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SOCIAL VALUE OF PUBLIC INFORMATION IN THE PRESENCE OF TRANSPARENCY MISPERCEPTIONS[1]

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VALOR SOCIAL DE LA INFORMACIÓN PÚBLICA EN PRESENCIA DE PERCEPCIONES ERRÓNEAS DE LA TRANSPARENCIA

RESUMEN

Las extensiones del famoso marco de Morris y Shin que incluyen la política económica han abierto muchas posibilidades para los análisis tanto teóricos como empíricos. El presente documento amplía dicho marco de políticas para dar cuenta del conocimiento común imperfecto sobre la transparencia. Se muestra que, en ausencia de una intervención política activa, se pueden lograr resultados socialmente eficientes combinando la transparencia real máxima y la transparencia percibida intermedia. Este hallazgo aleja considerablemente el equilibrio de la conclusión antitransparencia de Morris y Shin. Cuando se permite la formulación de políticas, se demuestra que es mejor tener una mínima transparencia percibida, siendo la transparencia real indeterminada. Esta indeterminación, junto con el hallazgo de que la formulación de políticas no es estrictamente necesaria para la eficiencia, constituyen advertencias desconocidas hasta ahora en relación a los argumentos a favor de un formulador de políticas opaco.

Palabras clave: Información privada heterogénea, Transparencia óptima, Percepciones erróneas de transparencia, Intervención política, Complementariedades estratégicas.

Clasificación JEL: E02, O43

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ABSTRACT

Extensions of the famous Morris and Shin framework to include economic policy have opened up many possibilities for both theoretical and empirical analyses. The present paper extends such policy framework to account for imperfect common knowledge about transparency. It is shown that, in the absence of active policy intervention, socially efficient outcomes can be attained by combining maximal actual transparency and intermediate perceived transparency. This finding shifts the balance considerably away from Morris and Shin's anti-transparency conclusion. When policymaking is allowed for, it is shown that it best to have minimal perceived transparency, with actual transparency being indeterminate. This indeterminacy, coupled with the present finding that policymaking is not strictly necessary for efficiency, constitute previously unknown caveats to common arguments in favour of an opaque policymaker.

Keywords: Heterogeneous private information, Optimal transparency, Transparency misperceptions, Policy intervention, Strategic complementarities.

Clasification JEL: E02, O43

Introduction

Considerable research attention has recently been devoted to the effect that the disclosure of public information exerts on economic outcomes. One of the standard approaches to this problem relies on the influential study of Morris and Shin (2002), who show that transparency is potentially bad for social welfare when private agents downplay their own information and rely on a noisy public signal to coordinate their actions.

Extensions of the Morris and Shin framework to include economic policy have opened up many possibilities for both theoretical and empirical analyses. Among recent relevant studies the following ones can be cited. One microeconomic study is Elnaboulsi, Daher and Saglam (2021), who analyse how environmental taxes should be optimally levied when the regulator and firms, face uncertainties about the state of the world. Luo, Gao and Shi (2021) set up an evolutionary game between the government and the public, considering two ways in which the government may release public information: mass communication and personalised recommendation. Kohlhas (2020) studies the relative merits of the exclusive use of a policy instrument or disclosure in a flexible class of economies that feature dispersed information, and payoff and learning externalities. Arguably the most dynamic area of analysis worth mentioning here concerns the optimality of monetary policy transparency. Iovino, La'O and Mascarenhas (2022) show that, when the monetary authority is uncertain about the economic state, public

information disclosure by the central bank is welfare-improving as long as either firms' or central bank information is sufficiently precise. Kohlhas and Walther (2021) find that the social value of information depends on nominal and real rigidities, on the sources of the business cycle, and on the conduct of monetary policy. Other studies have resorted to further details of the financial structure. Based on a beauty and nonbeauty contest model based on survey forecasts of interest rates, Lustenberger and Rossi (forthcoming) demonstrate how the precision of public and private information can be measured and their welfare implications can be assessed. Using an open-economy model, Candian (2021) reports that informational frictions may make central bank transparency raise volatility in financial markets and demand imbalances.

To keep the analysis tractable, the present study draws from the policy extension of the Morris and Shin model due to James and Lawler (2011). By showing that more public information increases welfare, the latter study is one of those extensions that have challenged Morris and Shin's anti-transparency result.[2] James and Lawler reconsider the social value of public information by taking into account the role played by the government, or its agent (e.g. the central bank), in directly influencing the economy via policy actions. As a result, it can be shown that the focus of the central bank debate is shifted toward policy intervention because the latter is found to be needed –in combination with zero disclosure– for social efficiency.

Although the role of public information in influencing economic outcomes is a rather general issue which is relevant for overall macroeconomic management, discussions have often centred on the extent to which central banks disclose or should disclose their private information to the wider public. For this reason, it is worth considering what is the actual central banking experience in this area. In contrast with the theoretical debate outlined above where authors favour the extremes of either full disclosure or zero disclosure, the international experience points to some intermediate degree of central bank transparency (Dincer, Eichengreen and Geraats, 2019). There has over recent years been a trend toward greater disclosure by central banks with sufficiently high transparency being now in place. At the same time, in many respects central banks continue to be ambiguous about the private information they possess. There appear to be limits to central bank transparency (Sánchez, 2013) concerning aspects such as the relative weight on inflation in the objective function, the measurement of the output gap, forecasts of economic shocks, and financial stability considerations. Although it would not be wise to attach a normative connotation to the intermediate degree of transparency actually observed, it is advisable to be aware of this evidence when interpreting equilibrium and welfare results of a given model.

