TALKING HEADS.

PUBLIC COMMUNICATION POLICIES IN AN INTERNATIONAL ECONOMY

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ABSTRACT

We study a non-cooperative communication game being played by national policymakers in a two-country economy including a beauty-contest argument in the utility function of agents and cross-border technology spillovers. Each policymaker receives some information either solely on the home technology idiosyncratic shock or on both shocks. She has the choice of revealing or not the received signal(s). The equilibrium of the non-cooperative game being played by policymakers may entail revelation, either full or partial, or opacity, full or partial. This crucially depends on the interplay between the size of countries and the strength of the beauty contest motive. From a normative point of view, full or partial opacity may be optimal, showing that the social value of some public information may be negative due to cross-border spillovers. Public information provided by non-cooperative policymakers may be too little or too much.

KEYWORDS

Communication policies, Beauty contest, Public information, Policy games.

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Talking heads.

Public communication policies in an international economy.[1]

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April 16, 2025

Abstract

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JEL Codes : D82, E61

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1 Introduction.

We study a communication game being played by national policymakers in a two-country economy where private agents value behaving as the rest of society, what is known as a beauty-contest argument in the individual utility functions. The striking result of Morris and Shin (2002) (hereafter MS) obtained in a closed economy is that public information may cause excessive volatility in the presence of such a beauty-contest motive. For this reason, transparency may be detrimental in economies with strong strategic complementarity. This result conflicted with the existed consensus among the academicians and practitioners about the benefits of transparency and attracted a lot of attention. Yet this issue has not been studied in the context of multiple jurisdictions and policymakers having to decide whether to disclose what they know or not.

The empirical relevance of the disclosure of public information in an international economy (more broadly, in a multi-jurisdiction economy) can be deduced from various examples. Several international institutions or organizations set guidelines for information disclosure to be used by their members or affiliated institutions. The "Basel Committee on Banking supervision", an offspring of the Bank for International Settlement (BIS), issues in its report (chapter 10) disclosure requirements which aim to encourage market discipline, describing "the scope of application of disclosure requirements, along with requirements on the location, frequency, timing of reporting, assurance considerations and guiding principles on high-quality disclosures".[1] The IMF advocates, both conceptually and empirically, for greater public debt transparency which implicitly shows that there exists some opacity in the management of national public debt.[2] Finally, every government relies on a classification policy for security reasons. Interestingly, this policy may vary over time, in particular because of the recent tendency to adopt freedom of information legislation. For example, the current U.S. classification policy was issued on December 29, 2009, by President Barack

[1]https://www.bis.org/basel-framework/standard/DIS.htm. The European Banking Authority also sets its regulatory framework for transparency to be applied by banks and supervised by national regulators. https://www.eba.europa.eu/regulation-and-policy/transparency-and-pillar-3.

[2]https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/07/28/Making-Debt-Public-Debt-Ongoing-Initiatives-and-Reform-Options-537306

Obama.[3]

Our paper tackles this issue. Our objective is to assess the social value of public informations in a two-country beauty-contest model which captures three important channels between countries. The first channel relies on a technological cross-border spillover between countries. This spillover corresponds to a positive correlation between the technology shocks which hit countries. The second channel is linked to the international strategic complementarity due to a international beauty-contest argument in the utility functions of agents. It is assumed that they have the incentive to mimic the actions of other agents residing not only in their home country but also abroad. Thus, our model can be seen as a model of an international beauty contest. The third channel is based on the disclosure by national policymakers of relevant economic informations when they are equally observed by private agents in both economies.

Given these international channels of interdependence, we study the outcome of a non-cooperative disclosure game being played by the two policymakers. Each policymaker tries to maximize the welfare of her own country. We successively study two cases. Firstly, we assume that each policymaker solely receives an imperfect information about the idiosyncratic shock hitting her country. Secondly, we enlarge our framework, considering that each receives two imperfect information bits on the two country-specific shocks. In both cases, the structure of the game is the same.

At the first stage of the game, policymakers simultaneously decide on their disclosure policy. Their decisions may be either full revelation of all received signals, revelation of one of them, or no revelation at all. After committing to the chosen disclosure strategy, each policymaker receives some imperfect information either on the home technology shock or on both shocks. When she only has information about her country-specific shock, her choice is thus about revealing or not. In the case of a pair of received signals, her choice may be partial revelation, that is, she may publish only one of her signals. Our notion of partial disclosure differs from the notions of partial publicity (Cornand and Heinemann, 2008, Baeriswyl and Cornand, 2014, Myatt and Wallace, 2014) and partial announcement (Arato, Hori and Nakamura, 2021) which both imply that only a fraction

[3] Executive Order 13526, replacing EO 12958 and EO 13292.

of agents receives the public signal. It is also different from the notion of partial transparency (Heinemann and Illing, 2002) which implies that all agents receive an ambiguous public signal. In our model, partial revelation refers to the situation in which a policymaker publishes part of her information, and this signal is equally and perfectly observed by all agents in the economy. Subsequently, private agents, motivated by a beauty-contest argument, make their decisions based on received information, both private and public.

We study the subgame perfect Nash equilibrium (SPNE) of this sequential game. The results of our study are as follows. We show that the characteristics of the SPNE depend on the interplay between the magnitude of the technological spillover and the relative size of countries. In the equilibrium corresponding to the case of a single information received by each policymaker, she adopts a dominant revelation strategy, either opacity or transparency. Countries may adopt different communication policies because of difference in size. For each country, given the beauty-contest parameter, if the size of a given country is lower than a threshold value, its policymaker chooses transparency. This threshold value is increasing in the beauty-contest parameter. The possibility of similar choices by the two policymakers is not ruled out.

Turning to the normative analysis of this case, we prove that the social planner taking equally care of every agent in the (two-country) world economy and able to decide upon which country-specific signal to reveal, may also choose a differentiated communication policy. She chooses transparency about a country-specific shock for a given beauty-contest parameter if the country is sufficiently small. Comparing the equilibrium and the welfare-maximizing outcomes, too little or too much information may be provided in equilibrium.

We then consider an extension of this model, where each policymaker receives an imperfect information on each country-specific shock. This case is studied under the simplifying assumption of equal country sizes. This case differs from the previous one because a new information-related cross-border effect comes into play. If the technological spillover is sufficiently weak, both policymakers are "home-transparent" and "foreign-opaque", revealing their information about their home shock and hiding their information about the foreign shock. However, strategic international complementarity induces private agents to place an inefficiently high weight on the public information about the foreign shock. Thus, the policymaker in a given country conceals her information about the foreign shock in order to prevent the private agents to over-react to this shock: she is inclined to be foreign-opaque. On the contrary, providing information about the home shocks is welfare-improving, as it keeps private actions closer to the relevant composite shock and she is inclined to be home-transparent. As the two policymakers have identical objectives, the resulting non-cooperative equilibrium is "home-transparent" and "foreign-opaque". The opposite logic is true when the technological spillover is extremely strong. In this case, the equilibrium is characterized by home opacity and foreign transparency. In this equilibrium, each policymaker reveals her signal on the foreign shock and is silent about the shock hitting her own economy. For intermediate values of technological spillover, the two opposing effects balance each other and there is full transparency in equilibrium. In this equilibrium policymakers reveal their signals about both shocks. A full opacity equilibrium is not possible in the studied framework: if a policymaker is fully opaque, the other one has at least an interest in being transparent about her foreign information. This is a consequence of the international beauty contest: the home (foreign) policymaker has an incentive to increase the coordination of the home (foreign) agents but to lessen the capacity of foreign (home) agents to coordinate. Lastly, we study the importance of the beauty-contest spillover relative to the technological one as well as its dependence on the relative precisions of the public signals with respect to the private ones.

The analysis of welfare properties of the SPNE shows that partial disclosure is never socially desirable. This is due to the assumption of equal sizes. The social optimum is characterized by either full transparency or full opacity. The latter case shows that the social value of public information may be negative in an international economy. Full opacity is optimal if the technological spillover is sufficiently weak. In this case, both countries are informationally autarkic. Moreover we show that the full transparency equilibrium is Pareto-optimal. The home opacity equilibrium is always dominated by full transparency whereas the foreign opacity equilibrium may be dominated by full opacity. This means that there may be too much or too little public information in equilibrium, depending on the strength of technological and beauty-contest spillovers.

On the whole, the issue of releasing public information is studied both from a positive and a normative point of view. Opacity (no revelation of some public information) is an outcome of the non-cooperative equilibrium, triggered both by the magnitude of the beauty-contest motive and the relative size of countries. It is also the choice made by a utilitarian social planner caring about all residents in the economy. The claim that the social value of public information may be negative is vindicated. The cross-border spillovers generated by public information may be negative enough so that the best choice is not to publicly communicate about shocks. More precisely, the subspace of the parameter space for which it is true is sizable and not restricted to extreme parameter values.

Related literature.

A useful survey of the beauty-contest issue is provided by Angeletos and Lian (2016, sections 7 and 8). The extensive debates about the social value of public and private information in beauty-contest economies, provoked by the Morris and Shin paper, have not ceased. Svensson (2006) questions the main conclusion of Morris and Shin (2002) and claims that this result can only be obtained under unrealistic assumptions about the quality of public information. James and Lawler (2011) debate the criticism of Svensson (2006) and find that transparency is always detrimental in a beauty-contest model if the policymaker governs the economy with both public signals and standard policy instruments. Angeletos and Pavan (2004) agree that transparency may decrease social welfare in environments with strong strategic complementarity, which may lead to multiple equilibria. Hellwig (2005) and Roca (2010) study the welfare effects of public information in models with imperfectly-informed monopolistically competitive firms and claim that public information is always welfare-improving. On the contrary, Walsh (2013) shows that transparency may be detrimental in a New-Keynesian model with aggregate supply and demand shocks while Myatt and Wallace (2008) argue that neither transparency nor opacity are optimal in a world without purely public signals. Angeletos and Pavan (2007) shed some light on the origins of these debates. In a general linear-quadratic framework, they explore a useful classification of economies and summarize conditions under which transparency can be detrimental.

Despite of this diversity of the views, these papers focus on the role of information in closed economies. In these economies, private payoffs are determined by the fundamentals and the strategic coordination inside the economy, without any recourse to the foreign sector. Actually, many markets with strategic complementarity in private actions are nowadays international, e.g. international financial markets. In these markets, investors try to guess not only their home fundamental factors and the actions of their neighbors but also the fundamentals and the actions of foreign investors. In such circumstances, it is not surprising that the public information signals affect the actions of investors in other countries. There is growing evidence that private actions respond to foreign signals. A number of studies reveal a significant impact of the US news on foreign financial markets (see Kim and Sheen, 2000, for Australian markets, Bredin, Gavin and O'Reilly, 2005, for Irish markets, Hausman and Wongswan, 2011, for 49 different countries). Ehrmann and Fratzscher (2005) investigate spillovers between the European Union and the US and find that macroeconomic news affects financial markets both domestically and abroad. Büttner, Hayo and Neuenkirch (2012) and Hanousek, Kočenda and Kutan (2009) find a significant effect of European and U.S. macroeconomic news on financial markets in the Czech Republic, Hungary, and Poland.

Our paper complements the existing literature which studies endogenous information structures. This literature links the endogeneity of informational structure to the informational acquisition of private agents (e.g. Colombo and Femminis, 2008, Van Nieuwerburgh and Veldkamp, 2009, and Colombo, Femminis and Pavan, 2014), learning from prices by private agents (Timmermann, 1993, Banerjee, 2011) or by the central bank (e.g. Morris and Shin, 2005, Bond, Goldstein and Prescott, 2009, Bond and Goldstein, 2015, Boleslavsky, Kelly and Taylor, 2017). In contrast to these studies we explore a new rationale to the endogeneity of informational structure when private agents have access to revealed public information at neither cost nor effort, focusing instead on the behavior of national policymakers. The two-region model of Arato and Nakamura (2013) is close to ours, as they also analyze the inter-country informational spillover effects in a beauty-contest economy. Nevertheless, their model does not allow for technological spillovers between countries and, assuming a single policymaker, does not address the non-cooperative game theoretical setting which is the focus of our paper.

Our paper differs from the literature on creative accounting (Bernoth and Wolff, 2008), strategic forecasting by central banks (Tillmann, 2011; Gomez-Barrero and Parra-Polania, 2014) and the studies of regime change with information manipulation (Edmond, 2013) as we do not discuss cheating equilibria when policymakers publish biased signals on shocks. Moreover, we do not look for cheap-talk equilibria which are studied, for example, in Moscarini (2007).

The rest of the paper is organized as follows. The next section focuses on the case where each policymaker receives an imperfect information on the idiosyncratic shock hitting her country. The following section enlarges the analysis by investigating the case where each policymaker receives different and imperfect informations on the two shocks affecting the two countries. Section 4 concludes. For each case, we characterize the equilibrium corresponding to the non-cooperative game being played between private and public agents, as well as the social optimum chosen by a "world" policymaker with utilitarian preferences. All proofs are contained in the appendix section.

2 The economy with domestic public information.

2.1 The model.

The economy consists of two interdependent countries, indexed by $j \in \{1, 2\}$.[4] The economy is populated by a unit mass of private agents, indexed by i. We assume that agents with $i \in [0, n]$ live in country $j = 1$, while agents with $i \in (n, 1]$ live in country $j = 2$. The size of country j is denoted by n_j and $n_1 + n_2 = 1$. S^j characterizes the population of country j.

[4]More generally, our economy is a two-jurisdiction economy. It could correspond to a two-region federation. We refer to "countries" or "nations" for clarity.

Country j is hit by a composite technology shock Θ^j:

$$\Theta^j = \lambda^j \theta^j + \left(1 - \lambda^j\right) \theta^{-j} \tag{1}$$
$$\theta^j \sim N\left(\mu, \sigma_\theta^2\right)$$

defining

$$\lambda^j = \frac{\phi n_j}{\phi n_j + (1-\phi)(1-n_j)} \tag{2}$$

where θ^j is a idiosyncratic (i.i.d.) shock of country j with mean μ and variance σ_θ^2. In what follows, we assume that μ is equal to zero. This assumption does not affect our results about the value of public information but considerably simplifies the solving of the game. Parameter ϕ in equation (2) characterizes the extent of a cross-border technology spillover. If $\phi = 1$, there is no such spillover and the composite shock of country j is simply the country-specific shock θ^j with $\lambda^j = 1$. If $\phi = 1/2$, the composite shock for country j is equal to the average of the country-specific shocks $n_j\theta^j + n_{-j}\theta^{-j}$ and $\lambda^j = n_j$. In other words, both countries share the same composite shock. If $\phi = 0$, the composite shock of country j is solely equal to the idiosyncratic shock hitting country $-j$. Equation (2) also clarifies the role of country size. If $n_j = 1$, the economy collapses to one country with $\lambda^j = 1$. If countries are of equal size $n^j = 1/2$, the weight associated with the country-specific shock θ^j is solely defined by the technology spillover $\lambda^j = \phi$. In this section, we provide results for $\phi \geq 1/2$.[5]

The true values of the composite shocks are not known by any agent. Nevertheless each private agent i in country j receives a private signal x_i^j on his country-specific shock θ^j:

$$x_i^j = \theta^j + \varepsilon_i^j \tag{3}$$
$$\varepsilon_i^j \sim N\left(0, \sigma_x^2\right)$$

[5]If $\phi < 1/2$, results are much more complex without driving any interesting insight. Computations are available upon request.

where ε_i^j is the noise (i.i.d.) included in the private signal x_i^j and σ_x^{-2} stands for the precision of the private signal. We assume that private agents in country j do not receive any private information about shock θ^{-j} affecting the foreign country $-j$. In each country, there is a policymaker, denoted by $\mathcal{P}_j$ for country j. Each policymaker $\mathcal{P}_j$ receives a distorted value of her country-specific shock. Her information y^j on θ^j is characterized by:

$$\begin{aligned} y^j &= \theta^j + \eta^j, j = 1, 2 \\ \eta^j &\sim N\left(0, \sigma_{y,j}^2\right), j = 1, 2 \end{aligned} \tag{4}$$

where η^j is the noise (i.i.d.) of a signal about shock θ^j, received by $\mathcal{P}_j$, and $\sigma_{y,j}^{-2}$ stands for its precision. η^j and ϵ_i^j are independently distributed. We assume that $\sigma_{y,1}^{-2} = \sigma_{y,2}^{-2} = \sigma_{y,h}^{-2}$ and that the public information about θ^j is more precise than the information received by private agents: $\sigma_{y,h}^{-2} > \sigma_x^{-2}$. This is justified by the fact that policymakers have at their disposal a professional body of statistical agencies and, therefore, a superior capacity to observe shocks.

The payoff function of a representative private agent is formalized by the following private loss function:

$$l_i^j = \left(\frac{1-r}{2}\right)\left(a_i^j - \Theta^j\right)^2 + \frac{r}{2}\left(L_i^j - \overline{L}\right) \tag{5}$$

where a_i^j is a private action of agent i in country j, $L_i^j = \int\limits_0^1 (a_k - a_i^j)^2 \,\mathrm{d}k$ and $\bar{L} = \int\limits_{S^j} L_m^j \,\mathrm{dm} + \int\limits_{S^{-j}} L_m^{-j} \,\mathrm{dm}$. The private loss is defined as the sum of two elements: the squared distance between the private action a_i^j and the composite shock Θ^j, and the average distance between the private action a_i^j and the actions of other agents. The latter element corresponds to a beauty-contest argument. The parameter $r \in [0, 1]$ characterizes the relative strength of the beauty-contest argument in private loss. If r is equal to zero, there is no beauty-contest effect and private actions are defined by the desire to be as close to the composite shock Θ^j as possible. If r is close to one, the beauty-contest effect is so strong that private actions are defined almost entirely by the desire to be close to the actions of others. As we can see from (5), a private agent cares not only about the average distance between his action and the actions of other agents in his home country but also about the distance between his actions and the actions of the agents in the other country. The parameter r characterizes the magnitude of the international beauty contest.[6] This specification of the individual payoff function is a straightforward extension to an international economy of the specification used by Morris and Shin.

The beauty-contest argument in (5) can be rewritten as follows:

$$L_i^j - \overline{L} = n_j \left(\overline{a}^j - a_i^j\right)^2 + n_{-j} \left(\overline{a}^{-j} - a_i^j\right)^2 - n_j \sigma_{a^j}^2 - n_{-j} \sigma_{a^{-j}}^2 - 2 n_j n_{-j} \left(\overline{a}^j - \overline{a}^{-j}\right)^2, \tag{6}$$

where $\overline{a}^j \equiv \left(n^j\right)^{-1} \int_{k \in S^j} a_k^j \, \mathrm{d}k$ is the average private action in country j and $\sigma_{a^j}^2 \equiv \left(n^j\right)^{-1} \int_{k \in S^j} \left(a_k^j - \overline{a}^j\right)^2 \mathrm{d}k$ is the dispersion in private actions in country j. Equation (6) clarifies the factors which contribute to private loss via beauty-contest argument. Due to beauty-contest motives, private agents value negatively the distance to the average action in their domestic country $\overline{a}^j$ and the distance to the average action abroad $\overline{a}^{-j}$. This means that an agent would prefer to keep his action as close to the averages in two countries as possible. According to the three last terms, the private loss depends negatively on variances of actions in each country, $\sigma_{a^j}^2$ and $\sigma_{a^{-j}}^2$, and the inter-country diversity measured by the squared difference between the two averages $\left(\overline{a}^j - \overline{a}^{-j}\right)^2$. These three terms measure the diversity of country-specific and inter-country private actions. It means that an agent prefers to live in a heterogeneous society, even though she cannot affect its diversity, as the three last terms in (6) do not depend on the action of agent i. As we will see later, policymakers on the contrary may affect this diversity and this fact determines the properties of equilibrium. According to (6), the distribution of actions, reflecting the heterogeneity of private information, matters in the interaction between individuals through higher-order expectational effects.[7]

[6] The presence of an international beauty contest differentiates the loss function (5) from the loss function in the two-region model by Arato and Nakamura (2013) who study a region-specific beauty contest.

