

# RESEARCH SUMMARY

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The central theme of my research is the analysis of the role of information in strategic situations that are of interest to both micro and macro economists. In particular, my research focuses on global games, the social value of information and coordination, and mechanism design. Below I explain the contribution of my work to each of these areas. In so doing, I hope to also give an idea of my research style; I am very much interested in theory but my contribution to it is always driven by applications.

## 1 Global games

Global games are games of incomplete information in which the uncertainty about the underlying payoff structure is “large” in the sense that players do not exclude ex-ante any possible payoff profile (although certain profiles may well be considered more likely than others). Global games have been used to examine a variety of phenomena, including currency crises, bank runs, debt crises, investment spillovers, liquidity crashes, adoption of technology standards, and political change.

Building on results from Carlsson and van Damme (1992), Morris and Shin (2002), and Frankel, Morris and Pauzner (2003), the approach followed in most applications of global games is to assume certain exogenous information structures as a selection device—as a tool to achieve the convenience of unique-equilibrium comparative statics—without investigating what determines information in the first place. For many questions, however, understanding the endogeneity of information is the key to understanding the phenomenon under examination. The distinctive feature of my research in this area (joint with Marios Angeletos and Christian Hellwig) is in investigating the consequences of endogenizing the sources of information both on the determinacy of equilibria and on the predictions that these games deliver in applications.<sup>1</sup>

The first paper that endogenizes information in global games is [6] “*Signaling in a Global Game: Coordination and Policy Traps.*” Consider a central bank trying to prevent a speculative run against the domestic currency by raising interest rates or taking other defense measures that increase the

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<sup>1</sup>Also related to global games is my work in progress with Bruno Jullien [18] “*The role of information in competition in two-sided markets.*”

cost of speculation. Such interventions convey information about the bank's perception of the underlying fundamentals, as well as its willingness and ability to defend the currency. Importantly, this information is endogenous, for it depends on the strategy of the policy maker. What the paper shows is that this endogeneity leads to multiple equilibria, despite the fact that market participants have heterogeneous information about the type of the policy maker.

The multiplicity in this paper originates from the combination of signaling and coordination; it vanishes when the policy maker faces a single receiver or when interventions do not convey information. Furthermore, contrary to the multiplicity in standard global games, this multiplicity does not rely on the policy being a public signal; it also obtains in environments in which the action of the policy maker is observed with idiosyncratic noise. Finally, contrary to the multiplicity in standard signaling games, the multiplicity documented here does not rely on the freedom to choose out-of-equilibrium beliefs; it is robust to perturbations in which the support of the policy signal is invariant to the policy choice, so that beliefs are always pinned down by Bayes' rule.

This paper has attracted attention both for its theoretical insights (warning against the use of incomplete information just as a selection device to achieve the convenience of unique-equilibrium comparative statics) and for its applied contribution (warning the policy maker that he may be trapped into a position in which the best he can do is to confirm market expectations).<sup>2</sup> These predictions seem relevant in many environments, including IMF interventions during debt crises and central bank interventions during credit crunches.

Another natural source of endogenous information is learning from past outcomes in a dynamic setting. We consider such a possibility in [2] "*Dynamic Global Games of Regime Change: Learning, Multiplicity, and Timing of Attacks.*" Games of regime change are coordination games in which a status quo is abandoned, causing a discrete change in payoffs, once a sufficiently large number of agents "attacks" it. These games have been used to model a variety of crises phenomena, i.e. situations where a significant change in outcomes can be triggered without any significant change in fundamentals. Virtually all applications of these games have been confined to static frameworks: they abstract from the possibility that agents take multiple shots against the status quo and that agents' beliefs about the underlying fundamentals evolve over time. Yet, these two possibilities are important, both from an applied and from a theoretical perspective. First, crises are intrinsically dynamic phenomena. For example, in currency crises, speculators can attack again and again until they induce devaluation, and their expectations about the possibility to induce devaluation in the present naturally depend on the central bank's interventions in the past. Second, learning in a dynamic setting may critically affect the level of strategic uncertainty (i.e. uncertainty about other players' actions) and thereby the dynamics of coordination and the determinacy of equilibria.

