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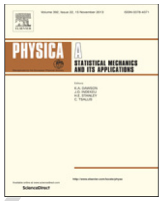

Q1 # Are transaction taxes a cause of financial instability?

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HIGHLIGHTS

- A model where many interacting agents trade a share of a risky asset is studied.
- Dynamics of equilibrium market shares and related returns and volumes are studied.
- Multiple equilibria and coexistence of fixed points and 2-cycles are detected.
- Transaction taxes may generate instability rising volatilities on return & volumes.
- Heteroscedasticity of returns and market activity endogenously arises.

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ABSTRACT

We analyze a stylized market where N boundedly rational agents may decide to trade or not a share of a risky asset at subsequent trading dates. Agents' payoff depends on returns, which are endogenously determined taking into account observed and forecasted demand and an exogenous transaction tax. We study the time evolutions of demand, returns and market activity. We show that the introduction of a transaction tax generally helps in reducing variability of returns and market activity. On the other hand, there are market conditions under which a low taxation may lead the market into a very unstable phase characterized by the fluctuation of the fundamentals around two different regimes; indeed, under these circumstances, heteroscedasticity of time series is detected and statistically analyzed.

1. Introduction

Instability in financial markets which seems not to be related to the oscillations of the fundamentals is quite often explained in financial literature by overtaking the agents' perfect rationality assumption that characterizes most of financial models. The vast (and perhaps inhomogeneous) bulk of literature that can be named as *behavioral finance*[1] focuses on the consequences of agents' bounded rationality on markets. However, it rests on external ad-hoc distinctions between agents' types, such as fundamentalists and trend-followers or chartists to give rise to specific market's dynamics.[2]

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1 The literature on behavioral finance is too vast to be reviewed here. We refer to books that categorize and review most common approaches, such as Shleifer [1] and Thaler [2], or recent textbooks such as Forbes [3].

2 See, for instance, Ref. [4] for a recent and comprehensive contribution on the modeling of complex economic systems and the role of heterogeneous expectations in market dynamics.

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On the contrary, it is interesting to evaluate the assets' return dynamics and the impact of financial transaction taxes that arise as the result of strategic interaction of homogeneous, boundedly rational agents. This is our target. We study how agents' strategic behavior in repeated trading dates is capable to generate nonlinear assets' returns dynamics and market activity. Moreover, we show (by testing it through a statistical analysis) the presence of a two-regime switching behavior, resulting in an endogenously generated heteroscedasticity of time series.[3] Tracing back to Föllmer and Schelling seminal contributions,[4] a recent flow of literature has focused on social interaction, i.e., the explicit dependence of agents' behavior on the other agents' action, as the driving force of individual activity.[5] We adopt here a binary choice model framework, assuming that utilities have a social component affecting the individual behavior through the Nash equilibria of a game representing the market. This defines an endogenous interaction between market's dynamics and agents' expectations. More precisely, we adopt a stylized model of a liquid market (i.e., a model such that the probability of closing a trade is one for all offers), in which each agent is infinitesimal with respect to the size of the market, thus the asset's value does not depend on the individual behavior, but rather on the aggregate one. Agents have different private signals about the value of the asset. This is expressed by a random term, that makes players' payoff a *binary random utility*.[6] We study market's dynamics and individual expectations that mutually reinforce themselves: if agents believe that the market value increases, they will rise their demand; this will grow the value, which in turn will increase the expectation and so on. However, at each point in time, the value depends on the strategic interactions of agents, which are functions of their expectations on other agents' behaviors. The explicit dependence on past actions endogenously generates the dynamics of the system that are studied in the paper. Our research aim is twofold: (a) we investigate the impact of the strategic interactions of a large population of boundedly rational agents on the equilibrium dynamics of the model; (b) we test the role that an exogenous transaction cost can play in reducing volatility and stabilizing the market. The former is justified by our interest in evaluating to what extent and under which conditions small albeit possible noisy behavior can induce instability in financial markets. The analysis is performed by comparing through simulations the equilibria of the asymptotic model (with infinite agents) with the results of the model for populations of large (yet finite) samples of agents. The latter is motivated by the vast debate on the allegedly stabilizing properties of exogenous transaction taxes, like the Tobin tax, which can lower the speed of adjustment in markets that react abruptly to changes in fundamentals, thus reducing the possibility of generating or propagating a financial contagion. It is, now, worth to briefly revise the main contributions on Tobin-like taxes focusing especially on reduced form market models with social interactions. James Tobin in 1978, reiterating a first proposal dated back to 1972, proposed in his celebrated paper Tobin [15] to "throw some sand" in the wheel of international money market to limit the excessive mobility of financial capital. Several authors have subsequently analyzed the effects that a Tobin-like tax could have on financial markets and, in particular, on its stability. Assuming exogenously given heterogeneous agents (fundamentalists and chartists) Westerhoff [16] shows that the introduction of a Tobin tax stabilizes the dynamics of the model, provided its rate is not too high. Also Westerhoff and Dieci [17] assume there exist fundamentalists and chartists and in a deterministic setting show the stabilizing effect of the introduction of a transaction tax in two linked markets. Mannaro et al. [18], on the contrary, show that the introduction of a Tobin tax on two related markets characterized by four types of traders increases volatility and decreases market volumes. In the chartist/fundamentalist framework with continuous double auctions Fricke and Lux [19] find that a Tobin tax can stabilize the market, even for relatively high tax rates. Pellizzari and Westerhoff [20] show that the stabilizing property of a Tobin tax in a market with heterogeneous traders depends on the market microstructure, being it either a continuous double auction market or a dealership market. Different microstructures (either OTC-markets or exchanges with market makers) are also proved to be determinant in an experimental setting in Ref. [21]. Bianconi et al. [22] study Tobin tax in minority games (where solutions do not arise as the optimization of strategic interactions) with two heterogeneous agents and find that its introduction reduces speculative trading at intermediate tax rates. Ehrenstein et al. [23] in a random matching model *à la* Cont and Bouchaud [10] consider the impact of a Tobin tax on the market depth and find that it has a stabilization property, provided that the price impact function is not too sensitive with respect to market depth. All these approaches do not explicitly consider any *strategic interaction* among traders. On the contrary, we characterize the Nash equilibria of the N-player game and show that the finite agents model converges to the asymptotic one. Then, by performing a comparative static analysis, we evaluate the impact on market returns and volumes of the increase of a Tobin tax like transaction cost. We see that (i) the transaction tax reduces returns and volumes volatility; (ii) however, the transaction tax can induce a change in the equilibria such that the system switches from a stable fix point to a coexistence regime area, in which periods of low and high volatility (of both returns and volumes) randomly oscillate; (iii) in the coexistence regime area, the simulated time series exhibit heteroscedasticity. These results show that the introduction of a tax on transactions in a liquid market characterized by boundedly rational agents can stabilize the market, but possibly crossing through a phase of high endogenous instability in which market randomly switches several times from periods of low volatility (of returns and volumes) to high volatility ones, and vice versa. This is, to the best of our knowledge, a novel outcome in the literature.

[3] Data analysis of real financial markets often assumes heteroscedasticity, for instance, by applying the ARCH (autoregressive conditional heteroscedasticity) model by Engle [5] (and subsequent evolutions). In the data of our model, on the contrary, heteroscedasticity is not exogenously assumed but arises endogenously as a result of the coexistence of equilibria.

[4] See Refs. [6,7].

[5] See Refs. [8–11].

[6] Binary random utility models have been inspired by Schelling [7], Manski [12] and McFadden [13] and later formalized in Ref. [14].