2 This favourable outcome has also been predicted in the presence of increasing returns to scale, monopolistic competition or when public information is disseminated among only a subset of agents.

The present paper relaxes the perfect-common-knowledge assumption about the degree of transparency. This allows economic outcomes to be affected by both the practice and private-sector perceptions of transparency. Transparency imperfections are introduced into Morris and Shin's framework both when active stabilisation policy is neglected (original Morris and Shin) and when it is included, as in James and Lawler. This widespread assumption of perfect common knowledge about transparency is problematic because private agents are unaware of how much information the central bank possesses, which makes it is hard for them to assess how transparent the policymaker actually is. The distinction between the two transparency dimensions here considered is found to substantially modify the results; it also enables us to identify whether the pros and cons of transparency reported in the literature arise from the actual reduction of information asymmetries and/or from private-sector actions based on perceived transparency. Transparency misperceptions can be maintained over time if private agents are not able to infer the actual degree of transparency, which in the present framework requires instability in the precision of the public signal. In a central banking context, since Geraats (2007) it has been argued that the precision of the public signals (about policy targets and supply shocks) should be seen as unstable and thus not learnable by private-sector agents. In such a case, transparency perceptions influence inflation perceptions and expectations. The link between actual and perceived transparency may be weak if transparency knowledge is limited and perceived transparency is affected by various individual and psychological characteristics. It is worth clarifying that the concept of transparency misperceptions used in this paper should not be confused with deviations between true and perceived fundamentals; these are not allowed for in the Morris and Shin approach which only has one source of fundamental uncertainty. In richer contexts that distinguish between temporary and permanent economic shocks, the signal-extraction problem faced by private agents may lead to permanent deviations between true and perceived fundamentals.

Two sets of results are produced here, depending on whether the evolution of the economy is influenced by active stabilisation policy or not. In the absence of stabilisation policy, the introduction of transparency misperceptions into Morris and Shin's framework considerably strengthens the case for transparency. It is found that it is optimal for the central bank to deliver full actual transparency alongside an intermediate perceived degree of transparency - the latter capturing a partially constructive role for ambiguity. This finding is parameter-free and thus holds more generally than that of Svensson (2006), who successfully argued that for reasonable parameter values the Morris and Shin model implies that more precise public information is socially beneficial. The pro-transparency result is here interpreted to stem from the actual decrease in information asymmetries, not from the private-sector response to transparency perceptions. Furthermore, it is found that optimal communication delivers socially efficient outcomes.

The second set of results obtained concerns active stabilisation policy. The inclusion of transparency misperceptions leads one to qualify previous findings. Although the present model corroborates James and Lawler's result that an optimal mix of policy and zero disclosure achieves efficiency, the latter can –as mentioned above– be reached in the absence of policymaking. James and Lawler's anti-transparency result is thus no more efficient than the considerably more pro-transparency outcome that is found here in the no-policy case. Moreover, it is found that it is optimal for the central bank to choose a minimal perceived degree of transparency, even as the degree of actual transparency is indeterminate. James and Lawler's anti-transparency result thus appears to be entirely driven by perceived transparency considerations. On the one hand, this can be interpreted favourably as leaving plenty of room for actual transparency to be relatively high and thus reconcile the optimality of zero perceived disclosure with present-day central banking practice, which is characterised by an intermediate (overall) degree of transparency. An arguably better interpretation is that the novel approach used here reveals that the indeterminacy of actual transparency, together with the finding that policymaking is not strictly necessary for efficiency, are previously unstated caveats to the case for an opaque policymaker.

The rest of the paper is organised as follows. Section II incorporates transparency misperceptions into the Morris and Shin framework; from the equilibrium of the model are derived the corresponding welfare consequences of the precision of public information. Section III completes the analysis for the more general case that allows for policymaking. The overall results are discussed and interpreted in Section IV, where it is also evaluated whether the optimal solutions found in each case achieve the socially-efficient outcome. Section V concludes.

The no-policy setup

Here the Morris and Shin model is extended to incorporate transparency misperceptions. Rather than a full-fledged policymaker the basic model includes simply a sender of the public signal (Morris and Shin's typical example is the media).

There is a continuum of economic agents indexed by the unit interval, [0, 1]. Agent $i \in [0,1]$ chooses an action $a_i \in \Re$. Agent i has the utility function

$$u_i = -\left[(1-r)(a_i - \theta)^2 + r\left(L_i - \bar{L} \right) \right] \qquad (1)$$

where $r \in (0,1)$ is a constant, θ represents the state of the economy (assumed to be uniformly distributed over the real line), $L_i = \int_0^1 (a_j - a_i)^2 dj$ is the mean-square

distance of *i*'s action from other agents' actions, and $\bar{L} = \int_0^1 L_j dj$ is the average of these distances. The first term of (1), in which each agent puts a weight of 1 - *r*, corresponds to a standard fundamentals-related payoff component: it is higher the closer the action is to the state of the economy. The second term, with a weight equal to *r*, represents a 'beauty contest' element reflecting a zero-sum coordination game of guessing other private agents' actions.

