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Financial Systemic Risk: Taxation or Regulation?

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Abstract

This paper describes financial systemic risk as a pollution issue. Free riding leads to excess risk production. This problem may be solved, at least partially, either by financial regulation or by taxation. From a normative viewpoint, taxation is superior in many respects. However, reality shows that financial regulation is adopted more frequently. This paper makes a positive, politico-economic argument. If the majority chooses regulation, the level is likely to be too harsh. If it chooses taxation, then the level is likely to be too low. Due to regressive effects, a tax on financial transactions receives low support from a majority of low polluting portfolio owners. The same kind of majority may strategically choose regulation in order to burden the minority with a larger share of the cost of reducing systemic risk.

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1. Introduction

The dilemma between regulation and taxation of financial activities has come under closer scrutiny as a result of the recent crisis. Both regulation and taxation are policy instruments that curb systemic risk, a peculiar externality resulting from contagion effects.

In a perfect Pigouvian world, taxation and regulation would be equivalent: both policies can achieve a first-best outcome if well calibrated to deal with the above-mentioned externality. But in the real world, financial regulation is largely preferred.

Over the last decade, several G20 countries have imposed different forms of financial transaction tax, but the general trend has been a reduction of their application (Matheson, 2011). More recent experiences confirm this trend. In the US, the 2010 Dodd Frank Act

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has focused on capital adequacy requirements instead of taxation. In the European Union, the efforts to introduce a financial tax have been frustrated so far by the impossibility to achieve consensus amongst all 27 member states, while they have been able to define common guidelines on banking regulation to face systemic risks. How is that regulation is so frequent in financial markets, while taxation is rarely employed to cope with systemic risk problems?

An intuitive explanation is based on a normative argument. Financial regulation has progressive effects on investors' risk taking, while flat taxation rates yield a proportional impact on risk. Thus policymakers choose the former in order to curb risk where it mostly arises. The presence of a bias in risk measurement strengthens this argument. Regulation has a more precise effect on the curbing of the systemic risk, thus it is less affected by the bias. In a world dominated by uncertainty and asymmetric information the bias can be a severe constraint.

Here we propose an alternative view, which adopts a positive approach based on political economics as first proposed by Alesina and Passarelli (2010) for a general pollution problem. Realistically regulation has a stronger impact on high-risk polluting portfolios, while taxation affects also low-risk polluting portfolios. The majority of low-polluting portfolio owners may have a strategic incentive to choose regulation in order to offload to the minority a larger share of the externality reduction burden. This may lead to a double political distortion: first, a suboptimal choice of the policy instrument; second, a suboptimal level of the policy.

The position of the "median risk producer" plays a crucial role in the political game. Taxes and rules are different in the way they allocate the sacrifices of an externality reduction. In the case of regulation, most of the sacrifices are made by top-risk producers. We show that even a median risk producer that is slightly above the average leads to a regulation level that is too restrictive. By contrast, with a tax low-risk producers bear a consistent amount of the costs. Thus a low median agent is induced to prefer taxes that are too low. As in the political analysis of income taxation (Meltzer and Richard, 1981), the distortion depends on the position of the median voter relative to the average.[1]

Our model predicts that a democratic society mostly populated by small, low-risk portfolio owners is more likely to choose regulation instead of taxation. This argument explains why regulation is so frequent in financial markets, whereas taxation is adopted much less. Such society is likely to choose a level of the regulation that is too high. This might explains why there is a widespread perception that current regulation policies in financial markets are inefficient and possibly too harsh.

A fundamental assumption is that, independently of the toxicity measure adopted, regulation has a more than proportional impact on more toxic instruments; i.e. it forces people to progressively abate risk in their portfolios. For example, a sharp prohibition rule (such as, "all instruments whose toxicity level is above a given threshold are banned") has a dramatic progressive impact and it works like an extremely convex tax function (such as: "infinite-tax rate above the threshold and zero-tax rate below"). By its nature, taxation tends to be less progressive, if not regressive.

The assumption that regulation is more progressive than taxation can be justified if one considers that usually lending institutions meet regulation on risk by drastically cutting on their most toxic assets. Vice versa, with a tax they may decide to keep some of those assets if they make high profits from them, and just pay the tax.

Moreover, the fact that regulation is more progressive may result from a measurement problem. In principle, the base of either taxation or regulation should be a non-distorted toxicity measure. However, measuring toxicity may be quite costly, if not virtually impossible. Rules and taxes are then applied to different measures of toxicity which are also differently distorted. In general, rules affect the supply of toxic instruments directly, and this may cause progressive effects. Taxes are usually levied on indirect and less than proportional measures

[1] Observe that Meltzer and Richard (1981), and all the subsequent literature, only consider the political distortion on the level of a given instrument. Alesina and Passarelli (2010) and the present paper are probably the first works which study the political distortion on the choice of the instrument too. For an extensive survey of the related political economy literature, see Persson and Tabellini (2002).

of toxicity, such as financial transactions or banks' turnover. This causes a regressive effect. We explore the relationship between measurement bias and political distortion. We claim that when the ability to tax systemic risk is sufficiently high (i.e. measurement bias is low), there is no regressive effect. In this case a small-portfolio median voter has the incentive to choose a high tax rate. Vice versa, if measurement bias is strong, a tax has a regressive effect. Thus even a small-portfolio median owner prefers a tax rate that is too low. This might explain why in the current debate on financial transaction everybody expects that, in case a transaction tax will be implemented, the tax rate will realistically be very low.

This paper is related to a large body of theoretical literature which has recently studied policy tools to reduce financial systemic risk. Major attention has been devoted to banks' liquidity management, which seems to have been a factor of contagion. In fact, the crisis of the wholesale credit market has determined the rapid withdrawing of short-term debt, with the consequent shock propagation across the system (Brunnermeier, 2009; Allen et al., 2010; Gorton, 2010).

In Perotti and Suarez (2011) the externality problem specifically resides in the wedge between the private and social value of banks' short-term funding. Based on a price vs quantity argument (Weitzman, 1974), the authors claim that, when the main source of bank heterogeneity is credit ability, a flat rate tax on short-term funding is efficient because it allows good banks to continue lending. When heterogeneity concerns solvency or risk-taking, quantity instruments, such as net funding or capital ratios, are preferable. Acharya and Öncü (2010) are in favor of a repo authority which takes over repo positions during systemic events. Gorton (2010) proposes to stop discounted price sales of large collaterals by a state blanket guarantee. Farhi and Tirole (2012) look at bail-out expectations, which imply an endogenous loss of public control over money supply. This calls for measures to reduce the private creation of liquidity risk.

Most of this literature adopts a normative viewpoint, in which the basic question is: "What is the best thing to do?". To the best of our knowledge, no existing work has addressed positive, political economy issues. This paper is novel in this respect. We try to answer a different question: "What is the most likely thing to happen?".

The reminder of this paper is organized as follows. Section 2 discusses the current debate on SRE taxation. Section 3 presents a general model where agents/voters are heterogeneous in the amount of systemic risk that they produce. Section 4 studies the effects of regulation and how people vote on it. Section 5 does the same for a tax. Section 6 addresses the issue of instrument choice. Section 7 contains our conclusions.