A difficulty with extending global games to dynamic settings comes from the fact that one has to keep track of the endogenous evolution of beliefs. The paper provides a recursive algorithm that permits one to do so in a tractable way. This result is then used to show how dynamics can lead

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<sup>2</sup>Also related is the work in progress [19] "*On the Ineffectiveness of Interest-Rate Defenses Against Speculative Currency Attacks.*"

to multiple equilibria under the same conditions on the precision of exogenous private and public information that guarantee uniqueness in the static benchmark. We also show that fundamentals may predict eventual outcomes, e.g. whether a currency is devalued, but not the timing and number of attacks and that equilibrium dynamics alternate between phases of “tranquility,” in which no attack is possible, and phases of “distress”, in which an attack can be triggered by a shift in “sentiments,” without any change in fundamentals.

The multiplicity of equilibria that emerges in global games with endogenous information is very different from the multiplicity in standard coordination environments with complete information and need not preclude concrete and testable predictions. We demonstrate this point in [12] “*Robust Predictions in Global Games with Multiple Equilibria: Defense Policies against Currency Attacks.*” While [6] focuses on documenting multiplicity and showing its robustness to alternative information assumptions, the questions this paper addresses are the following: What predictions, if any, one can deliver regarding policy choices and devaluation outcomes that are robust across all equilibria? How different are these predictions from those that obtain under complete information? Answering these questions is important both for the specific application under examination but also from a broader methodological perspective. If endogenizing the sources of information implied that the equilibrium outcomes become similar to that under complete information, then for practical purposes one could largely ignore both the endogeneity and the incompleteness of information and go back to the earlier models that assume common knowledge. What the paper shows is that global games can retain significant selection power leading to interesting predictions that otherwise would not have been possible, even when the endogeneity of information sustains multiple equilibria.

From a theoretical viewpoint, the contribution here is in constructing a procedure of iterated deletion of strategies that cannot be part of an equilibrium (as opposed to dominated strategies) that permits one to pin down the entire set of equilibrium outcomes. This procedure is different from the one in standard global games because of signaling. First, beliefs about payoffs in the coordination game among the receivers are endogenous; they are a function of the strategy of the sender. Second, iterated deletion of strategies that cannot be part of an equilibrium imposes restrictions not only on coordination among the receivers but also on the information sent by the sender.

Summarizing, the contribution of my research in global games is in showing that information is an integral part of the analysis, not just a selection device. Studying the sources of information permits a better understanding of the phenomena under examination and can give guidance on what information structure are more likely to emerge in different environments. Endogenizing information can bring back multiple equilibria; this is because the same information can be interpreted differently depending on which strategy has led to it. This multiplicity is however very different from the one that emerges under common knowledge and need not preclude useful predictions. In this respect, I find the recent debate about uniqueness versus multiplicity in global games potentially distracting from what, to me, is the main contribution of this literature: having highlighted the role that information plays in sharpening the mapping from model assumptions

to model predictions. The insightfulness of this mapping, and not the determinacy of equilibria, is what matters in applications.

## 2 Social value of information and coordination

What are the welfare effects of the information disseminated by prices, market experts, or the media? Should central banks disclose the information they collect and the forecasts they make in a transparent and timely manner? Also, is the equilibrium use of information socially efficient? If not, how does this inefficiency depend on the value agents assign to aligning their decisions to those of others? And what policies can restore efficiency or at least improve upon equilibrium welfare?

While the positive properties of the interaction between information and coordination have been largely examined, the welfare implications of such interaction are far less understood. Filling this gap is the goal of my ongoing research with Marios Angeletos on the social value of information and coordination.

In [1] “*Efficient Use of Information and Social Value of Information*,” we examine a tractable class of economies (games) with externalities, strategic complementarity or substitutability, and incomplete information on commonly relevant fundamentals. Contrary to global games, the distinctive feature of this class is that the equilibrium is unique, regardless of the information structure. Examples of economies that fit into this class are the large Bertrand and Cournot games examined in Vives (1990), the beauty contest model of Morris and Shin (2002), the investment spillover model in [8], and the business cycle models of Woodford (2002), Hellwig (2005), and Lorenzoni (2005).

We first identify possible inefficiencies in the equilibrium response to different sources of information; this is done by characterizing an efficiency benchmark that captures the best society can do under the sole constraint that information must remain decentralized. This efficiency benchmark, more than standard second best concepts that allow the planner to transfer information from one agent to another, is what in these games permits one to answer the type of questions raised above.