Social welfare *W*, equals the average utility of the agents (normalised by 1 - *r*):

$$W \equiv \frac{1}{1-r}\int_0^1 u_i di = -\frac{1}{1-r}\int_0^1 (a_i - \theta)^2 di \qquad (2)$$

Aggregation eliminates the beauty contest term, so that *W* depends only on the fundamentals-related payoff component.

The sender of the public signal observes the noisy signal $z = \theta + \phi$, where ϕ, the noise in the public signal, is normally distributed with mean zero and variance σ_ϕ^2 and is independent of θ.

Each agent receives the same public signal of θ, $y = \theta + \phi + \xi$, where ξ, the noise in the public signal, is normally distributed with mean zero and variance σ_ξ^2. The variance σ_ξ^2 captures the noise in the public signal. Each agent *i* also receives the individual private signal $x_i = \theta + \varepsilon_i$, where ε_i , the noise in the private signal, is normally distributed with mean zero and variance σ_ε^2 and is independent of θ and ξ. The variance σ_ε^2 measures the noise in the private signal. No private agent is able to observe the chosen action of any other private agent before making her own decision. Notwithstanding, agent *i* cannot observe any a_j $(j \neq i)$ prior to choosing a_j. Agent *i*'s expectations are thus conditioned only o n the observed values of *y* and x_i.

In contrast with the related literature, it is assumed that the private sector has an informational disadvantage vis-à-vis the sender of the public signal y as it does not observe the actual stochastic distribution of ξ, the error made in interpreting y. That is, instead of basing their decisions on $\xi \sim N\left(0, \sigma_\xi^2\right)$, private agents use the perceived (or prior) distribution $\xi \sim N\left(0, \tilde{\sigma}_\xi^2\right)$.[3] More transparency is identified here with higher precision of (less noise in) the public signal. In line with the two concepts for precision of public information, a distinctios is made between two dimensions of transparency: actual and perceived transparency (measured inversely by σ_ξ^2 and $\tilde{\sigma}_\xi^2$, respectively).

3 The present extension to transparency misperceptions brings significance into the distinction between the policymaker's private signal and that disclosed publicly by the policymaker. Instead, in Morris and Shin the analysis is simplified by considering the sum of $\phi + \xi$, or of their corresponding variances, as one single object. Consideration of active policies also renders the distinction between ϕ and ξ relevant, so this distinction is maintained in the rest of the paper.

After each agent has received the signals, each agent chooses the action a_i so as to maximise her utility. The unique equilibrium action a_i of agent i can be shown to satisfy

$$a_i = (1-r)E_i(\theta) + rE_i(\bar{a}) \tag{3}$$

where $\bar{a} = \int_0^1 a_i di$ is the average action and E_i denotes agent i's expectation conditional on the public and private signals, that is, y and x_i, respectively.

To solve for equilibrium, each agent's action is determined, given the (actual and perceived) quality of the public signal. The next step is to examine the welfare implications of transparency by identifying the values of the actual and perceived precision of the public signal (i.e, σ_ξ^2 and $\tilde{\sigma}_\xi^2$, respectively) which maximise social welfare.

Given that the public signal is common knowledge, in equilibrium each agent gives more weight to the public signal and less weight to the private signal than their respective precisions, as shown by the factor 1 - r multiplying the precision of the private signal in (3). As in Morris and Shin, it is postulated that agent i's action is a linear function of the two signals, y and χ_i, i.e.:

$$a_i = \kappa_1 \chi_1 + \kappa_2 y \tag{4}$$

Since $\int_0^1 \varepsilon_i di = 0$, on average one gets $\bar{a} = \kappa_1 \theta + \kappa_2 y$, implying:

$$E_i(\bar{a}) = \kappa_1 E_i(\theta) + \kappa_2 y \tag{5}$$

Substituting (5) into (3), and using the result that

$E_i(\theta) = \left[\sigma_\varepsilon^2 y + \left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right) x_i\right] / \left(\sigma_\varepsilon^2 + \sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)$[4], agent i's optimal action can be written as a function of the two signals. Equating coefficients on χ_i and y between this equation and (4), an expression is derived for the weights κ_1 and κ_2:

$$\kappa_1 = \frac{(1-r)\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)}{\sigma_\varepsilon^2 + (1-r)\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)}; \qquad \kappa_2 = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + (1-r)\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)} \tag{6}$$

Agent i's equilibrium action is described by (4) and (6), which can be substituted into the expression of social welfare (2) before taking expectations to find:

4 This involves a standard signal-extraction problem with two signals and independent noise, for which the properties of θ, y and X_i are taken into consideration.

$$E(W \mid \theta) = -\left[\kappa_1^2 \sigma_\varepsilon^2 + \kappa_2^2 \left(\sigma_\phi^2 + \sigma_\xi^2\right)\right]$$

$$= -\frac{\sigma_\varepsilon^2 \left\{1 - r^2 \left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)\right\}^2 \sigma_\varepsilon^2 + \sigma_\varepsilon^2 \sigma_\phi^2 + \sigma_\xi^2}{\left[\sigma_\varepsilon^2 + 1 - r\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)\right]^2} \qquad (7)$$

In the following, social welfare refers to expected social welfare for a given θ. $E(W \mid \theta)$ reflects the ex ante expectation of the public signal's sender and, since it is based on actual stochastic distributions, it matches average volatility *ex post*. It depends on both the actual and perceived precision of the public signal, as related inversely to σ_ξ^2 and $\tilde{\sigma}_\xi^2$, respectively.