2. The current debate

The main kind of externality that justifies government intervention in the financial industry as a whole is systemic risk contagion (a macro prudential externality; Claessens et al., 2010; Goodhart, 2011; Hanson et al., 2011). The definition of any financial portfolio is based on leverage contracts, characterized by the fact that the potential effects are not completed internalized within the contractual relation itself. The default of a specific financial portfolio can originate negative and self-amplifying effects on the claims of other interconnected operators, producing a domino effect. Therefore each financial portfolio can be characterized by a given level of toxicity in terms of systemic risk externality (SRE). At the same time, any financial firm can also be considered as a more or less complex financial portfolio, and its overall attributes – institutions, size, interconnections, substitutability – can contribute to systemic risk (Claessens et al., 2010; Acharya et al., 2012b). In other words, some financial institutions contribute more than others to produce financial system risk (Acharya et al., 2009).

To cope with the financial externality, governments can use two broadly defined policies: taxation or regulation. An SRE tax is aimed at reducing the gap between social and private cost of systemic risk. The latter becomes more costly, thus agents reduce the risk content of their private portfolios. Alternatively the government can directly limit the possibility to build high SRE portfolios, by issuing and enforcing ad hoc SRE regulation.

In principle, taxation is superior to regulation. A nice non-linear SRE tax scheme can be designed to yield any desired progressive impact. The marginal tax rates can be set so that they reflect the agents' marginal costs of reducing risk. Moreover, a tax solves the Mirrlees problem, when the government cannot detect those costs. A tax works best in an environment where information about agents' preferences is costly or impossible to gather (Claessens et al., 2010; Jeanne and Korinek, 2010). Keynes (1936) is the most famous proponent of an SRE tax, although he identified securities as the sole source of instability. He has been followed by many others (among them, Stiglitz, 1989).

An SRE tax is more efficient than a generic financial tax. As it has been clearly highlighted by Goodhart (2011), a SRE tax can be calibrated to reduce the expected welfare costs produced by the financial activity. The consequent deterrence effect can be produced gradually by an appropriate tax schedule. Furthermore an SRE tax is a "forward looking". It can affect the future behavior of the financial market participants, while generic financial taxes on ex post basis are backward looking. They are levied on the survived financial firms, punishing the good bankers, not the bad ones.

Despite many authors have recently claimed that SRE taxation represents an effective tool to prevent systemic risk (Acharya et al., 2009; Adrian and Brunnermeier, 2011; Acharya et al., 2012a), both academic and policy debates have paid relatively little attention to the possible use of this kind of tax. In the real world, regulation is the main instrument to curb financial externalities, while corrective taxation seems to have a minor complementing role, if any.

The recent policy debate within the European Union is illuminating. The 2007-2009 crisis caused damaging turmoil in the banking and financial markets. Several European governments adopted a variety of regulatory measures to prevent future production of systemic risk, such as bank recapitalization and financial guarantee programs. Additional measures were adopted at the European level, with the establishment of financial regulatory and supervisory institutions. At the same time there was a debate – still ongoing - on the opportunity to impose a financial taxation, without concrete policy action (Cortez and Vogel, 2011).

As pointed out earlier the stance strongly in favor of regulation may be explained by the measurement bias. Since taxation is more subject to such bias, policy makers prefer regulation in order to produce progressive effects on risk curbing. This also explains why so far proposals for a wide reconfiguration of financial taxation have followed principles which are different from a proper SRE taxation scheme. In fact, taxes on banks are usually levied on ex-post basis; they are mostly based on funding, profits, or banking bonuses, rather than stricter measures of systemic risk. In some cases, financial taxes are part of a general taxation design (Lockwood, 2010), or they are aimed to facilitate the macroeconomic management of aggregate demand (Tobin, 1978). In other cases, proposals have concerned taxes that would ensure that banks bear the direct financial costs of bailouts, or which make the implementation of bankruptcy schemes possible (Claessens et al., 2010).

It appears from the current debate that, while the most preferred instrument to prevent SRE is regulation, financial taxation is mostly aimed at facing *ex post* the consequences of systemic risk rather than preventing externalities *ex ante*. In other words, no proposal on financial taxation so far has followed a pure and coherent SRE principle. There is a proliferation of taxes on specific issues (securities transactions, currency transactions, capital levies, bank transactions, insurance premia, real estate transactions,...) which hardly fit into a coherent framework of systemic risk reduction.[2]

Finally, the international coordination argument has been used to over-emphasize the risks of discrepancies among different national jurisdictions in setting and implementing financial taxation policies, with the consequence of the "race to the bottom" phenomenon, since financial globalization increases the likelihood of financial cross-border arbitrage.

In this paper we try to explain this sort of aversion towards SRE taxation. We argue that in a democracy citizens/voters are heterogeneous in the toxicity of their portfolios. They are affected by SRE taxation and regulation in a different way. Thus they have heterogeneous

[2] See Matheson (2011) for a complete survey.

preferences regarding the two instruments and their levels. Considering these preferences into a political economy model allows us to explore the political distortions that occur when the society's decision on systemic risk is made through voting. The occurrence of political distortions may help explaining why taxation of systemic risk is unlikely to be implemented and why, if implemented, it is unlikely to be efficient.

3. The model

Consider a continuum of investors/voters, and denote with i a generic agent. Each investor/voter makes a portfolio choice. Systemic risk derives from individual portfolio choices. We assume that a certain amount of systemic risk is associated to the financial instruments in any possible portfolio. Call t_i, or "type i", the risk produced when i chooses his most preferred portfolio. In a sense t_i is a measure of the "polluting" activity of investor i when his portfolio choice is not constrained whatsoever. We say that i is a "high" type when the risk of his most preferred portfolio is high, and vice versa. A high type is an investor who unilaterally chooses a portfolio with a large amount of "toxicity". This occurs either because the portfolio includes many toxic assets or because the portfolio is quite large, in the sense that it includes a large quantity of financial instruments with a low average level of toxicity. For example, suppose that i's type is $t_i = \frac{4}{5}$. This means that i's most preferred portfolio contains instruments that produce a total $\frac{4}{5}$ of systemic risk. On the contrary, we say that i is a low type, when t_i is low; that is, he prefers a small, low toxicity portfolio.

Let $t_i \in [0, 1]$. Types as locations in the unit interval. Let $F(t)$ be the distribution of types in $[0, 1]$. This function describes how systemic risk is produced across the population when investors choose their most preferred portfolios. For example, a rightward slanted distribution means that there are relatively few big risk producers, whereas the majority of investors own small portfolios and prefers non-toxic instruments. Assume for simplicity that the population has unit measure: $F(1) = 1$.

