Finance

FINANCIAL TRANSACTION TAXATION IN AGENT-BASED SIMULATION

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Introduction

The need for a financial transaction tax (FTT) has been attracting more attention because of the financial crisis in 2008, although ideas about introducing a new tax on financial sector have been debated at various times over the last thirty years. Due to the crisis' different effects on different countries, consensus has not yet been achieved, although Keynes (1936) proposed a FTT for the stock market and Tobin (1978; 1996) recommended a FTT for the foreign-exchange market. Schulmeister et al. (2008) describe a general FTT, Keen (2011) explores the possible purposes and broad design of distinctive tax measures for financial institutions, focusing especially on the potential role of corrective taxation. Next, Schulmeister (2014) outlines reasons to introduce a FTT. First, the economic crisis was deepened by the instability of stock prices, exchange rates and commodity prices. This instability might be dampened by such a tax. Second, as a consequence of the crisis, the need for fiscal consolidation has increased substantially. A FTT would provide governments with substantial revenues. Third, the dampening effects of a FTT on the real economy would be much smaller than other tax measures such as increasing the VAT. Szarowská (2014) notes that the main expectation is that a new FTT could dissuade harmful speculation by financial markets and that its revenues would appear to be a fair way of recovering the costs of the crisis.

On the other hand, Shackelford et al. (2010) and Rieger (2014) present opponents' arguments, such that the high trading volume observable in financial markets does not cause price volatility and is in fact a stabilizing influence. He argues that the introduction of a FTT would lower liquidity; as a result, trades would have a larger impact on prices, which, in turn, would increase volatility. Thus, from the point of view of opponents, a FTT could destabilize financial markets.

The aim of this paper is to investigate the impact of FTTs on the stability of the financial market. Because FTTs may be defined in different ways, assets are defined as tax objects in this paper. We use the model developed by Westerhoff (2009) but extended it to FTTs and consequential transaction-cost influences. An agent-based model was implemented and managed as a simulation in the netLogo development platform to provide the research basis for simulation experiments. In the model, virtual market participants in the form of intelligent agents traded one type of asset.

This paper is structured as follows: Section 1 briefly summarizes the main facts about FTTs and its relationship with transaction costs and financial sector stability while introducing the agent-based methods for modeling and simulation. Section 2 presents the original agent-based model and its extension. Section 3 presents the simulation results.

1. Theoretical Background

This section introduces a short literature review and the theoretical basis for the concepts used in this paper.

1.1 Financial Transaction Taxation

The transaction costs for financial markets are mainly the costs of obtaining and interpreting information, the time required to make decisions, as well as various types of fees, etc. Transaction costs, according to Burian (2010), are often viewed as negative phenomena, but there are cases in which increases in transaction costs can be viewed positively and contribute to the stability of the market. Increases in transaction costs may also occur in the form of non-market regulation

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such as taxes. Tobin (1978) suggested that all short-term transactions in foreign-exchange markets should be taxed at a low fixed rate (the proposal was later identified as the so-called Tobin tax) because currency speculation can lead to the sudden withdrawal of currencies from circulation to artificially increase prices. The results, according to Tobin, would avoid short-term currency speculation and stabilize the market.

The question of whether new taxes should be levied on the financial sector to complement regulations and bank levies has been a topic since the beginning of the economic crisis. Generally, the concept of FTTs is based on the application of a tax to all financial transactions, in particular, those carried out in organized markets, such as the trade of equity, bonds, derivatives, currencies, etc. It would be levied at a relatively low statutory rate and would apply each time the underlying asset was traded. The tax collection or the legal tax incidence occurs – as far as possible – via the trading system that executes the transfer.

Although the FTT is connected to and understood as a Tobin tax in most cases, several different tax instruments are generally referred to as "financial transaction taxes." Matheson (2011) defines a securities transaction tax (STT) as a tax on trades in all or certain types of securities (equity, debt and their derivatives). A currency transaction tax (CTT) is a securities transaction tax imposed specifically on foreign exchange transactions and possibly also their derivatives: currency futures, options and swaps. It is often used as pecuniary foreign exchange control in lieu of administrative and regulatory measures. A capital levy or registration tax is imposed on increases in business capital in the form of capital contributions, loans and/or issuance of stocks and bonds. The registration tax may encompass all forms of business capital or be limited to a particular type of capital (e.g. debt or equity) or form of business, such as corporations or partnerships. A registration tax may also be charged to individuals on bank loans and/or mortgages. A bank transaction tax (BTT) is a tax on deposits and/or withdrawals from bank accounts. Most commonly seen in Latin American and Asia, BTTs are usually imposed on an ad valorem basis as a percentage of the deposit or withdrawal. BTTs effectively tax purchases of goods and services, investment products and factor payments paid for with funds intermediated by banks. Shaviro (2012) summarizes the history of the FTT.