The welfare implications of transparency can be assessed by finding the values of σ_ξ^2 and $\tilde{\sigma}_\xi^2$ on which maximise $E(W \mid \theta)$. Notice that, for this to be an interesting problem in (7), the private sector must have imperfect private information about fundamentals (i.e. $\sigma_\varepsilon^2 > 0$). For finite values of $\tilde{\sigma}_\xi^2$,[5] differentiating (7) indicates that social welfare is monotonically decreasing in σ_ξ^2, so that increased actual precision of public information is unambiguously favourable in both a local and a global sense. Conditional on $\sigma_\xi^2 = 0$, the first order condition for $\tilde{\sigma}_\xi^2$ yields

$$\tilde{\sigma}_\xi^2 = \frac{r\sigma_\phi^2}{1-r} \qquad (8)$$

From these results, Proposition 1 follows:

Proposition 1: Excepting full information cases, when there is asymmetric information about the precision of the public signal it is optimal to have maximum actual transparency about the public signal ($\sigma_\xi^2 = 0$) but intermediate perceived transparency about it ($\tilde{\sigma}_\xi^2 \in (0, \infty)$).

The present extension of the Morris and Shin model with transparency misperceptions has important welfare implications. It strengthens considerably the case for transparency. Svensson's pro-transparency result is here interpreted to stem from the actual decrease in information asymmetries, as opposed to the private-sector response to transparency perceptions. While falling short of supporting the full transparency advocated by Svensson, the present finding is parameter-free and thus holds more generally than Svensson's. The lack of

5 In the limit, when $\tilde{\sigma}_\xi^2$ tends to infinity, social welfare is independent of σ_ξ^2. This case can be ignored here because it does not yield an optimal solution.

parameter dependence of the results obtained reveals that the focus of the analysis has shifted. The debate between Morris and Shin and Svensson concerns the relative precision in the public and private signals. Here, optimal communication is independent of the private signal, σ_ε^2. As far as optimal perceived transparency is concerned, the relevant link captured in (8) is between the private information possessed by the sender and the public information seen as being disclosed (i.e. between σ_ϕ^2 and $\tilde{\sigma}_\xi^2$).

The value of social welfare to which optimal public communication gives rise can be computed from (7):

$$E(W \mid \theta)\Big|_{\sigma_\xi^2=0;\tilde{\sigma}_\xi^2=\frac{r\sigma_\phi^2}{1-r}} = -\frac{\sigma_\varepsilon^2\sigma_\phi^2}{\sigma_\varepsilon^2+\sigma_\phi^2} \qquad (9)$$

A discussion of this result is left for section IV.

Finally, in addition to the above results for the precision of the public signal, from (7) it is possible to confirm Morris and Shin's finding that in equilibrium greater precision of the public's private information (i.e. a decrease in σ_ε^2) is invariably beneficial.

The model with policy intervention

This section extends the analysis to include policy intervention. Alternatively, it can be interpreted as the introduction of transparency imperfections into James and Lawler. As assumed by these authors, there is a single policymaker who influences the economy not just through words but also directly via policy actions.

The extension involved here requires modifying agent *i*'s utility to

$$u_i = -\left[(1-r)(a_i - g - \theta)^2 + r\left(L_i - \bar{L}\right)\right] \qquad (1')$$

where *g* is the policy instrument setting. Concerning the fundamentals-related component in the first term of (1'), the payoff is seen to increase the closer the action is to the state of the economy adjusted taking *g* into account.

Accordingly, *W* becomes

$$W = -\frac{1}{1-r}\int_0^1 (a_i - g - \theta)^2 di \qquad (2')$$

The informational assumptions made in section II carry over to the present case, with the following twists and additions. Prior to setting *g*, the policymaker

observes the same noisy signal as in (3), but cannot observe any a_i. Neither does any private agent observe g before deciding her action. Therefore, agent i's expectations continues to be conditioned solely on the observed values of y and x_i, while policymaker's expectations are conditioned only on z.

Policy is assumed to be conducted under commitment. As mentioned earlier, this allows one to concentrate on a unique equilibrium solution. Commitment is always socially desirable, although it can be shown that the optimal policy rule corresponding to a given precision of the public signal is time-inconsistent. Owing to the model's linear-quadratic structure the optimal policy rule is linear. Without loss of generality, the policymaker follows the policy rule

$$g = \rho z \qquad (10)$$

with g thus being chosen on the basis of current information about z. The value of the rule parameter, ρ, is common information and is set by the policymaker so as to maximise social welfare.[6]

One solves for equilibrium in two steps: i) each agent's action is determined, taking the value of the rule parameter and the quality of the public signal as given; and ii) one finds the value of ρ which maximises social welfare. Once equilibrium is thus fully described, the attention turns to the welfare consequences of the policymaker's approach to disclosure.

