A NEW STRATEGY OF CURBING FINANCIAL DISTRESS

Wang Dong, Guanghua School of Management, Peking University, 100871 China
86-10-6275-4817, wangdong@gsm.pku.edu.cn
(Supported by National Nature Science Foundation of China No. 79930600)

Abstract: The proliferation of computerized trading, derivative markets and competition from other countries' exchanges in the past 15 years has inevitably put pressure on financial watchdogs to update their regulation of stock, futures and other instruments exchanges, in order to curb financial distress. In this paper, mechanics of speculating with futures were derived. Based on the net present value (NPV) rule, profits of an investor with long or short position, considering the weighted average cost of capital and transactions costs (TC), were studied. According to the results above, a possible strategy of curbing financial distress with transaction tax policy, under the reform of security transaction tax in China, was proposed. Some key points of the curbing strategies were discussed and probability density of different circumstances was simulated.

(1) Title: A NEW STRATEGY OF CURBING FINANCIAL DISTRESS
(2) Authors: Wang Dong, Wang Qiwen, Zhang Shiyi
(3) Position and Affiliations:
   Wang Dong,
   Associate professor, Guanghua School of Management, Peking University
(4) Address:
   Wang Dong
   Department of Finance
   Guanghua School of Management
   Peking University
   Beijing, 100871 P.R.China

   Tel/Fax/Voice: (86-10) 6275-4817
   Fax: (86-10) 6275-1463
   Email: wangdong@gsm.pku.edu.cn

(5) Topic Area: Finance
A NEW STRATEGY OF CURBING FINANCIAL DISTRESS

Wang Dong, Guanghua School of Management, Peking University, 100871 China
86-10-6275-4817, wangdong@gsm.pku.edu.cn
(Supported by National Nature Science Foundation of China No.79930600)

Abstract: The proliferation of computerized trading, derivative markets and competition from other
countries' exchanges in the past 15 years has inevitably put pressure on financial watchdogs to update their
regulation of stock, futures and other instruments exchanges, in order to curb financial distress. In this paper,
mechanics of speculating with futures were derived. Based on the net present value (NPV) rule, profits of an
investor with long or short position, considering the weighted average cost of capital and transactions costs
(TC), were studied. According to the results above, a possible strategy of curbing financial distress with
transaction tax policy, under the reform of security transaction tax in China, was proposed. Some key points
of the curbing strategies were discussed and probability density of different circumstances was simulated.

Keywords: Market Supervision, Speculation, Tax Policy, Futures,

0. INTRODUCTION

Futures price in the markets changes over the time in an uncertain way and may described as to follow a
stochastic process. In this paper, futures prices behavior were expressed in terms of what are know as
winner processes. A winner process is a particular kind of Markov stochastic process which is a type of
stochastic process where only the present value is relevant for predicting the future and the past history and
the way in which the present has emerged from the past are irrelevant. The Markov property of prices is
consistent with the weak form of market efficiency.

Futures contracts are usually used both for speculating and hedging. Speculating were focused on here and
mechanics of speculating are of great important to making decisions for both small investors and large
international investment houses. The understanding of the mechanics will also do great help to governments
to take strategies of market supervision in order to curb prices volatility and control risks.

In recent years, speculating with futures was discussed in some papers [1][2][3][4], and the results achieved
routinely hold the assumptions as no transaction costs (TC), no different between borrowing and landing
rates, and all trading profits being subject to the same tax rate. The main problem is that neither of these
assumptions is likely to hold in the real world.

The purpose of this paper was trying to find mechanics of speculating with futures for different investors,
considering that investors usually have different weighted average cost of capital, different tax rate, and have
to purchase transaction costs, in order to investigate new strategies for market supervision. Thus, the
following parts had been studied.

1. MECHANICS OF SPECULATING

Futures contracts usually are used both for speculating and hedging. Speculating were focused on here and
mechanics of speculating with futures may be illustrated in Figure 1.

\[ F(i,t_1) \quad F_+ \quad t_1 \quad F - \quad F(i,t_2) \]
\[ (a) \quad \text{Cash flows of long position} \]

\[ F(i,t_1) \quad F_+ \quad t_1 \quad F - \quad F(i,t_2) \]
\[ (b) \quad \text{Cash flows of short position} \]