The motivation for the FTT is based on two claims about the tax. First, it improves the functioning of financial markets through curbing harmful short-term speculation and reducing volatility by making it less profitable. Second, it raises significant amounts of revenue even if the tax rate is very low (for details look at Nerudová and Dvořáková (2014)).

As was already noted, there are several types of FTTs, and each has its own purpose. Some FTT types have already been implemented, whereas some are still only proposals. Griffith-Jones and Persaud (2012) state that 40 countries had FTTs in operation, raising $38 billion (€29bn) in 2011. Other arguments for their adoption include progressivity and ease of implementation. However, as Matheson (2011) notes, experiences regarding revenue from securities transaction taxes over the past two decades have varied widely.

There is currently a growing number of empirical studies analyzing the possibility of using FTTs to regulate the financial market and enhance financial sector stability. In line with the European Commission´s expectation (2010), FTTs should heighten the efficiency and stability of financial markets and reduce their volatility, as well as the harmful effects of excessive risk-taking, which can create negative externalities for the rest of the economy. Unfortunately, Habermeier and Kirilenko (2001) conclude that in most circumstances, transaction taxes or their equivalents, such as capital controls, can have negative effects on price discovery, volatility, and liquidity, and lead to a reduction in market efficiency.

Phylaktis and Aristidou (2007) examine the effects of security transaction taxes on volatility. Tab. 1 shows the results of earlier empirical studies based on different market samples and periods. The authors focus on whether the tax has a greater effect on highly traded stocks because it penalizes entering and exiting the market, and whether the effect depends on the state of the stock market. Their results highlight that effects are stronger during bull periods and for highly traded stocks, but that volatility increases instead of decreases, as intended by the proponents of transaction taxes.

Tab. 1: Volatility effects of transaction taxes

Author	Sample (Market)	Sign of Effect
Roll (1989)	23 countries	Zero
Umlauf (1993)	Sweden	Positive
Jones and Seguin (1997)	U.S.A.	Positive
Saporta and Kan (1997)	United Kingdom	Zero
Hu (1998)	Hong Kong, Japan, Korea, Taiwan	Zero
Green, Maggioni and Murinde (2000)	United Kingdom	Positive
Hau (2003)	France	Positive

Source: Phylaktis and Aristidou (2007)

Schäfer (2012) argues that FTTs complement financial market regulation. With FTTs, governments have an additional instrument for influencing trading activity. FTTs can reduce regulatory arbitrage, flash trading, overactive portfolio management, excessive leverage and speculative transactions of financial institutions. If, contrary to expectations, harmful transactions will not be curbed, FTTs at least generate large tax revenues that can help cover the costs of a financial crisis.

Rieger (2014) studies the impact of a financial transaction tax on trading volume and asset price volatility in a model with heterogeneous beliefs. He studies a tax on bond and asset purchases. The simulated model shows that the introduction of a transaction tax results in a lower trading volume and thereby less liquid financial markets because of the decreased liquidity and increased volatility of the stock market.

Schulmeister (2014 and 2015) and DeMooij and Nicodeme (2014) summarize the main arguments in favor of and against FTTs and provides empirical evidence about the movements of the most important asset prices. He shows that their long swings result from the accumulation of extremely short-term price runs over time. Therefore, a (very) small FTT – between 0.1 and 0.01 percent – would mitigate price volatility not only over the short-run but also over the long run. Next, he combines empirical results with an analysis of technical trading systems and formulates a hypothesis about trading behavior and asset price dynamics (the "Bull-Bear-Hypothesis"). On the one hand, asset trading has become progressively more short-term-oriented ("faster"); on the other hand, the phenomenon of long-term trends ("bulls" and "bears") has also become more pronounced. This coincidence can be explained by the fact that long-term trends are the results of the accumulation of very short-term price runs that are exploited and strengthened by the use of ever "faster" trading systems. The results of his research suggest that the FTT should be levied on all transactions of any type of financial asset. The "faster" an asset is traded and the riskier it is, the more will the FTT increase transactions costs. At the same time, holding a financial asset will not be burdened by the FTT. Hence, an FTT with a uniform rate will specifically dampen very short-term speculation in derivatives because the effective tax burden relative to the cash (margin) requirement increases with the leverage factor.