A. Private-sector actions

The unique equilibrium action a_i of agent i is analogous to (6), but now includes a role for g:

$$a_i = (1-r)\left[E_i(\theta) + E_i(g)\right] + rE_i(\bar{a}) \qquad (6')$$

In analogy to the reasoning used in section II, agent i's equilibrium action continues to be described by (4) while the values of κ_1 and κ_2 become

$$\kappa_1 = \frac{(1-r)\left[\sigma_\phi^2 + (1+\rho)\tilde{\sigma}_\xi^2\right]}{\sigma_\varepsilon^2 + (1-r)\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)}; \quad \kappa_2 = \frac{(1+\rho)\sigma_\varepsilon^2 + (1-r)\rho\sigma_\phi^2}{\sigma_\varepsilon^2 + (1-r)\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)}; \qquad (11)$$

6 It is worth clarifying that, although the general expression of ρ will contain σ_ξ^2, in equilibrium this coefficient will not influence policy and will thus not be revealed to the public. This enables the policymaker to differentiate between actual and perceived transparency.

Note that, to save on notation, the same labels are used for weights as in section II.

B. *Optimal policy*

To determine optimal policy one starts by deriving the relation between the rule parameter, ρ, and social welfare. An expression for the latter can be obtained by substituting (4), with the use of (11), into (2') before taking expectations, which yields

$$E(W \mid \theta) = -\left[\kappa_1^2\sigma_\varepsilon^2 + (\kappa_2 - \rho)^2\sigma_\phi^2 + \kappa_2^2\sigma_\xi^2\right] \qquad (12)$$

where the implication from (11) that $\kappa_1 + \kappa_2 = 1 + \rho$ is used. The first order condition for ρ gives

$$\rho^* = -\frac{\sigma_\varepsilon^2\left\{\chi\left[\sigma_\varepsilon^2 + (1-r)^2\sigma_\phi^2\right] + (1-r)^2\tilde{\sigma}_\xi^2\right\}}{\chi\left[\sigma_\varepsilon^2 + (1-r)\sigma_\phi^2\right]^2 + (1-r)^2\left(\sigma_\varepsilon^2 + \sigma_\phi^2\right)\tilde{\sigma}_\xi^2} \qquad (13)$$

which uses the equality $\sigma_\xi^2 = \chi\tilde{\sigma}_\xi^2$, which implicitly defines χ as the ratio between actual and perceived noise in the public signal.

Apart from the cases of perfect information concerning the policymaker and the private sector, (13) implies that $\rho > -1$. This means that the policy reaction induced by any non-zero observation of z is less than the one required to fully offset the policymaker's expectation of θ. Under the optimal disclosure results derived below (in item C of this section), the range of values for the rule parameter can be further restricted to $\rho \in (-1,0)$, in particular implying that at least some policy reaction will follow any non-zero realisation of z. The welfare implications of policy intervention are discussed further in Section IV.

C. *Optimal transparency*

For welfare analysis purposes, the expressions for κ_1, κ_2 and ρ^* are substituted into (12) to get

$$E(W \mid \theta) = -\frac{\sigma_\varepsilon^2\sigma_\phi^2\left[\chi\sigma_\varepsilon^2 + (1-r)^2\left(\chi\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)\right]}{\chi\left[\sigma_\varepsilon^2 + (1-r)\sigma_\phi^2\right]^2 + (1-r)^2\left(\sigma_\varepsilon^2 + \sigma_\phi^2\right)\tilde{\sigma}_\xi^2} \qquad (14)$$

It is of interest how the policymaker's transparency affects social welfare, having in mind that the quality of the signal provided to private agents has two dimensions: σ_ξ^2 and $\tilde{\sigma}_\xi^2$, or alternatively $\tilde{\sigma}_\xi^2$ and χ. For finite values of χ,[7] differentiating (14) indicates that social welfare is monotonically increasing in $\tilde{\sigma}_\xi^2$, so that increased perceived precision of public information is detrimental. Conditional on $\tilde{\sigma}_\xi^2 \to \infty$, $E(W \mid \theta)$ does not depend on χ, which implies that actual transparency is indeterminate. Two values for χ are possible: $\chi = 0$ if σ_ξ^2 is finite, and $\chi = 1$ if $\sigma_\xi^2 \to \infty$. From these observations, Proposition 2 follows:

Proposition 2: Excepting full information cases, social welfare is monotonically increasing in $\tilde{\sigma}_\xi^2$, with increased perceived precision of public information thus being unambiguously detrimental in both a local and a global sense. Optimal actual transparency is indeterminate.