[7] Baeriswyl and Cornand (2014) use an alternative specification for the payoff function, as they reason on a reduced-form utility function which solely depends on the levels of individual actions and not their variances. Arato and Nakamura (2013) also reason on individual reaction functions which solely depend on the levels of individual actions and thus do not take into consideration their distributions. Angeletos and Pavan (2007) provide a very

Any policymaker is benevolent and utilitarian: her goal is to minimize the sum of private losses of agents residing in her country: $L_{P_j} \equiv \int_{i \in S^j} l_i^j \, \mathrm{d}i$. Thus the public loss of country j is:

$$L_{P_j} = \frac{1-r}{2} \int_{i \in S^j} \left(a_i^j - \Theta^j\right)^2 \mathrm{d}i + \frac{r}{2} \int_{i \in S^j} \left(L_i^j - \overline{L}\right) \mathrm{d}i \tag{7}$$

The public loss of country j is defined by the average squared distance of private actions to the home composite shock and the public beauty-contest argument represented by the second term in (7). Taking into account (6), we rewrite the public beauty-contest argument as follows:

$$\int_{i \in S^j} \left(L_i^j - \overline{L}\right) \mathrm{d}i = n_j n_{-j} \left[\sigma^2_{a^j} - \sigma^2_{a^{-j}} + (1 - 2n_j) \left(\overline{a}^j - \overline{a}^{-j}\right)^2\right] \tag{8}$$

According to (8), the public beauty-contest argument depends positively on the variance of private actions in the home country and negatively on the variance of private actions in the foreign country. Due to the beauty-contest motive, a policymaker is better-off with a lower diversity inside her home country and a higher diversity abroad. Yet, she is better-off with a lower inter-country diversity if her country is large ($n_j > 1/2$). These properties of the public beauty-contest argument result from the aggregation of the private beauty-contest arguments over the population of one country instead of the whole population of the economy. Comparing (8) and (6) highlights the difference between private and public beauty-contest arguments. Private agents value positively the diversity in their domestic region. However, higher domestic diversity on average leads to higher squared distances of actions to the averages in two countries (the first two terms in (6)). This, in turn, increases the public loss and any policymaker values domestic diversity negatively. Similarly, private agents positively value the inter-country diversity measured by the last term in (6). However, higher inter-country diversity makes it more difficult for domestic agents to mimic the foreign average actions. This increases the public loss and compensates the decreasing effect of this factor on the average

general implicit specification of a utility function with beauty contest argument, allowing them to differentiate the various spillover effects due to higher-order expectations. But given the implicit characteristics of this specification, it is impossible to obtain explicit solutions of games and thus make comparisons about the outcomes in different settings which is our goal here.

private losses. The resulting effect of the inter-country component on the public loss depends on the size of the region. A small country ($n_j < 1/2$) does not appreciate the inter-country gap, as $(1 - 2n_j)$ is positive and the loss increases. A large country ($n_j > 1/2$) values the inter-country gap positively as $(1 - 2n_j)$ is then negative and the loss decreases.

For what follows, it is useful to rewrite the expected public loss (7):

$$EL_{P_j} = \frac{1}{2} n_j \left[(1-r) E \left(\overline{a}^j - \Theta^j \right)^2 + (1 - rn_j) \sigma^2_{a^j} - rn_{-j} \sigma^2_{a^{-j}} + rn_{-j} (1 - 2n_j) E \left(\overline{a}^j - \overline{a}^{-j} \right)^2 \right] \tag{9}$$

The first component in Equation (9), $(E \left(\overline{a}^j - \Theta^j \right)^2)$, reflects the incentive of the policymaker to keep the average private actions in her domestic country as close to the relevant composite Θ^j as possible. Providing information on domestic shock θ^j to private agents forces them to pay more attention to a corresponding public signal. This can move the average actions either closer to the relevant composite shock or farther from it, depending on the quality of available information, the strength of the beauty contest and the relative weight of domestic shock in the relevant composite shocks. The second component in (9), $((1 - rn_j) \sigma^2_{a^j})$ reflects the desire of a policymaker to reduce the diversity of *domestic* private actions. An increase in the quality of the signal about the domestic shock forces the private agents to pay more attention to it and less attention to their private signals, reducing this diversity. The third component of the expected loss, $(-rn_{-j}\sigma^2_{a^{-j}})$, makes clear that the loss of policymaker $\mathcal{P}_j$ decreases with the diversity of *foreign* private actions. As we will see later, in our setting the home policymaker cannot influence this loss component, as she does not receive any information about the foreign local shock.[8] The last component of the expected public loss, $(rn_{-j} (1 - 2n_j) E \left(\overline{a}^j - \overline{a}^{-j} \right)^2)$, has an inter-country nature as it mixes parameters belonging to the two countries. The policymaker in a large country ($n_j > 1/2$) is interested in the increase in the inter-country diversity, while a policymaker in a small country ($n_j < 1/2$) would prefer a lower difference in the average actions in the two countries. The effect of a signal sent by a policymaker on this inter-country term can be positive or negative depending on the quality of

[8] We relax this assumption in Section 3.

available information, the strength of the beauty contest and the asymmetric effect of local shocks on the average actions in different countries. In our setting, *three* components of the public loss depend on the decision of policymaker $\mathcal{P}_j$ to reveal her information.

2.2 Public signals.

$\mathcal{P}_j$ may send one signal s^j to private agents. Its precision is denoted by $\sigma_{s,j}^{-2}$. We assume that policymakers cannot discriminate among private agents. Once published, signal s^j is equally available to all agents in both countries.

We assume that the choice of a policymaker is about revealing or not the true value of her information about the domestic shock. The signal sent by $\mathcal{P}_j$ about θ^j is either y^j or the empty set:

$$s^j \quad \in \{\emptyset, y^j\} \quad , j = 1, 2.$$

If $\mathcal{P}_j$ chooses to reveal her information about θ^j, her signal s^j is equal to y^j. The precision of the sent signal $\sigma_{s,j}^{-2}$ is equal to $\sigma_{y,h}^{-2}$. In this case, she applies a transparency policy about θ^j and is referred to as "transparency of $\mathcal{P}_j$ about θ^j". If $\mathcal{P}_j$ chooses not to reveal the information about θ^j, the precision of s^j is equal to zero. This situation is equivalent to adding an infinite noise to signal y^j and is referred to as "opacity of $\mathcal{P}_j$ about θ^j".

Let z^j denote a common posterior of θ^j given only public information:

$$z^j \equiv E\left(\theta^j \middle| s_j^j, s_{-j}^j\right) = \omega^j s^j + \left(1 - \omega^j\right)\mu$$

where $\omega^j \equiv \omega^j\left(\sigma_{s,j}^{-2}; \sigma_\theta^{-2}\right) = \frac{\sigma_{s,j}^{-2}}{\sigma_{s,j}^{-2} + \sigma_\theta^{-2}}$ is the signal component of public information and μ is a common prior about the fundamental shock. The precision of the conditional expectation z^j is equal to $\sigma_{z,j}^{-2} = \sigma_\theta^{-2} + \sigma_{s,j}^{-2}$. As it is assumed that μ is equal to zero, the common posterior z^j is given by

$$z^j = \omega^j s^j. \tag{10}$$

The next section describes the game played between the two policymakers.

2.3 A non-cooperative game on public information.

Given the two cross-border spillover effects, the technological one and the beauty-contest one, the two economies are interdependent. Moreover, public information is shared internationally. Agents individually base their actions both on what they know about the shocks and on the other agents' actions. This creates an interdependence between the decisions by policymakers to disclose or not what they know about shocks: a priori, each policymaker's welfare depends both on her revelation strategy and the other policymaker's strategy given that both impact the entire set of actions made by private agents.

Assuming that the two policymakers do not cooperate on their strategies, this raises a game-theoretical issue which we explore by means of a simple extensive game based on the absence of cooperation between policymakers. The game played in the economy consists of several steps:

Step 1. Each policymaker non-cooperatively decides whether or not she will truthfully reveal the information she will receive on the home country-specific shocks, based on her expected loss function. The two policymakers make their announcements, simultaneously. Given that each policymaker has two decision possibilities as shown above, there are four possible outcomes at this stage of the game. Policymakers commit to their revelation strategies.

Step 2. Private agents and the two policymakers receive their specific informations on the shocks. Public signals are emitted in accordance with decision of Step 1.

Step 3. Expectations of private agents, based on their information sets, are computed. Private actions are chosen non-cooperatively so as to minimize the expected private losses. Given the equilibrium of the game as well as the realized shocks, actual losses obtain.

We first search for the solution of the private stage of the game (step 3) and then solve the public revelation stage (step 1) to find the Subgame Perfect Nash equilibrium of this game.

2.4 Private actions (step 3).

A private agent i living in country j chooses his action a_i^j on the basis of the received signals x_i^j, s^j, s^{-j}. The information set of agent i in country j consists of three signals: one private signal x_i^j and one public signal s^j on the home shock, and one public signal on the foreign shock, s^{-j}. Thus the whole information set I_i^j is defined as $\left(x_i^j, s^j, s^{-j}\right)$.

The objective of agent i living in country j is to minimize the expected value of the loss (6) given his information set I_i^j. His optimal choice is as follows:

$$\begin{aligned} a_i^j = &\arg\min_{a_i'} E\left[\frac{1-r}{2}\left(a_i' - \Theta^j\right)^2 + \right. \\ &\left.\frac{r}{2}\left[n_j\left(\overline{a}^j - a_i'\right)^2 + n_{-j}\left(\overline{a}^{-j} - a_i'\right)^2 - n_j\sigma_{a^j}^2 - n_{-j}\sigma_{a^{-j}}^2 - 2n_jn_{-j}\left(\overline{a}^j - \overline{a}^{-j}\right)^2\right]\right| I_i^j\right] \end{aligned} \quad (11)$$

As an agent cannot influence the dispersion in private actions and the gap between average actions in the two countries, the solution to (11) is:

$$a_i^j = E\left[(1-r)\left(\lambda^j\theta^j + \left(1-\lambda^j\right)\theta^{-j}\right) + r\left(n_j\overline{a}^j + n_{-j}\overline{a}^{-j}\right)\right| I_i^j\right] \quad (12)$$

As we can see from (12), this private action is defined by expected country-specific shocks and expected average actions in both countries, according to the information set I_i^j. We observe that the action of a given agent in country j is an increasing function of the average action in his home country j and the average action in the other country $-j$. The extent of this response is parameterized by r, the beauty contest parameter. If r is equal to zero, private actions do not depend on the expected average actions in the economy. In this case, the optimal private action is equal to the expected value of the composite shock, Θ^j. If there is no technological spillover ($\phi = 1$), the action of agent i does not depend on the foreign shock.

The rational expectations of the country-specific shocks formed by agent i in country j are given by the following expressions:

$$E\left(\theta^j \middle| z^j, x_i^j\right) = \frac{\sigma_{z,j}^{-2}}{\sigma_{z,j}^{-2} + \sigma_x^{-2}} z^j + \frac{\sigma_x^{-2}}{\sigma_{z,j}^{-2} + \sigma_x^{-2}} x_i^j \tag{13}$$

$$E\left(\theta^{-j} \middle| z^{-j}, 0\right) = z^{-j} \tag{14}$$

As we can see in (13), a private agent weighs the two components of her information set according to their precisions. The weight of the public signal z^j in forming the expectation of the home shock depends positively on the precision of the public information, $\sigma_{z,j}^{-2}$, whereas the weight of the private signal x_i^j depends negatively on this precision. The sum of the two coefficients is equal to 1. As the only source of information about the foreign shock is the public signal, the expectation of this shock is equal to the value of signal z^{-j}. According to equations (13) and (14), agents in the two countries use public signals differently. Agents in country j weigh the value of signal z^j using their private signal and the weight of public signal is less than 1. Agents in country $-j$ have no other information about country j than the public signal z^j and the weight of this signal in the expectation of the shock affecting country $-j$ is equal to 1.

The first-order condition (12) along with (13) and (14) implies the following private linear strategy:

$$a_i^j = b^j x_i^j + c^j z^j + d^j z^{-j} \tag{15}$$

The average of private actions, computed for the linear strategies (15), is:

$$\overline{a}^j = b^j \theta^j + c^j z^j + d^j z^{-j}, \tag{16}$$

given that $x_i^j = \theta^j + \varepsilon_i^j$ and ε_i^j are $i.i.d.$ shocks, the number of agents being large. Combining (13-

16) and the first-order condition (12), we get:

$$b^j = \frac{(1-r)\,\lambda^j \sigma_x^{-2}}{(1-rn_j)\,\sigma_x^{-2} + \sigma_\theta^{-2} + \sigma_{s,j}^{-2}} \tag{17}$$

$$c^j = \lambda^j + rn_{-j}\left(1-\lambda^{-j}-\lambda^j\right) - \frac{(1-r)\,\lambda^j \sigma_x^{-2}}{(1-rn_j)\,\sigma_x^{-2} + \sigma_\theta^{-2} + \sigma_{s,j}^{-2}} \tag{18}$$

$$d^j = \left(1-\lambda^j\right) + rn_{-j}\left[\lambda^{-j} - \left(1-\lambda^j\right)\right] \tag{19}$$

All coefficients given by (17), (18) and (19) are positive and

$$b^j + c^j + d^j = 1.$$

The coefficients b^j, associated with the private signal, and c^j, associated with the home public signal depend on σ_θ^{-2}, σ_x^{-2} and $\sigma_{s,j}^{-2}$. An increase in σ_x^{-2} means that the private signal becomes more informative and leads to an increase in b^j and a decrease in c^j. An increase in σ_θ^{-2} or in $\sigma_{s,j}^{-2}$ means that the private signal becomes relatively less informative and leads to a decrease in b^j and an increase in c^j. The joint impact of domestic information on the private action is defined by the weights of local shocks in composite shocks and the extent of beauty contest:

$$b^j + c^j = \lambda_j + rn_{-j}\left[1-\lambda_{-j}-\lambda_j\right].$$

When the beauty contest is absent ($r=0$), the joint impact of domestic information coincides with the weight of the local shock θ^j in the composite shock ($b^j + c^j = \lambda_j$) and the coefficient associated with the foreign public information is equal to the weight of the foreign shock ($d^j = 1-\lambda_j$). When $r \neq 0$ and $\phi < 1/2$, $b^j + c^j > \lambda_j$. When $\phi > 1/2$, $b^j + c^j < \lambda_j$. This deviation from the weight of θ^j in the composite shock for country j arises because of the international beauty contest. As private agents want to mimic the actions of foreigners, they adjust their actions accordingly and the extent of this effect depends positively on the strengths of the beauty contest and the size of the foreign country. The larger is the foreign country and the stronger is the beauty contest, the larger is the deviation from the weight of the domestic shock. When $\phi = 1/2$, the weights of any shock coincide in both countries and there is no incentive to deviate from this weight despite the international beauty contest ($b^j + c^j = \lambda_j = n_j$). When the international beauty contest is in play and the weights of θ_{-j} do not coincide in the two countries, coefficient d^j deviates from the weight λ_j in the composite good. If $\phi > 1/2$, d^j is larger than $(1 - \lambda_j)$. If $\phi < 1/2$, it is lower than $(1 - \lambda_j)$. If $\phi = 1/2$, the weights of any shock are equal in two countries and the impact of the foreign information on the private agents coincides with its weight in the composite shock ($d^j = 1 - \lambda_j = 1 - n_j$).

As the actions of private agents depend on the two signals sent by the policymakers, this gives rise to informational cross-border spillovers. These spillovers are based on the fact that any bit of public information is available to and used by any agent residing in any country of the economy. These informational spillovers create the possibility for each policymaker to influence private actions in both countries. In the reaction function (15) defining the action of agent i in country j, the coefficient associated with his private signal, b^j, and the coefficient associated with the home public signal, c^j, are affected by the revelation decision of $\mathcal{P}_j$. In this setting with a single public signal (on the domestic shock), the only component of the loss function (9) that cannot be affected by $\mathcal{P}_j$, is the diversity of foreign private actions. The loss supported by $\mathcal{P}_j$ decreases when it increases but she cannot affect it. We shall see in Section 3 that, when two signals are received by policymakers, this creates an additional cross-border spillover, linked to public signals.

2.5 The Subgame Perfect Nash Equilibrium.

In the first stage of the game, both policymakers decide on their disclosure strategies knowing that the private actions at Step 3 are chosen according to the strategies given by (15). When substituting the private strategies (15) and coefficients (17-19) for $j = 1, 2$, the public loss function (9) appears to be formed by two components. Each of them depends on the country-specific information (see Appendix A). The "home" loss component depends on information about the domestic shock and can be affected by the decision of $\mathcal{P}_j$ about revealing or not her signal. The "foreign" loss component depends on information about the foreign country-specific shock and is affected by the disclosure policy of $\mathcal{P}_{-j}$. This means that the function of expected public loss is separable in $\sigma_{s,j}^{-2}$ and $\sigma_{s,-j}^{-2}$.

The non-cooperative simultaneous solution of the public information stage is based on the mutually consistent decisions of policymakers to reveal or not their information on the technology shocks. Formally, a strategy for policymaker $\mathcal{P}_j$ is the precision of the sent signal: $P_j = \left(\sigma_{s,j}^{-2}\right)$. We define the Subgame Perfect Nash Equilibrium (SPNE) as follows:

Definition 1. The SPNE is the pair of strategies (P_1^*, P_2^*), $P_j^* = \left(\sigma_{s,j}^{-2}\right)^*$, such that
$\left(\sigma_{s,j}^{-2}\right)^* = \arg \min\limits_{\sigma_{s,j}^{-2} \in \left\{0, \sigma_{y,h}^{-2}\right\}} EL_{P_j}\left(\sigma_{s,j}^{-2}, \sigma_{s,-j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$ for $j = 1, 2$,
and $EL_{P_j}\left(\sigma_{s,j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$ is obtained from (9) by substituting (15) and (17-19).

Finally, we make a simple "tie-break" assumption so as to avoid the multiple solutions generating the same outcome.

Assumption 1. *If* $EL_{P_j}\left(\sigma_y^{-2}, \sigma_{s,-j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right) = EL_{P_j}\left(0, \sigma_{s,-j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$, $\mathcal{P}_j$ *chooses revealing* y^j.