Finally, Szołno-Koguc and Twarowska (2014) contest the hypothesis that FTTs reduce the scale of market speculation, which is not confirmed by the results of empirical studies. To prove this hypothesis, the proponents of the tax carry out simulations based on econometric models. Regardless of the testing method, the analytical results are inconclusive. These doubts concern not only whether FTTs affect the scale of market speculation and price volatility of financial instruments but also whether the impact is positive or negative.

1.2 Agents and Agent-Based Models

The roots of this research lay in computational social science, which involves the use of agent-based modeling and simulation (ABMS) to study complex social systems (Kaegi, 2009; Epstein & Axtell, 1996). ABMS is a core technique used by this paper to study financial system. ABMS consists of a set of agents and a framework for simulating their decisions and interactions. Although the ABMS shares many traits with other models, the ABMS is differentiated by its focus on finding the set of basic decision rules and behavioral interactions that can produce the complex results experienced in the real world (Sallach & Macal, 2001). ABMS tools are designed to simulate the interactions of large numbers of individuals to study the macro-scale consequences of these interactions (Tesfatsion, 2001).

The intelligent agent technology used in this paper has a long history in economic theory, mainly in the ideas of Hayek (1949) and Simon (1955). Hayek (1949) claims that the economic system should be studied from the bottom. He stresses the need to look at the market economy as a decentralized system that consists of mutually influencing individuals (the same goes for financial markets). This approach contrasts with the assumption of perfect information, which is used in traditional equilibrium analysis. In the theory of complex systems, where ABMS belongs, this idea is the primary principle (Macal & North, 2006). Agents, unlike in a classical equilibrium approach, do not have perfect information about all processes in the system.

The market participants in multi-agent models use technical and fundamental analysis to assess financial markets. Multi-agent financial market models have strong empirical foundations. This paper uses and extends the original model developed by Westerhoff (2009), combining the basics from three known agent-based financial market models.

In the first model, Brock (1997 and 1998) chooses a continuum of financial market participants endogenously between different trading rules. The agents are rational in the sense that they tend to pick trading rules that have performed well in the recent past, thereby displaying some kind of learning in their behavior. The performance of trading rules is measured as a weighted average of previously realized profits, and the relative importance of the trading rules is derived via a discrete choice model. Contributions developed in this manner are often analytically tractable. Moreover, numerical investigations reveal that complex endogenous dynamics may emerge due to an ongoing evolutionary competition between trading rules. In such a setting, agents interact only indirectly with one another: their orders have an impact on price formation, which, in turn, affects the performance of trading rules and agents' selection of rules. Put differently, agents are not directly affected by the actions of others.

Kirman (1991; 1993) introduces an influential opinion formation model with interactions between a fixed numbers of agents. Agents may hold one of two views. At each moment in time, two agents may meet at random and there is a fixed probability that one agent may convince the other agent to adopt his opinion. In addition, there is also a small probability that an agent will change his opinion independently. A key finding of this model is that direct interactions between heterogeneous agents may lead to substantial opinion swings. Applied to a financial market setting, one may therefore observe periods in which either destabilizing technical traders or stabilizing fundamental traders drive the market dynamics. Agents may change rules due to direct interactions with other agents but the switching probabilities are independent of the performance of the rules.

The models of Lux (1998) and Lux and Marchesi (1999) also focus on the case of a limited number of agents. Within this approach, an agent may either be an optimistic or a pessimistic technical trader or fundamental trader. The probability that agents switch from having an optimistic technical attitude to a pessimistic one (and vice versa) depends on the majority opinion among the technical traders and the current price trend. For instance, if the majority of technical traders are optimistic and if prices are increasing, the probability that pessimistic technical traders turn into optimistic technical traders is relatively high. The probability that technical traders (either being optimistic or pessimistic) switch to fundamental trading (and vice versa) depends on the relative profitability of the rules. However, a comparison of the performance of the trading rules is modeled in an asymmetric manner. Although the attractiveness of technical analysis depends on realized profits, the popularity of fundamental analysis is a result of expected future profit opportunities. This class of models is quite effective at replicating several universal features of asset price dynamics.