Call b_i the amount of systemic risk associated to i's *actual* portfolio choice. By definition, an investor maximizes his utility when his actual choice is his most preferred portfolio; in this case $b_i = t_i$. Making a different portfolio choice with $b_i \neq t_i$ entails a disutility, which we describe here with a cost function that is increasing and quadratic in the distance between b_i and t_i:[3]

$$c(b_i, t_i) = (|b_i - t_i|)^2 \tag{1}$$

For example, if the high type in $t_i = \frac{4}{5}$ actually chooses a portfolio with a lower toxicity level, say $b_i = \frac{3}{5}$, he bears a cost which amounts to $c(\frac{3}{5}, \frac{4}{5}) = \left(\left|\frac{3}{5} - \frac{4}{5}\right|\right)^2 = \frac{1}{25}$.

Let ε be the externality, or the *social* cost, of the systemic risk produced by i's actual portfolio toxicity, b_i. Assume that the externality function is linear in systemic risk:[4]

$$\varepsilon(b_i) = -b_i$$

Thus, if i's actual portfolio toxicity is $b_i = \frac{3}{5}$, the externality amounts to $-\frac{3}{5}$. Had he chosen his t_i portfolio, the externality would have been $-\frac{4}{5}$. The idea is that if an investor produces an amount of systemic risk that is lower than his type ($b_i < t_i$), he generates a lower externality. This is a *social* benefit that spreads over the population. In this case, however, he bears a *private* sacrifice given by (1). Let $G(b) : [0, 1] \rightarrow \Re$ be the distribution of investor's actual portfolio choices. This function illustrates how systemic risk is actually produced within the population. Investor i's utility function is:

$$U_i = -\int_0^1 b dG(b) - (|b_i - t_i|)^2 \tag{2}$$

The integral is the amount of loss that i suffers from the actual portfolio choices of the entire population (including himself); i.e. the negative externality that he receives. The

[3] A fundamental assumption is that the cost function is convex. Assuming that it is also quadratic greatly simplifies calculus.

[4] Also the linearity of ε is a simplifying assumption. The main results are not affected by this assumption. Alesina and Passarelli (2010) use a more general externality function which leads to similar results.

quadratic term is the private sacrifice that he makes in choosing b_i instead of t_i. Of course, there is no incentive to choose $b_i > t_i$. Moreover, since individuals are infinitesimal in the population, the private benefit that anyone obtains from choosing $b_i < t_i$ is infinitesimal too. Hence, nobody has any incentive to reduce unilaterally his portfolio's systemic risk below his type. Therefore, $b_i = t_i$ for all i. This means that, for any t, in equilibrium $G(t) = F(t)$ and nobody bears any costs. Thus i's equilibrium utility is:

$$U_i = -\int_0^1 t dF(t) \tag{3}$$

A free-rider problem emerges as a result of the possible discrepancy between private and social benefits from externality reductions. Investors make portfolio choices with too much systemic risk production. There is scope for government intervention in terms of either regulation or taxation.

Observe that we can omit the index in (3), $U_i = U$; i.e. equilibrium utility is the same for everybody. Moreover, since the population size is one, U represents individual utility, per-capita utility, and laissez-faire welfare in the society.

Example 1. *As it will become clear later, much of our results depend on the distribution of risk "polluters" in society, namely the $F(t)$ function. Let us make an example with two alternative distributions in two different countries. All over the paper, this example will serve as an illustration for what is going on. We will keep returning to it in the following Sections.*
Suppose there are two countries, A and B, with two different populations of investors/risk producers. Financial markets in these two countries are completely separated. In country A the production of risk is uniformly distributed over the population of investors, say $F^A(t) = t$. Country B displays a concentration of low-risk investors; assume $F^B(t) = \sqrt{t}$. Free riding implies that these distributions also represent the equilibrium behavior within the two countries.
According to (3), individual utility is $U_i^A = -\int_0^1 tdt = -\frac{1}{2}$ in country A, and it is $U_i^B = -\int_0^1 td\sqrt{t} = -\frac{1}{3}$ in country B. As pointed out earlier, $-\frac{1}{2}$ and $-\frac{1}{3}$ are also the laissez-faire welfare levels within the two countries:

$$W^A = -0.5 \quad \text{and} \quad W^B = -0.333$$

Of course, welfare is higher in country B because of a larger number of low-risk portfolio owners; i.e., a lower amount of systemic risk produced..

4. SRE regulation

By financial regulation we denote a policy that directly aims to prevent financial institutions from issuing instruments with too much systemic risk. The supply of large SRE instruments is strongly limited, therefore investors with those kind of assets in their portfolios will have to make substantial changes. Arguably, this kind of policy has a quite strong impact on "highly polluting" portfolios while it only moderately affects the low toxicity ones.

We can formalize this idea in our model by assuming that regulation forces investors to more than proportional reductions in systemic risk production. In other words, for any t_i, actual risk production, b_i, has to decrease more than proportionally. Call ρ the policy parameter that measures the regulation level (with $0 \leq \rho \leq 1$). Once ρ is enforced individual i must reduce systemic risk and choose a portfolio with b_i such that:

$$b_i(t_i, \rho) = (1 - \rho \cdot t_i) \cdot t_i. \tag{4}$$

For instance, suppose that $\rho = 0.5$. For a low-risk type with $t_l = \frac{1}{5}$ actual risk production decreases to $b_l = 0.18$, with a 10% risk reduction. For a high-risk type with $t_h = \frac{4}{5}$ actual risk production becomes $b_h = 0.48$, with a 40% reduction. Formulation (4) is mainly for mathematical convenience. More sophisticated or realistic descriptions of progressive effects of regulation do not change results substantially. The idea is that, for any level of the regulation parameter, risk production decreases more than proportionally for larger t_i. Of course, the harsher the regulation, the stronger this effect.

The decision regarding the level of the regulation parameter is made by voting. The timing sequence is the following: at time 1, given the distribution of types $F(t)$, individuals compute their preferences regarding ρ; at time 2, they select a Condorcet winner in simple majority voting; at time 3, they choose their portfolios and their pollution levels, b_i.[5]

[5] A Condorcet winner is a level of regulation that cannot be beaten by any alternative level in an open-agenda pair-wise competition (for details, see Persson and Tabellini, 2002).

Each agent/voter computes his preferences regarding the regulation level, ρ, knowing that once ρ has been enforced, everyone will have to reduce their risk production according to (4), and he will have to bear a compliance cost. Therefore, individual i's "policy" preferences can be computed by plugging (4), which serves as an incentive constraint, into the utility function, (2):

$$V_i(\rho) = -\int_0^1 t - \rho \cdot t^2 dF(t) - \rho^2 t_i^4 \tag{5}$$

Maximizing (5) yields i's most preferred rule, which is the solution of the following FOC:

$$\int_0^1 t^2 dF(t) = 2\rho t_i^4 \tag{6}$$

Convexity of the cost function takes care of the SOC. The most preferred rule is set where the private benefit due to a marginal increase in the rule parameter (the left-hand side of (6)) equals the marginal private cost of complying with the rule (the right-hand side).