From (14), one can calculate the value of welfare consistent with the mix of policy and public communication that maximises social welfare:

$$\lim_{\tilde{\sigma}_\xi^2 \to \infty} E(W|\theta)|_{\rho=\rho^*} = -\frac{\sigma_\varepsilon^2 \sigma_\phi^2}{\sigma_\varepsilon^2 + \sigma_\phi^2} \qquad (15)$$

As with the result in (9), further discussion is left for the next section. A comparison between (9) and (15) indicates that, conditional on the optimal public communication involved in each case, the social welfare level attained is the same regardless of whether the policymaker intervenes or not. This, together with the indeterminacy of actual transparency reported in Proposition 2, constitute previously unknown caveats to the argument in favour of an opaque policymaker, as laid out by James and Lawler.

Discussion

The main reason given by Morris and Shin for their anti-transparency finding is a strategic complementarity arising from the beauty contest element in private agent's utility. Private agents attach too high a weight (relative to the efficient benchmark) to public information, which in turn implies that public signals of higher precision may be potentially harmful.

The overall results of this section can be discussed in two directions. First, one can evaluate whether the optimal solutions found (both with and without policy intervention) in the presence of transparency misperceptions achieve the socially

7 In the limit, when χ tends to infinity, social welfare no longer depends on $\tilde{\sigma}_\xi^2$. This case is neglected here because it does not deliver an optimal solution.

efficient outcome. This turns out to involve a comparison with the benchmark of efficient weights assigned by private agents to public vis-à-vis private information. Second, it is assessed whether the findings are robust to an alternative payoff function proposed by James and Lawler, which reverses the ranking between the equilibrium and socially efficient degrees of coordination from the Morris and Shin model.

A. Efficiency

In Morris and Shin, private-sector agents put an inefficiently high weight on public information, and it is this that gives rise to the possibility that an improvement in the quality of public information might be damaging. Let agent *i*'s action be given by:

$$a_i = \tilde{\kappa}_1 x_i + \tilde{\kappa}_2 y \tag{16}$$

As explained by James and Lawler, the appropriate efficient weights (which are here labelled $\tilde{\kappa}_1$and $\tilde{\kappa}_2$) are those consistent with the relative accuracy of public and private information, as follows:

$$\tilde{\kappa}_1 = \frac{\sigma_\phi^2 + \tilde{\sigma}_\xi^2}{\sigma_\varepsilon^2 + \sigma_\phi^2 + \tilde{\sigma}_\xi^2}; \quad \tilde{\kappa}_2 = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\phi^2 + \tilde{\sigma}_\xi^2} \tag{17}$$

These weights are associated with a collectively optimal response of individual agents to private and public information when there is no active policy intervention. Earlier in this paper two sets of weights have been calculated (for which the same notation of κ_1 and κ_2 was used) in two different contexts: i) in (6) for the no-policy case (section II), and ii) in (10) when there policy intervention is allowed for (section III). Comparing $\tilde{\kappa}_1$ and $\tilde{\kappa}_2$ with the values of κ_1 and κ_2 in both (6) and (10) –in the latter case setting $\rho = 0$– one sees that $\kappa_1 < \tilde{\kappa}_1$ and. Let $E\left(\tilde{W} \mid \theta\right)$ denote social welfare evaluated at the efficient weights in (17). Then

$$E\left(\tilde{W} \mid \theta\right) = -\frac{\sigma_\varepsilon^2\left(\sigma_\phi^2 + \tilde{\sigma}_\xi^2\right)}{\sigma_\varepsilon^2 + \sigma_\phi^2 + \tilde{\sigma}_\xi^2} \tag{18}$$

By differentiating (18) with respect to σ_ε^2 and $\tilde{\sigma}_\xi^2$, it is evident that $E\left(\tilde{W} \mid \theta\right)$ is strictly increasing in the precision of both private and public signals. The welfare properties of optimal decisions concerning communication (in section II) and both communication and policy (in section III) can be judged against the benchmark given by evaluating (18) at $\tilde{\sigma}_\xi^2 = 0$. From (18), this yields

$$E\left(\tilde{W} \mid \theta\right)\Big|_{\tilde{\sigma}_{\xi}^{2}=0} = -\frac{\sigma_{\varepsilon}^{2}\sigma_{\phi}^{2}}{\sigma_{\varepsilon}^{2}+\sigma_{\phi}^{2}} \qquad (19)$$

Comparison of equation (19) with (9) and (15) establishes the following:

Proposition 3: The social optimum is reached in both of the following cases:

i) Appropriately designed communication of private information, as given intermediate perceived public disclosure (see equation (8)) and full actual public disclosure.

ii) Appropriately designed policy intervention, as described by equations (10) and (13), alongside zero perceived disclosure and indeterminate actual disclosure of the policymaker's private information to the public.