Westerhoff´s (2009) model combines key ingredients of the three aforementioned approaches to build a simple model that is able to reproduce the stylized facts of financial markets. Direct interactions between a numbers of agents are considered. To avoid asymmetric profit measures, he defines a fitness function. The attractiveness of a rule is approximated by a weighted average of current and past myopic profits.

2. Methodology

Simulating financial markets is a new, quickly growing research area with two primary motivations. The first motivation is the need to provide a development platform for the ever-increasing automation of financial markets. The second is the inability of traditional computational mathematics to predict market patterns that result from the choices made by interacting investors in a market.

The agent-based model simulating the financial market developed by Westerhoff (2009) was chosen for the implementation. Two base types of traders are represented by agents:

- Fundamental traders, whose reactions are based on the fundamental analysis. They believe that asset prices in long term approximate their fundamental price. They buy assets when the price is under the fundamental value.
- Technical traders, who decide using technical analysis. They believe that prices tend to move in trends and by their extrapolating there comes the positive feedback, which can cause the instability.

Price changes reflect current excesses of demand. These excesses express the amount of orders submitted by technical and fundamental traders each turn and the rate between their orders evolves over time. Agents regularly meet and discuss their trading performance. One agent can be persuaded by the other to change its trading method if the initial method's rules are less successful than the other's. Communication is a direct conversation between one agent and others. The agents meet randomly and there is no special relationship between them. The success of rules is represented by a current and past profitability. To emphasize this, the model assumes the ability of traders to define the fundamental value of assets and their rational behavior.

The price reflects the relationship between assets that have been bought and sold in a turn (trading period), and the price change caused by these orders. This can be formalized as a simple log-linear price impact function:

$$P_{t+1} = P_t + a(W_t^C D_t^C + W_t^F D_t^F) + \alpha_t, \qquad (1)$$

where a is a coefficient of a positive price change, D^C are the orders generated by technical agents, and D^F are the orders of fundamental traders. W^C and W^F are weights of agents using the technical and fundamental rules, respectively. The weights reflect the current ratio between the technical and fundamental agents. The α coefficient brings randomness to Equation 1 because the model is a single representation of a real financial market. It is an independently distributed random variable with a zero average and a constant standard deviation σ^α.

As mentioned earlier, the technical analysis extrapolates the price trends, which means when prices grow, trading agents buy the assets. As a result, the formalization for technical order rules can be:

$$D_t^C = b(P_t - P_{t-1}) + \beta_t \qquad (2)$$

The reaction parameter b has a positive influence and represents the agent's sensitivity to price changes. The difference in brackets reflects the trend and β is a parameter from the normal distribution with a zero average and a constant standard deviation σ^β.

The theory of fundamental analysis argues that asset prices can differ from the fundamental price in the short term. However, the theory assumes that asset prices converge to the fundamental value in the long run. Because the fundamental analysis suggests buying (or selling) assets when the actual prices are under (or above) the fundamental value, the fundamental business rules can be formalized as follows:

$$D_t^F = c(F - P_t) + \gamma_t \qquad (3)$$

where c is the parameter of a positive reaction and the parameter F is a fundamental value. In our case, we keep this value constant to simplify the implementation as much as possible (In our implementation, F = 0). Parameter γ is a random variable with a normal distribution, a zero average and a constant standard deviation σ^γ.

If we say that N is a total number of agents and K is a number of technical traders, then we define the weight of technical traders as follows:

$$W_t^C = K_t/N \tag{4}$$

And the weight of fundamental traders as:

$$W_t^F = (N - K_t)/N \tag{5}$$

The number of technical and fundamental traders is set out as follows. As in Kirman's (1991; 1993) models, two traders randomly meet at each point in time. The probability that the first trader adopts the view of the second trader is $(1-\delta)$. In addition, there is a small probability ε that the trader changes his mind independently of the others. Contrary to Kirman (1991; 1993), we say that the probability of a trader changing views is asymmetric and depends on the current and past profitability of the rules. This is indicated by the attractiveness variables A^C and A^F, which are defined later. The assumption is that the technical trading rules generated higher profits in the past than the rules used by fundamental traders. It is therefore more likely that a technical trader will persuade a fundamental trader than vice versa. Likewise, when the fundamental rules are more profitable than the technical rules, the chance of a successful meeting of a fundamental trader with a technical trader becomes higher. Therefore, we define the probability K as follows:

$$K_t = \begin{cases} K_{t-1} + 1 \text{ with probability } p_{t-1}^{+} = \\ K_{t-1} - 1 \text{ with probability } p_{t-1}^{-} = \\ K_{t-1} \text{ with probability } 1 + p_{t-1}^{+} - \end{cases} \tag{6}$$

$$= \frac{N-K_{t-1}}{N}\left(\varepsilon + (1-\delta)_{t-1}^{F\to C} \quad \frac{K_{t-1}}{N-1}\right)$$

$$= \frac{K_{t-1}}{N}\left(\varepsilon + (1-\delta)_{t-1}^{C\to F} \quad \frac{N-K_{t-1}}{N-1}\right),$$

$$- p_{t-1}^{-}$$

where the probability that a fundamental agent becomes a technical one is:

$$(1-\delta)_{t-1}^{F\to C} = \begin{cases} 0.5 + \lambda \text{ for } A_t^C > A_t^F \\ 0.5 - \lambda \text{ otherwise} \end{cases} \tag{7}$$

and the probability that a technical agent becomes a fundamental one is:

$$(1-\delta)_{t-1}^{C\to F} = \begin{cases} 0.5 - \lambda \text{ for } A_t^C > A_t^F \\ 0.5 + \lambda \text{ otherwise} \end{cases} \tag{8}$$

A success (fitness of the rule) is represented by the past profitability of rules, which are formalized as:

$$A_t^C = (\exp[P_t] - \exp[P_{t-1}])D_{t-2}^C + dA_{t-1}^C \tag{9}$$

for the technical rules, and:

$$A_t^F = (\exp[P_t] - \exp[P_{t-1}])D_{t-2}^F + dA_{t-1}^F \tag{10}$$

for the fundamental rules. Agents use the most recent performance (at the end of the A^C formula with respect to A^F). The orders submitted in a *t-2* period are executed at the prices started in the *t-1* period. The profits are calculated accordingly. Agents have memory, which is represented by the d parameter ($0 \leq d \leq 1$). If $d = 0$, then the agent has no memory. With higher values for the d parameter, the influence of profits on the rule fitness rises.

The stability of financial markets is measured by price volatility (the stable the market is, the smaller are price differences are at a given time). The entrance of transaction costs in the form of FTTs will have direct effects on asset prices. The original model was changed to include this aspect into the calculated price.

$$P_{t+1} = P_t + a(W_t^C D_t^C + W_t^F D_t^F) + FTT + \alpha_t \tag{11}$$

where *FTT* is a value of the transaction costs, which are constant during the simulation experiments. Because the tax is an out-of-trade factor, all agents will be affected in the same way. In general, there can be other transaction costs besides taxes (e.g., the costs of obtaining the information). We expect that increases in *FTT*s should have the following results:

- Price **increases** will stimulate the usage of technical rules. Their influence on expected future profit opportunities (as the fundamental value of the asset) is irrelevant. They depend on the state of the company rather than transaction costs.
- In a **short time**, price increases will attract technical traders. However, after the realization of profits, prices will decrease and fundamental traders will start to dominate. This will lead to market stabilization (price volatility will be lower).

3. Results and Discussion

On the basis of Westerhoff's model (2009) an agent-based model was implemented and managed as a simulation in netLogo development platform to provide the research basis for simulation experiments. Virtual market participants trade with one type of asset and are involved in the model as intelligent agents. Agents follow technical and fundamental trading rules to determine their speculative investment positions. We consider direct interactions between speculators, due to which they may decide to change their trading behavior (Šperka & Spišák, 2012; Šperka & Spišák, 2013). To be more accurate, 20 simulations were processed. The averaged values are plotted in graphs below.