Let us solve the voting stage. Since all V_i's are single peaked, each voter i has one single most preferred regulation level, or bliss point, call it ρ_i^*:

$$\rho_i^* = \frac{\int_0^1 t^2 dF(t)}{2t_i^4} \tag{7}$$

Observe that bliss points are negatively related to types. An investor with a highly polluting portfolio (high t_i) wants a low rule (low ρ_i), and vice versa. The reason is simple. Heterogeneity in policy preferences is only due to differences in costs. Private benefits are the same for all, but for any rule level a higher type bears larger private costs. Since costs are convex individual's utility is maximized with a lower rule. Since preferences are single peaked, there is no room for strategic voting and there is a single equilibrium level for ρ, the Condorcet winner, which is the level preferred by the median. This regulation level wins against any other level in pair-wise comparisons, and it is the median type's most preferred level (Black, 1948). Call t_m the median type. The regulation level which is selected by majority voting is:

$$\rho_m^* = \frac{\int_0^1 t^2 dF(t)}{2t_m^4} \tag{8}$$

Let us look at the efficiency of this policy outcome. Let $W(\rho)$ be the Benthamite social welfare function, which is given by the sum of individual utilities:

$$W(\rho) = -\int_0^1 t - \rho \cdot t^2 dF(t) - \int_0^1 \rho^2 t^4 dF(t) \tag{9}$$

The first integral in $W(\rho)$ is the total externality and the second integral represents total compliance costs. $W(\rho)$ captures the social loss due to systemic risk plus the cost of complying with regulation. A higher level of $W(\rho)$ implies a lower social loss.

Differently from the median voter, the Social Planner takes all individuals' costs into consideration. The socially optimal rule, ρ^*, maximizes $W(\rho)$; therefore:

$$\rho^* = \frac{\int_0^1 t^2 dF(t)}{2\int_0^1 t^4 dF(t)} \tag{10}$$

The difference between ρ_m^* and ρ^*can be viewed as a "political distortion" due to voting. We say that regulation adopted by the majority is too restrictive if $\rho_m^* > \rho^*$; vice versa, regulation is too permissive if $\rho_m^* < \rho^*$.

By comparing (8) with (10) we can see that regulation is too restrictive if:

$$t_m^4 < \int_0^1 t^4 dF(t)$$

Let us discuss this condition. Observe that t^4 is a convex transformation of t. By Jensen's inequality, we have that $\int_0^1 t^4 dF(t) > \bar{t}^4$, where $\bar{t}$ is the average type. This means that if $t_m < \bar{t}$, then the condition for the rule to be too restrictive is satisfied for sure; in fact $t_m^4 < \bar{t}^4 < \int_0^1 t^4 dF(t)$. In other words, a median lower than the average is a *sufficient* condition for the emergence of an excessively restrictive rule. Consequently, excessively restrictive regulation occurs also if the median is only slightly above the average. It is easy to see that with more convex costs, the rule is too restrictive even if the median is consistently above the average. This result is not affected by the assumption of linear externalities.

The main idea is that when financial regulation is decided through voting, a too restrictive policy is rather likely to emerge. Even if the median voter owns a portfolio which pollutes more than the average, he may opportunistically choose too restrictive of a rule in order to force the minority of top polluters to substantial portfolio changes. The reason is that regulation mostly impacts on top risk investors, forcing them to large adjustments in their portfolio choices. The median voter does not consider the cost incurred by top risk producers in his voting calculations. He rather looks at regulation as a way to offload to them the main burden of systemic risk reduction.

Thus voting on financial regulation is likely to yield too socially restrictive rules. Inefficiency in voting outcomes is larger when costs are more convex and when the median is in a relatively low position with respect to the highest types. Let us find numerical evidence of this result by comparing the voting outcomes in the two countries of our example above.

Example 2. *Consider country A. The socially optimal rule can be computed using the (10), where the distribution is $F^A(t) = t$. The Social Planner would choose $\rho^{*A} = \int_0^1 t^2 dt / (2 \int_0^1 t^4 dt) = 0.83$. Let us compute what the majority decides. In country A the median voter is also the average risk producer, $t_m^A = \bar{t}^A = \frac{1}{2}$. Plugging this value into (8) yields a rule $\rho = 2.\bar{6}$. Since policy is constrained in $[0, 1]$, the actual policy outcome is $\rho_m^{*A} = 1$. This confirms that the rule is too restrictive even in a population where the median risk producer equals the average.*
In country B risk producers are distributed according to $F^B(t) = \sqrt{t}$. The median is lower than the average: $t_m^B = \frac{1}{4} < \frac{1}{3} = \bar{t}^B$. Also in this country we expect a policy level that is too restrictive. In fact, the Social Planner would adopt $\rho^{*B} = 0.9$. The median voter is constrained to choose the maximum rule $\rho_m^{*B} = 1$.
Observe that it is not surprising that in the second country the Social Planner wants a stricter rule. Those who pollute a lot are fewer, the social cost of reducing risk pollution is lower. Thus the country can "afford" a stricter rule.
Social optimum in country A is computed by plugging ρ^{*A} into (9). This yields,

$$W^A(\rho^{*A} = 0.83) = -\int_0^1 t - 0.83t^2 dt - \int_0^1 0.83^2 t^4 dt = -0.36$$

Skipping the calculations we have made for other cases we have

$$W^A(\rho^{*A} = 0.83) = -0.36 \quad \textit{and} \quad W^B(\rho^{*B} = 0.9) = -0.243$$

whereas the voting outcomes yield

$$W^A(\rho_m^{*A} = 1) = -0.37 \quad \textit{and} \quad W^B(\rho_m^{*B} = 1) = -0.244$$

The welfare loss due to political distortion is 0.01 *in country* A *and it is lower,* 0.001*, in country* B*. The reason is that there is a lower difference between the Social Planner's choice and the majority's choice in country* B *than in country* A

5. SRE taxation

An SRE tax aims to increase the private cost of systemic risk production. The problem with this instrument is that usually risk is not easy to measure. As pointed out earlier, the tax is often levied on biased measures of SRE, as for example the monetary value of financial transactions. This is largely referred to as the Tobin tax, and it is being widely discussed as a result of a generalized demand to curb financial systemic risk, after the 2008 subprime crisis. With this kind of tax, investors who do the same amount of financial transactions pay the same amount of tax, independently of actual systemic risk produced. Thus this tax is charged on a biased risk measure and realistically it is likely to have a regressive impact: those who pollute more pay less in proportion to risk.

We show that taxing a biased measure of risk is not only socially inefficient, but may also lead to a different type of political distortion. We start by exploring what the Social Planner would do if it could tax risk directly (Section 5.1). Then we look at what it actually does when it taxes transactions (Section 5.2). This gives rise to a first source of distortion, due to the adoption of a biased measure of risk. The second is political distortion, due to the fact that the median voter makes a different choice with respect to the Social Planner (Section 5.3). We show that political distortion is smaller when the median voter has to decide about a tax on transactions, rather than a tax on risk.

5.1. Tax on systemic risk

Consider the following policy benchmark. Suppose that the Social Planner is able to detect and tax the true systemic risk in every portfolio. The tax is charged on the actual externality level produced by each single investor. A basic result in optimal taxation theory applies here: welfare is maximized if, for any agent, after-tax private marginal cost equals the social marginal externality. Since in our model the marginal externality is independent of t_i, the optimal tax must ensure that marginal costs are the same for all investors. Assume that preferences are quasi-linear in money, a standard assumption in taxation theory. The optimality condition is satisfied by a proportional tax with lump-sum refunds of proceeds.