Assumption 1 states that if a policymaker is indifferent between revealing or not her information, she chooses revealing. Let $\psi \equiv \sigma_{\theta}^{-2}/\sigma_x^{-2}$ denote the relative precision of the common prior and $\xi \equiv \sigma_{y,h}^{-2}/\sigma_x^{-2} \geq 1$ denote the precision of information received by policymakers relative to the precision of information received by private agents. Regarding the existence and characteristics of a SPNE, we offer the following

Proposition 1. *For given* (ξ, r, n_j) *and* $\phi \geq 1/2$, *there exist* $\hat{n}_j(r)$ *and* $\hat{\psi}(r, n_j, \phi, \xi)$ *such that opacity is chosen by* $\mathcal{P}_j$ *in equilibrium if the following set of conditions is fulfilled:*

1. $n_j > \hat{n}_j \equiv 1/(2-r)$,

2. $\psi_j < \hat{\psi}(r, n_j, \phi, \xi)$

Otherwise, transparency is chosen by $\mathcal{P}_j$ *in equilibrium.*

Proof. See Appendix B. □

Proposition 1 states that opacity may be chosen by a policymaker in a large country (see Figure 1 for the regioning in (r, n) space), even if the information received by policymakers has a higher precision than the information received by private agents. To understand this result, let us discuss the properties of the loss function (9). The first component in (9), $(\frac{1}{2}n_j\,(1-r)\,E\left(\overline{a}^j - \Theta^j\right)^2)$, represents the expected squared error in the average private action relative to the relevant composite shock. Public information about the domestic shock can either decrease this loss component because better information helps agents to better forecast their relevant composite shock or increase it as the beauty contest may lead them to pay too much attention to this signal. The second component in (9), $(\frac{1}{2}n_j\,(1-rn_j)\,\sigma^2_{a^j})$, represents the diversity of private actions in country j and depends negatively on the precision of public information. When the policymaker $\mathcal{P}_j$ decides to publish her information, agents put more emphasis to it (increase the related coefficient) less to their private information (decrease the related coefficient), which leads to a decrease in the second loss component. When $\phi \geq 1/2$ and $\sigma_y^{-2} > \sigma_x^{-2}$, the sum of two first components decreases when $\mathcal{P}_j$ decides to communicate her information. To see this, let us consider the limit case of $n_1 = 1$, which corresponds to a closed economy and is the case studied in MS.

Using equation (9), the public loss is given by

$$EL_{P_1}\left(n_1 = 1\right) = \frac{1}{2}(1-r)\frac{\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-r)^2\sigma_x^{-2}}{\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-r)\sigma_x^{-2}\right)^2}.$$

This function is increasing in $\sigma_{s,j}^{-2}$ when $(\sigma_{s,j}^{-2} + \sigma_\theta^{-2})$ is small. However, if we compare the loss when the policymaker does not reveal her information ($\sigma_{s,j}^{-2} = 0$) and the loss when the information is revealed ($\sigma_{s,j}^{-2} = \sigma_{y,h}^{-2} > \sigma_x^{-2}$), we see that the loss is lower under revelation. This result contrasts with the result obtained by MS. This is due to the assumption that the public precision is higher than the private one whereas MS assume that it is close to zero.[9]

[9] Instead of an international beauty contest argument, if we assume that the private payoff function includes a regional beauty contest one, results would be similar to those obtained when $n_j = 1$ and the equilibrium is always transparency for any parameter vector. This is due to the disappearance of the difference between the average actions in the public loss functions.

When $n_j \neq 1$, the expected loss includes other components, but components 1 and 2 of the public loss still favor the choice of transparency. The third component in the public loss function $(-rn_{-j}\sigma^2_{a^{-j}})$ represents the effect of the diversity in foreign private actions. As it solely depends on the information about country$-j$, it cannot be affected by $\mathcal{P}_j$. The fourth component $\left(rn_{-j}(1-2n_j)E\left(\overline{a}^j - \overline{a}^{-j}\right)^2\right)$ represents the inter-country component and can be affected by $\mathcal{P}_j$. When she reveals her information, it becomes easier for private agents to coordinate and the gap between average actions in the two countries shrinks. For the smaller country $(n_j < 1/2)$, the public loss decreases. In this case, all relevant components in the loss function (9) are pro-transparency and $\mathcal{P}_j$ chooses transparency. On the contrary, for the large country $(n_j > 1/2)$, the impact of revelation on the inter-country component is negative and this favors opacity. As the public loss in this case decreases with an increase in the inter-country gap in average actions, policymaker $\mathcal{P}_j$ would prefer opacity, again despite the quality of her information. It implies that the inter-country component in the public loss function drives the regioning presented by Figure 1.

Proposition 1 makes clear that the policymaker in a larger country do not chose opacity if r is large. This happens because agents can use other types of public information (like the priors) to coordinate. Disclosure or not, average actions in both countries are close to each other due to a strong motive to coordinate. If, in such a situation, a policymaker does not reveal her information, this cannot improve much the inter-country component while harming the domestic components in the loss function. In the extreme case of $r = 1$, private agents do not use their private information $(b^j = 0)$ but they entirely rely on public information and the weights associated with public information are equalized across the countries $(c^j = d^{-j} = n_j\lambda_j + n_{-j}(1-\lambda_{-j}))$. If the policymakers do not reveal their informations, private agents are still able to perfectly coordinate using the common priors. In this case, $\overline{a}^j = \overline{a}^{-j}$ and the only pro-opacity loss component disappears. If the beauty-contest parameter is small and the quality of the prior is low $(\psi_j < \hat{\psi}(r, n_j, \phi, \xi))$, private agents predominantly rely on the prior μ (which conveys very little information) if the public information is not revealed. In this case, $\mathcal{P}_j$ chooses opacity as it decreases the inter-country component of the public loss function.

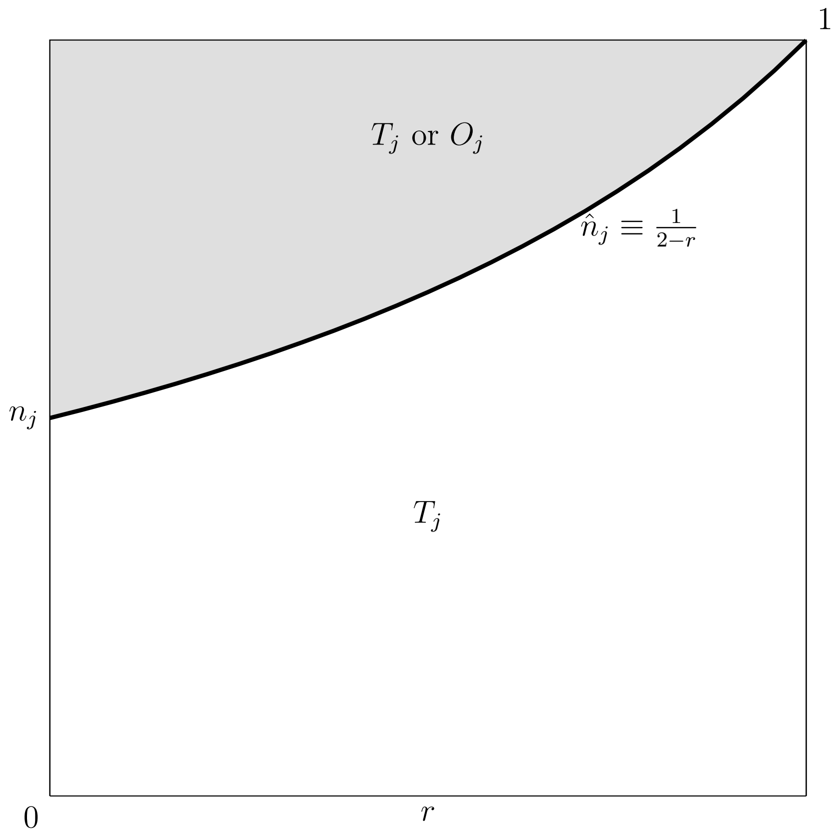

Figure 1: The regioning of equilibrium policy in the (r, n_j) space

2.6 Welfare analysis

To find the socially optimal information policy, we consider the problem of a social planner who minimizes the average loss of private agents in the whole economy and decides on the revelation of signals. As noticed above, the losses of private agents in each country are separable in precisions of information about the two country shocks. Consequently, the sum of losses of all agents in the economy is also separable in two components; the first one is related to the signal about θ^j and the other on the signal about θ^{-j}. Hence, the decision of the social planner on the revelation of signal about one country is independent from the decision about the signal on the other country.

The social planner has 2 possibilities for the revelation of her information about θ^j. She may choose transparency: this disclosure policy is equivalent to publishing one signal on θ^j with precision $\sigma_{y,h}^{-2}$. Or she may choose opacity and reveal nothing about θ^j which is equivalent to emitting a signal with zero precision.

Using (9), we get the social loss function $L_S \equiv \sum_{j\in 1,2} L_{P_j}$ in the following form:

$$L_S = \frac{1}{2}(1-r)\left[n_j\left(\overline{a}^j - \Theta^j\right)^2 + n_j\sigma^2_{a^j} + n_{-j}\left(\overline{a}^{-j} - \Theta^{-j}\right)^2 + n_{-j}\sigma^2_{a^{-j}}\right] \tag{20}$$

As we can see from (20), it depends positively on the gaps between the average actions and composite shocks in both countries. Notice that the social loss function (20) differs from the policymakers' loss function (9) in a crucial way: it includes the expected squared error in the average private action relative to the composite shock in country $-j$, $\left(\overline{a}^{-j} - \Theta^{-j}\right)^2$. This expected error depends on the revelation of public signals in both countries but is not included in the loss function of $\mathcal{P}_j$. Moreover, whereas the policymaker for a given country aims at reducing the dispersion of private actions in her country but at increasing the dispersion of private actions in the other country, the social planner wishes to reduce the dispersion of private actions in both countries. Lastly, the social loss function does not contain an inter-country component, which is in contrast with the local public interests reflected by (9). These differences in the social and country-specific public loss functions may lead to a discrepancy between the equilibrium and socially optimal information policies, which will be discussed below in subsection 2.7.

Formally, the optimization problem of the social planner is defined as follows:

Definition 2. The social optimum is the vector $\left(\tilde{\sigma}^{-2}_{s,1}, \tilde{\sigma}^{-2}_{s,2}\right)$ such that

$$\tilde{\sigma}^{-2}_{s,j} = \arg \min_{\sigma^{-2}_{s,j}\in\left\{0,\sigma^{-2}_{y,h}\right\}} E\left(L_S\right), j = 1,2$$

where $EL_S \equiv E\int_{j\in\{1,2\}}\int_{i\in S^j} l^j_i \,\mathrm{d}i\,\mathrm{d}j = EL^1_{\mathcal{P}} + EL^2_{\mathcal{P}}$ stands for the expected social loss, equal to the sum of expected losses of all private agents in the economy and EL^J_P is given by equation (9).

We then offer the following

Proposition 2. *For given (ξ, r, n_j), there exist $\tilde{r}_j(n_j)$, $\tilde{\phi}_j(r,n_j) > 1/2$ and $\tilde{\psi}_j(r,n_j,\phi,\xi)$ such that opacity about country j is socially optimal if the following set of conditions is fulfilled:*

1. $r < \tilde{r}_j \equiv \frac{1-\sqrt{1-n_j}}{n_j} \leq 1$,

2. $\phi > \tilde{\phi}_j$,

3. $\psi_j < \tilde{\psi}_j$,

Otherwise, transparency about country j is socially optimal.

Proof. See Appendix C. □

Similar to the public loss function (9), the expected social loss includes the expected squared error in the average private action relative to the composite shock, $\left(\overline{a}^j - \Theta^j\right)^2$, and the diversity of private actions, $\sigma^2_{a^j}$, in country j. Both components depend on the disclosure of public information about the country-specific shock θ_j. Whereas the first component can either increase or decrease with an increase in the precision $\sigma^{-2}_{s,j}$, the second one necessarily decreases. But under the assumption that $\sigma^{-2}_{y,h} > \sigma^{-2}_{x}$, the sum of them decreases when the policymaker decides to be transparent.

As mentioned above, in equilibrium the inter-country gap in average actions drives the opacity result. Even though this component is absent in the social loss function (20), proposition 2 shows that opacity may be socially optimal because of the inter-country information spillovers which are taken into account by the social planner. Component $n_{-j}\left(\overline{a}^{-j} - \Theta^{-j}\right)^2$ in the social loss function (20) represents the expected squared error in the average private action relative to the composite shock in country $-j$. This term depends on the information about country j. If $\phi > 1/2$, the weight of local shock θ_j in the composite Θ_{-j} is small and equal to $1-\lambda_{-j} < 1/2$, and the coefficient associated with the foreign public signal exceeds the weight of the foreign country-specific shock in the relevant composite shock ($d^{-j} > 1-\lambda_{-j}$) because of the beauty contest. As a result, providing public information about country j drives the average foreign action farther from the relevant composite shock in country $-j$ and can be detrimental for welfare and the inter-country effect of the public information provision can be negative. If it is strong enough, it can outweigh the positive effect of transparency on the first two "domestic" components in the social loss function (20).

Proposition 2 gives the conditions under which opacity is socially optimal. The regioning illustrating Proposition 2 is shown in Figure 2. When $r \geq \tilde{r}$, the inter-country beauty contest is so strong that opacity about θ_j cannot prevent the average action in country $-j$ to be driven away from the composite shock Θ_{-j}. In this case, opacity does not decrease the inter-country component in the expected social loss by much, while increasing the first two "domestic" components in the social loss function. On the contrary, a reasonable degree of beauty contest ($r < \tilde{r}$) justifies opacity, if the two additional conditions are met.

Proposition 2 highlights the role of technological spillovers. If ϕ is small enough ($\phi < \tilde{\phi}$), the gap between the coefficient associated with the foreign public information and the weight of the foreign shock in the composite shock ($d^{-j} - (1 - \lambda_{-j})$) is small. In this case, possible benefits of opacity cannot outweigh its negative effect on two first terms in the social loss function. On the contrary, when ϕ is large and the domestic country-specific shock plays a predominant role in the composite shock, the inter-country effect of opacity on social welfare can be large. As an example, consider a limiting case with $\phi = 1$. The weight of shock θ_j in composite shock Θ_{-j} is negligible: ($1 - \lambda_{-j} = 0$). Nevertheless, strategic complementarity ensures that agents in country $-j$ use the public information about country j when deciding about their actions: $d^{-j} = rn_j$. When no public signal is provided (opacity), they have to rely on the prior value of the shock μ_j, which is null and does not lead to a further deviation of their average actions from the relevant composite shock. When the public signal s_j is published, the average private action in country $-j$ deviates from the relevant composite shock by $\omega_j r n_j s_j$, which increases the squared error by $r^2 n_j^2 \omega_j^2 \sigma_s^2$. In this case, opacity can be desirable.

Proposition 2 also highlights the role of the common prior precision on the social optimum. If prior information is relatively good ($\psi_j > \tilde{\psi}_j$), the benefits of withholding information are small as it cannot prevent a large degree of coordination; its increasing impact on the domestic components of the social loss function can be large and the social planner should choose transparency.

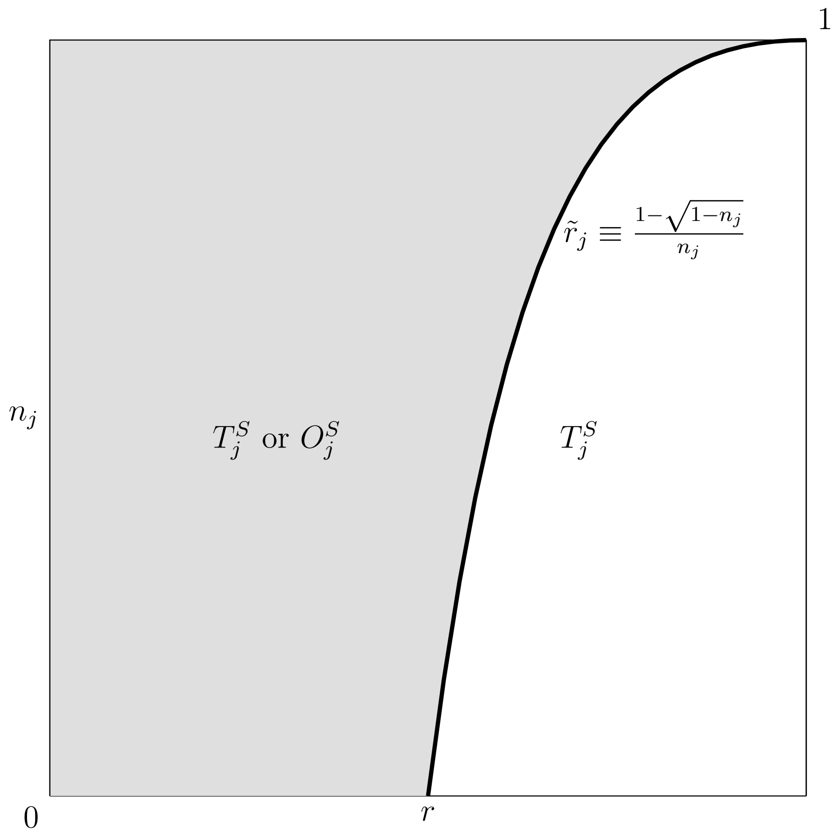

Figure 2: The regioning of socially optimal policy in the (r, n_j) space

2.7 Comparing the equilibrium and the social optimum

In the two previous sections, we showed that opacity may be obtained both in equilibrium and as the social optimum. However, the reasons driving the choice of opacity by non-cooperating policymakers and a social planner differ. It is obtained in equilibrium because of the inter-country component of the public loss function whereas it may be socially optimal because the inter-country informational spillovers are taken into account. Both factors are not strong enough in case of a large strategic complementarity effect. In this case, opacity cannot provide a sufficient decrease in the foreign social loss component as private agents coordinate whatever are the decisions of the policymakers. Neither can it improve the expected public loss. Consequently, for $r \geq \max\left\{\frac{2n_j-1}{n_j}; \frac{1-\sqrt{1-n_j}}{n_j}\right\}$ (Region 1 in Figure 3) both equilibrium and the social optimum are characterized by transparency.

For $n > 3/4$ and $\frac{1-\sqrt{1-n_j}}{n_j} < r < \frac{2n_j-1}{n_j}$ (Region 2) the inter-country component in the public loss function makes opacity tempting for $\mathcal{P}_j$ as she values a lot the inter-country diversity. However, opacity about θ^j for this interval increases the expected error in country $-j$'s average action and the overall effect of opacity on the expected social loss is negative. Hence, opacity, if chosen in equilibrium, is not socially optimal. Equilibrium in Region 2 coincides with the social optimum only if the policymaker chooses transparency. Otherwise, there is too little information in the equilibrium.

Region 3 corresponds to the subset for which $\left(\max\left\{\frac{2n_j-1}{n_j}, 0\right\} < r < \frac{1-\sqrt{1-n_j}}{n_j}\right)$. Under these conditions, $\mathcal{P}_j$ always chooses transparency. If $n_j < 1/2$, she negatively values the gap between the average actions $(\bar{a}^j - \bar{a}^{-j})$ and transparency decreases this gap. If not, as she negatively values the diversity in the home actions and transparency reduces it so much, the possible benefit of opacity due to an increase in the inter-country diversity cannot overcome the gain obtained through transparency. However, transparency may create considerable inter-country spillovers and move the average action in country $-j$ farther from its composite shock. In the case countries are close to being technological autarkies (ϕ close to 1) and the country-specific shocks are very volatile (ψ close to 0), the social planner chooses opacity. As $\mathcal{P}_j$ chooses transparency in equilibrium, too much information is provided compared to what is socially optimal.