This means that the optimal decisions found in sections II and III are not only desirable, but they also attain the same collectively efficient outcome that would arise if all private-sector agents' actions reflected the relative accuracy of public and private information.[8]

The results in Proposition 3 are best understood in relation to Morris and Shin. The most direct comparison concerns Proposition 3(i), which shares with Morris and Shin the lack of policy stabilisation. In the original Morris and Shin framework, private-sector agents put a too high weight on the public signal, with their own private information correspondingly not been given enough emphasis. For this reason, optimal communication fails to attain efficiency – a result that also applies to Svensson's parameterisation. This stands in contrast with the present no-policy analysis which instead finds that optimal communication delivers socially efficient outcomes. This is due to the differentiation introduced here between actual and perceived transparency. As shown in section II, optimal communication involves maximum actual transparency about the public signal ($\sigma_{\xi}^{2}=0$) but intermediate perceived transparency about it ($\tilde{\sigma}_{\xi}^{2}\in(0,\infty)$). Intuitively, it is beneficial to have actual transparency about the public signal because it avoids a volatile response on the part of private agents. It is also desirable to have intermediate perceived transparency about the public signal so that private-sector expectations become

8 As also found by James and Lawler for their model with policy intervention and no transparency misperceptions, the Proposition 3 derived here is affected by persistence in θ. This is true for both the policy and no-policy extensions incorporating transparency misperceptions. The reason for this is that, in the present context, past realisations of g allow the public to infer the history of θ. This introduces a deviation from efficiency that cannot be eliminated by the policymaker's optimal decisions, even if the latter achieve the first best vis-à-vis current period innovations. Proposition 1 may also be affected in that, for sufficiently strong persistence in θ, intermediate perceived transparency could be dominated by full perceived transparency (in any case, further away from the original Morris and Shin result). Proposition 2 is unaffected by persistence in fundamentals.

ex ante more closely aligned with fundamentals. Perceived transparency above the value in (8) would still give incentives to private agents to put a too high weight on the public signal, while values of $\tilde{\sigma}_{\xi}^{2}$ below (8) would overly restrict the informational content of the public signal (at the expense of the private signal). By setting $\tilde{\sigma}_{\xi}^{2}=r\sigma_{\phi}^{2}/(1-r)$ the weights in (6) turn out to be identical to those obtained in a standard signal-extraction problem without any beauty contest element. Indeed, in this case $\kappa_1=\sigma_{\phi}^{2}/(\sigma_{\varepsilon}^{2}+\sigma_{\phi}^{2})$ and $\kappa_2=\sigma_{\varepsilon}^{2}/(\sigma_{\varepsilon}^{2}+\sigma_{\phi}^{2})$. Therefore, it is useful to create the perception of ambiguity even as actual transparency is beneficial. This mix ensures that private actions are aligned with an efficient use of all information available about fundamentals.[9]

Let us now turn to the case of policy stabilisation. Proposition 3(ii) shows that an optimal combination of communication and policy achieves efficiency. This is a point in common with James and Lawler. By optimally choosing communication, the policymaker affects the sensitivity of agent *i*'s individual actions to private and public information (that is, x_i and *y*, respectively). A lower precision in public information induces private-sector individuals to put a stronger emphasis on their own agent-specific information. It is found to be optimal to make the public signal entirely noisy, so that individual agents' decisions are conditioned only on their private signals. In comparison with the no-policy scenario, the way in which policymakers attain efficiency thus also involves raising the weight private-sector agents place on their own information, but it differs in that the policy action now makes it undesirable for individuals to react at all to public information. To see this, one can start by noting that, in the face of purely uninformative public information, each agent *i*'s individual action equals the expectation of the average action of all other agents, i.e. This implies, from (6'), that $a_i = E_i(\theta + g)$, with the influence of the beauty contest term on individual choices thus being eliminated. Given that the public signal plays no role in determining private-sector expectations, it is evident that $E_i(z) = E_i(\theta) = \chi_i$ and thus $a_i = (1 + \rho)\chi_i$. This shows two things: i) with policy stabilisation, individual actions depend exclusively on private-sector agents' own information;[10] and ii) the policymaker's choice of ρ influences the relative strength of individuals' reactions to the two signals which they observe. The responsiveness of private-sector actions to χ_i is decreasing in the sensitiveness of policy to the policymaker's own private signal.[11]

9 In contrast with the debate Morris and Shin versus Svensson, here the relative accuracy of private and public information plays no role in optimal communication. In particular, the intermediate degree of perceived transparency is proportional to the accuracy of public information (or σ_{ϕ}^{2}), regardless of how precise private information (or σ_{ε}^{2}) is.

10 This can also be verified by replacing the value of ρ from (13) into the expression for weights in (11) when $\tilde{\sigma}_{\xi}^{2}\to\infty$.

11 This uses the result that in the socially optimal equilibrium $\rho \in (-1,0)$.

In sum, compared with fully transparent but inefficient equilibrium of Morris and Shin, efficiency can thus be obtained in two ways. Both involve a deterioration in the public information disclosed, which is limited in the no-policy case and more extreme in the case when policy stabilisation is used. The efficiency gains involved in both scenarios indicate that the welfare-decreasing effect of information loss is more than offset by an improved coordination of private-sector actions. The latter is reflected in the finding that private agents' weights are purged of the non-fundamental 'beauty contest' element.

B. Alternative individual payoff functions

Let us now turn to examine the robustness of the results obtained above to the alternative payoff function proposed by James and Lawler, namely:

$$u_i = -\left[a_i - (1-r)(\theta + g) - r\bar{a}\right] \qquad (20)$$

Unlike the utility function (1) introduced by Morris and Shin, the non-fundamental term –which gives rise to the possibility that greater precision of public information might be damaging– is absent from (20). As a result, in (20) the equilibrium degree of coordination is higher than the socially efficient degree of coordination.[12] In (20) agent *i*'s utility depends on the actions followed by other agents, with the complementarity involved consisting in some type of fundamental economic interconnectedness –instead of adopting the form of a beauty contest term, as in (1).