To show this, call τ the tax rate; i.e. the per-unit tax of systemic risk. Given τ, every investor i optimizes his portfolio by choosing a risk level $b_i(t_i, \tau)$ such that the marginal cost of reducing risk in his portfolio equals the tax per unit of risk: $c'(t_i - b_i) = \tau$. Therefore, after-tax optimal risk choice is:

$$2(t_i - b_i) = \tau.$$

The after-tax risk production, as a function of type and tax rate, is:

$$b_i(t_i, \tau) = t_i - \tau/2 \qquad (11)$$

This is an IC constraint which illustrates how every type of investor reacts to a proportional tax τ. Since costs are quadratic, it turns out that all investors reduce systemic risk in their portfolios by the same amount, $\tau/2$. For example, an investor in $t_i = 0.8$ will react to a $\tau = 0.4$ risk tax by reducing risk in his portfolio down to $b_i = 0.6$.

As a result of a tax, total systemic risk in the society is lowered by $\tau/2$; i.e. $\bar{b} = \bar{t} - \tau/2$. The socially optimal tax, τ^*, must ensure that total marginal cost equals total marginal externality, provided that, for every i, individual risk choice satisfies the IC constraint in (11). Optimal taxation level can be computed by solving the following equation:

$$\int_0^1 [\varepsilon'_b \mid b_i = t_i - \tau/2] \, dF(t) = \int_0^1 [c'_b \mid b_i = t_i - \tau/2] \, dF(t) \qquad (12)$$

The marginal externality in the left-hand side is -1. The marginal cost in the right-hand side is $-\tau$. Equation (12) is simply $-1 = -\tau$.[6] Thus the socially optimal tax rate is,

$$\tau^* = 1 \tag{13}$$

This is a *first-best*, that is achieved thanks to the government's ability to detect and tax actual systemic risk production.

The policy runs as follows. The government sells (i.e. taxes) for one dollar a unit of systemic risk ($\tau^* = 1$). Individual tax burden is proportional to the risk produced: $\tau^* \cdot b_i = b_i$. All investors reduce risk by $\frac{1}{2}$ and pay for the residual risk production. Thus they all bear the same marginal cost, and the social optimum is ensured. Proceeds are lump-sum redistributed. Per capita refund amounts to $\bar{b}$, where $\bar{b}$ is the after-tax average risk produced. Observe that $\bar{b} = \bar{t} - \frac{1}{2}$ and $\bar{b}$ also measures first-best social welfare. Total risk is cut by $\frac{1}{2}$, which is the socially optimal reduction.

Thanks to quasi-linear preferences, this tax schedule solves the Mirrlees problem. Thus, the schedule would be optimal even if types were not observable. The government does not need to know anything about the cost incurred by every single agent in reducing risk in his portfolio.

As for the assumption of linear externalities, no big changes occur if one removes it. The Social Planner can establish a nice non-linear tax schedule such that the (variable) marginal systemic risk produced by each agent equals the marginal tax rate.

Example 3. *Let us resume the example and compute social welfare with the first-best policy computed above, $\tau^* = 1$. In both countries all investors reduce their risk production by $\frac{1}{2}$.*
For country A the formula for the first-best welfare is:

$$W^A(\tau^* = 1) = -\int_0^1 \left(t - \frac{1}{2}\right) dt - \int_0^1 \left(\frac{1}{2}\right)^2 dt = -0.25$$

observe that, in order to get rid of corner solutions, investors with $t_i < \frac{1}{2}$ are let choose portfolios with $b_i < 0$. This is for mathematical convenience, however it is not in contrast with the main idea

[6] More precisely, since $\varepsilon_b' = -1$, the LHS is $-\int_0^1 dF(t) = -1$. As for the RHS, observe that $c_b' = -2(t_i - b_i)$. Plugging the IC and taking the integral, the RHS becomes $-2\int_0^1 (t_i - (t_i - \tau/2))d{:}F(t) = -\tau$.

because the externality remains negative ($\varepsilon' < 0$ even if $b_i < 0$).
For country B,

$$W^B(\tau^* = 1) = -\int_0^1 \left(t - \frac{1}{2}\right) d\sqrt{t} - \int_0^1 \left(\frac{1}{2}\right)^2 d\sqrt{t} = -0.083$$

Notice that welfare improves in both countries. Taxation at the first-best level yields higher welfare with respect to regulation. As for cost convexity it is easy to show that if $c = (t-b)^\alpha$, with $\alpha > 1$, nothing changes. Some changes may occur with more complex cost functions.

5.2. Tax on transactions: the measurement bias

As pointed out earlier, the problem with a tax is that in reality it is levied on biased measures of systemic risk. Here we consider a tax on financial transactions. In order to study this kind of tax we have to specify how the tax is related to the risk being produced. Arguably, systemic risk in a portfolio is due to two factors: first, the number of toxic assets; second, the portfolio size, i.e. the amount of transactions made by the investor. With a proportional transaction tax, however, an investor pays only according to the second factor. This means that a proportional transaction tax does not bear on the full amount of the externality produced. Thus we can realistically assume that a tax proportional to financial transactions is *de facto* regressive with respect to the externality produced.

Let us formalize this idea. Denote by μ the transaction tax rate. A tax is regressive if marginal taxation of risk decreases in the risk produced, b_i. Assume a simple linear relation. The tax rate on risk equals the transaction tax, μ, minus a linear measure of b_i; specifically, $\left(\mu - \frac{1}{\beta} b_i\right)$. Parameter β is a measure of the amount of systemic risk that is actually taxed through the transaction tax μ. High values of β imply that transactions are a good proxy of risk. With a tax levied on transactions the amount of, say, tax-free risk is rather limited. In a sense, β inversely captures the distortion due to measurement bias.

Let us compute the socially optimal transaction tax, when there is a measurement bias. The tax burden of investor i on a portfolio that produces b_i units of risk is $\left(\mu - \frac{1}{\beta} b_i\right) \cdot b_i$. The investor chooses the risk content in his portfolio in order to minimize the private cost of reducing risk plus the tax burden. Therefore b_i is chosen in order to minimize

$$(t_i - b_i)^2 + \left(\mu - \frac{1}{\beta} b_i\right) \cdot b_i$$

The first term is the cost of reducing risk to b_i; the second term is the tax paid on b_i, taking into account the regressive impact of the measurement bias. Optimization with respect to b_i implies that the marginal cost from reducing risk equals the marginal tax: $c'(t_i - b_i) = \mu - \frac{2}{\beta} b_i$. From the solution of this equation we get the investor's IC, which illustrates the after-tax portfolio choices as a function of the individual type and the transaction tax:

$$b_i(t_i, \mu) = \frac{\beta}{\beta - 1} (t_i - \mu/2) \tag{14}$$

We assume that $\beta > 1$. Then $t_i - b_i$ is decreasing in t_i. This means that a large investor reduces his risk production by less than a small one. The reason is regressivity: a larger risk polluter has to pay lower marginal tax on risk, thus he reduces risk production by a lower amount. Further observe that as the measurement bias becomes negligible (i.e. $\beta \to \infty$), a transaction tax leads to the same portfolio choice as a tax on risk.[7]