For the subset represented by Region 4, the comparison between the socially optimal and the equilibrium information policies may lead to a different result. For example, if ψ is large but ϕ is small, transparency is the equilibrium solution as well as the choice of the social planner. However, if both ψ and ϕ are small, opacity is the equilibrium solution whereas it is not the choice of the social planner. Hence, too little information is now provided in equilibrium compared to what is socially optimal. The next corollary suggests the following:

Corollary 1. *Depending on the parameters of the model, too much or too little public information may be provided in equilibrium compared to what is socially optimal.*

MS did not investigate this issue since they considered a closed economy with a unique public authority providing information. On the contrary, it arises in our model because of the plurality of jurisdictions (countries) which generates the plurality of such authorities.

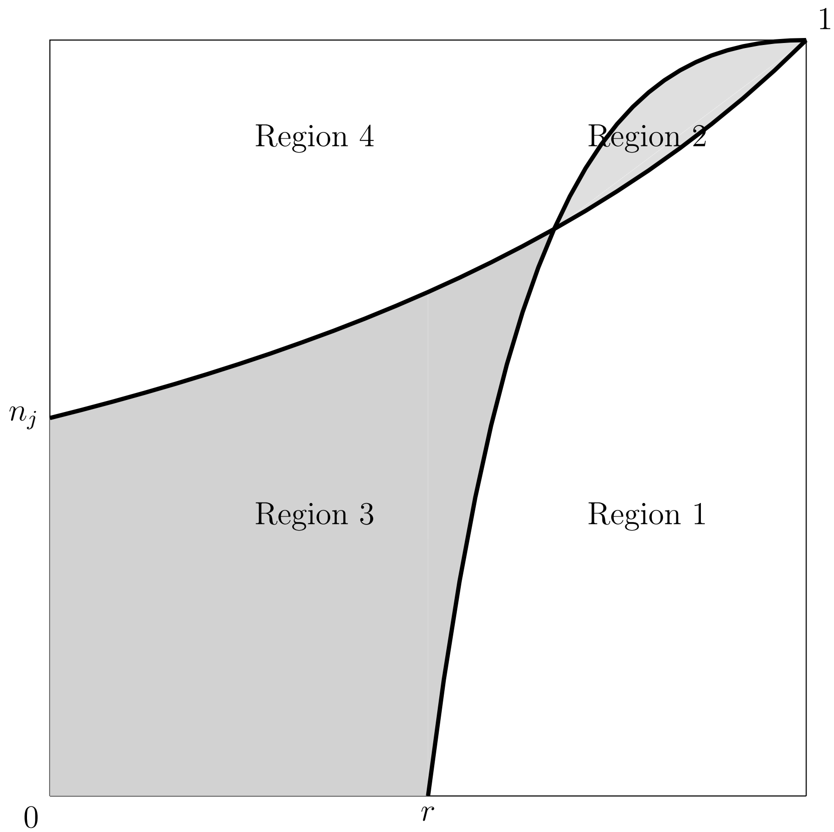

Figure 3: The regioning of SPNE and social optimum in the (r, n_j) space

3 The economy with multiple public informations.

In this section, we extend our analysis to the case where each policymaker receives an information on each of the two shocks hitting the economy. The disclosure problem is therefore enlarged: policymaker P_j may decide to reveal all information, her information about shock θ_j only, her information about shock θ_{-j} only, or nothing. The information issue becomes much more complex since now a policymaker may be willing to differentiate her disclosure decision given the plurality of its information. In particular, discussing about the social value of "public information" is inadequate because it is a too vague concept; what is at stake is the social value of each specific item of public information. As in the previous section, we shall first look for the existence and characteristics of the SPNE of the game and then study the setting minimizing the aggregate loss at the world level. In order to get easily readable results, we shall restrict the analysis to the case of countries of equal size.

3.1 The modified model.

Assuming $n^1 = n^2 = 1/2$, the weight of the country-specific shock, λ_j, is equal to ϕ and the composite shock for country j, Θ^j, is equal to $\phi\theta^j + (1-\phi)\,\theta^{-j}$. In each country $(j = 1, 2)$, the policymaker $\mathcal{P}_j$ receives two signals, one on each of the two country-specific shocks. Her information set $\left(y_j^1, y_j^2\right)$ on the shocks (θ^1, θ^2) is characterized by:

$$\begin{aligned} y_j^k &= \theta^k + \eta_j^k, k = 1, 2, j = 1, 2 \\ \eta_j^k &\sim N\left(0, \sigma^2_{y,k,j}\right), k = 1, 2, j = 1, 2 \end{aligned} \tag{21}$$

where η_j^k is the (i.i.d.) noise of a signal about shock θ^k, received by $\mathcal{P}_j$, and $\sigma^{-2}_{y,k,j}$ stands for its precision. All noises in the signals are independently distributed. The signal received by $\mathcal{P}_j$ about the idiosyncratic shock θ^j is her "home" public information and the signal received by $\mathcal{P}_j$ about the foreign shock θ^{-j} is called her "foreign" information. Their precisions are the same for both policymakers: $\sigma^{-2}_{y,1,1} = \sigma^{-2}_{y,2,2} = \sigma^{-2}_{y,h}$ and $\sigma^{-2}_{y,-j,j} = \sigma^{-2}_{y,f} = \sigma^{-2}_{y,f}$ for $j \in \{1, 2\}$. We assume that $\sigma^{-2}_{y,h} \geq \sigma^{-2}_{y,f}$. In other words, the home information received by a policymaker cannot be less precise than her information about the foreign shock. Moreover, we assume that $\sigma^{-2}_{y,f} > \sigma^{-2}_x$. This assumption means that the foreign policymaker's information about θ^j is better than the information received by private agents in country j. As mentioned above, this is justified by the superior capacity of policymakers to observe shocks.

$\mathcal{P}_j$ may send two signals, equally available to all agents in both countries: a home signal, s_j^j, and a foreign signal, s_j^{-j}. As the choice is between opacity and transparency, the signal sent by $\mathcal{P}_j$ about the country-specific shock θ_j^k is either y_j^k or the empty set:

$$s_j^k \in \left\{\emptyset, y_j^k\right\}, \quad k = 1, 2.$$

The precision of signal s_j^k is denoted by $\sigma_{s,k,j}^{-2}$. If $\mathcal{P}_j$ chooses transparency about θ^k, the precision of the sent signal $\sigma_{s,k,j}^{-2}$ is equal to $\sigma_{y,k,j}^{-2}$. If she chooses opacity about θ^k, the precision of signal s_j^k is equal to zero. Thus, a policymaker can adopt one of the four following information policies:

1. "full transparency": she reveals all her information about the home and the foreign shocks;

2. "home transparency and foreign opacity": she reveals her information about the home shock and does not reveal any information about the foreign shock;

3. "home opacity and foreign transparency": she does not reveal her information about the home shock but reveals her information about the foreign one;

4. "full opacity": she does not reveal any information.

The composite signal s^k received by private agents about the country-specific shock θ^k is defined by:

$$s^k = \frac{\sigma_{s,k,j}^{-2} s_j^k + \sigma_{s,k,-j}^{-2} s_{-j}^k}{\sigma_{s,k,j}^{-2} + \sigma_{s,k,-j}^{-2}}, \qquad k = 1, 2; j = 1, 2.$$

The precision of composite public signal s^k on θ^k is equal to $\sigma_{s,k}^{-2} = \sigma_{s,j,j}^{-2} + \sigma_{s,j,-j}^{-2}$. If both policymakers are transparent about θ^k, we get $\sigma_{s,k}^{-2} = \sigma_{y,h}^{-2} + \sigma_{y,f}^{-2}$. If both are opaque, we get $\sigma_{s,k}^{-2} = 0$. If there is home transparency ($\mathcal{P}_k$ is transparent) and foreign opacity ($\mathcal{P}_{-k}$ is opaque) θ^k, then $\sigma_{s,-k}^{-2} = \sigma_{y,h}^{-2}$. If there is home opacity and foreign transparency about θ^k, then $\sigma_{s,k}^{-2} = \sigma_{y,f}^{-2}$.

3.2 The sequential game

The sequential game is slightly modified compared to Section 2.3. In Step 1, each policymaker non-cooperatively decides what she will truthfully reveal from her information on the two country-specific shocks, based on her expected loss function. The two policymakers make their announcements simultaneously. Given that each policymaker has four decision possibilities as shown above, there are sixteen possible outcomes at this stage of the game. The private agent's optimization problem is based on two composite signals, instead of two country-specific signals, as in Section 2.4. The coefficients in the equilibrium strategy of private agents (15) are now given by

$$b^j = \frac{(1-r)\,\phi\sigma_x^{-2}}{(1-{}^r\!/\!_2)\,\sigma_x^{-2} + \sigma_\theta^{-2} + \sigma_{s,j}^{-2}} \tag{22}$$

$$c^j = \phi + {}^r\!/\!_2\,(1-2\phi) - \frac{(1-r)\,\phi\sigma_x^{-2}}{(1-{}^r\!/\!_2)\,\sigma_x^{-2} + \sigma_\theta^{-2} + \sigma_{s,j}^{-2}} \tag{23}$$

$$d^j = (1-\phi) + {}^r\!/\!_2\,(2\phi - 1) \tag{24}$$

Coefficients (22-24) are derived from (17-19) assuming $n_j = 1/2$. Contrary to (19), the coefficient associated with the foreign public information is not country-specific anymore ($d^1 = d^2$). Notice that the coefficients associated with the private signal b^j and the home public signal c^j depend on the precision of the *composite* public signal $\sigma_{s,j}^{-2}$. As each public composite signal consists of two signals sent by the policymakers, this gives rise to informational cross-border spillovers.

When $n = 1/2$, the expected public loss (9) can be rewritten as follows:

$$EL_{P_j} = \frac{1}{4}\left[(1-r)\,E\left(\bar{a}^j - \Theta^j\right)^2 + (1-{}^r\!/\!_2)\,\sigma_{a^j}^2 - {}^r\!/\!_2\sigma_{a^{-j}}^2\right] \tag{25}$$

As we can see, the main pro-opacity public loss component studied in section 2.5 is absent in the economy when $n = 1/2$. $\mathcal{P}_j$ does not care about the inter-country gap in average actions if the countries have equal sizes. The diversity in the private actions abroad now becomes a variable of interest for any policymaker. By revealing or not her signal on the foreign country-specific shock, she is now able to affect the third component in (25). As the expected public loss decreases in the diversity in the private actions abroad and this diversity increases when the policymaker does not reveal her foreign information, this constitutes a pro-opacity motive for any policymaker in the setting with multiple public signals. Moreover, in the setting with multiple public signals a policymaker can also affect the first term in (25) by being transparent about the foreign country-specific shock. The intensity of this effect depends on the parameter of the technological spillover, ϕ.

The simplifying assumption of equal sizes allows us to study a broader range of technological spillovers, ϕ, which we now allow to vary from 0 to 1.[10] When $\phi < 1/2$, the weight of the domestic shock in the composite shock is small. Nevertheless, the strategic complementarity term increases the joint coefficient in the private actions associated with the domestic information: $b^j + c^j > \phi$. In this case, revelation of the domestic public information may considerably increase the gap between the average action and the relevant composite shock in country j. When ϕ is small enough this may outweigh the positive effect of revelation on the second component in the expected public loss (25) and make opacity about domestic country-specific shock preferable.

Similar to the case with domestic public signal, the expected public loss is separable in the precisions of the signals about country-specific shocks. Therefore, the decision of any policymaker about the revelation of her domestic public signal is independent from her revelation decision about her foreign public signal. Nevertheless, as both policymakers have informations on each shock, their disclosure decisions about a particular θ^j become interdependent. This creates a strategic element in the information revelation game played by the policymakers and there is no more a dominant strategy feature.

3.3 The subgame perfect Nash equilibrium

A strategy for policymaker $\mathcal{P}_j$ is now a pair of precisions of sent signals: $P_j = \left(\left(\sigma_{s,j,j}^{-2}\right), \left(\sigma_{s,-j,j}^{-2}\right)\right)$ and the Subgame Perfect Nash Equilibrium (SPNE) is defined as follows:

Definition 3. The SPNE is the pair of strategies (P_1^*, P_2^*), $P_j^* = \left(\left(\sigma_{s,j,j}^{-2}\right)^*, \left(\sigma_{s,-j,j}^{-2}\right)^*\right)$, such that

1. $\left(\sigma_{s,j,j}^{-2}\right)^* = \arg \min\limits_{\sigma_{s,j,j}^{-2} \in \left\{0, \sigma_{y,h}^{-2}\right\}} EL_{P,j}\left(\sigma_{s,j,j}^{-2} + \left(\sigma_{s,j,-j}^{-2}\right)^*, \sigma_{s,-j,j}^{-2} + \sigma_{s,-j,-j}^{-2}\, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$
2. $\left(\sigma_{s,-j,j}^{-2}\right)^* = \arg \min\limits_{\sigma_{s,-j,j}^{-2} \in \left\{0, \sigma_{y,f}^{-2}\right\}} EL_{P,j}\left(\sigma_{s,j,j}^{-2} + \sigma_{s,j,-j}^{-2}, \sigma_{s,-j,j}^{-2} + \left(\sigma_{s,-j,-j}^{-2}\right)^*, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$

for $j = 1, 2$ and $EL_{P,j}\left(\sigma_{s,j,j}^{-2} + \sigma_{s,j,-j}^{-2}, \sigma_{s,-j,j}^{-2} + \sigma_{s,-j,-j}^{-2}\, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$ being the expected public loss (25) after the substitution of strategies (15) and coefficients (22-24).

[10] In Section 2 we made an assumption that $\phi \geq 1/2$. As we have shown above, in this case the sum of two first components in the expected public loss (25) decreases when the policymaker chooses to publish her information on her domestic shock. We made this assumption solely for expository reasons. When $\phi < 1/2$, the regioning becomes much more complex.

Given 4 possible decisions of each policymakers, there are 16 types of possible equilibrium configurations in pure strategies, 4 of which are symmetric. We define a symmetric SPNE as follows:

Definition 4. A symmetric SPNE is such that $P_1^* = P_2^*$.

The "tie-break" assumption 1 is modified and now reads:

Assumption 2. *If* $EL_{P,j}\left(\sigma_{s,k,j}^{-2} + \sigma_{s,k,-j}^{-2}, \sigma_{s,-k,j}^{-2} + \sigma_{s,-k,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) =$
$EL_{P,j}\left(\sigma_{s,k,-j}^{-2}, \sigma_{s,-k,j}^{-2} + \sigma_{s,-k,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)$*, policymaker* $\mathcal{P}_j$ *chooses to reveal* y_j^k *about country* k*.*

Assumption 2 states that if a policymaker $\mathcal{P}_j$ is indifferent between revealing or not her information about θ^k, she chooses revealing.

We establish the existence of a unique and symmetric SPNE and characterize its properties in the following:

Proposition 3. *For any* $\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}, r, \phi\right)$*, there exists a unique and symmetric SPNE. For given* $\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}, r\right)$*, there exist* $\underline{\phi}$ *and* $\overline{\phi}$ *such that* $0 \leq \underline{\phi} < 1/2 < \overline{\phi} \leq 1$ *and*

1. *if* $\phi < \underline{\phi}$*, the equilibrium is "home opacity, foreign transparency":* $P_j^* = \left(0, \sigma_{y,f}^{-2}\right)$ *for any* $j \in \{1, 2\}$*.*
2. *if* $\underline{\phi} \leq \phi \leq \overline{\phi}$*, the equilibrium is "home transparency, foreign transparency":* $P_j^* = \left(\sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}\right)$ *for any* $j \in \{1, 2\}$*.*
3. *if* $\overline{\phi} < \phi$*, the equilibrium is "home transparency, foreign opacity":* $P_j^* = \left(\sigma_{y,h}^{-2}, 0\right)$ *for any* $j \in \{1, 2\}$*.*

Proof. See Appendix D. □

According to Proposition 3, for any technological parameter ϕ, beauty contest parameter r and precision of information, there is a unique and symmetric equilibrium in pure strategies. It is worth noticing that we did not restrict our analysis to symmetric equilibria. This characteristic comes from the symmetry of the countries.

Three incentives facing any policymaker are captured in the public loss function (25) and help understanding the properties of this equilibrium. The first incentive is to help the agents in her home country to keep their actions close to the composite shock Θ^j. The second incentive is to lower the dispersion in private actions in the home country. Finally, the third incentive is to increase the dispersion in private actions in the foreign country, measured by the term $-{}^r\!/\!{}_2\sigma^2_{a^{-j}}$ in equation (25). As we can see in Proposition 3, the policy choice depends on the value of parameter ϕ.

If ϕ is low, the weight of the domestic shock in the composite shock is lower than the weight of the foreign shock. Nevertheless, the agents strongly react to their domestic information due to the strategic complementarity argument and $b^j + c^j > \phi$. In order to prevent the domestic average action to deviate too much from the relevant composite shock, policymaker $\mathcal{P}_j$ chooses to hide the information about her home shock θ^j and reveal her information about the foreign shock. This helps to decrease the expected squared error in the domestic average action relative to the relevant composite shock which, in this case, is predominantly defined by the foreign country-specific shock. Due to symmetry, $\mathcal{P}_{-j}$ makes the same decision. These decisions do not considerably affect the diversity in private actions in both countries, as the private agents have alternative public signals which can be used to coordinate.

For high values of ϕ, agents in country j are attentive almost solely to the information about their home shock θ^j, as their payoffs predominantly depend on the distance between their actions and the true value of θ^j. The higher is ϕ, the closer is the economy to technological autarky where the home fundamentals are defined only by the home shocks. As the closeness of the agents to their home country shocks is crucial in the case of a high value of ϕ, $\mathcal{P}_j$ chooses home transparency and reveals her information about the home country shock. This also helps the agents to coordinate and lowers the dispersion in private actions. In order to prevent the coordination of the agents in the other country, $\mathcal{P}_j$ chooses foreign opacity and hides her information about the foreign country shock θ^{-j}.

For the intermediate set of ϕ, both country shocks θ^j and θ^{-j} are relevant for private actions and payoffs. Policymakers do not want to hide any information, as they do in the previous two cases. Imagine that, similar to the case with low ϕ, $\mathcal{P}_j$ decides to hide her information about the home shock θ^j. This does not allow the agents in the home country j to keep their actions close to Θ^j. Moreover, as the agents in country j now pay much attention to the information about their home shock, the lack of information about this variable prevents them from coordination and increases the dispersion in their actions. Opacity generates too many negative consequences and a policymaker chooses both home and foreign transparency. Hence, for any value of ϕ, at least one signal is emitted by a policymaker. Thus the equilibrium of the game is never characterized by the full opacity. But partial opacity (home opacity or foreign opacity) may be an equilibrium outcome. As in the previous section, this result is obtained despite the fact that the home or foreign public informations are of a better quality (a higher precision) than private informations. The impact of the three cross-border spillovers, including the informational one, at play in this game, may be negative enough to overcome this informational advantage.