We then show how the discrepancy, if any, between the equilibrium and the efficient use of information determines the social value of information, i.e. the comparative statics of equilibrium welfare with respect to the information structure. Examples of the results that the paper delivers are the following. In economies in which the equilibrium is efficient, welfare necessarily increases with the precision of any type of information. In contrast, in economies in which inefficiency emerges only under incomplete information, more accuracy (i.e. less noise in the agents’ forecasts of underlying fundamentals) necessarily boosts welfare, while more commonality (i.e. more correlation in the noise across agents) decreases welfare if and only if the equilibrium degree of coordination is excessively high (i.e. the private value of aligning decisions is higher than the socially optimal one). Finally, in economies that are inefficient even under complete information, ignorance can be bliss, i.e. welfare may decrease with both the commonality and the accuracy of information (this happens when there is a certain correlation between the complete-information equilibrium and the first best).

Although the framework developed in [1] is fairly abstract, its insights are relevant for many

applications. For example, Morris and Shin (2002) show that in economies that resemble Keynes' beauty contest metaphor for financial markets, more precise public information can reduce welfare. In contrast, public information is always welfare improving in the investment game examined in [8] "*Transparency of Information and Coordination in Economies with Investment Complementarities*" as well as in the business cycle models of Hellwig (2005) and Roca (2006) and in the large Bertrand games of Vives (1990). The equilibrium is essentially the same in all these economies, so why are the welfare effects of public information so different? As the paper shows, this is because the social value of information depends not only on the form of strategic interaction, but also on external effects that determine the gap between equilibrium and efficient use of information.

The work initiated in [1] has now been extended in a few promising directions. In [14] "*Policy with Dispersed Information,*" we develop a novel theory of taxation that aims at correcting inefficiencies in the equilibrium response to different sources of information. We generalize the framework in [1] to allow for arbitrary information structures and consider economies in which the decentralized use of information can fail to be efficient not only because of payoff externalities but also because of informational externalities. With payoff externalities, inefficiency manifests itself in excessive non-fundamental volatility (overreaction to common noise) or excessive cross-sectional dispersion (overreaction to idiosyncratic noise). With informational externalities, inefficiency manifests itself in suboptimal social learning (lower quality of information contained in macroeconomic data, financial prices, and other indicators of economic activity). In either case, a novel role for policy is identified: even if the government cannot centralize and communicate information to society, it can improve welfare by manipulating the incentives agents face in using their available sources of information. The key result is that this can be done, and efficiency can be restored, by appropriately conditioning marginal taxes on aggregate activity.

Related to [1] and [14] is also [3] "*Socially Optimal Coordination: Characterization and Policy Implications.*" In this short paper—written for the 2006 meetings of the European Economic Association—we ask whether the heightened inertia (slow response to changes in fundamentals) and volatility (variation in aggregate activity generated by correlated noise in information) documented in many macro models with complementarities and heterogenous information are undesirable from a social viewpoint. We argue that the key to answering this question is the relation between the equilibrium and the socially optimal degree of coordination. The former summarizes the private value of aligning individual decisions, whereas the latter summarizes the value that society assigns to such alignment once all externalities are internalized. Anticipating results from [14], the paper shows how the socially optimal degree of coordination can be induced by appropriately designing the contingencies in the tax system.

The interaction between information and coordination is also explored in [13] "*Wall Street and Silicon Valley: a Delicate Interaction*" (joint with Marios Angeletos and Guido Lorenzoni). In contrast to previous work, in this paper a strategic complementarity emerges endogenously purely because of informational reasons.

It is well known that financial markets look at data on aggregate investment for signals about underlying economic fundamentals (e.g. the profitability of a new technology or a new sector). At the same time, firms' incentives to invest increase with expected financial prices (this is because high financial prices raise the value of installed capital). In this paper we study the positive and normative implications of this two-way feedback during periods of intense technological change (e.g. the internet bubble at the end of the 90's or the recent investment boom in China), when information about the profitability of new technologies/markets is widely dispersed.

Because high aggregate investment is "good news" for profitability, asset prices increase with aggregate investment. Because an entrepreneur's incentives to invest in turn increase with the financial market assessment of his capital, an entrepreneur is willing to invest more when he expects others to invest more. This endogenous complementarity induces entrepreneurs to rely more on common sources of information regarding profitability and less on idiosyncratic sources of information.