3.1 Original Model Results

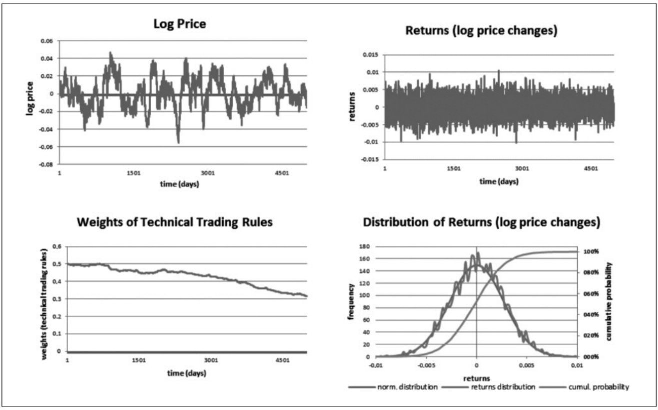
The model was parameterized using the original parameterization from Westerhoff (2009). Nevertheless, the number of agents (*N*) was set to 10.000 to obtain more relevant results. The parameters are:

$$a = 1,\ b = 0.05,\ c = 0.02,\ d = 0.95,\ \lambda = 0.45,\ \varepsilon = 0.1,\ \sigma^{\alpha} = 0.0025,\ \sigma^{\beta} = 0.025,\ \text{and}\ \sigma^{\gamma} = 0.0025 \tag{12}$$

With these parameters, the model is calibrated to the daily data. The number of turns with respect to periods of time is 5,000 days, which presents more than 13.5 years. Westerhoff (2009) found that increases in the number of agents reduced the model's dynamicity and price volatility, whereas agents' behavior tended to be fundamental. This can be reduced by adding more communication turns. We decided to give 1% of agents the opportunity to talk, which had a positive influence on the model's dynamicity.

Price values are on the top left of figures 1, 2 and 3. The top-right graph represents changes in asset prices at a given point in time. The bottom-left graph shows the weights of technical trading rules (in the long run, there is a tendency to prefer fundamental to technical trading rules in figure 1). The bottom-right graph includes the distribution of returns (which are log price changes) compared with the normal distribution. In figure 1, the asset prices oscillate over a narrow interval, as does

Fig. 1: Simulation results – original model



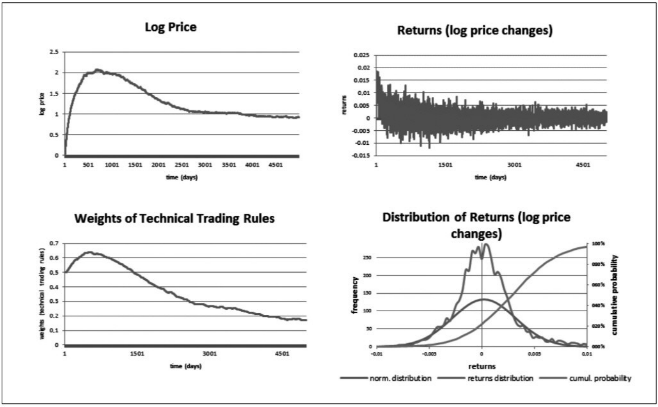
Source: own

volatility. The distribution of returns follows the normal distribution curve almost perfectly. This situation is similar to the real financial market as it currently appears.

3.2 Extended Model Results

In a new set of simulation experiments, all parameters remained the same, except for newly added FTT costs. The *FTT* parameter is a constant value equal to *0.015*. One can see from the following graphs in figure 2 that FTT costs have a significant influence on the model. The price grows in the short run, but in the long run, it decreases. The technical weight evolution is similar. As one can see from the results, the price grows in the short run, but after some time, it starts to decline. The reason for this reaction is that agents prefer the fundamental strategy at this point. The market stabilizes with more fundamental traders.

Fig. 2: Simulation results – FTT (0.015)

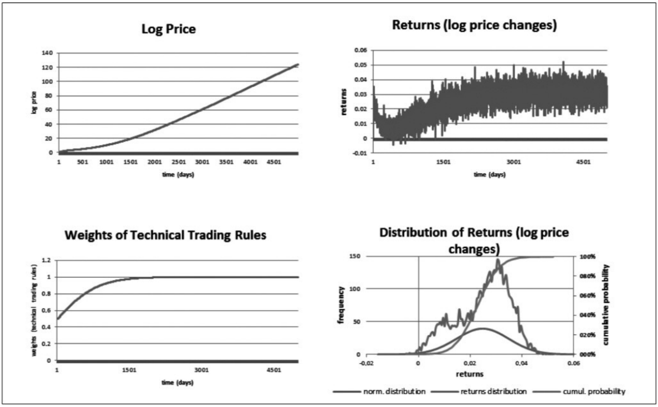


Source: own

We achieved different results with the last set of simulations. All the parameters remained the same, except for the *FTT*, which was doubled, and the constant, which was set equal to *0.03*. The higher value of *FTT* caused the model to become destabilized. Technical trader rules won in this case (*weight* = *1*) and the price increased without limit. Figure 3 demonstrates the contradictory effect on the market; instead of stabilizing, the market become unstable.