Despite the fact that the loss functions are highly non-monotone in their arguments, we can uncover some properties of functions $\underline{\phi}\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}, r\right)$ and $\overline{\phi}\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}, r\right)$. We are particularly interested in the impact of the beauty-contest parameter r on the obtained equilibrium. The following proposition characterizes its effects without imposing further restrictions on the model:

Proposition 4. *For given* $\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}\right)$ *and* $r < 1$, *thresholds* $\underline{\phi}$ *and* $\overline{\phi}$ *depend on* r *and are such that:*

1. $\overline{\phi} \in \left(1/2; 1/2 + \frac{1/2}{1+r}\right)$ *and* $\underline{\phi} \in \left(0; 1/2 - \frac{1}{6-2r}\right)$
2. *If* $r = 0$, *then* $\underline{\phi} = 0$ *and* $\overline{\phi} = 1$. *If* r *tends to 1, then* $\overline{\phi}$ *tends to* $3/4$ *and* $\underline{\phi}$ *tends to* $1/4$.
3. *The subset of parameters with* $\phi > \frac{1+r/2}{1+r}$ *is always characterized by foreign opacity and home transparency in equilibrium. The subset of parameters with* $1/2 > \phi > \frac{2-r}{6-2r}$ *is always characterized by home transparency and foreign transparency in equilibrium.*

Proof. See Appendix E. □

According to Proposition 4, the two thresholds defined in Proposition 3, $\underline{\phi}$ and $\overline{\phi}$, are functions of r. These functions, $\underline{\phi}(r)$ and $\overline{\phi}(r)$, define the boundaries in the relevant (ϕ, r) space separating the three regions corresponding to the SPNEs presented in Proposition 3. Region 1 is characterized by home transparency and foreign opacity. For a given r, when ϕ is high, the impact of the technological spillover is sufficiently large so that policymakers prefer not to counter the other player's action by revealing her information on the foreign shock and trigger a beauty contest which would diminish the informational impact of the home signal on the technological shock. Therefore both policymakers choose home transparency and foreign opacity. Its upper limit is obviously for $\phi = 1$. Its lower boundary cannot be explicitly characterized. Proposition 4 states that $\overline{\phi}$ and $\underline{\phi}$ depend on r. However, these functions are so complex that it is impossible to precisely obtain them in a workable form. These functions are continuous and may not be monotone. Using Propositions 3 and 4, we know that $\overline{\phi}(r)$ is above $1/2$ and tends to $3/4$ when r tends to 1 and $\overline{\phi}(0)$ is equal to 1.

Region 2, characterized by full transparency, is below the lower boundary of region 1. Its own lower boundary is obtained from the function $\underline{\phi}(r)$. $\underline{\phi}(0)$ is equal to $1/3$ and $\underline{\phi}(r)$ tends to $1/4$ when r tends to 1. This region is intermediate: for a given ϕ, the value of the r parameter is not so large and the home policymaker does not fear too negative impacts of the beauty contest generated by revealing her information on the foreign shock. Therefore, she chooses foreign transparency. On the other hand, for a given r, the value of the technological parameter is sufficiently large to make a public information on the home shock relevant: she also chooses home transparency.

Finally Region 3, below Region 2, is characterized by home opacity and foreign transparency. The analysis is just the reverse of the analysis of Region 1. The beauty contest parameter is sufficiently large, compared to the technological parameter, to legitimate for a policymaker the countering of the action of her counterpart and revealing her foreign information. In contrast, a policymaker does not want to contribute to the beauty contest by revealing her information on the home shock because the allocative effects of this revelation are outweighed by the adverse consequence of a rather strong beauty contest. Figure 4 illustrates this regioning of the (ϕ, r) space.[11]

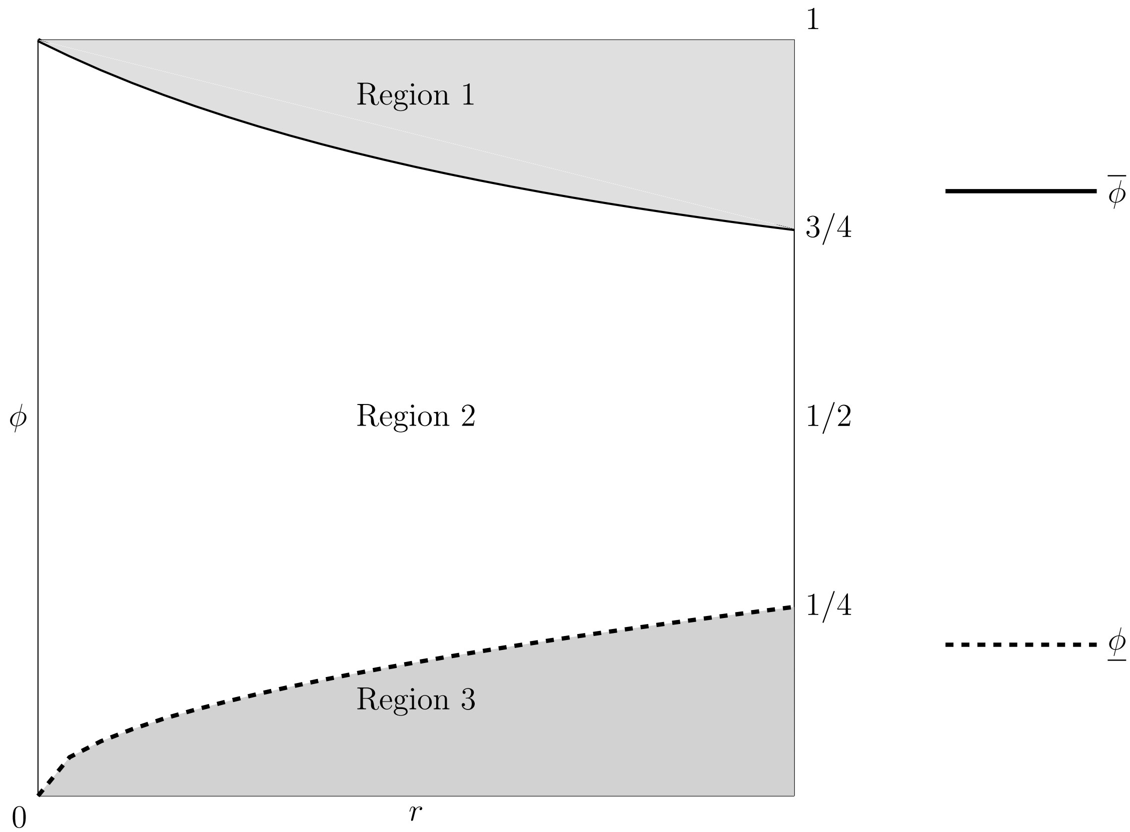

Figure 4: The SPNE countries in the (ϕ, r) space

3.4 Welfare

Turning to the welfare analysis of the case with multiple signals, we consider the problem of a social planner who minimizes the average loss of private agents in the whole economy. This social planner decides on which signal to reveal. The social planner has 4 possibilities for the revelation of the signals about country j, for $j = 1, 2$. It may choose full transparency and publish both signals about θ^j: this revelation policy is equivalent to publishing one composite signal on θ^j with precision $(\sigma_{y,h}^{-2} + \sigma_{y,f}^{-2})$. If the social planner chooses home transparency, it publishes only the home

[11]The boundaries of the intermediate region do not correspond to a precise calibration of the $\overline{\phi}(r)$ and $\underline{\phi}(r)$ functions but are consistent with the extreme values when r is equal to 0 or 1. They are drawn as monotone for ease of reading.

signal: precision of this signal is equal to $\sigma_{y,h}^{-2}$. If the social planner chooses foreign transparency, it publishes only the foreign signal about θ^j: precision of this signal is equal to $\sigma_{y,f}^{-2}$. Finally, the social planner may choose full opacity and hide both signals about θ^j. This is equivalent to emitting a signal with zero precision. As we already saw, the losses of private agents in each country are separable in precisions of information about the two country shocks. Consequently, the sum of losses of all agents in the economy is also separable in two components; the first one is related to the signals about θ^j and the other on the signals about θ^{-j}. Thus, the decision of the social planner on the revelation of signals about one country is independent from her decision about the signals on the other region.

Formally, the problem of the social planner is defined as follows:

Definition 5. The social optimum is the vector $\left(\tilde{\sigma}_{s,1}^{-2}, \tilde{\sigma}_{s,2}^{-2}\right)$ such that

$$\tilde{\sigma}_{s,j}^{-2} = \arg \min_{\sigma_{s,j}^{-2} \in \left\{0, \sigma_{y,f}^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2} + \sigma_{y,h}^{-2}\right\}} EL_S\left(\sigma_{s,j}^{-2}, \sigma_{s,-j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right), \; j = 1, 2$$

where $EL_S\left(\sigma_{s,j}^{-2}, \sigma_{s,-j}^{-2}, \sigma_{\theta}^{-2}, \sigma_x^{-2}\right)$ is the expected social loss (20), given (15) and (22-24).

The problem of a social planner is equivalent to the one studied in subsection 3.4. The main difference is that now the social planner chooses among 4 options instead of two for the optimal precision of the signal about θ^j. We then offer the following

Proposition 5. *The characteristics of the social optimum are such that*

1. *Partial transparency is never socially optimal.*

2. *Full opacity is socially optimal if the following set of conditions is fulfilled:*

   (a) $r < \tilde{r}$,

   (b) $\phi > \tilde{\phi}$,

   (c) $\psi < \tilde{\psi}$,

where the threshold values $\tilde{r}$, $\tilde{\phi}$ are positive and finite numbers and $\tilde{\psi} \geq 0$.

3. *Otherwise, full transparency is socially optimal.*

Proof. See Appendix F. □

Point 1 of Proposition 5 directly comes from the symmetry between countries and the equal weight given to each of them: as the social planner's emitted signal is common to both countries, any partial information solution is irrelevant. Eliminating the possibility of a partial disclosure of information, the social planner has to choose between full transparency versus full opacity. This alternative in a multi-country economy is reminiscent of the alternative studied by Morris and Shin in the case of a closed economy. Therefore, for a given vector of shock variances, the choice by the world social planner depends in a complex yet understandable way on the technological parameter and the beauty-contest one, as both parameters determine the magnitude of the structural cross-border spillovers which are taken into account by the social planner but are neglected by non-cooperating policymakers. Points 2 and 3 of Proposition 5 echo Proposition 2. Once the partial revelation situation is eliminated (Point 1 of Proposition 5), the factors which are important for the social optimum in the setting with domestic public signals dominate the choice of the socially optimal revelation in the setting with multiple signals. A sufficiently high value of the technological parameter ϕ ($\phi > \tilde{\phi}$) means that the home (foreign) shock has a high impact on home (foreign) actions and the international beauty contest causes a large gap between the coefficient associated with the foreign public information and the weight of the foreign shock in the composite shock ($d^{-j} - (1 - \lambda_{-j})$). In this case, as opacity can considerably decrease the "foreign" component in the social loss function, which outweighs the negative effect of opacity on the variety in private action, the social planner is inclined to choose full opacity. However, if the beauty-contest parameter r is sufficiently high ($r > \tilde{r}$), the beauty contest argument is predominant in private agents's payoff functions, henceforth the social planner chooses transparency because it provides better information to private agents and help them to coordinate. Opacity cannot create a sufficient effect on the average actions and is not socially optimal. To see this, consider the case of $r = 1$.

For any ϕ, private agents do not use their private information ($b^j = 0$) and they only react to the public signals with equal weights: $c^j = d^j = 1/2$. As a result, the private actions are perfectly coordinated and opacity cannot affect them. To the contrary, for reasonably low values of r ($r < \tilde{r}$), the positive effect of opacity on the expected squared errors more than compensates for its negative effect on diversity, justifying the social optimality of opacity.

The last parameter coming into play when considering the socially optimal information decision is the relative precision of common prior ψ, which depends on the variances of shocks and private signals. For a given value of σ_x^{-2}, a high value of σ_θ^{-2} (implying a low volatility of the home shock and corresponding to $\psi > \tilde{\psi}$) implies that the mean values of the shocks are reliable focal points for coordination both inside and between countries. In this case, opacity does not have a sufficient effect on the average actions which move away from the relevant composite shocks due to the beauty contest motive. On the other hand, its effect on the diversity of actions is large and full opacity is socially optimal. For a given σ_θ^{-2}, if σ_x^{-2} is large, the private signal received by private agents is very informative and they benefit from a good capacity to forecast this shock. When ϕ is high ($\phi > \tilde{\phi}$), the deviations of private actions from the relevant composite shocks become a predominant argument in the social loss function. In this case, the social planner does not have much incentive to give public information and full opacity is socially optimal. However, for a given σ_θ^{-2}, when σ_x^{-2} is sufficiently low (implying $\psi > \tilde{\psi}$), the private signal received by private agents is not very informative. Public information increases somewhat the complexity of the beauty contest argument but the adverse consequences of this are low when r is low. Thus, the social planner is induced to provide as much information to private agents as possible and chooses transparency. On the whole, these effects combine in explaining why these three conditions together are sufficient to make full opacity the socially optimal solution. They are also jointly necessary: if one of them fails, full transparency is socially optimal.

We pursue the comparison of the SPNE with the social optimum in our model in the next subsection.

3.5 Assessing the welfare properties of the SPNE.

The characteristics of thresholds $\tilde{\phi}$, $\underline{\phi}$ and $\overline{\phi}$ allow us to compare the welfare levels associated with the equilibrium and with the social optimum. We offer the following

Proposition 6. *The SPNE is socially optimal if and only if* $\phi \in \left[\underline{\phi}, \overline{\phi}\right]$.

Proof. See Appendix G. □

We can show that $\tilde{\phi}(r) > \overline{\phi}\left(\sigma_{\theta}^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_{x}^{-2}, r\right)$ for any $\left(\sigma_{\theta}^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_{x}^{-2}, r\right)$, meaning that $\tilde{\phi}$ is higher than the threshold $\overline{\phi}$ which separates the full transparency interval and the foreign opacity interval (see Proposition 3). Since the full transparency is socially desirable for all $\phi < \tilde{\phi}$ and the SPNE is characterized by full transparency for $\phi \in \left[\underline{\phi}, \overline{\phi}\right]$, we can conclude that for all ϕ in $\left[\underline{\phi}, \overline{\phi}\right]$ the equilibrium coincides with the social optimum. As we have seen in the previous subsection (Proposition 5), partial transparency is never socially optimal. If the technological spillovers are strong and $\phi < \underline{\phi}$, the "home opacity and foreign transparency" equilibrium obtains. If technological spillovers are weak and $\phi > \overline{\phi}$, the "home transparency and foreign opacity" equilibrium obtains. Consequently, the SPNE is optimal neither for $\phi < \underline{\phi}$ nor for $\phi > \overline{\phi}$. This explains Proposition 6.

To put it differently, Proposition 6 states that if the SPNE corresponds to full transparency, it is socially optimal. If the SPNE corresponds to partial transparency (either home transparency and foreign opacity or home opacity and foreign transparency), it is never socially optimal. Thus, for extreme values of ϕ, the SPNE does not produce the efficient informational structure. For small values of ϕ and strong technological spillovers, there is too little information in comparison with the social optimum. As a result, the policymakers are home opaque while society (i.e. the social planner) would prefer them to be transparent. For high values of ϕ and weak technological spillovers there may be either too little or too much information in the SPNE. For example, if $\phi \in \left[\overline{\phi}, \tilde{\phi}\right]$, country policymakers are foreign opaque while society would prefer them to be transparent. Thus, the SPNE conveys too little information. To the contrary, if $\phi > \tilde{\phi}$ and the country-specific shocks are sufficiently volatile ($\sigma_\theta^{-2}/\sigma_x^{-2} < \tilde{\psi}$), society would prefer full opacity, while the SPNE implies home transparency. Obviously, the SPNE conveys too much information. In other words, Corollary 1 also applies to the case of multiple public informations received by policymakers on multiple shocks in an international economy.

The possible non-optimality of the SPNE gives rise to a question: is it possible to replicate the socially optimal result in such an economy? The following proposition shows that both country policymakers are better-off if they choose the socially optimal policy:

Proposition 7. *For given $\left(\sigma_\theta^{-2}, \sigma_{y,h}^{-2}, \sigma_{y,f}^{-2}, \sigma_x^{-2}, r\right)$ and $\phi \notin \left[\underline{\phi}, \overline{\phi}\right]$, the social optimum Pareto-dominates the SPNE.*

Proof. See Appendix H. □

When there is partial transparency, both policymakers would be better-off if the optimal information policy was enforced upon them. In other words, a commitment technology imposing full opacity when the social value of public information is negative and full transparency when the social value of public information is positive would increase social welfare in each country. Thus suppressing "communication wars" can be beneficial for anyone and direct negotiations would impose a better equilibrium than the SPNE.

4 Conclusion.

The seminal paper of Morris and Shin (2002) shows that the social value of public information may be negative. Despite the extensive debates about this result found in the literature, the role and value of public information has never been addressed in the international environment. The goal of our paper is to study this issue. The other broad issue which we address is the understanding of the process of informational policy-making in such an environment. Moving from autarky to an international environment (or more broadly, to a multi-jurisdictional environment) considerably complicates the matter. Not only multiple sources of information but also multiple policymakers deciding on their communication policy must be taken into account. This creates a strategic dimension which is absent in the simple one-country model studied by Morris and Shin (2002) and their successors. This strategic environment generates two issues. The first issue is the finding of the equilibrium of the non-cooperative game played by policymakers caring about the social welfare of their own countries. The second issue is the evaluation of this equilibrium (or possibly, equilibria) with respect to a normative criterion such as the Pareto criterion or social welfare.

We address these issues by solving a communication non-cooperative game played between the country policymakers who have to decide upon which information in their possession to reveal to the public. The multi-country model displays three types of spillovers: a real or technological spillover, a beauty-contest effect *à* la Morris and Shin and the informational spillover created by the fact that the information revealed by policymakers is free and reaches the entire set of private agents in the whole economy. Policymakers can neither modify the information they reveal nor target a subset of agents benefiting from their information policy. The results reached in this paper shed some light on the two questions mentioned above. There exists a unique linear subgame perfect Nash equilibrium. Opacity (full or partial) may be an equilibrium outcome of the game and may be socially optimal, for subspaces of the parameter space which are not negligible. In other words, the non-cooperative nature of a game between multiple policymakers may lead to a negative social value of at least some information detained by public authorities, vindicating the Morris and Shin claim that the social value of public information may be negative. Interestingly, this is obtained in a world where the quality of public information (its precision) is higher than the quality of private information (its precision). A corollary is that the non-cooperative equilibrium may convey too little or too much public information depending on the values of parameters.

In the case of a single information received by policymakers on their home shock, the equilibrium is affected by the relative size of countries, for a given value of the beauty-contest parameter. The large country does not behave like the small one. Therefore, its policymaker may not disclose her information whereas the other one always chooses transparency. If the size of the small country is sufficient large, then both countries choose transparency. The higher is the beauty-contest parameter, the higher the critical size of a country above which its policymaker may choose opacity. A social planner for the world economy may also be partially transparent, disclosing the public information about one country and hiding the information about the other one.

In the case of multiple informations received by policymakers, assuming equal country size, this equilibrium always involves some revelation by the policymakers. In other words, full opacity is never an equilibrium. Nevertheless, this does not imply that full opacity cannot be a superior policy. Actually, we prove that for a subset of the parameter space, full opacity is Pareto-dominant with respect to the partial transparency reached in the equilibrium. On the contrary, the full transparency equilibrium which is obtained for intermediate values of the real spillover parameter is the Pareto-dominant solution. The partial communication solutions may be the equilibrium outcome but can never be optimal.