The positive contribution of the paper is in showing how this endogenous complementarity reduces the impact of fundamental shocks (shifts in underlying profitability) and amplifies the impact of expectational shocks (correlated errors in assessment of profitability). The normative contribution is in showing that these effects are also symptoms of inefficiency: investment reacts too little to fundamental shocks and too much to expectational shocks. This inefficiency originates from the dispersion of information, not from the fact that entrepreneurs care about financial prices. In this respect, the paper is also the first one to provide a complete micro-foundation for Keynes' beauty-contest-like inefficiencies in the interaction between real and financial activity.

### **3 Mechanism design**

My research in mechanism design can be divided in four related and interdependent areas. The first one is competing principals (also known as common agency). The second is privacy in sequential contracting. The third is dynamic mechanism design. The fourth is the design of auctions for divisible goods.

#### **3.1 Common agency**

Common agency refers to a situation in which multiple principals contract non-cooperatively with the same agent. Depending on the application of interest, the principals can be manufacturers selling to a common retailer, lobbyists exerting influence on a politician, firms hiring a common consultant, or federal and state authorities regulating a firm.

There are many ways common agency can be modelled depending on the restrictions one imposes on the mechanisms the principals can use to select their contracts. One possibility is to assume that principals simply make take-it-or-leave-it offers to the agent (these offers can be price-quantity pairs in a trading relationship or an employment contract in a labor relationship). Alternatively, one can think of the principals engaging in more sophisticated negotiation procedures during which

the parties exchange information (for example about competing offers) before selecting the final contract.

While in games with a single mechanism designer, the entire set of sustainable outcomes can be conveniently characterized restricting the principal to offer simple direct revelation mechanisms in which the agent reports his “type,” i.e. his exogenous private information, unfortunately, this is not the case in games with competing principals. The reason is that the agent may have private information not only about his type but also about the offers made by (and the decisions taken with) other principals.

My research in this area (joint with Giacomo Calzolari) aims at identifying classes of mechanisms that are flexible enough to support all outcomes of interest in applications, while at the same time maintaining tractability.

In [9] “*Truthful Revelation Mechanisms for Simultaneous Common Agency Games*,” we consider games in which multiple principals contract simultaneously with the same agent. We introduce a new class of revelation mechanisms that, although it does not always permit a complete equilibrium characterization, it facilitates the characterization of the equilibrium outcomes that are typically of interest in applications (those sustained by pure-strategy profiles in which the agent’s behavior in each relationship depends only on payoff-relevant information such as the agent’s type and the decisions he is inducing with the other principals). We then illustrate how these mechanisms can be put to work in environments such as menu auctions, competition in nonlinear tariffs, and moral hazard settings. Lastly, we show how one can enrich the revelation mechanisms, albeit at a cost of an increase in complexity, to characterize also equilibrium outcomes sustained by non-Markov strategies and/or mixed-strategy profiles.

Most of the literature on common agency assumes the principals contract simultaneously with the agent. While this is a natural benchmark, there are many interesting environments in which contracting is sequential. Despite a fast growing number of applications, no general characterization results have been established for these games. This is what we do in [11] “*Sequential Contracting with Multiple Principals*.”

One of the difficulties with sequential contracting is that there is no single extensive form that fits all applications. Our baseline model assumes contracting is private (in the sense that downstream principals do not observe upstream mechanisms nor the decisions taken in these mechanisms) and that the sequence of bilateral relationships is exogenous (in the sense that the agent cannot choose with whom to contract at each date). We first show that all PBE outcomes can be characterized through pure-strategy profiles in which the principals offer menus of contracts and delegate to the agent the choice of the contractual terms. We then show that, in most cases of interest for applications, the characterization of the equilibrium outcomes is further facilitated by the fact that the principals can be restricted to offer incentive-compatible extended direct mechanisms in which the agent reports the endogenous payoff-relevant decisions contracted upstream in addition to his exogenous private information. This is the case e.g. when the agent’s strategy is Markov, i.e. when it depends on upstream histories only through their payoff-relevant component (we also show that restricting the agent’s strategy to be Markov is without loss when information

is complete and decisions are deterministic). Finally we show how the aforementioned results must be adjusted to accommodate alternative assumptions about the observability of upstream histories and/or the timing of contracting examined in the literature.