These results correspond with the European Commission's (2010), whose proposal considered FTT values at a low rate. Our conclusions are in line with Szołno-Koguc and Twarowska (2014), who highlight the importance of selection methodology and data samples for analytical results. This choice determines not only whether a FTT affects the scale of market speculation and the price volatility of financial instruments but also whether the impact is positive or negative. Although Habermeier and Kirilenko (2001) present negative effects on price discovery, volatility and liquidity, they do not specify a transaction tax rate, so their conclusions agree with our conclusions about high values of FTT & consequent costs. Phylaktis & Aristidou (2007) refer to many studies (e.g. Umlauf, 1993; Jones & Seguin,

Fig. 3: Simulation results – FTT (0.03)



Source: own

1997; Green et al., 2000 or Hau, 2003) that report the positive volatility effects of transaction taxes, which support our conclusions. This variety of conclusions is generated by the differences used in econometric models, country samples, observation periods and variables. It must be emphasized that most researchers have used ex-post data (Phylaktis & Aristidou, 2007; Schulmeister, 2014; 2015; Rieger, 2014), but this study has used a general agent-based approach.

Conclusions

The aim of this paper was to investigate the impact of a FTT on the stability of the financial market. Because FTTs may be defined in various ways, this paper defines assets as tax objects. The agent-based financial model designed by Westerhoff (2009) was implemented and extended by a FTT and rising transaction costs. The model includes direct interactions between speculators, which may lead them to decide to change their trading behavior, and addresses the technical and fundamental strategies of market participants.

Our extended model has a tendency to stabilize itself in a long term if the fundamental trading rules outweigh the technical trading method thanks to the introduction of FTTs. This could be used when bubbles and crashes occur in financial markets. Asset prices would be stabilized because their value targets are near the fundamental value. The volatility would also be minimized. Introducing a low FTT rate makes asset price rises to a bubble while technical traders take over the market. However, prices start to fall after some time in accordance with the growth of a technical strategy. At that moment, volatility minimizes and the market stabilizes. Different results are achieved with a higher rate of FTT. If FTT and consequent costs are too high, the financial system destabilizes and the price grows without limit.

The model described in this paper explores dependence market stability to the extent of FTTs. However, the model should not be interpreted as a model only for the introduction of FTT, but as a general model of transaction costs' influence on the financial market.

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Abstract

FINANCIAL TRANSACTION TAXATION IN AGENT-BASED SIMULATION

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The aim of this paper is to investigate the impact of financial transaction taxes (FTTs) on the stability of financial markets. This paper presents an agent-based financial market model and simulations in which agents follow technical and fundamental trading rules to determine their speculative investment positions. The model developed by Westerhoff (2009) was chosen for implementation and was extended by FTT and arising transaction costs. Because FTTs may be defined in various ways, this paper defines assets as tax objects. The model includes direct interactions between speculators, which may lead them to decide to change their trading behavior and addresses a technical and a fundamental strategy of market participants. The results suggest that the modified model has a tendency to stabilize itself in the long term if fundamental trading rules outweigh the technical trading method. This model could be used when bubbles and crashes occur in financial markets. Asset prices would be stabilized because their value targets near the fundamental value and volatility would also be minimized. Setting FTTs at a low rate for market stabilization is important. If FTTs and consequent transaction costs are too high, then the financial system will destabilize and prices will grow without limit. The model described in this paper explores dependence market stability to the extent of FTTs. However, the model should not be interpreted as a model only for the introduction of FTT, but as a general model of transaction costs' influence on the financial market.

Key Words: *Financial transaction tax, agent-based model, technical and fundamental analysis, simulation.*

JEL Classification*: F38, G18, C63, C88.*

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