These results are obtained in an abstract model. Yet the methodology used here could be applied to explicitly developed economic models.[12] It could be applied to issues where information policy plays a role in a multi-jurisdictional economy. For example, a two-country version of a Lucas-Phelps island economy as done by Myatt and Wallace (2014) could be considered. Information policies to be applied in international monetary games could also be tackled using our methodology (Taylor, 2013). An other issue of interest is the study of public good games in a multi-jurisdictional setting (Scotchmer, 2002). Similarly our methodology could be applied to speculative attacks on currencies (Goldstein, Ozdenoren and Yuan, 2011), bank runs (Chakravarty et al., 2021) or on asset markets (Ruiz-Buforn et al., 2021), obviously in more specific models. Combining communication tools and policies with standard economic policy tools within different settings appears to be a challenging task which is left to further research.

[12] Angeletos and Lian (2016, Section 8) provide examples of applications of beauty-contests. The extension of these applications to multi-country settings would meet the issues studied in the present paper.

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Appendix

A Expected public and social loss in a general model

A.1 Expected public loss

The expected regional loss is composed of four components, as shown in the main text:

$$L_{P_j} = \frac{1}{2}n_j E\left[(1-r)\left(\overline{a}^j - \Theta^j\right)^2 + (1-rn_j)\,\sigma^2_{a^j} - rn_{-j}\sigma^2_{a^{-j}} + rn_{-j}\,(1-2n_j)\left(\overline{a}^j - \overline{a}^{-j}\right)^2\right]$$

The next four subsections (corresponding to the loss components) discuss the factors which affect the expected public loss.

A.1.1 The expected squared error in the average action

The first component in the expected public loss represents the expected squared error in the average action in country j:

$$L_{P_j;\bar{a}} = \frac{1}{2}n_j E\,(1-r)\left(\overline{a}^j - \Theta^j\right)^2 \tag{26}$$

Using the average actions (16), we rewrite this component as a sum of two terms:

$$L_{P_j;\bar{a}} = \frac{1}{2}n_j\,(1-r)\,E\left(b^j\theta^j + c^j z^j - \lambda^j\theta^j\right)^2 + \frac{1}{2}n_j\,(1-r)\,E\left(d^j z^{-j} - \left(1-\lambda^j\right)\theta^{-j}\right)^2 \tag{27}$$

The first term in (27) is defined by the the available information about country j, as coefficients b^j (17) and c^j (18) depend on the precision of signals about θ^j. In what follows, we will refer to the components of the loss function function of country j affected by information about θ^j as to its "home" components. The second term in (27) does not depend on the information about country j, as coefficient d^j (19) does not depend on it. On the contrary, this term depends on the information about the foreign country $-j$. In what follows, we will refer to the components of the loss function of country j affected by information about θ^{-j} as to its "foreign" components. Equation (27) shows that the first public loss component is separable in two sets of information. The same is true for the other components of the public loss function. The first term in (27) can be rewritten as follows:

$$\frac{1}{2}n_j\left(1-r\right)E\left(b^j\theta^j+c^jz^j-\lambda^j\theta^j\right)^2=\frac{1}{2}n_j\left(1-r\right)E\left(\left[b^j+c^j-\lambda^j\right]\theta^j+c^j\left[z^j-\theta^j\right]\right)^2 \tag{28}$$

Equation (28) highlights three factors influencing the home component in the expected squared error in the average action. The first factor is the gap between the coefficient in the actions associated with the home information and the weight of the home country-specific shock in Θ_j. This gap is driven by the beauty contest and does not depend on the precisions of signals:

$$\left[b^j+c^j-\lambda^j\right]=rn_{-j}\left[1-\lambda^{-j}-\lambda^j\right]$$

As far as $\phi\neq 1/2$ and $r(1-r)n_j(1-n_j)\neq 0$, this gap leads to an increase in the regional loss equal to $1/2n_jn_{-j}r(1-r)\left[1-\lambda^{-j}-\lambda^j\right]^2\sigma_\theta^2$.

The second home factor driving the expected squared error in the average action is the noisiness of public information z^j. As far as $c^j\neq 0$, the imprecision of this information increases the expected public loss by $1/2n_j(1-r)\left[c^j\right]^2\sigma_{z,j}^2$. If the policymaker increases the precision of her signal, c^j increases while $\sigma_{z,j}^2$ decreases. The joint effect of the precision of the home public signal on the expected public loss is ambiguous. The third home factor defining the home public loss component is the correlation between the noise in the public information z^j and the country-specific shock. This factor contributes to an increase in the expected public loss equal to $-n_j(1-r)\left[b^j+c^j-\lambda^j\right]c^j(1-\omega_j)\sigma_\theta^2=-n_j(1-r)\left[b^j+c^j-\lambda^j\right]c^j\sigma_{z,j}^2$. This term depends ambiguously on the precision of the public signal, as in this case c^j and $\sigma_{z,j}^2$ change in opposite directions. Summing up all three factors, we get

$$\frac{1}{2}n_j\,(1-r)\,E\left(b^j\theta^j+c^jz^j-\lambda^j\theta^j\right)^{\,2}=\frac{1}{2}n_j\,(1-r)\,\frac{(rn_{-j})^{\,2}\left[1-\lambda^{-j}-\lambda^j\right]^2}{\sigma_\theta^{-2}} + \frac{1}{2}n_j\,(1-r)\,c^j\frac{c^j-2\left[1-\lambda^{-j}-\lambda^j\right]rn_{-j}}{\sigma_{z,j}^{-2}} \tag{29}$$

The second term in (27) represents the foreign component defined as:

$$\frac{1}{2}n_j\,(1-r)\,E\left(d^jz^{-j}-\left(1-\lambda^j\right)\theta^{-j}\right)^2=\frac{1}{2}n_j\,(1-r)\,E\left(d^j\left(z^{-j}-\theta^{-j}\right)+\left(d^j-\left(1-\lambda^j\right)\right)\theta^{-j}\right)^2 \tag{30}$$

Similar to the discussion above, three foreign factors affect the expected squared error in the average action. The first factor is the difference between the coefficient associated with the foreign information and the weight of the foreign country-specific shock in Θ_{-j}: $(d^j-(1-\lambda^j))$. This difference is driven by the beauty contest and does not depend on the precision of any signal:

$$\left(d^j-\left(1-\lambda^j\right)\right)=rn_{-j}\left[\lambda^{-j}-\left(1-\lambda^j\right)\right]$$

As far as $\phi\neq 1/2$ and $r(1-r)n_j(1-n_j)\neq 0$, it leads to an increase in the expected regional loss equal to $(1/2n_jn_{-j}r(1-r)\left[1-\lambda^{-j}-\lambda^j\right]^2\sigma_\theta^2)$. This term does not depend on the precision of the signals. The second factor behind this component of the public loss function is the noisiness of public information z_{-j}. As far as $d^j\neq 0$, it increases the expected public loss by $1/2n_j(1-r)(d^j)^2\sigma_{z,-j}^2$. Coefficient d^j does not depend on the precision of the public information about θ^{-j} and its increase unambiguously leads to a decrease in this loss component. The third foreign factor behind the error in the average action is the correlation between the noise in foreign public information z^j and the foreign country-specific shock. This correlation gives a rise to the expected public loss equal to$-n_j(1-r)\left[d^j-(1-\lambda^j)\right]d^j(1-\omega_j)\sigma_\theta^2=-n_j(1-r)\left[d^j-(1-\lambda^j)\right]d^j\sigma_{z,-j}^2$. Using all three factors, the foreign part in the first component of the public loss function can be rewritten as

$$\frac{1}{2}n_j\left(1-r\right)E\left(d^jz^{-j}-\left(1-\lambda^j\right)\theta^{-j}\right)^2 = \frac{1}{2}n_j\left(1-r\right)\frac{\left(rn_{-j}\right)^2\left[\lambda^{-j}-\left(1-\lambda^j\right)\right]^2}{\sigma_\theta^{-2}} + \frac{1}{2}n_j\left(1-r\right)d^j\frac{d^j-2\left[\lambda^{-j}-\left(1-\lambda^j\right)\right]rn_{-j}}{\sigma_{z,-j}^{-2}} \tag{31}$$

A.1.2 The diversity of domestic private actions

The second component in the public loss function (9) is defined by the diversity of domestic private actions:

$$L_{P_j;a_j} = \frac{1}{2}n_j\left(1-rn_j\right)\sigma_{a^j}^2 = \frac{1}{2}n_j\left(1-rn_j\right)\frac{\left(b^j\right)^2}{\sigma_x^{-2}} \tag{32}$$

Taking into account (17), we get

$$L_{P_j;a_j} = \frac{1}{2}n_j\left(1-rn_j\right)\left(\frac{\left(1-r\right)\lambda^j}{\left(1-rn_j\right)\sigma_x^{-2}+\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}\right)^2\sigma_x^{-2} \tag{33}$$

An increase in $\sigma_{s,j}^{-2}$ unambiguously leads to a decrease in this public loss component.

A.1.3 The diversity of foreign private actions

The third component in the loss function is defined by the variance of private actions in the foreign region:

$$L_{P_j;a_{-j}} = -\frac{1}{2}rn_jn_{-j}\sigma_{a^{-j}}^2 = -\frac{1}{2}rn_jn_{-j}\frac{\left(b^{-j}\right)^2}{\sigma_x^{-2}} \tag{34}$$

Taking into account (17), we get

$$L_{P_j;a_{-j}} = -\frac{1}{2}rn_jn_{-j}\left(\frac{\left(1-r\right)\lambda^{-j}}{\left(1-rn_{-j}\right)\sigma_x^{-2}+\sigma_\theta^{-2}+\sigma_{s,-j}^{-2}}\right)^2\sigma_x^{-2} \tag{35}$$

The loss of country j depends negatively on the variance of the foreign private actions and therefore positively on the precision of foreign public information.

A.1.4 Inter-country gap in average actions

The last component in the public loss function (9) characterizes the inter-country gap in average actions:

$$L_{P_j;\bar{a}^j-\bar{a}^{-j}} = \frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) E\left(\overline{a}^j - \overline{a}^{-j}\right)^2 \tag{36}$$

Using the average actions (16), we rewrite this component:

$$L_{P_j;\bar{a}^j-\bar{a}^{-j}} = \frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) E\left(\left[b^j\theta^j + c^j z^j - d^{-j} z^j\right] - \left[d^j z^{-j} - c^{-j} z^{-j} - b^{-j}\theta^{-j}\right]\right)^2 \tag{37}$$

The term $[b^j\theta^j + c^j z^j - d^{-j} z^j]$ is defined solely by shock θ^j and information about it. The term $[d^j z^{-j} - c^{-j} z^{-j} - b^{-j}\theta^{-j}]$ is defined solely by shock θ^{-j} and information about it. As the country-specific shocks are not correlated, we can simply rewrite the expected squared inter-country gap in average actions as follows:

$$L_{P_j;\bar{a}^j-\bar{a}^{-j}} = \frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) \left(E\left[b^j\theta^j + c^j z^j - d^{-j} z^j\right]^2 + E\left[d^j z^{-j} - c^{-j} z^{-j} - b^{-j}\theta^{-j}\right]^2\right) \tag{38}$$

The first domestic term in (38) is defined as follows:

$$\begin{aligned} \frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) E\left[b^j\theta^j + c^j z^j - d^{-j} z^j\right]^2 = \\ \frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) E\left[\left(b^j + c^j - d^{-j}\right)\theta^j + \left(c^j - d^{-j}\right)\left(z^j - \theta_j\right)\right]^2 \end{aligned} \tag{39}$$

Similar to subsection A.1.1, there are three domestic factors driving the inter-country gap. The first factor refers to the different weight of the information about country j in the average actions in two countries: $(b^j + c^j - d^{-j})$. It effect on the expected public loss is then equal to $\frac{1}{2} r n_j n_{-j} \left(1-2n_j\right) \left(b^j + c^j - d^{-j}\right)^2 \sigma_\theta^2$. This term does not depend on the signal sent by the policy-maker, as

$$\left(b^j + c^j - d^{-j}\right) = \left(1-r\right)\left(\lambda^j - \left(1-\lambda^{-j}\right)\right).$$

The second factor refers to the different impact of public information about country j on the average actions in two countries. This leads to an increase in the expected public loss equal to $\frac{1}{2}rn_jn_{-j}\left(1-2n_j\right)\left(c^j-d^{-j}\right)^2\sigma^2_{z,j}$. This term is affected by the precision of the public signal about θ^j not only through the direct effect on $\sigma^2_{z,j}$, but also through the value $\left(c^j-d^{-j}\right)$ which is defined as follows:

$$\left(c^j-d^{-j}\right)=\left(1-r\right)\left(\lambda^j-\left(1-\lambda^{-j}\right)\right)-b^j.$$

The third domestic factor affecting the inter-country gap in average actions is the correlation between the noise in public information and θ^j. Its effect on the expected public loss is equal to $-rn_jn_{-j}\left(1-2n_j\right)\left(b^j+c^j-d^{-j}\right)\left(c^j-d^{-j}\right)\left(1-\omega_j\right)\sigma^2_\theta = -rn_jn_{-j}\left(1-2n_j\right)\left(b^j+c^j-d^{-j}\right)\left(c^j-d^{-j}\right)\sigma^2_{z,j}$. To see how the revelation of public information impacts this term, we rewrite it to obtain the following:

$$\begin{aligned}\frac{rn_jn_{-j}}{2}\left(1-2n_j\right)E\left[b^j\theta^j+c^jz^j-d^{-j}z^j\right]^2=\frac{1}{2}rn_jn_{-j}\left(1-2n_j\right)\frac{\left(1-r\right)^2\left(\lambda^j-\left(1-\lambda^{-j}\right)\right)^2}{\sigma_\theta^{-2}}- \\ -\frac{1}{2}rn_jn_{-j}\left(1-2n_j\right)\frac{\left(1-r\right)^2\left[\lambda^j-\left(1-\lambda^{-j}\right)\right]^2-\left(b^j\right)^2}{\sigma_{z,j}^{-2}}\end{aligned} \tag{40}$$

With an increase in the precision of the public signal, coefficient b^j decreases. The effect on the loss depends on the size of the region. For a large country $(n_j > 1/2)$, this leads to an increase in the inter-country public loss component. For a small country $(n_j < 1/2)$, this leads to a decrease in the inter-country public loss component.

In overall, the second term in (38), defined by the information about the foreign shock, can be rewritten as follows:

$$\begin{aligned}\frac{rn_jn_{-j}}{2}\left(1-2n_j\right)E\left[d^jz^{-j}-c^{-j}z^{-j}-b^{-j}\theta^{-j}\right]^2=\frac{1}{2}rn_jn_{-j}\left(1-2n_j\right)\frac{\left(1-r\right)^2\left(\lambda^{-j}-\left(1-\lambda^{j}\right)\right)^2}{\sigma_\theta^{-2}}- \\ -\frac{1}{2}rn_jn_{-j}\left(1-2n_j\right)\frac{\left(1-r\right)^2\left[\lambda^{-j}-\left(1-\lambda^{j}\right)\right]^2-\left(b^{-j}\right)^2}{\sigma_{z,-j}^{-2}}\end{aligned} \tag{41}$$

A.1.5 The expected public loss

Taking into account A.1.1-A.1.4, we can rewrite the public loss as

$$E\left(L_{\mathcal{P}_j}\right) = \frac{1}{2} n_j \left(1-r\right) \left[\rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) + \rho_j^{-j} \left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) + t.i.p\right], \tag{42}$$

where $\rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)$ is the "home" loss component, which depends on the information about shock θ^j, and $\rho_j^{-j} \left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)$ is the "foreign" loss component which depends on the information about shock θ^{-j}. The term $t.i.p.$ is independent of the information policies chosen by the policymakers in both countries:

$$t.i.p. = 2r(1-n_j)\left(1-2n_j+rn_j\right) \frac{\left[1-\lambda^{-j}-\lambda^j\right]^2}{\sigma_\theta^{-2}} \tag{43}$$

The "home" loss component is:

$$\begin{aligned} \rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = &\frac{\left[\lambda^j - b^j\right]^2 - \left(rn_{-j}\right)^2 \left[\lambda^j - \left(1-\lambda^{-j}\right)\right]^2}{\sigma_{z,j}^{-2}} + \frac{\left(1-rn_j\right)}{\left(1-r\right)} \frac{\left(b^j\right)^2}{\sigma_x^{-2}} - \\ &-rn_{-j}\left(1-2n_j\right) \frac{\left(1-r\right)^2 \left[\lambda^j - \left(1-\lambda^{-j}\right)\right]^2 - \left(b^j\right)^2}{\left(1-r\right)\sigma_{z,j}^{-2}} \end{aligned} \tag{44}$$

Using the equilibrium value for coefficient b^j (17) we get the home public loss component as a function of $\sigma_{s,j}^{-2}$:

$$\begin{aligned} \rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = &A_{1,j} \frac{\lambda_j^2 - (1-rn_j)^2 \left(\lambda_j - \left(1-\lambda_{-j}\right)\right)^2}{\sigma_{s,j}^{-2} + \sigma_\theta^{-2}} + A_{2,j} \frac{\lambda_j^2}{\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-rn_j)\sigma_x^{-2}\right)} \\ &+A_{3,j} \frac{\lambda_j^2 \sigma_x^{-2}}{\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-rn_j)\sigma_x^{-2}\right)^2}, \end{aligned} \tag{45}$$

where $A_{1,j} = \frac{r(1-n_j)}{(1-rn_j)^2}(rn_j + 1 - 2n_j)$, $A_{2,j} = \frac{(1-r)}{(1-rn_j)^2}(1 + rn_j(1-2n_j))$, and $A_{3,j} = \frac{n_j r(1-r)}{(1-rn_j)}(rn_j + 1 - 2n_j)$. The "foreign" public loss component is given by:

$$\rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = d^j \frac{d^j - 2\left[\lambda^{-j} - (1-\lambda^j)\right] rn_{-j}}{\sigma_{z,-j}^{-2}} - \frac{rn_{-j}}{1-r}\frac{\left(b^{-j}\right)^2}{\sigma_x^{-2}} \tag{46}$$
$$-rn_{-j}(1-2n_j)\frac{(1-r)^2\left[\lambda^{-j} - (1-\lambda^j)\right]^2 - \left(b^{-j}\right)^2}{(1-r)\,\sigma_{z,-j}^{-2}}$$

Using the equilibrium values for coefficients b^{-j} (17) and d^j (19), we get the foreign loss component as a function of $\sigma_{s,-j}^{-2}$:

$$\rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = B_{1,j}\frac{\lambda_{-j}^2 - (1-rn_{-j})^2\left(\lambda_j - (1-\lambda_{-j})\right)^2}{\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}} + \frac{(1-\lambda_j)^2 - r^2 n_{-j}^2\left(\lambda_j - (1-\lambda_{-j})\right)^2}{\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}} \tag{47}$$
$$+B_{2,j}\frac{\lambda_{-j}^2}{\left(\sigma_{s,-j}^{-2} + \sigma_\theta^{-2} + (1-rn_{-j})\sigma_x^{-2}\right)} + B_{3,j}\frac{\lambda_{-j}^2\sigma_x^{-2}}{\left(\sigma_{s,-j}^{-2} + \sigma_\theta^{-2} + (1-rn_{-j})\sigma_x^{-2}\right)^2},$$

$B_{1,j} = \frac{r(1-n_j)(1-r)(1-2n_j)}{(1-rn_{-j})^2}$, $B_{2,j} = \frac{(1-r)r(1-n_j)(2n_j-1)}{(1-rn_{-j})^2}$, and $B_{3,j} = -\frac{n_{-j}^2 r(1-r)(2-r)}{(1-rn_{-j})}$.