Related to [11] is [10] “*On the Use of Menus in Sequential Common Agency.*” In this paper, we construct two examples to show why, in certain sequential contracting environments, simple menus may fail to characterize all possible outcomes. The first example features an environment in which downstream principals observe upstream contracts, but not the mechanisms used to select them. In this environment, restricting the principals to offer menus means restricting the extent to which different principals can have different out-of-equilibrium beliefs about the mechanisms used upstream to select an off-equilibrium contract. When the agent’s strategy is not Markov, this means imposing restrictions on the principals’ expectations about the agent’s behavior downstream. Such restrictions may preclude the possibility of sustaining certain outcomes.

The second example features an environment in which downstream principals observe both the mechanisms and the contracts selected upstream. The problem with simple menus is that they do not permit the principals to use payoff-irrelevant information as a correlation device. In the absence of alternative instruments (e.g. sunspots or cheap talk messages), this means restricting the extent to which a principal can correlate her decisions with those of other principals.

### 3.2 Privacy

Consider a buyer-seller relationship. Suppose the seller expects the buyer to contract downstream with another seller. When is it in her interest to grant the buyer full privacy, i.e. to commit not to disclose any information? We address this question in [4] “*On the Optimality of Privacy in Sequential Contracting*” (joint with Giacomo Calzolari) which builds on my job market paper “Optimal Design of Privacy Policies.”

The reason why a downstream seller may be interested in receiving information from an upstream seller is twofold. First, the buyer’s willingness to pay for the downstream product/service may depend on the products/services purchased upstream. Second, even in the absence of complementarities, knowing what products the buyer has purchased upstream may permit the downstream seller to better tailor her contract offers and price discriminate.

To shed light on what determines the optimality of privacy, we model the exchange of information between the two sellers as a common agency game in which two principals contract sequentially with the same agent. The main result then shows that when (a) the upstream principal is not personally interested in the downstream level of trade, (b) the agent’s valuations are positively correlated (i.e. the sign of the single crossing condition is the same for upstream and downstream decisions), and (c) preferences in the downstream relationship are separable, then it is always optimal for the upstream principal to grant the agent full privacy. On the contrary, when any of these conditions is violated, there exist preferences for which (partial) disclosure is strictly optimal, even if the downstream principal does not pay for the information. The paper also examines the welfare effects of disclosure and shows that, contrary to what is often believed, disclosure does

not necessarily reduce consumer surplus and in some cases may even yield a Pareto improvement.

From a methodological viewpoint, my work on privacy illustrates how to design mechanisms that optimally screen the agent’s types and signal information to a third party. In [4], the third party is a downstream principal. In [5] “*Monopoly with Resale*” (joint with Giacomo Calzolari), the third party is another buyer in a resale market. This paper examines the intricacies associated with the design of revenue-maximizing mechanisms for a monopolist who expects her buyers to resell. Two cases are considered: resale to a third party who does not participate in the primary market and inter-bidder resale, where the winner resells to the losers. We show the following results. First, the monopolist may find it optimal to use a stochastic selling procedure, for example, using lotteries and/or inducing the buyers to randomize over different bids. Second, the monopolist may need to adopt a disclosure policy richer than the simple announcement of the decision to sell to a particular buyer (for example, she may need to disclose information about the bids). Stochastic selling procedures and richer disclosure policies permit the monopolist to better control the beliefs of the participants in the secondary market so as to extract more surplus from those bidders who participate in the primary market. The paper also shows that, when the distribution of bargaining power in the resale game depends not only on the allocation of the good in the primary market, but also on personal bargaining abilities, then it is generically impossible to obtain the same revenue as when resale can be prohibited. This result warns against what is predicted by the literature that assumes sellers have full bargaining power in the resale game (e.g. Zheng, 2002).