Figure 1. Mechanics of speculating with futures

Some of the notation that used in the Figure1 is as follow:
\[ F(i,t) : \text{future price at time } t \text{ with the underling } i \]
\[ F_+ : \text{long position taken by a speculator} \]
\[ F_- : \text{short position taken by a speculator} \]
\[ t_1 : \text{current time (years)} \]
\[ t_2 : \text{time when futures contract is terminated (years)} \]
For an investor, considering the rate of weighted average cost of capital (WACC), borrowing and lending rates is assumed to be \( r \), interest per annum at time \( t_1 \), with continuous compounding, for an investment maturing at time \( T \). The assumption of \( r = WACC \) is different from the risk-free rate usually used. According to the mechanics given, if there is no TC, then the NPV of an investor with long position is
\[
NPV(i; F_+, t_1; F_-, t_2) = F(i, t_2)e^{-r(t_2-t_1)} - F(i, t_1)
\]
and the NPV of an investor with short position is
\[
NPV(i; F_-, t_1; F_+, t_2) = -F(i, t_2)e^{-r(t_2-t_1)} + F(i, t_1)
\]
Thus,
\[
NPV(i; F_+, t_1; F_-, t_2) = -NPV(i; F_-, t_1; F_+, t_2)
\]
If the NPV is positive in equation (1), then for a long position, it is easy to see that
\[
F(i, t_2) \geq F(i, t_1)e^{r(t_2-t_1)}
\]
which shows that only the future price \( F(i, t_2) \) is expected higher then \( F(i, t_1)e^{r(t_2-t_1)} \), should an investor go long.
Similarly, for a short position, it is
\[
F(i, t_2) \leq F(i, t_1)e^{r(t_2-t_1)}
\]
which shows that only \( F(i, t_1)e^{r(t_2-t_1)} \) is higher then the future price \( F(i, t_2) \), should an investor short sell futures contracts.
Figure 2 illustrates these NPV graphically.

![NPV of speculating](attachment:figure2a.png)  
![NPV of speculating](attachment:figure2b.png)

Figure 2. NPV of speculating

2. TRANSACTION COSTS VERSUS SPECULATION AND NPV

Behavioral finance found that, when making decisions in uncertain conditions, people weigh prospective losses about twice as heavily in their calculations as prospective gains [3][5]. In the real world, investors usually face different tax rate, and have to purchase transaction costs. All these make it different from the results of speculating with futures obtained before.

2.1 Transaction Cost versus Speculation

Some of the notation that will be used is as follows:
\( \tau_+ \): the total ratio of transaction costs when buy futures
\( \tau_- \): the total ratio of transaction costs when short futures

Considering the TC and the mechanics given in Figure 1, the NPV of an investor with long position is
\[
NPV(i; \tau_+, t_1; \tau_-, t_2) = (1 - \tau_+)F(i, t_2)e^{-r(t_2-t_1)} - (1 + \tau_+)F(i, t_1)
\]
and the NPV of an investor with short position is
\[
NPV(i; \tau_-, t_1; \tau_+, t_2) = -(1 + \tau_+)F(i, t_2)e^{-r(t_2-t_1)} + (1 - \tau_+)F(i, t_1)
\]
Different from equation (3), when transaction costs considered, it is easy to obtain that
\[
NPV(i; \tau_+, t_1; \tau_-, t_2) \neq -NPV(i; \tau_-, t_1; \tau_+, t_2)
\]
Let $Z_3$ be the price of futures evolves according to
\[ NPV(i; \tau_s, t_1; \tau_-, t_2) = NPV(i; \tau_s, t_1; \tau_+, t_2) \]
then we get
\[ Z_3 = F(i, t_2) = F(i, t_1) e^{-\tau_-(t_2-t_1)} \]
For an investor who takes a long position, let
\[ NPV(i; \tau_s, t_1; \tau_-, t_2) \geq 0 \]
The solution is
\[ F(i, t_2) \geq \frac{1 + \tau_+}{1 - \tau_-} F(i, t_1) e^{\tau_-(t_2-t_1)} \]
Similarly, if the $NPV$ is not less than zero for an investor who short futures, that is
\[ NPV(i; \tau_s, t_1; \tau_+, t_2) \geq 0 \]
then we have
\[ F(i, t_2) \leq \frac{1 - \tau_-}{1 + \tau_+} F(i, t_1) e^{\tau_-(t_2-t_1)} \]
According to the results obtained above, we can conclude that the mechanics of speculation with futures under $TC$ is quite different form the mechanics when $TC$ is not considered before. The investment decision should be made, according to the information obtained at time $t_1$, when the futures price
\[ F(i, t_2) \leq \frac{1 - \tau_-}{1 + \tau_+} F(i, t_1) e^{\tau_-(t_2-t_1)} \]
and a long position should be taken when futures price is predicated to be
\[ F(i, t_2) \geq \frac{1 + \tau_+}{1 - \tau_-} F(i, t_1) e^{\tau_-(t_2-t_1)} \]
also, an investor should short sell the futures if there is information indicates the futures price will be
\[ F(i, t_2) \leq \frac{1 - \tau_-}{1 + \tau_+} F(i, t_1) e^{\tau_-(t_2-t_1)} \]
![Figure 3. NPV with TC existed](image)