The tax chosen by the government maximizes social welfare, subject to the individual optimization constraint in (14). The FOC is:

$$\int_0^1 \left[\varepsilon_b' \mid b_i = \frac{\beta}{\beta - 1} (t_i - \mu/2)\right] dF(t) = \int_0^1 \left[c_b' \mid b_i = \frac{\beta}{\beta - 1} (t_i - \mu/2)\right] dF(t) \tag{15}$$

As for the tax on risk the marginal externality in the left-hand side is just -1. As for the right-hand side, let us plug equation (14) into the marginal cost function and compute the integral: $-2 \int_0^1 (t_i - \left(\frac{\beta}{\beta-1} (t_i - \mu/2)\right) dF(t)$. Solving the equation yields the government's

[7] The assumption that $\beta > 1$ will be needed to solve the voting stage in Section 5.3.2. With this specification, we also need a condition on parameter β: after-tax risk must be lower than pre-tax risk; i.e., $b_i(t_i, \mu) < t_i$, where $b_i(t_i, \mu)$ is given by (14). This condition is satisfied when $\beta > \frac{2}{\mu}$.

most preferred transaction tax, call it μ°:

$$\mu^{\circ} = \left(1 - \frac{1}{\beta}\right) + \frac{2}{\beta}\bar{t} \tag{16}$$

This tax is a *second-best.* Taxing transactions forces the government to adopt a tax that is *de facto* regressive in the externality, whereas the first-best instrument would be a proportional tax. Departure from first-best occurs because the government taxes a distorted measure of risk. Suppose $\bar{t} < \frac{1}{2}$, the difference between first and second-best increases in the measurement bias. If the latter is large, the ability to tax externalities through transactions is low (i.e. β is low), thus μ° is substantially lower than τ^*. The reason is that the Social Planner does not want to "overtax" low types, who are the bulk of the population. The vice versa happens if $\bar{t} > \frac{1}{2}$.

Interestingly, when $\bar{t} = \frac{1}{2}$, first and second-best tax levels are the same: $\mu^{\circ} = \tau^*$. Notice, however, that inefficiency occurs in any case: despite the fact that the tax rate is optimal, its impact on risk production is distorted by the fact that tax rate has regressive impact on risk reduction. We will provide numerical evidence below.

Summing up, when the Social Planner adopts a tax on financial transactions, it cannot implement the first-best. The reason is that a distorted measure of risk is used as the taxation base. Top risk polluters do not pay enough taxes; their private marginal cost is too low, compared to the marginal externalities produced, and vice versa low-risk polluters pay too much. Specifically, the second-best level of the tax is too low when the average type is enough low.[8]

Example 4. *Let us compute the second-best tax rates and social welfare levels within the two countries. Recall that in country A the average type is $\bar{t}^A = \frac{1}{2}$. Therefore, $\mu^{\circ A} = 1$, as in the first-best case. This is independent of β. Assume there is a severe measurement bias, $\beta = 4$. By (14), after-tax portfolio choice is $b_i = \frac{4}{3}(t_i - 1/2)$. In country A, the welfare with the second-best tax is:*

$$W^A(\mu^{\circ A} = 1) = -\int_0^1 \frac{4}{3}\left(t - \frac{1}{2}\right) dt - \int_0^1 t - \frac{4}{3}\left(t - \frac{1}{2}\right)^2 dt = -0.259$$

[8] By comparing (13) with (16) it is easy to see that $\mu^{\circ} < \tau^*$ if $\bar{t} < \frac{1}{2}$.

Recall that the first-best welfare level computed in Section 5.1 is $W^A(\tau^* = 1) = -0.25$*. Taxing transactions instead of risk causes a lower gain in country* A *which amounts to* 0.009*. Observe that, although the tax rate is the same, welfare is lower because of regressivity. This provides evidence of what we pointed out earlier.*
From (16), country B*'s tax rate is* $\mu^{\circ B} = 11/12$*. By (14), after-tax risk production is* $b_i = \frac{4}{3}(t_i - 11/24)$*. The second-best welfare in country* B *is:*

$$W^B(\mu^{\circ B} = \frac{11}{12}) = -\int_0^1 \frac{4}{3}\left(t - \frac{11}{24}\right) d\sqrt{t} - \int_0^1 \left(t - \frac{4}{3}\left(t - \frac{11}{24}\right)\right)^2 d\sqrt{t} = -0.093$$

Not surprisingly, also in country B *welfare level is lower with a transaction tax than with a tax on risk (*-0.093 *instead of* -0.083*).*

5.3. Political distortions

This Section studies the political distortions that may occur when the decision about taxes is made through voting. We start with Subsection 5.3.1, which considers the case in which a proportional tax is levied on risk production directly. There is no measurement bias in this case. Then we proceed with Subsection 5.3.2, which explores voting on financial transactions, where a measurement bias occurs. We will see that the political distortion in this case counteracts the distortion due to measurement bias.

5.3.1. Tax on risk

In the absence of measurement bias, risk is taxed directly and the Social Planner chooses the first-best tax rate $\tau^* = 1$. Below we show that, unsurprisingly, the majority possibly chooses a different tax rate. Thus there is political distortion.

Recall that tax revenues are lump-sum redistributed out of a balanced government budget. Every individual receives a refund that is equal to the average tax burden $\tau \cdot \bar{b}$. Investor i's indirect utility is:

$$V_i(\tau) = -\int_0^1 b dF(t) - (t_i - b_i)^2 - \tau \cdot (b_i - \bar{b}) \tag{17}$$

Recall also that, for any given τ, each individual reduces the amount of risk in his portfolio by $\tau/2$, as in (11). In other words, behavior in (17) depends on τ, in the way that is specified by the IC constraint in (11). Each investor i chooses his most preferred tax rate in order to maximize (17) subject to (11). Let us substitute the IC constraint into (17) and then compute the FOC:

$$V_i(\tau) = -\int_0^1 (t - \frac{\tau}{2})dF(t) - (t_i - (t_i - \frac{\tau}{2}))^2 - \tau \cdot ((t_i - \frac{\tau}{2}) - (\bar{t} - \frac{\tau}{2}))$$