A.2 Expected social loss

Taking into account A.1.1-A.1.4, we rewrite the public loss (20) as follows:

$$E\left(L_{\mathcal{S}}\right) = \frac{1}{2}(1-r)\left[\rho_S^1\left(\sigma_{s,1}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) + \rho_S^2\left(\sigma_{s,2}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) + t.i.p\right], \tag{48}$$

where $\rho_S^j\left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = \rho_j^j\left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) + \rho_{-j}^j\left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)$ for $j = 1, 2$, is the component which depends on the precision of information about θ^j.

$$\rho_S^j\left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = A_{1,S}\frac{\lambda_j^2 - (1-rn_j)^2\left(\lambda_j - (1-\lambda_{-j})\right)^2}{\sigma_{s,j}^{-2} + \sigma_\theta^{-2}} + (1-n_j)\frac{(1-\lambda_{-j})^2 - r^2 n_j^2\left(\lambda_j - (1-\lambda_{-j})\right)^2}{\sigma_{s,j}^{-2} + \sigma_\theta^{-2}} \tag{49}$$
$$+A_{2,S}\frac{\lambda_j^2}{\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-rn_j)\sigma_x^{-2}\right)} + A_{3,S}\frac{\lambda_j^2\sigma_x^{-2}}{\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2} + (1-rn_j)\sigma_x^{-2}\right)^2},$$

where $A_{1,S}=\frac{n_j r^2(1-n_j)^2}{(1-rn_j)^2}$, $A_{2,S}=\frac{(1-r)nj}{(1-rn_j)^2}\left(1+r(1-2n_j)\right)$, $A_{3,S}=-\frac{n_j^2 r(1-r)^2}{(1-rn_j)}$. Notice that $A_{m,S}=n_1A_{m,1}+n_2B_{m,2}$, $m\in\{1,2,3\}$. The term $t.i.p$ is independent of information disclosure and defined as:

$$t.i.p=2r^2n(1-n)\frac{\left[1-\lambda^{-j}-\lambda^j\right]^2}{\sigma_\theta^{-2}} \tag{50}$$

B Proof of Proposition 1

Let Δ_j^j denote the difference between the domestic expected public loss component under transparency and opacity about θ^j:

$$\Delta_j^j=\rho_j^j\left(\sigma_{y,h}^{-2},\sigma_\theta^{-2},\sigma_x^{-2}\right)-\rho_j^j\left(0,\sigma_\theta^{-2},\sigma_x^{-2}\right) \tag{51}$$

We can rewrite this loss difference as

$$\Delta_j^j=\Delta_{j,1}^j+\Delta_{j,2-3}^j,$$

where $\Delta_{j,1}^j=A_{1,j}\left[\lambda_j^2-(1-rn_j)^2\left(\lambda_j-(1-\lambda_{-j})\right)^2\right]\left[\frac{1}{\sigma_{y,h}^{-2}+\sigma_\theta^{-2}}-\frac{1}{\sigma_\theta^{-2}}\right]$ and

$$\Delta_{j,2-3}^j \;=\; \lambda_j^2\left[\frac{A_{2,j}}{\left(\sigma_y^{-2}+\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)}+\frac{A_{3,j}\sigma_x^{-2}}{\left(\sigma_y^{-2}+\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)^2}-\frac{A_{2,j}}{\left(\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)}-\frac{A_{3,j}\sigma_x^{-2}}{\left(\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)^2}\right].$$

Under assumption of $\sigma_{y,h}^{-2}>\sigma_x^{-2}$, the value of $\Delta_{j,2-3}^j$ is finite and not positive. The sign of $\Delta_{j,1}^j$ is ambiguous. For $\phi\in[1/2,1]$, the value of $\left(\lambda_j^2-(1-rn_j)^2\left(\lambda_j-(1-\lambda_{-j})\right)^2\right)$ is positive. When $n\leq\frac{1}{2-r}$, coefficient $A_{1,j}$ is either positive or equal to zero. On overall, $\Delta_{j,1}^j\leq 0$ and the policymaker chooses transparency (here we use the tie-break assumption 1). If $1>n_j>\frac{1}{2-r}$, coefficient $A_{1,j}$ is negative and $\Delta_{j,1}^j>0$. With $\sigma_\theta^{-2}\to 0$, $\Delta_{j,1}^j$ is infinitely large and the overall loss difference Δ_j^j is positive for any $\Delta_{j,2-3}^j$. As a result, the policymaker chooses opacity. When $n=1$, $A_{1,j}=0$ and $\Delta_{j,1}^j=0$, implying that the policymaker chooses transparency. Proposition 1 comes immediately.

C Proof of Proposition 2

Let Δ_S^j denote the difference between the expected social loss under transparency and opacity about country j:

$$\Delta_S^j = \rho_S^j \left(\sigma_{y,h}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) - \rho_S^j \left(0, \sigma_\theta^{-2}, \sigma_x^{-2}\right) \tag{52}$$

We can rewrite the social loss difference as

$$\Delta_S^j = \Delta_{S,1}^j + \Delta_{S,2-3}^j,$$

where $\Delta_{S,1}^j = \left[A_{1,S}\lambda_j^2 + (1-n_j)\left(1-\lambda_{-j}\right)^2 - \left(A_{1,S}(1-rn_j)^2 + (1-n_j)r^2n_j^2\right)\left(\lambda_j - (1-\lambda_{-j})\right)^2\right]\left[\frac{1}{\sigma_{y,h}^{-2}+\sigma_\theta^{-2}} - \frac{}{\sigma}\right.$

and

$$\Delta_{S,2-3}^j \;=\; \lambda_j^2 \left[\frac{A_{2,S}}{\left(\sigma_y^{-2}+\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)} + \frac{A_{3,S}\sigma_x^{-2}}{\left(\sigma_y^{-2}+\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)^2} - \frac{A_{2,S}}{\left(\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)} - \frac{A_{3,S}\sigma_x^{-2}}{\left(\sigma_\theta^{-2}+(1-rn_j)\sigma_x^{-2}\right)^2}\right].$$

Under assumption os $\sigma_{y,h}^{-2} > \sigma_x^{-2}$, term $\Delta_{S,2-3}^j$ is finite and negative. The sign of term $\Delta_{S,1}^j$ is ambiguous. If $r > (1-\sqrt{1-n_j})/n_j$, $\Delta_{S,1}^j$ is negative for any ϕ. In this case transparency is socially optimal. If $r < (1-\sqrt{1-n_j})/n_j$ there is $\tilde{\phi}$ such that $\Delta_{S,1}^j$ is negative if $\phi < \tilde{\phi}$ and positive if $\phi > \tilde{\phi}$. In the latter case with $\sigma_\theta^{-2} \to 0$, $\Delta_{S,1}^j$ is positive and infinitely large, meaning that the overall loss difference Δ_S^j is for any $\Delta_{S,2-3}^j$. In this case, the social planner chooses opacity. When $n = 1$, $A_{1,S} = 0$ and $\Delta_{S,1}^j = 0$, implying that transparency is socially optimal. Proposition 2 comes immediately.

D Proof of Proposition 3

In case of $n_j = 1/2$, the home public loss component (45) is given by:

$$\begin{aligned}\rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = A_{1,j}\frac{\phi^2 - (1-r/2)^2\left(2\phi-1\right)^2}{\sigma_{s,j}^{-2}+\sigma_\theta^{-2}} &+ A_{2,j}\frac{\phi^2}{\left(\sigma_{s,j}^{-2}+\sigma_\theta^{-2}+(1-r/2)\sigma_x^{-2}\right)} \\ &+ A_{3,j}\frac{\phi^2\sigma_x^{-2}}{\left(\sigma_{s,j}^{-2}+\sigma_\theta^{-2}+(1-r/2)\sigma_x^{-2}\right)^2},\end{aligned} \tag{53}$$

where $A_{1,j} = \frac{r^2}{(2-r)^2}$, $A_{2,j} = \frac{4(1-r)}{(2-r)^2}$, and $A_{3,j} = \frac{r^2(1-r)}{2(2-r)}$.

The foreign public loss component (47) becomes:

$$\rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = \frac{(1-\phi)^2 - r^2/4\,(2\phi-1)^2}{\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}} - \frac{r(1-r)\phi^2\sigma_x^{-2}}{2\left(\sigma_{s,-j}^{-2} + \sigma_\theta^{-2} + (1-r/2)\sigma_x^{-2}\right)^2}, \tag{54}$$

The proof of Proposition 3 consists of three steps:

- Step 1. We investigate the choice between home transparency and home opacity and show that there exists some ϕ^* such that: if $\phi < \phi^*$, policymaker $\mathcal{P}_j$ chooses home opacity; if $\phi \geq \phi^*$, she chooses home transparency.
- Step 2. We investigate the choice between foreign transparency and foreign opacity and show that there exists some ϕ^{**} such that: if $\phi > \phi^{**}$, policymaker $\mathcal{P}_j$ chooses foreign opacity; if $\phi \leq \phi^{**}$, she chooses foreign transparency.
- Step 3. We compare the values ϕ^* and ϕ^{**} and conclude about the existence, unicity and properties of equilibrium

Step 1. Choice between home transparency and home opacity

$\mathcal{P}_j$ chooses either home opacity ($\sigma_{s,j,j}^{-2} = 0$) or home transparency ($\sigma_{s,j,j}^{-2} = \sigma_{y,h}^{-2}$). Let Δ_j^j denote the difference between the expected public loss under home transparency and home opacity:

$$\Delta_j^j = \rho_j^j\left(\sigma_{y,h}^{-2} + \sigma_{s,j,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) - \rho_j^j\left(\sigma_{s,j,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) \tag{55}$$

The derivative of (53) over $\sigma_{s,j}^{-2}$ is given by:

$$\begin{aligned}\frac{\partial \rho_j^j}{\partial \sigma_{s,j}^{-2}} = -\frac{r^2\left(4\phi^2 - (2-r)^2(2\phi-1)^2\right)}{4(2-r)^2\left[\sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^2} &- \frac{4\phi^2(1-r)}{(2-r)^2\left[(1-{}^r\!/_2)\,\sigma_x^{-2} + \sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^2} \\ &- \frac{\phi^2 r^2(1-r)\,\sigma_x^{-2}}{(2-r)\left[(1-{}^r\!/_2)\,\sigma_x^{-2} + \sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^3}\end{aligned} \tag{56}$$

Notice that if $\phi \in \left[\frac{2-r}{6-2r}, 1\right]$, the value $\left(4\phi^2 - (2-r)^2 (2\phi - 1)^2\right)$ is positive. In this case, all terms in (56) are negative. This means that the expected public loss is decreasing in home precision implying that $\Delta_j^j < 0$ and $\mathcal{P}_j$ chooses home transparency.

To decide on the sign of Δ_j^j for $\phi < \frac{2-r}{6-2r}$, we rewrite (55) in the following way:

$$\Delta_j^j = \int_{\sigma_{s,j,-j}^{-2}}^{\sigma_{s,j,-j}^{-2}+\sigma_{y,h}^{-2}} \frac{\partial \rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)}{\partial \sigma_{s,j}^{-2}} \, \mathrm{d}\sigma_{s,j}^{-2} \tag{57}$$

The derivative of (57) over ϕ is:

$$\frac{\partial \Delta_j^j}{\partial \phi} = \int_{\sigma_{s,j,-j}^{-2}}^{\sigma_{s,j,-j}^{-2}+\sigma_{y,h}^{-2}} \frac{\partial^2 \rho_j^j \left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)}{\partial \sigma_{s,j}^{-2} \partial \phi} \, \mathrm{d}\sigma_{s,j}^{-2} \tag{58}$$

From (56) we get:

$$\begin{aligned} \frac{\partial^2 \rho_j^j}{\partial \sigma_{s,j,j}^{-2} \partial \phi} = \frac{r^2 \left(2\phi (1-r)(3-r) - (2-r)^2\right)}{(2-r)^2 \left[\sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^2} &- \frac{8\phi (1-r)}{(2-r)^2 \left[(1 - r/2)\, \sigma_x^{-2} + \sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^2} \\ &- \frac{2\phi r^2 (1-r)\, \sigma_x^{-2}}{(2-r) \left[(1 - r/2)\, \sigma_x^{-2} + \sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right]^3} \end{aligned} \tag{59}$$

The value $\left(2\phi (1-r)(3-r) - (2-r)^2\right)$ is negative if $\phi \in \left(0, \frac{2-r}{6-2r}\right)$. Thus, all terms in (59) are negative. This means that $\frac{\partial \Delta_j^j}{\partial \phi}$ is negative and the loss difference Δ_j^j is decreasing in ϕ. We have shown earlier that $\Delta_j^j < 0$ for $\phi = \frac{2-r}{6-2r}$. If ϕ is equal to 0, $\rho_j^j = -\frac{r^2}{4\left(\sigma_{s,j}^{-2} + \sigma_\theta^{-2}\right)}$ and $\Delta_j^j = -\frac{r^2}{4\left(\sigma_\theta^{-2} + \sigma_{y,h}^{-2} + \sigma_{s,j,-j}^{-2}\right)} + \frac{r^2}{4\left(\sigma_\theta^{-2} + \sigma_{s,j,-j}^{-2}\right)} > 0$. Thus, for a given $\sigma_{s,j,-j}^{-2}$ there exists a value $\phi^* \left(\sigma_{s,j,-j}^{-2}\right) \in \left(0, \frac{2-r}{6-2r}\right)$ such that: Δ_j^j is positive if $\phi < \phi^* \left(\sigma_{s,j,-j}^{-2}\right)$; Δ_j^j is equal to 0, if $\phi = \phi^* \left(\sigma_{s,j,-j}^{-2}\right)$; Δ_j^j is negative, if $\phi > \phi^* \left(\sigma_{s,j,-j}^{-2}\right)$. Taking into account the tie-break assumption, we conclude that if $\phi < \phi^* \left(\sigma_{s,j,-j}^{-2}\right)$, $\mathcal{P}_j$ chooses home opacity; if $\phi \geq \phi^* \left(\sigma_{s,j,-j}^{-2}\right)$, she chooses home transparency.

Step 2. Choice between foreign transparency and foreign opacity

$\mathcal{P}_j$ chooses either foreign opacity ($\sigma_{s,-j,j}^{-2} = 0$) or foreign transparency ($\sigma_{s,-j,j}^{-2} = \sigma_{y,f}^{-2}$). Let Δ_j^{-j} denote the difference between the foreign component in the expected public loss under foreign transparency and foreign opacity:

$$\Delta_j^{-j} = \rho_j^{-j}\left(\sigma_{y,f}^{-2} + \sigma_{s,-j,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) - \rho_j^{-j}\left(\sigma_{s,-j,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) \tag{60}$$

The derivative of (54) over $\sigma_{s,-j}^{-2}$ is as follows:

$$\frac{\partial \rho_j^{-j}}{\partial \sigma_{s,-j}^{-2}} = -\frac{\left[(1-\phi)^2 - {}^{r^2}\!/_4\,(1-2\phi)^2\right]}{\left(\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}\right)^2} + r\frac{\phi^2\,(1-r)\,\sigma_x^{-2}}{\left((1-{}^r\!/_2)\,\sigma_x^{-2} + \sigma_{s,-j}^{-2} + \sigma_\theta^{-2}\right)^3} \tag{61}$$

Notice that if $\phi \in \left[\frac{1+r/2}{1+r}, 1\right]$, the value $\left[(1-\phi)^2 - {}^{r^2}\!/_4\,(1-2\phi)^2\right]$ is negative. In this case, all terms in (61) are positive. This means that the loss ρ_j^{-j} is increasing in precision $\sigma_{s,-j}^{-2}$ (implying $\Delta_j^{-j} > 0$) and $\mathcal{P}_j$ chooses foreign opacity. To decide on the sign of Δ_j^{-j} for $\phi \in \left(0, \frac{1+r/2}{1+r}\right)$, we rewrite the loss difference:

$$\Delta_j^{-j} = \int_{\sigma_{s,-j,-j}^{-2}}^{\sigma_{s,-j,-j}^{-2}+\sigma_{y,f}^{-2}} \frac{\partial \rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)}{\partial \sigma_{s,-j}^{-2}}\, \mathrm{d}\sigma_{s,-j}^{-2} \tag{62}$$

The derivative of (62) over ϕ:

$$\frac{\partial \Delta_j^{-j}}{\partial \phi} = \int_{\sigma_{s,-j,-j}^{-2}}^{\sigma_{s,-j,-j}^{-2}+\sigma_{y,f}^{-2}} \frac{\partial^2 \rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)}{\partial \sigma_{s,-j}^{-2}\partial\phi}\, \mathrm{d}\sigma_{s,-j}^{-2} \tag{63}$$

From (61) we get:

$$\frac{\partial^2 \rho_j^{-j}\left(\sigma_{s,-j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right)}{\partial \sigma_{s,-j}^{-2}\partial\phi} = -\frac{\left[(2\phi-1)\,(1-r^2)-1\right]}{\left(\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}\right)^2} + r\frac{2\phi\,(1-r)\,\sigma_x^{-2}}{\left((1-{}^r\!/_2)\,\sigma_x^{-2} + \sigma_{s,-j}^{-2} + \sigma_\theta^{-2}\right)^3} \tag{64}$$

The coefficient $[(2\phi-1)\,(1-r^2)-1]$ depends positively on ϕ. If $\phi = 1$, this coefficient equals to $[1-r^2-1] = -r^2 \leq 0$. From here we can conclude that $[(2\phi-1)\,(1-r^2)-1]$ is negative for all values of ϕ. Thus, both terms in (64) are positive and value $\frac{\partial \rho_j^{-j}}{\partial \sigma_{s,-j}^{-2}}$ is increasing in ϕ. We have shown earlier that Δ_j^{-j} is positive if $\phi \in \left[\frac{1+r/2}{1+r}, 1\right]$. For ϕ equal to $1/2$, Δ_j^{-j} is negative. Consequently, for a given $\sigma_{s,-j,-j}^{-2}$ there exists a value $\phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$ such that: Δ_j^{-j} is positive if $\phi > \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$;

Δ_j^{-j} is equal to 0 if $\phi = \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$; Δ_j^{-j} is negative if $\phi < \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$. Taking into account the tie-break assumption, we conclude that if $\phi \leq \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$, $\mathcal{P}_j$ chooses foreign transparency; if $\phi > \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$, she chooses foreign opacity. If $r < 1$, $\phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right) \in \left({}^1\!/_2, \frac{1+r/2}{1+r}\right)$. If $r = 1$, $\phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right) = 1$.

Step 3. Equilibrium

As we have shown, for any $\left(\sigma_x^{-2}, \sigma_\theta^{-2}, \sigma_{y,f}^{-2}, \sigma_{y,h}^{-2}\right)$, $\phi^*\left(\sigma_{s,j,-j}^{-2}\right) < \frac{2-r}{6-2r} < \frac{1}{2}$ and $\phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right) > {}^1\!/_2$. Thus $\phi^*\left(\sigma_{s,j,-j}^{-2}\right) < {}^1\!/_2 < \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$. This ensures the existence of equilibrium. The "tie-break" assumption ensures the uniqueness of equilibrium. Proposition 3 comes immediately with $\underline{\phi} = \phi^*\left(\sigma_{y,f}^{-2}\right)$ and $\overline{\phi} = \phi^{**}\left(\sigma_{y,h}^{-2}\right)$. The symmetry of the equilibrium comes from the underlying symmetry of the countries.