### 3.3 Dynamic Mechanism Design

In my work with Ilya Segal and Juuso Toikka [15] “*Dynamic Mechanism Design: Incentive-Compatibility, Profit Maximization, and Information Disclosure*,” we study the problem of how to design incentive-compatible mechanisms in environments in which the agents’ private information evolves stochastically over time and in which decisions have to be made in each period. The environments we consider are fairly general in that the agents’ types are allowed to evolve in a non-Markov way, decisions are allowed to affect the type distributions and payoffs are not restricted to be separable over time. Our first result is the characterization of a dynamic payoff formula that describes the evolution of the agents’ equilibrium payoffs in an incentive-compatible mechanism. The formula summarizes all local first-order conditions taking into account how current information affects the dynamics of expected payoffs. The formula generalizes the familiar envelope condition from static mechanism design: the key difference is that a variation in the current types now impacts payoffs in all subsequent periods both directly and through the effect on the distributions of future types. First, we identify assumptions on the primitive environment that guarantee that our dynamic payoff formula is a necessary condition for incentive compatibility. Next, we specialize this formula to quasi-linear environments and show how it permits one to establish a dynamic “revenue-equivalence” result and to construct a formula for dynamic virtual surplus which is instrumental for the design of optimal mechanisms. We then turn to the characterization of sufficient conditions for incentive compatibility. Lastly, we show how our results can be put to work in a variety of

applications that include the design of profit-maximizing dynamic auctions with AR(k) values and the provision of experience goods.

In [20] “*Infinite-Horizon Mechanism Design: the Independent Shock Approach*,” also joint with Ilya Segal and Juuso Toikka, we propose a different approach to the characterization of incentive-compatibility in dynamic settings. This approach consists in using the Probability Integral Transform Theorem to represent the evolution of each agent’s private information as a function of shocks that are serially independent. We first show that any stochastic process admits at least one independent-shock representation and then show how this representation can be used to identify conditions for incentive compatibility. One advantage of this approach is that it permits one to extend the analysis of incentive compatibility to infinite-horizon settings. Furthermore, the results in this paper complement those in [15] in that, when applied to finite-horizon models, they permit one to validate the dynamic envelope formula identified in that paper under a different (and not nested) set of assumptions. Lastly, we apply the results to the design of revenue-maximizing mechanisms for the provision of “new experience goods” such as the sale of a new drug. We show how our dynamic envelope formula facilitates the characterization of optimal mechanisms by permitting one to adapt results from the complete-information literature on experimentation (e.g. Gittins indexes) to settings with private information.

Related is also [16] “*Long-term Contracting in a Changing World*.” This paper (which is now partly superseded by [15] and is under revision) studies the dynamics of distortions in an environment that stylizes a buyer-seller relationship. It first shows, through a simple example with finitely many types, that distortions need not vanish over time and need not be monotonic in the shock to the buyer’s valuation. These results are in contrast to those obtained in the literature that assumes a Markov process with a binary state space—e.g. Battaglini, 2005. The paper then discusses situations in which (a) the optimal mechanism is the same irrespective of whether the shocks are the buyer’s private information or are observed also by the seller, (b) the distortions in the optimal quantities are independent of whether the shocks are transitory or permanent.

My recent work with Daniel Garrett [17] “*Dynamic Managerial Compensation: a Mechanism Design Approach*,” applies some of the techniques developed in [15 and 20] to examine the properties of optimal incentive schemes for a manager who faces costly effort decisions and whose ability to generate profits for the firm varies stochastically over time. The optimal contract is obtained as the solution to a dynamic mechanism design problem with hidden actions and persistent shocks to the agent’s private information. We show that, when the agent is risk-neutral, the optimal contract can often be implemented with a simple pay package that is linear in the firm’s profits. Furthermore, the power of the incentive scheme typically increases over time, thus providing a possible justification for the frequent practice of putting more stocks and options in the package of managers with a longer tenure in the firm. Contrary to other explanations proposed in the literature (e.g. declining disutility of effort, career concerns), the optimality of seniority-based reward schemes is not driven by variations in the agent’s preferences or in his outside option. It results from an optimal allocation of the manager’s informational rents over time. Building on the insights from the risk-neutral case, we then explore the properties of optimal incentive schemes for risk-averse managers. Contrary to

the risk-neutral case, the optimal pay package is typically non-linear in the firm's profits (although, there are instances where it is a convex function of a linear aggregator). Furthermore, we find that risk-aversion may contribute to reducing (but not necessarily eliminate) the benefit of offering incentives whose power increase, on average, over time.

### 3.4 Auctions of divisible goods

At the very beginning of my career, I wrote a paper (joint with Marco LiCalzi) on auctions for divisible goods: [7] “*Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions.*” Uniform-price auctions were originally designed for Treasury securities; they have now become a popular mechanism also for on-line initial public offerings of unseasoned shares (Open IPOs), for electricity markets, and for markets for emission permits.