The FOC is:

$$\frac{1}{2} - \frac{\tau}{2} + (\bar{t} - t_i) = 0$$

The SOC is immediately satisfied, therefore solving the FOC yields i's most preferred tax rate, τ_i^*:

$$\tau_i^* = 1 + 2(\bar{t} - t_i)$$

The τ_i^*'s represent voters' bliss points. They are decreasing in t_i. Higher types pay larger amounts of taxes because their after-tax risk production is higher, thus they want lower tax rates. Since bliss points are unique and inverse-monotone in types, the majority chooses the median's bliss point:

$$\tau_m^* = 1 + 2(\bar{t} - t_m) \tag{18}$$

The difference between τ_m^* and τ^* is a measure of the political distortion due to majority decision. Recall that $\tau^* = 1$, thus the political distortion is:

$$\tau_m^* - \tau^* = 2(\bar{t} - t_m) \tag{19}$$

If the median type is below (above) the average, the majority chooses a tax rate that is too high (too low). Political distortion occurs because the amount of taxes preferred by the median risk producer are different from those preferred by the average one. For example, a low median has an incentive to fix a high rate in order to have others paying for a larger share of the cost of reducing systemic risk. No political distortion occurs only if the median's risk production equals the average. This result on systemic risk taxation is similar to a well-known result in the public finance literature on income taxation (Roberts, 1977; Meltzer and Richard, 1981). When the government is able to tax systemic risk, political distortion is only determined by the difference between the median and the mean of the population distribution. Consider that this elegant result relies on two important assumptions, quadratic costs and linear externalities.[9]

Example 5. *Let us compute the tax adopted by the majority. In country A the median risk producer equals the average. Thus, according to (19), voting yields a first-best: the tax rate is one. We already computed social welfare for this case:*

$$W^A(\tau^{*A} = \tau_m^{*A} = 1) = -0.25$$

As expected, no loss due to political distortion occurs.
In country B, the median is lower than the average ($t_m^B = \frac{1}{4} < \frac{1}{3} = \bar{t}^B$). There will be a distortion. According to (18), the policy outcome is $\tau_m^{*B} = \frac{7}{6}$. According to (11) investors reduce risk in their portfolios by $\frac{7}{12}$. Therefore welfare is

$$W^B(\tau_m^{*B} = \frac{7}{6}) = -\frac{1}{2}\int_0^1 (t - \frac{7}{12}) d\sqrt{t} - \frac{1}{2}\int_0^1 \left(\frac{7}{12}\right)^2 d\sqrt{t} = -0.09$$

In country B political distortion occurs. It results from the difference between the average and the median in $F^B(t)$. There is a welfare loss (-0.09 instead of -0.083, which is the first-best computed in Section 5.1 above).

5.3.2. Tax on transactions

Consider now the majority decision when the tax, μ, is levied on financial transactions. A measurement bias occurs: systemic risk is not entirely taxed. As pointed out earlier, the tax has a regressive effect. Let us explore how this kind of effect affects voters' decision and which kind of political distortion, if any, occurs.

Individual policy preference is the same as (17). The difference is in the IC constraint; regressivity causes a different reaction to the tax. With a transaction tax, individuals' after-

[9] Specifically, when cost are more convex (i.e. $c''' > 0$), even a median equal to the average prefers a tax rate that is too high.

tax risk production is given by (14). Taking this IC as a constraint in utility maximization, we get the following objective function.

$$V_i(\tau) = -\int_0^1 (\frac{\beta}{\beta-1}(t_i - \mu/2))dF(t) - (t_i - \frac{\beta}{\beta-1}(t_i - \mu/2))^2 - \mu \cdot \frac{\beta}{\beta-1}(t_i - \bar{t})$$

The FOC is:

$$\frac{\partial V_i(\mu)}{\partial \mu} = \frac{1}{2} + \frac{t_i}{\beta-1} - \frac{\beta}{\beta-1}\frac{\mu}{2} + (\bar{t} - t_i) = 0$$

The SOC is satisfied if $\beta > 1$, which we assumed already. Solving for μ yields i's most preferred transaction tax:

$$\mu_i^* = \left(1 - \frac{1}{\beta}\right) + \frac{2}{\beta}t_i + 2(1 - \frac{1}{\beta})(\bar{t} - t_i)$$

The bliss points are decreasing in t_i. Then the transaction tax chosen by the majority is the one preferred by the median type:

$$\mu_m^* = \left(1 - \frac{1}{\beta}\right) + \frac{2}{\beta}t_m + 2(1 - \frac{1}{\beta})(\bar{t} - t_m) \tag{20}$$

The difference between the median voter's tax, μ_m^*, and the Social Planner's tax, μ°, gives a hint of where the political distortion comes from. Subtracting (16) form (20) yields:

$$\mu_m^* - \mu^\circ = \frac{4}{\beta}(t_m - \bar{t}) + 2(\bar{t} - t_m) \tag{21}$$

The political distortion is given by the sum of the two terms in the right-hand side of (21). This first term is positively related to the relative position of the median. The reason is that a high median is "tempted" to choose a high tax rate since his marginal cost of reducing risk decreases because of regressivity. The second term is the "usual" political distortion, as in (19), and it works in the opposite direction: a high median wants a low tax rate since he pays a large amount of taxes.

The net political distortion results from this trade-off. Interestingly, the solution to the trade-off depends on parameter β. If $\beta < 2$ the tax is too low when $t_m < \bar{t}$. The "usual" political distortion prevails on the distortion due to regressivity. The idea is that when the ability to tax systemic risk through a transaction tax is sufficiently high (i.e. $\beta > 2$), the low position of the median, rather than regressivity, plays a major role.

Example 6. *Let us verify these results returning to the numerical example. Recall that $\beta = 4$. In Country A, $\bar{t} = t_m$. According to (21) the median chooses the socially optimal level: $\mu_m^{*A} = \mu^{\circ A} = 1$. No political distortion occurs. However the first-best is not achieved because of regressivity. Voting yields the Social Planner's second-best, that we computed earlier:*

$$W^A(\mu_m^{*A} = \mu^{\circ A} = 1) = -0.259$$

In country B, since $\beta > 2$, we expect the usual political distortion to occur. In fact, from (20) we find that $\mu_m^{*B} = 1$, instead of the second-best level, $\mu^{\circ B} = \frac{11}{12}$. From (14), the IC is $b_i = \frac{4}{3}(t_i - 1/2)$. Therefore:

$$W^B(\mu_m^{*B} = 1) = -\int_0^1 \frac{4}{3}\left(t - \frac{1}{2}\right) d\sqrt{t} - \int_0^1 \left(t - \frac{4}{3}\left(t - \frac{1}{2}\right)\right)^2 dt = -0.096$$

The welfare loss due to political distortion (i.e. $W^B(\mu_m^{*B} = 1) - W^B(\mu^{\circ B} = \frac{11}{12})$) amounts to -0.03.

Let us compare political distortion in the case of a transaction tax, with political distortion in case of regulation. Consider the most interesting case: transactions are a poor measure of risk, $\beta < 2$. Suppose the median is lower than the average. A rule is always too restrictive: a low median uses regulation as a tool to charge high-risk investors the largest share of total cost, but this causes social welfare loss. By contrast, a tax is too low: due to tax regressivity a low median must pay large amounts of tax and thus he prefers too low a tax level.

This relationship between political distortion and the median's position is continuous. If the median is moderately above the average, regulation is too restrictive and taxation is too permissive. With a very high median both regulation and taxation are too permissive.