![Figure 4. Efficient transaction area (ETA)](image)

The results were depicted in Figure 3. Comparing (a) with (b) of Figure 2, it can be seen that the horizon axis moves up in the Figure 4. It also says that comparing with the state of no TC, in order to gain a positive $NPV$, under TC, much higher futures price will be necessary for a long position; and much lower futures price will have to be seen for a short position.

### 2.2 Transaction Cost versus NPV

Equation (9) involves the relationship between the $NPV$ of an investor with long position and transaction costs. And note that the futures price is not less than zero, it is convenient to obtain the following results
\[ \frac{\partial NPV(i; \tau_s, t_1; \tau_+, t_2)}{\partial \tau_+} = -F(i, t_1) < 0 \]
\[ \frac{\partial NPV(i; \tau_s, t_1; \tau_-, t_2)}{\partial \tau_-} = -F(i, t_2) e^{-\tau_-(t_2-t_1)} < 0 \]
Also for an investor who short futures, we may through the equation (10) get the relations between $NPV$ and
transaction costs.

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_+} = \frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_-} = -F(i, t_2) e^{-r(t_2-t_1)} < 0
\]

Equations (21-24) all say that the net present value will decrease as the level of the transaction costs increase. This result holds for both side of the transaction. And it is interesting that

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_+} = \frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_-}
\]

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_+} = \frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_-}
\]

2.3 NPV versus Future Price

Similarly to the steps above, we have

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_+} = F(i, t_2) = (1-\tau_-) e^{-r(t_2-t_1)}
\]

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_-} = -F(i, t_2) = - (1 + \tau_+) e^{-r(t_2-t_1)}
\]

Usually, the total ratio of transaction costs \( \tau_+, \tau_- \leq 1 \), thus

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_+} \geq 0
\]

\[
\frac{\partial \text{NPV}(i; \tau_+; \tau_-, t_2)}{\partial \tau_-} \leq 0
\]

Equation (29-30) shows that investors who take long position will gain much when the futures price goes up; and investors who short sell the futures will increase their payoff as the price goes down.

3. STRATEGY OF CURBING FINANCIAL DISTRESS

3.1 Ways to Curb Volatility

There are many ways to curb volatility in financial markets. Many pundits have studied the differing margin requirements (that is, the collateral that investors must put up in exchange for securities). Other attempts are also being made to curb stock and futures market volatility, such as daily price movement limits, position limits and by curbing trading when markets move violently. The purpose of daily price movement limits is to prevent large price movements occurring because of speculative excesses, and the position is to prevent speculators from exercising undue influence on the market. Already, restrictive measures, so-called circuit breakers, are in place in stock and futures markets. But evidence of the effect of circuit breakers on volatility is inconclusive. It is well known that in China, if the price of a stock falls or rises by 10 percent, then trading is usually temporarily suspended. Such limit up and limit down also exit in china futures markets, but more flex to different futures contracts.

All the ways may classed into direct and indirect control. Indirect control will curb volatility through the factors (economics, politician, et) associated with the financial markets; the direct control is a way which will adjust the rules or construction of financial markets directly. In the direct control, hard control and soft control may be classed in detail. Circuit breakers belong to hard control. Bellow under the tax reform in China, the soft control with tax will be discussed according to the results achieved.

**Definition 1:** The efficient transaction area (ETA) is the price volatile area in which the long position or short position have a positive net present value (NPV).

**Definition 2:** The efficient transaction Time (ETT) is the time in which the long position or short position have a positive net present value (NPV).