Starting with the no-policy case, it is found that a higher quality of public information (in terms of both perceived and actual transparency) is unambiguously favourable and that greater precision in private information may be harmful. The former result indicates that the optimal communication mix reported in section II is not entirely robust to the alternative payoff function (20): while optimal actual transparency is still maximum, optimal perceived transparency rises from intermediate to full. In any case, the main conclusion here concerning the no-policy scenario is robust and continues to be that the balance of the discussion about optimal public disclosure is considerably shifted away from Morris and Shin's anti-transparency finding. The message conveyed here is different from Svensson's earlier critique of Morris and Shin. Finally, concerning welfare considerations, the optimal outcome obtained using (20) differs from that derived in section II in that it fails to attain social efficiency.

12 It can be shown that they are equal to *r* and *(2 - r)r*, respectively.

As in section III, welfare is maximised by the combination of an optimally-designed stabilisation policy and zero perceived public disclosure of the policymaker's own information (regardless of the policymaker's degree of actual transparency). This implies that, with the payoff function described by (20), the no-policy case is dominated by a scenario with active policy intervention. As in section III, the results concerning optimal communication are driven by perceived transparency, with the indeterminacy of actual transparency remaining a feature of the model that combines policy with transparency misperceptions.

Conclusion

A growing debate has emerged from Morris and Shin's work on the social value of public information. These authors show that central bank transparency is potentially (i.e. for particular combinations of parameter values) detrimental. While Svensson questions the practical significance of this result, James and Lawler strengthen Morris and Shin's conclusions considerably by finding that increased accuracy of the public signal is unambiguously undesirable in the presence of active policy intervention. The goal of the present paper has been to investigate how the balance of this debate is affected when one makes the assumption of imperfect common knowledge about the degree of central bank transparency, in which case economic outcomes are affected by both the actual and perceived degree of transparency. This is a case of special interest when there is instability in the precision of the public signal, so that private agents are not able to learn the actual degree of transparency over time.

Two sets of results have been presented here. Concerning the first set, corresponding to the absence of policymaking it has been shown that the introduction of transparency misperceptions into Morris and Shin's framework considerably strengthens the case for transparency. It is found that it is optimal for the central bank to deliver full actual transparency, coupled with a partially constructive role for perceived ambiguity. In contrast with Morris and Shin (and Svensson), it is shown that the differentiation between actual and perceived transparency allows the central bank's optimal decisions to achieve socially efficient outcomes. Against this background, the case for full transparency made by Svensson appears to stem exclusively from the actual reduction of information asymmetries, which directly improves social welfare by dampening uncertainty. Less than perfect perceived transparency contributes to mute market volatility, as arising from the too high weight that the private sector puts *ex ante* on noisy public information. Although the case for transparency made here is in this sense weaker than that of Svensson, it also is in part stronger because it holds in both a local and a global sense. The lack of parameter dependence of the present results stands in contrast with the debate Morris and Shin versus Svensson, which hinges around the relative precision in the public and private signals.

Turning to the second sets of results, which obtain when account is taken of active stabilisation policy, it is found that it is optimal for the central bank to choose a minimal perceived degree of transparency, with the degree of actual transparency being indeterminate. It is thus possible to reinterpret James and Lawler's unambiguous anti-transparency result as originating exclusively in private-sector reactions induced by transparency perceptions. When policymaking is allowed for, it is shown that James and Lawler's unambiguous anti-transparency result is entirely driven by perceived transparency considerations. The indeterminacy of actual transparency, coupled with the present finding that policymaking is not strictly necessary for efficiency, are previously unknown caveats to the argument in favour of opaque policymaking. The present results do not depend on the Morris and Shin model's payoff function, which involves a particular relation between the equilibrium and socially efficient degrees of coordination.

The present study has abstracted from a number of issues that other studies have also leave for further research. Concerning policymaking, three aspects are missing from the analysis: i) the policymaker may not be the sole source of public information; ii) policy may require that instrument adjustments are subject to any costs or constraints; iii) the policymaker may face multiple objectives. Interestingly, the present analysis sheds new light into the possible consequences of further extensions. For instance, if policy requires that instrument adjustments are subject to any costs or constraints (item ii above), and given that policy has no efficiency advantage over its no-policy alternative (as shown here), then policy would be expected to be dominated by no policy. The introduction of multiple objectives mentioned under item iii) would inevitably lead to policy trade-offs. This could potentially imply some beneficial role for public disclosure, as mentioned by Jones and Lawler. In addition, multiple policy goals might not be well handled by simply differentiating between actual and perceived transparency, and they could support a welfare-enhancing role for policymaking.[13]

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13 It would be interesting to check whether any argument of this type in favour of policymaking holds for at least the two specifications for the individual payoff functions here considered. In the case with only one objective analysed here, opaque policymaking dominated the no-policy scenario using the alternative payoff function (capturing intrinsic structural connections across the economy), but failed to do so under the baseline payoff function taken from Morris and Shin (relying on the extrinsic motive behind the 'beauty contest' term).

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