In a uniform-price auction, bidders submit an entire demand (supply) schedule for the divisible good being offered. The seller compares the aggregate demand with the aggregate supply and then computes a clearing (stop-out) price. Demand above the stop-out price is awarded in full, while marginal demand is prorated. Since all buyers pay the same price, these auctions are analogous to a Walrasian market—the important difference is that demand schedules are submitted strategically. This difference makes uniform-price auctions susceptible to substantial underpricing. In fact, as shown first in Wilson (1979), by submitting high inframarginal demands, bidders can prevent competition on prices and support equilibria in which the stop-out price is significantly below its Walrasian equivalent.

A feature of these auctions is that supply is inelastic and fixed in advance. This seemingly innocuous assumption implies a strategic asymmetry between the bidders and the seller: the former can use their demand schedules to inhibit price competition, but the latter cannot use her supply schedule to enhance it. Allowing the seller to use an elastic supply is a simple way to limit underpricing. Intuitively, while the steepness of the competitors' demand curves has a price effect which increases the marginal cost of a higher bid, an increasing supply schedule induces a quantity effect that raises its marginal revenue. Making the quantity effect greater than the price effect enhances competition on higher prices. What we show in [7] is that precommitting to an increasing supply schedule can be optimal even when accounting for the costs of issuing a quantity different from a target supply.

## References

- [1] “Efficient Use of Information and Social Value of Information,” *Econometrica*, Vol. 75(4), July 2007, 1103-1142 (with G-M. Angeletos)

- [2] “Dynamic Global Games of Regime Change: Learning, Multiplicity, and Timing of Attacks,” *Econometrica*, Vol. 75(3), May 2007, 711-756 (with G-M. Angeletos and C. Hellwig)
- [3] “Socially Optimal Coordination: Characterization and Policy Implications,” *Journal of the European Economic Association (PEP)* Vol. 5(3), May 2007, 585-593 (with G-M. Angeletos)
- [4] “On the Optimality of Privacy in Sequential Contracting,” *Journal of Economic Theory*, Vol. 130(1), September 2006, 168-204 (with G. Calzolari)
- [5] “Monopoly with Resale,” *Rand Journal of Economics* Vol. 37(2), Summer 2006, 362-375 (with G. Calzolari)
- [6] “Signaling in a Global Game: Coordination and Policy Traps,” *Journal of Political Economy*, Vol. 114(3), June 2006, 452-485 (with G-M. Angeletos and C. Hellwig)
- [7] “Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions,” *European Economic Review*, Vol. 49, January 2005, 227-250 (with M. LiCalzi)
- [8] “Transparency of Information and Coordination in Economies with Investment Complementarities,” *American Economic Review (PEP)* Vol. 94(1), May 2004, 91-98 (with G-M. Angeletos)
- [9] “Truthful Revelation Mechanisms for Simultaneous Common Agency Games,” November 2008 (with G. Calzolari)
- [10] “On the Use of Menus in Sequential Common Agency,” April 2007 *Games and Economic Behavior*, September 2008, Vol. 64(1), 329-334 (with G. Calzolari)
- [11] “Sequential Contracting with Multiple Principals,” *Journal of Economic Theory*, February 2009, Vol. 144(2), 503-531 (with G. Calzolari)
- [12] “Robust Predictions in Global Games with Multiple Equilibria: Defense Policies against Currency Attacks” August 2008 (with G-M. Angeletos and C. Hellwig)
- [13] “Wall Street and Silicon Valley: a Delicate Interaction,” September 2007 (with G-M. Angeletos and G. Lorenzoni)
- [14] “Policy with Dispersed Information,” *Journal of the European Economic Association*, March 2009, Vol. 7(1), 1-50 (with G-M. Angeletos)
- [15] “Dynamic Mechanism Design: Incentive-Compatibility, Profit Maximization, and Information Disclosure” November 2008 (with Ilya Segal and Juuso Toikka)
- [16] “Long-Term Contracting in a Changing World,” December 2007.
- [17] “Dynamic Managerial Compensation: a Mechanism Design Approach” February 2009 (with Daniel Garrett)

- [18] “The role of information in competition in two-sided markets,” (with B. Jullien)
- [19] “On the Ineffectiveness of Interest-rate Defenses against Speculative Currency Attacks,” (with G-M. Angeletos and C. Hellwig)
- [20] “Infinite-Horizon Mechanism Design: the Independent Shock Approach,” January 2009 (with Ilya Segal and Juuso Toikka),