Figure 4 shows the efficient transaction area (ETA). Where we denote \( m(t) \) as the futures price at time \( t \), \( m(t_0) = m_0 \) as the opening price, and \( k_1, k_2 \) is the fall or rise ratio of trading suspended. Thus the ETA for a long position and short position is

\[
L \in [z_2, k_2m_0] = m_0 \left[ \frac{1 + \tau_+}{1 - \tau_-} e^{r(t-t_0)} , k_2 \right], \text{ and}
\]
According to \( z_2 \) and \( z_1 \) given in figure 3 and figure 4, we get

\[
\frac{\partial Z_2}{\partial \tau_-} = -m(t_0)e^{r(t_1-t_0)} \leq 0
\]

\[
\frac{\partial Z_1}{\partial \tau_+} = - \frac{1 - \tau_-}{(1 + \tau_+)^2} m(t_0)e^{r(t_1-t_0)} \leq 0
\]

\[
\frac{\partial Z_2}{\partial \tau_+} = m(t_0)e^{r(t_1-t_0)} \geq 0
\]

\[
\frac{\partial Z_2}{\partial \tau_-} = \frac{1 + \tau_-}{(1 - \tau_-)^2} m(t_0)e^{r(t_1-t_0)} \geq 0
\]

They tell that the efficient transaction area (ETA) will be decreased as \( z_1 \) and \( z_2 \) moves down and up in figure 4 when the TC increases.

Considering the efficient transaction area (ETA) in figure 4, we will find that the ETA is constructed by soft control (transaction costs) and hard control.

In order to curb the market volatility, two prospects must be considered properly. The first one is how the ETA is to be made up; and the second one is how to decide the scale of ETA. Based on the results achieved above, it is not difficult to propose some possible constructions with the same ETA. Naturally, we have noticed that the ETA could be influenced by tax, an import part of transaction cost. And it has been realized that if tax had been employed as a kind of soft control, the government could not only held the market volatility in a satisfied condition, but also gain much money from the tax to stimulate the development of economy. Much more, if the tax policy was made before the Asian financial crisis, the Hong Kong government maybe need not directly take part in the financial markets and invested lots of money. As for the second prospect, it was completed. But compare the differences between the ETAs through a method of calculating the efficient transaction time may be one way to cope with the scale of the ETA. The time was to discussed and simulated later.

### 3.2 Market Supervision with Taxes

If we focus on the policy of tax holding in china, it will find the tax in financial market was made in Jun 1992. And introductions of security transaction tax have been studying for 5 years since the tax reform in 1994. Because the affection of security transaction tax reform is of great importance to the investors and the boost of markets, the policy will have to be studied carefully according to the whole financial markets.

Generally, tax-rate cuts will boost financial market. Michael hold the same point and said that tax cuts could help boost American stocks 40% and allow lower interest rates by 2000 [7]. Also he took a look at the tax-rate cuts of 1981-1983:

- Following Ronald Reagan's 1981-83 cuts in individual tax rates, the Dow Jones industrial average soared 48% and long-term interest rates plummeted four percentage points by mid-1986.
- John F. Kennedy's 1963 tax-cut proposal, which Lyndon Johnson signed into law in 1964, contributed to the Dow's 19% gain over the next two years.
- Reductions in the effective capital-gains tax rate in both 1978 and 1981 helped boost stock prices as much as 25% within two years.

We also noticed that the tax cuts from 0.5% to 0.4% in Jun 1998 might have helped a lot to boost the China's security markets. And the change of tax from 0.4% to 0.3% since Jun 1999 in China's B stock market is expected to a result of boosting stock markets.

But we should not forget the other aspect that a little higher tax could curb the market volatility and increase the money obtained from tax.

Therefore, according to mechanics of speculating and the control of ETA above, a possible strategy under usual situation is derived in table 1. The ratio of security transaction tax is better to be classed into 2-5 for the convenient of investors to master and to curb the market volatility efficiently. The ratio of tax to buy or sell may be different according to the securities applied.
In the table 1 below, the volatility of the financial markets is divided into four classes. More details in the table such as the ratios of tax, L1 < L2 < L3 < L4, need calculated according to the different market volatility, V1 < V2 < V3 < V4.

In the futures market, one example of the futures transaction tax and the volatility divided may be showed in table 2. Buy or sell ratios of tax, L1 < L2 < L3 < L4, is suggested the same in common states.

The table 1, also the table 2, is only a describing plan, much work should be done before it can be put into practice. But more important is that they all tell us if the strategies involved in the tables could be employed, the market volatility would be curbed to a satisfied condition and much money from the tax would collect than today.