E Proof of Proposition 4.

Proof of Part 1. In Appendix D, it is shown that $\underline{\phi} = \phi^*\left(\sigma_{s,-j,j}^{-2}\right)$, when $\sigma_{s,-j,j}^{-2} = \sigma_{y,f}^{-2}$. As for any $\sigma_{s,-j,j}^{-2}$, threshold $\phi^* \in \left(0, \frac{2-r}{6-2r}\right)$; it is also true for $\sigma_{s,-j,j}^{-2} = \sigma_{y,f}^{-2}$. Moreover, $\frac{2-r}{6-2r} = {}^1\!/_2 - \frac{1}{6-2r}$ and $\underline{\phi} \in \left(0, {}^1\!/_2 - \frac{1}{6-2r}\right)$.

In Appendix D, it is also shown that $\overline{\phi} = \phi^{**}\left(\sigma_{s,-j,-j}^{-2}\right)$ for $\sigma_{s,-j,-j}^{-2} = \sigma_{y,h}^{-2}$. As for any $\sigma_{s,-j,-j}^{-2}$ and if $r < 1$, threshold $\phi^{**} \in \left(\frac{1}{2}, \frac{1+r/2}{1+r}\right)$; it is also true for $\sigma_{s,-j,j}^{-2} = \sigma_{y,f}^{-2}$. Moreover, $\frac{1+r/2}{1+r} = \frac{1}{2} + \frac{1/2}{1+r}$ and $\overline{\phi} \in \left(\frac{1}{2}, \frac{1}{2} + \frac{1/2}{1+r}\right)$.

Proof of Part 2. Using Equation (53), when $r = 0$, we get:

$$\rho_j^j(r=0) = \frac{\phi^2}{\sigma_x^{-2} + \sigma_{s,j}^{-2} + \sigma_\theta^{-2}} \tag{65}$$

Function (65) is decreasing in $\sigma_{s,j}^{-2}$ for any positive ϕ. For $\phi = 0$, the home public loss component is constant and equal to 0. Thus, for any ϕ, $\mathcal{P}_j$ chooses home transparency and threshold $\underline{\phi}$ is equal to 0. Using Equation (54), when $r = 0$, we get:

$$\rho_j^{-j}\left(r=0\right) = \frac{\left(1-\phi\right)^2}{\sigma_{s,-j}^{-2} + \sigma_\theta^{-2}} \tag{66}$$

Function (66) is decreasing in $\sigma_{s,-j}^{-2}$ for any $\phi \neq 1$. For $\phi = 1$, the foreign loss component is constant and equal to 0. Thus, for any ϕ, $\mathcal{P}_j$ chooses foreign transparency and threshold $\overline{\phi}$ is equal to 1.

To prove the second part of this proposition, notice that, for r close (but not equal to) 1, the two last terms in (56) are negligible and the first term is equal to $-\frac{\left(4\phi^2-(2\phi-1)^2\right)}{4\left[\sigma_{s,j}^{-2}+\sigma_\theta^{-2}\right]^2} = -\frac{4\phi-1}{4\left[\sigma_{s,j}^{-2}+\sigma_\theta^{-2}\right]^2}$. Thus, for $\phi \in [0; 1/4)$ and r close to 1, the loss function is increasing in the precision of public information and $\mathcal{P}_j$ chooses home opacity. If $\phi \geq 1/4$, the loss function is either constant or decreasing in the precision of public information and $\mathcal{P}_j$ chooses home transparency. Hence, we can conclude that with r close to 1, $\underline{\phi}$ tends to $1/4$. Similarly, we observe that for r close (but not equal to) 1, the last term in (61) is negligible and the first term is equal to $-\frac{\left[4(1-\phi)^2-(1-2\phi)^2\right]}{4\left(\sigma_{s,-j}^{-2}+\sigma_\theta^{-2}\right)^2} = -\frac{\left[4-8\phi+4\phi^2-1+4\phi-4\phi^2\right]}{4\left(\sigma_{s,-j}^{-2}+\sigma_\theta^{-2}\right)^2} = -\frac{[3-4\phi]}{4\left(\sigma_{s,-j}^{-2}+\sigma_\theta^{-2}\right)^2}$. Thus, for $\phi \geq 3/4$ and r close to 1, the foreign loss component is increasing in the precision of public information and $\mathcal{P}_j$ chooses foreign opacity. If $\phi < 3/4$, the foreign loss component is decreasing in the precision of public information and $\mathcal{P}_j$ chooses foreign transparency. Hence, if r is close to 1, $\overline{\phi}$ is close to $3/4$. If $r = 1$, the loss is equal to zero and $\mathcal{P}_j$ chooses transparency for all values of ϕ meaning that $\underline{\phi} = 0$ and $\overline{\phi} = 0$.

Proof of Part 3. As we have shown earlier, $\underline{\phi} \in \left(0, 1/2 - \frac{1}{6-2r}\right)$ and $\overline{\phi} \in \left(\frac{1}{2}, \frac{1}{2} + \frac{1/2}{1+r}\right)$ if $r < 1$. If $\phi > \frac{1}{2} + \frac{1/2}{1+r}$, we can see that $\phi > \underline{\phi}$ and $\mathcal{P}_j$ chooses home transparency. Moreover in this case $\phi > \overline{\phi}$ and $\mathcal{P}_j$ chooses foreign opacity. If $\phi \in \left(1/2 - \frac{1}{6-2r}, 1/2\right)$, we can see that $\phi > \underline{\phi}$ and $\mathcal{P}_j$ chooses home transparency. Moreover, in this case $\phi < \overline{\phi}$ and $\mathcal{P}_j$ chooses foreign transparency.

F Proof of Proposition 5.

Substituting $n_j = 1/2$ into the home component of the expected social loss (50) provides:

$$\rho_S^j\left(\sigma_{s,j}^{-2}, \sigma_\theta^{-2}, \sigma_x^{-2}\right) = A_{1,S}\frac{\phi^2 - (1-r/2)^2(2\phi-1)^2}{\sigma_{s,j}^{-2}+\sigma_\theta^{-2}} + \frac{1}{2}\frac{(1-\phi)^2 - r^2/4\,(2\phi-1)^2}{\sigma_{s,j}^{-2}+\sigma_\theta^{-2}} \\ + A_{2,S}\frac{\phi^2}{\left(\sigma_{s,j}^{-2}+\sigma_\theta^{-2}+(1-r/2)\sigma_x^{-2}\right)} + A_{3,S}\frac{\phi^2\sigma_x^{-2}}{\left(\sigma_{s,j}^{-2}+\sigma_\theta^{-2}+(1-r/2)\sigma_x^{-2}\right)^2}, \tag{67}$$

where $A_{1,S} = \frac{r^2}{2(2-r)^2}$, $A_{2,S} = \frac{2(1-r)}{(2-r)^2}$, $A_{3,S} = -\frac{r(1-r)^2}{2(2-r)}$.

The proof of Proposition 5 consists of two steps:

- **Step 1.** We show that the social loss function is either decreasing in the precision of public information or has an inverted-U shape. In this case the social planner always chooses among two options available to her: either opacity or full revelation of the signals on θ^j. Part 1 of Proposition 5 follows immediately. Moreover, we show that the social loss function has an inverted-U shape only if conditions 2.a) and 2.b) from Proposition 5 hold.

- **Step 2.** This part of the proof is equivalent to the proof of Proposition 2. We show that if all conditions 2.a)-c) from Proposition 5 hold, the social loss under opacity is lower than the loss under transparency and thus, full opacity is socially optimal. Otherwise, transparency is socially optimal.

Step 1. We take the derivative of the social loss (67) over $\sigma_{s,j}^{-2}$:

$$\frac{\partial\rho_S^j}{\partial\sigma_{s,j}^{-2}} = -\frac{\left(4r^2\phi^2 - 2r^2(2-r)^2(1-2\phi)^2 + 4(2-r)^2(1-\phi)^2\right)}{8(2-r)^2\left(\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)^2} - \frac{4\phi^2(1-r)}{2(2-r)^2\left((1-{}^r\!/\!_2)\,\sigma_x^{-2}+\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)^2} + \\ + \frac{2(1-r)^2\phi^2 r\sigma_x^{-2}}{2(2-r)\left((1-{}^r\!/\!_2)\,\sigma_x^{-2}+\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)^3},$$

from where

$$\frac{\partial\rho_S^j}{\partial\sigma_{s,j}^{-2}} = -\frac{\left((2-r)-2\phi\,(1-r)\right)\left((2-r)\,(2-r^2)-2\phi\,(1-r)\,(2+2r-r^2)\right)}{4\,(2-r)^2\left(\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)^2} \\ -\phi^2\,(1-r)\,\frac{2\left(\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)+(2-r)\,(1-r+r^2)\,\sigma_x^{-2}}{(2-r)^2\left((1-{}^r\!/_2)\,\sigma_x^{-2}+\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\right)^3}. \tag{68}$$

Firstly, we show that there exists $\tilde{r} \equiv 2-\sqrt{2}$ such that if $r \geq \tilde{r}$, the social loss function is decreasing in the precision of public information. To get this result, we should analyze the sign of the right-hand side of equation (68). The second term of this expression is negative, the first term can be negative or positive depending on the parameters. The term $((2-r)-2\phi\,(1-r))$ is always positive. The term $((2-r)\,(2-r^2)-2\phi\,(1-r)\,(2+2r-r^2))$ is positive for all values of ϕ, if $r \geq \tilde{r} \equiv 2-\sqrt{2}$. Thus, $r \geq \tilde{r}$ is sufficient for $\frac{\partial\rho_S^j}{\partial\sigma_{s,j}^{-2}}$ to be negative.[13] Under this condition, the social loss is a decreasing function of the precision of public information.

Secondly, we show that if $r < \tilde{r}$, there exists $\tilde{\phi} \equiv \frac{(2-r)\left(2-r^2\right)}{2(1-r)(2+2r-r^2)}$ such that the social loss function has an inverted U-shape, if $\phi > \tilde{\phi}$, and is decreasing in the precision of public information, if $\phi \leq \tilde{\phi}$. To show that, we analyze expression $((2-r)\,(2-r^2)-2\phi\,(1-r)\,(2+2r-r^2))$ from the first term of equation (68). If $r < \tilde{r}$, this expression is positive if $\phi < \frac{(2-r)\left(2-r^2\right)}{2(1-r)(2+2r-r^2)} \equiv \tilde{\phi} \leq 1$ and negative if $\phi > \frac{(2-r)\left(2-r^2\right)}{2(1-r)(2+2r-r^2)} \equiv \tilde{\phi} \leq 1$. Therefore, if $r < \tilde{r}$ and $\phi \leq \tilde{\phi}$, both terms in the right-hand side of equation (68) are negative and the social loss is a decreasing function of the precision of public information. If $r < \tilde{r}$ and $\phi > \tilde{\phi}$, the first term in (68) is positive and the second term is negative. As $\lim_{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}\to 0} \frac{\partial\rho_S^j}{\partial\sigma_{s,j}^{-2}} = \infty$, the loss function is increasing in the precision of public information if this precision is close to zero. To further characterize the loss function when the precision of public information is not close to zero, we note that the sigh of (68) is defined by the sign of cubic polynomial $\mathcal{L} = A\left(\frac{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}{\sigma_x^{-2}}\right)^3 + B\left(\frac{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}{\sigma_x^{-2}}\right)^2 + C\left(\frac{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}{\sigma_x^{-2}}\right) + D$ with $A = -\left(2\phi^2(1-r)\left((2-r)^2(1+r)-r^2(3-r)+4\right)\right)+4\phi(2-r)^2(1-r^2)+(2-r)^2(2-r^2)$, $B = 3A+4\phi^2(1-r)\,(8-(2-r)(1-r+r^2))$, $C = 3(1-r/2)^2\,(A+8\phi^2(1-r))$, $D = (1-r/2)^3\,(A+8\phi^2(1-r))$. The discriminant of this polynomial $\Delta_3 = B^2C^2-4AC^3-4B^3D-27A^2D^2+$

[13] Worth to mention that if $\sigma_x^{-2}=0$, public loss is decreasing in $\sigma_{s,j}^{-2}$. All that follows for $\sigma_x^{-2}>0$.

$18ABCD$ is negative and $A < 0$. This means that expression (68) is either negative (when the only real root of polynomial $\mathcal{L}$ is negative) or is positive for low values of $\frac{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}{\sigma_x^{-2}}$ and negative for high values of $\frac{\sigma_\theta^{-2}+\sigma_{s,j}^{-2}}{\sigma_x^{-2}}$ (when the only real root of polynomial $\mathcal{L}$ is positive). This means that the social loss is either decreasing in precision $\sigma_{s,j}^{-2}$ or has an inverted-U shape (increasing for low values of $\sigma_{s,j}^{-2}$ and decreasing for high values of $\sigma_{s,j}^{-2}$). We have shown earlier that the loss function is increasing in the precision of public information when this precision is close to zero, if $r < \tilde{r}$ and $\phi > \tilde{\phi}$. Taking into consideration this fact, we can conclude that under these conditions the social loss function has an inverted-U shape. If any of these two conditions does not hold, the social loss function is decreasing in the precision of public information. Obviously, if the social loss function is decreasing in the precision of public information, full transparency is socially optimal. If the social loss function has an inverted U-shape, either full transparency of full opacity is optimal. Partial transparency is never socially desirable. This concludes the first part of the Proof.

Step 2. Step 1 demonstrates that conditions 2.a) and 2.b) in Proposition 5 ensure that the social loss function has an inverted U-shape. In this case, either full opacity or full transparency is socially optimal. For full opacity to be optimal, two additional conditions are necessary: the precision of public information under full opacity should be on the increasing part of the loss function and the loss under transparency should be higher than the loss under opacity. We can rewrite the social loss difference as

$$\Delta_S^j = \Delta_{S,1}^j + \Delta_{S,2-3}^j,$$

where

$\Delta_{S,1}^j = \left[A_{1,S}\phi^2 + {}^1\!/_2\,(1-\phi)^2 - (A_{1,S}(1-{}^r\!/_2)^2 + {}^{r^2}\!/_8)\,(2\phi-1)^2\right]\left[\frac{1}{\sigma_{y,h}^{-2}+\sigma_{y,f}^{-2}+\sigma_\theta^{-2}} - \frac{1}{\sigma_\theta^{-2}}\right]$ and

$\Delta_{S,2-3}^j = \phi^2\left[\frac{A_{2,S}}{\left(\sigma_{y,h}^{-2}+\sigma_{y,f}^{-2}+\sigma_\theta^{-2}+(1-\frac{r}{2})\sigma_x^{-2}\right)} + \frac{A_{3,S}\sigma_x^{-2}}{\left(\sigma_{y,h}^{-2}+\sigma_{y,f}^{-2}+\sigma_\theta^{-2}+(1-\frac{r}{2})\sigma_x^{-2}\right)^2} - \frac{A_{2,S}}{\left(\sigma_\theta^{-2}+(1-\frac{r}{2})\sigma_x^{-2}\right)} - \frac{A_{3,S}\sigma_x^{-2}}{\left(\sigma_\theta^{-2}+(1-\frac{r}{2})\sigma_x^{-2}\right)^2}\right].$

Assuming $\sigma_{y,h}^{-2} + \sigma_{y,f}^{-2} > \sigma_x^{-2}$, $\Delta_{S,2-3}^j$ is finite and negative. The sign of $\Delta_{S,1}^j$ is ambiguous. If $r > 2-\sqrt{2}$, $\Delta_{S,1}^j$ is negative for any ϕ. In this case, transparency is socially optimal. If $r < 2-\sqrt{2}$ there is $\tilde{\phi}$ so that $\Delta_{S,1}^j$ is negative if $\phi < \tilde{\phi}$ and positive if $\phi > \tilde{\phi}$. In the latter case, when $\sigma_\theta^{-2} \to 0$, $\Delta_{S,1}^j$ is positive and infinitely large, meaning that the overall loss difference Δ_S^j is for any $\Delta_{S,2-3}^j$.

In this case, the social planner chooses opacity. Proposition 5 comes immediately.

G Proof of Proposition 6.

As we have seen before, $\tilde{\phi} = \frac{(2-r)\left(2-r^2\right)}{2(1-r)(2+2r-r^2)}$ and $\overline{\phi} \leq \frac{2+r}{2(1+r)}$. The ratio between two thresholds is:

$$\frac{\tilde{\phi}}{\overline{\phi}} \geq \frac{\tilde{\phi}}{\frac{2+r}{2(1+r)}} = \frac{(1+r)(2-r)(2-r^2)}{(1-r)(2+2r-r^2)(2+r)} = 1 + \frac{2r^2}{(1-r)(2+2r-r^2)(2+r)} \geq 1.$$

Thus, $\tilde{\phi} > \overline{\phi}$ if $r \neq 0$ and $\tilde{\phi} = \overline{\phi}$ if $r = 0$. We know that if $\phi \leq \tilde{\phi}$, full transparency is socially optimal. Nevertheless, full transparency obtains in equilibrium only if $\phi \in \left[\underline{\phi}, \overline{\phi}\right]$. Thus, if $\phi \in \left[\underline{\phi}, \overline{\phi}\right]$ the equilibrium coincides with the social optimum. If $\phi < \underline{\phi} < \overline{\phi} \leq \tilde{\phi}$, home opacity and foreign transparency obtain in equilibrium, although full transparency is socially optimal. and the equilibrium policy is not socially optimal in this case. If $\phi > \overline{\phi}$, home transparency and foreign opacity obtain in equilibrium. Full transparency is socially optimal if $\overline{\phi} > \phi > \tilde{\phi}$ and full opacity is socially optimal if $\phi > \tilde{\phi}$. Thus equilibrium is not socially optimal if $\phi > \overline{\phi}$. From that, Proposition 6 derives immediately.

H Proof of Proposition 7.

As the social optimum minimizes the sum of losses,

$$\Delta_j^j \left(\left(\sigma_{s,j,j}^{-2}\right)^* + \left(\sigma_{s,-j,j}^{-2}\right)^*, \tilde{\sigma}_{s,j}^{-2}\right) + \Delta_{-j}^j \left(\left(\sigma_{s,j,j}^{-2}\right)^* + \left(\sigma_{s,j,-j}^{-2}\right)^*, \tilde{\sigma}_{s,j}^{-2}\right) < 0.$$

Due to symmetry, $\Delta_{-j}^j \left(\left(\sigma_{s,j,j}^{-2}\right)^* + \left(\sigma_{s,j,-j}^{-2}\right)^*, \tilde{\sigma}_{s,j}^{-2}\right) = \Delta_j^{-j} \left(\left(\sigma_{s,-j,j}^{-2}\right)^* + \left(\sigma_{s,-j,-j}^{-2}\right)^*, \tilde{\sigma}_{s,-j}^{-2}\right)$. Thus,

$$\Delta_j^j \left(\left(\sigma_{s,j,j}^{-2}\right)^* + \left(\sigma_{s,-j,j}^{-2}\right)^*, \tilde{\sigma}_{s,j}^{-2}\right) + \Delta_j^{-j} \left(\left(\sigma_{s,-j,j}^{-2}\right)^* + \left(\sigma_{s,-j,-j}^{-2}\right)^*, \tilde{\sigma}_{s,-j}^{-2}\right) < 0.$$

This means that each policymaker gets a negative loss difference when moving from the equilibrium to the social optimum. Thus, the social optimum is Pareto-superior.

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