Summing up, with both policy tools majority voting yields political distortion. This may cause large inefficiency losses. However, the distortion is considerably different when voting concerns taxation instead of regulation, especially if there is a problem of measurement bias. Too restrictive regulation is more likely to emerge than too restrictive taxation. The reason being that regulation is a progressive mechanism, whereas taxation on transactions is regressive. Thus, on the one hand a relatively low median voter, who is not necessarily below the average, prefers restrictive regulation in order to force higher types to large risk reductions; on the other hand, he prefers a low taxation rate because otherwise he would have to pay high taxes.

6. The choice of policy instrument

Suppose now that the majority determines not only the level of the policy, but also which instrument to adopt. We can realistically assume that voting takes place sequentially: first, the majority selects the policy instrument; then it chooses its level.[10] Voters know that, whatever the instrument, the level that will pass at the second stage is the one preferred by the median. Every voter compares his own utility in both cases, and chooses his most preferred instrument. At the first stage, the majority behaves as a Stackelberg leader: it selects the instrument and it lets a possibly different majority choose the level at the second stage. There is no scope for strategic voting.

When does the majority choose a rule at the first stage? A low-pollution investor has to make small adjustments to comply with the rule, whereas with the tax he has to pay a relatively large amount, due to regressivity. Thus he prefers a rule. A top-pollution type has reversed preferences: a tax is better than a rule because with a tax a larger share of the burden of systemic risk reduction is transferred to low-pollution investors.

A likely scenario is that if the number of low-risk portfolios is sufficiently large, then a

[10] In general, with bi-dimensional policy issues the existence of a Condorcet winner cannot be taken for granted. However, with sequential voting in which the first issue is binary this problem does not arise. Consider that with bi-dimensional sequential voting the outcome is sensitive to the voting sequence. In our situation we do not have such a problem. An inverse sequence in which the majority decides the instrument after having decided the level of policy is quite innatural. For an exaustive analysis of sequential bi-dimensional voting, see De Donder et al. (2010).

majority in favor of the rule will arise. Observe that we do not require that the median is below the average in this case. If the rule is strongly progressive then also moderately high-risk portfolio owners will prefer it. Vice versa, high-pollution investors prefer a regressive tax to a rule. If regressivity is stronger more moderate types prefer the tax. Thus a majority in favor of a tax will form only if it is strongly regressive with respect to the rule and the population of low-risk investors is relatively small.

Let us consider the normative characteristics of these positive results. In our model the social cost of systemic risk is linear. Thus, the Social Planner is not interested in who produces the externality, it is rather interested in choosing an instrument that shares the costs evenly. A rule is strongly progressive: the cost is concentrated on high-risk investors. Vice versa, a tax levied on a biased risk measure may be regressive; thus the cost is concentrated on low polluters. The socially optimal instrument is a tax if regressivity is not too high; i.e. if the measurement bias is not too strong.

Consider however, that when the measurement bias causes strong regressivity or when the distribution is slanted towards highly polluting portfolios a majority of voters prefers the rule. In this case a double political distortion occurs. First, the majority selects the wrong instrument: regulation instead of a taxation. Second, the majority of low polluters chooses a too restrictive level of regulation.

Example 7. *Let us provide numerical evidence of the double distortion. Let us compute the utility of the median in country A, at the equilibrium rule and at the equilibrium transaction tax, respectively:*

$$V_m(\rho_m^{*A} = 1) = -\int_0^1 (t - t^2)\, dt - \frac{1}{16} = -0.23$$

and

$$V_m(\mu_m^{*A} = 1) = -\int_0^1 \frac{4}{3}\left(t - \frac{1}{2}\right) dt - \frac{1}{4} = -0.25$$

Of course the median would choose regulation.
The Social Planner would rather choose a transaction tax. Social welfare would be larger with a tax: $W^A(\mu^{\circ A} = 1) = -0.259$ rather than $W^A(\rho^{*A} = 0.83) = -0.36$. Regressivity is not sufficient to lead the Social Planner to prefer the rule.
It is easy to see that in this case majorities at the first and second stage do not "mix up"; i.e. the median voter is pivotal both when the instrument is decided and when the level is set.
Observe that the majority prefers the wrong instrument although the distribution of types is symmetric. This confirms our theoretical results.

7. Conclusions

The main point in this paper is that when policies to reduce financial systemic risk are made through voting, the political aspects of decision-making are quite relevant and may cause significant distortions. These distortions are substantially different when taxation rather than regulation is considered.

We approach systemic risk contagion as an externality issue and we consider it as a general interest policy. In a sense, everybody is interested in reducing systemic risk and, as a consequence of the policy, all investors must readjust their own portfolio or bear a cost. If regulation is adopted, most costs and adjustments are shouldered by high-risk producers; with taxation, sacrifices are more evenly distributed across the population. Political distortions hinge on the distribution of sacrifices of the externality reduction. A majority of small portfolio owners with low-risk production will tend to choose regulation in order to concentrate sacrifices on high-risk producers. Even a median that is above the average might prefer regulation, provided it has a sufficiently progressive effect on risk adjustments.

We show that regulation may be highly inefficient. In particular, majorities tend to choose too restrictive regulation. Loosely speaking, if "risk is due to everybody" (as in the case where externalities are linearly related to risk), and the cost of complying with regulation grows at a fast rate, concentrating risk reduction on top risk producers is not socially optimal. However, if the majority is made by low-risk producers, the decision will be harsh regulation.

With a tax, the political distortion is quite different. Systemic risk is reduced by taxing distorted measures of risk, such as transactions, intermediaries' profits or their turnover. We argue that a tax is likely to yield a regressive effect: small risk producers pay proportionally more than large risk producers. As a consequence, a majority of small risk producers has less incentive to choose a tax; if this is the case, it will choose a too low tax level. This political economy argument is possibly helpful to understand the current reality in which taxes on risky financial instruments are usually rare and low, whereas financial regulation is much more frequent.

Of course there might be many other circumstances, not considered in this paper, that explain the frequency and efficiency of policies. For example, taxes can be better calibrated to financial activity, and produce more gradual externality reductions. From a normative viewpoint, taxation is preferable when contribution to systemic risk is more evenly distributed across financial instruments and investors. Vice versa, regulation is more effective when there are information concerns. If risk production is private information, a rule that limits specific financial activities is more effective than a tax on those activities.

Financial risk externalities are also an international issue. In these circumstances common decisions rely on the existence of institutions that ensure a sufficient degree of coordination among parties. Incentives and enforceability issues may severely limit the set of available policy options and distort common decision-making.

Finally, one might object that a specific interest lobbying model à la Stigler is possibly more appropriate to address politico-economic issues in financial markets. Financial intermediaries may find that engaging in lobbying activities is profitable in order to affect political decisions in a favorable direction. In this case, however, one would need to explain why banks lobby for regulation rather than taxation. Moreover, the idea that financial policies are specific-interest policies is questionable. We rather think that any policy intervention in financial markets is in principle a general-interest policy. Every citizen is a potential portfolio owner. Thus anyone can perceive the private consequences of any policy measure that may affect, directly or indirectly, the relative cost of his alternative portfolios and the relative benefits from systemic risk reduction.

These are relevant aspects of policy making in relation to systemic financial risk. They are not alternative, but rather complementary to the points made in this paper and they may eventually suggest extensions to our approach.

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