If the situation is unusual or the market is in emergency, such as financial crisis occurred, much higher transaction tax may be employed according the situation. And all these new tax policies mentioned above should be announced before it is exercised in order that all the participants of the market knew what would happen in different circumstances.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>VOLATILITY</th>
<th>RATIO OF LONG</th>
<th>RATIO OF SHORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; V1</td>
<td>L1</td>
<td>S1</td>
</tr>
<tr>
<td>2</td>
<td>&lt; V2</td>
<td>L2</td>
<td>S2</td>
</tr>
<tr>
<td>3</td>
<td>&lt; V3</td>
<td>L3</td>
<td>S3</td>
</tr>
<tr>
<td>4</td>
<td>&gt; V4</td>
<td>L4</td>
<td>S4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS</th>
<th>VOLATILITY</th>
<th>RATIO OF TAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 2 %</td>
<td>R1</td>
</tr>
<tr>
<td>2</td>
<td>&lt; 5 %</td>
<td>R2</td>
</tr>
<tr>
<td>3</td>
<td>&lt; 10 %</td>
<td>R3</td>
</tr>
<tr>
<td>4</td>
<td>&gt; 10 %</td>
<td>R4</td>
</tr>
</tbody>
</table>

### 4. Evaluating different Strategies and Simulations

Different strategies to curb the market volatility may employ different ratio of security transaction tax and lead different market supervision system with different efficient transaction area and different efficient transaction time. If market supervision with taxes is considered, then how to decide the scale of ETA and ETT is very important in comparing the different situations.

There are several ways to evaluating the difference strategies. Here, as shown in Figure 4, the difference of first reaching time when the price start from the $m_0$ to the barrier, say $[z_1, z_2]$, is considered. We denote $T_{z_1,z_2}(m_0)$ is the first reaching time when the price start from the $m_0$ at time $t_0$ to the barrier $[z_1, z_2]$. In the discussion we regard $m(t)$ as smooth Markov process.

The results\(^9\) of the density function and distribution function of $T_{z_1,z_2}(m_0)$ are

$$f_{T_{z_1,z_2}}(t \mid m_0) = \frac{\pi}{z_1^2} \sum_{j=0}^{\infty} (-1)^j \left( j + \frac{1}{2} \right) \cos \left\{ \left( j + \frac{1}{2} \right) \frac{m_0}{z_1} \right\} \exp \left\{ -\left( \frac{j + \frac{1}{2}}{2z_1^2} \right) t \right\}$$

(36)

$$F_{T_{z_1,z_2}}(t \mid m_0) = 1 - \frac{2}{\pi} \sum_{j=0}^{\infty} (-1)^j \left( j + \frac{1}{2} \right) \cos \left\{ \left( j + \frac{1}{2} \right) \frac{m_0}{z_1} \right\} \exp \left\{ -\left( \frac{j + \frac{1}{2}}{2z_1^2} \right) t \right\}$$

(37)

Thus, the expectation of $T_{z_1,z_2}(m_0)$ is

$$E[T_{z_1,z_2}(m_0)] = \int_{-\infty}^{\infty} t f_{T_{z_1,z_2}}(t \mid m_0) \, dt$$

$$= 4z_1^2 \pi \sum_{j=0}^{\infty} (-1)^j \left( j + \frac{1}{2} \right)^{-3} \cos \left\{ \left( j + \frac{1}{2} \right) \frac{m_0}{z_1} \right\} \left\{ -\exp \left( -\left( \frac{j + \frac{1}{2}}{2z_1^2} \right)^2 \right) \left( \frac{j + \frac{1}{2}}{2z_1^2} + 1 \right) \right\}$$
\[
\begin{align*}
\exp\left(\frac{(j+\frac{1}{2})^2 \pi^2}{2z_1} - \frac{(j+\frac{1}{2})^2 \pi^2}{2z_1} + 1\right) \end{align*}
\]

(38)

According to the results above, some of the first reaching time simulation results of the price start from \(m_0 = 0\) to \(a = z_1 = z_2\) are given the Figure 5 and Figure 6. The density and cumulated probability of \(T_{z_1,z_2}(m_0)\) is shown in Figure 5 and Figure 6 separately. In the calculation, we let \(j\) equals 500; the start time is 0.001, and the step is 0.001, 300 steps is completed, but only 60 data is given in the figure.

![Figure 5 Probability Density of \(T_{z_1,z_2}(m_0)\)](image1)

![Figure 6 Cumulated Probability of \(T_{z_1,z_2}(m_0)\)](image2)

### 5. CONCLUSION

Regulation of stocks, futures and other instrument exchanges is now facing the pressure on updating financial watchdogs to control financial risks in the markets.

Considering the transaction costs, mechanics of speculating with futures for different investors were presented theoretically. According to the mechanics studied, a strategy of market supervision with taxes was derived. One way to evaluating the difference strategies is comparing the difference of first reaching time when the price first across the barrier. When we regard prices as winer processes, we could analysis the density and cumulated probability of the first reaching time. And some simulation is completed.

The reform of tax is being push forward in china. And the best for it must be done.

### REFERENCES


