}{da_i}\Pi(a_i), \frac{d}{db_i}\Pi(b_i) < 0$. For the second part, it suffices to demonstrate the existence of $\bar{\gamma}$ at the two extreme equilibria under rules based systems, as the corporate profits are monotonically decreasing in b_i. First consider the equilibrium under principles based systems $a_i^* = a_j^* = 0$, which yields $\Pi(0) = V^* - \varphi\theta + (\varphi - \gamma)\epsilon$, and an equilibrium under rules based systems $b_i^* = b_j^* = \theta + \nu\frac{\Delta}{2}$ (where $\theta \leq \theta + \nu\frac{\Delta}{2} \leq \theta + \nu\max\left(0, \left(1 - \frac{V^* + \theta}{(1+\delta)E^*}\right)\right)$), which yields $\Pi(\theta + \nu\frac{\Delta}{2}) = V^* + \varphi\frac{\nu}{2} - \varphi\theta - \varphi\frac{\nu}{2}\Delta$. Assuming the latter is greater than the former yields the inequality $V^* + \varphi\frac{\nu}{2} - \varphi\theta - \varphi\frac{\nu}{2}\Delta \geq V^* - \varphi\theta + (\varphi - \gamma)\epsilon$, which reduces to

$\varphi\frac{\nu}{2}(1-\Delta) \geq (\varphi-\gamma)\epsilon$. Substituting for ϵ (taking into account the restriction of regulatory indifference in autarky) we find $\varphi\frac{\nu}{2}(1-\Delta) \geq (\varphi-\gamma)\frac{\nu}{2}\frac{\varphi}{\gamma}\left(1-\frac{\varphi}{E^*}\right)$, which reduces to $\gamma \geq \varphi\frac{E^*-\varphi}{(2-\Delta)E^*-\varphi}$. In this case, $\bar{\gamma}$ is defined as the right hand side of this inequality with a value strictly less than φ. We can see that $\bar{\gamma} \in (0,\varphi)$ for $\Delta < 1$. Also, we find that the condition $\theta + \nu\frac{\Delta}{2} \leq \theta + \nu \max\left(0, \left(1 - \frac{V^*+\theta}{(1+\delta)E^*}\right)\right)$ can always be satisfied for some $\Delta < 1$. $\square$

Proof of Proposition 11: We know that regulatory diversity leads to some regulatory arbitrage in equilibrium. Therefore, the firms that engage in regulatory arbitrage are always better off than they would be without the ability to relocate to a different regulatory system. If we start from principles based harmonisation a switch to regulatory diversity will benefit the firms that are able to relocate to the new system and leave all other firms equally well off (if they are regulated they pay compliance costs; if they are in the ambiguity zone they pay ambiguity costs, and if they are unregulated they pay zero costs). There is therefore always a net gain that arises from firms saving compliance costs or ambiguity costs. Using the same logic, if we start from rules based harmonisation a switch to regulatory diversity will benefit the firms that are able to relocate to the new system and leave all other firms equally well off. The gain arises from firms saving compliance costs or incur the lower ambiguity cost instead of the higher compliance costs.