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Timing Asset Market Peaks: The Role of the Liquidity Risk Cycle of the Banking System*

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Abstract

Recent financial crisis showed how the unfolding of liquidity risks of financial intermediaries spilled over to asset markets, contributing to asset price deteriorations and the triggering of liquidity spirals. This paper derives and tests a financial fragility condition for predicting asset price peaks on a real-time basis, by combining the term spread and the aggregate funding liquidity risks of the banking system into a simple binary fragility indicator. The main empirical result of this paper is that the fragility condition predicted *all major* equity market peaks in Germany during the time period 1973 to 2010, including the subprime crisis of 2007, the New Economy Bubble of 2000, and the 1987 stock market crash. The average lead time of the indicator is 2.9 months. About 80% of the declines were later on associated with significant declines in Industrial Production.

Keywords: Liquidity Spirals, Macrofinancial Linkages, Asset Price Cycle, Liquidity Management of Financial Intermediaries, Early Warning Indicator

JEL-Classification: G01, G17, E44, E51

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1 Introduction and Motivation

Recent financial crisis showed how the unfolding of liquidity risks of financial intermediaries spilled over to asset markets, contributing to asset price deteriorations and the triggering of liquidity spirals[1]. This paper will investigate if the aggregate funding liquidity risk cycle of the banking sector can be used to time the occurrence of a liquidity spiral which leads to an asset price peak, where liquidity risks for banks arise from their maturity transformation activity in the spirit of Diamond-Dybvig. There is so far only one study which investigated if the liquidity transformation measure and therefore the aggregated liquidity risks of the banking sector can be connected to financial stress[2]. However, there is so far no empirical study which tries to link the liquidity risk cycle of financial intermediaries to the asset price cycle.

The aim of this paper is to develop a fragility condition which times peaks on asset markets, based on a macroeconomic relationship between the term spread and the liquidity risk cycle of the banking sector. Whereas the term spread is a popular choice for early warning systems for real economic stress, in this paper it is used as an indicator for the marginal profitability of bank liquidity transformation and therefore as an indicator for the incentive for banks to take on funding liquidity risks. The position within the funding liquidity risk cycle in turn indicates the severity of a potential liquidity spiral. As long as the term spread is rising, banks are willing to sustain their funding liquidity risk and provide liquidity to economic agents. However, when there is either a tightening of the policy rate by the central bank or a negative shock for long-term interest rates which persists for some time, the incentive for banks to supply further liquidity to the economy (and take on funding liquidity risk) is successively reduced. Once banks start to cut back their funding liquidity risks, the liquidity transformation cycle will peak and a liquidity spiral for financial markets and, possibly with a lag, for the real economy will unfold. Therefore, *at the point in time* where liquidity transformation peaks, the aggregate liquidity constraints of the economy become tighter and asset prices are likely to peak. The goal of this paper is to test if this fragility condition could predict the onset of a decline in the financial markets within the bank-dominated German financial system for the time period 1973 to 2010.

The main finding of this paper is that the fragility condition predicted *all* major equity market peaks in Germany for the past 37 years, including the subprime crisis of 2007, the New Economy Bubble of 2000, and the 1987 stock market crash. The average lead time of the indicator is 2.9 months. Moreover, nearly all predicted peaks in the equity market were later on associated with economic recessions. The remainder of this paper is structured as follows: the next section gives a short overview of the economic idea on which the financial fragility signal is based. Section 3 describes the data series and shows how the fragility indicator is constructed. This is followed by a section presenting the empirical results. The final section concludes.

[1] see Adrian and Shin (2010), Krishnamurthy (2010), Brunnermeier and Pedersen (2009), Fecht (2004)

[2] see Berger and Bouwman (2008)

2 Outline of the Financial Fragility Condition

The idea to use the term spread and the funding liquidity risk of the banking sector for deriving a financial fragility condition is based on the papers of Fecht and Weber (2011), Adrian, Estrella, and Shin (2010), Brunnermeier and Pedersen (2009), and Berger and Bouwman (2008). The term spread is defined as the difference between long-term and short-term interest rates. Funding liquidity risk and liquidity transformation are one and the same concept and refer to the activity of banks to issue long-term assets such as loans and to finance these assets with shorter-term liabilities (see Diamond and Dybvig, 1983). It can be argued that liquidity transformation provides a valuable service to the economic system by allowing economic agents to hold assets of a longer maturity than their liabilities[3]. Indeed, Fecht and Weber (2011), using a Panel VAR for major European Monetary Union members, find that an increase in liquidity transformation leads to a positive reaction of economic growth. Banks which transform liquidity earn the difference between the interest rate on long-term assets and short-term liabilities (net interest margin) but incur one unit of funding liquidity risk for each unit of created liquidity.

The forecasting power of the term spread for economic recessions is well documented in the literature (e.g. Estrella and Mishkin, 1998). However, it is less well known why the term spread actually has forecasting power. In a recent paper, Adrian, Estrella, and Shin (2010) try to investigate this issue and set up a causality chain trough which a decline in the term spread may be transmitted to the economy. They argue that a tighter monetary stance leads to a reduction in the term spread which makes it less profitable for banks to engage in maturity transformation due to the reduction in the net interest margin. This leads to a lower supply of credit and ultimately to lower economic growth. Moreover, they argue that the decrease in credit supply spills back to the term spread, leading to a downward spiral for real economic activity. Their paper stresses a supply-side perspective on the economy, where balance sheet conditions and risk-taking of financial intermediaries drive real economic outcomes. Financial institutions thereby actively manage their balance sheets and react to changes in risk perceptions (see Borio and Zhu [2008] for a survey on the risk-taking channel of monetary policy).

This paper will follow a similar line of argumentation. The fragility argument which is derived in this paper, rests on the relationship between the term spread and the willingness of the banking sector to take on funding liquidity risks on the on hand, and the relationship between liquidity transformation and asset prices on the other hand. When the term spread is wide, i.e. the difference between long-term and short-term interest rates is large, the marginal profitability of liquidity transformation is high and banks are willing to accept a high funding

[3]Consider the following cases: If a long-term loan is financed by a long-term deposit, banks do not add liquidity to the economy since a depositor has to give up his liquidity for a long-term borrower. On the other hand, if a long-term loan is financed by a short-term deposit, both the borrower and the depositor stay liquid and can react to consumption or investment opportunities.

liquidity risk and provide a high amount of liquidity to agents in an economy. Hence, the amount of liquidity transformation and funding liquidity risk-taking are therefore a function of the size of the term spread. Indeed, Fecht and Weber (2011), find that liquidity transformation is positively affected by increasing long-term rates and negatively affected by increases in the policy rate. A persistent decline in the term spread starts to reduce the upward momentum of liquidity transformation and leads to an increase in the risk aversion of banks which no longer accept the current level of funding liquidity risk. Ultimately, the liquidity transformation cycle peaks and this will have ramifications for credit growth and the purchasing power as well as the confidence of investors. Allen and Gale (2000, 2002, 2003) demonstrate that financial fragility occurs at the point in time, when a positive credit expansion is insufficient to facilitate further asset price increases. In this paper, financial fragility occurs at the point in time when liquidity transformation enters its peak phase. Moreover, Allen and Gale (2002) argue that the uncertainty (and therefore the expectations) of investors about the future path of credit expansion impacts asset prices. This paper argues that when agents realize that the decline in the term spread reduces the momentum of liquidity transformation, the demand for risky assets will start to fall. Hence, the peak phase in asset prices should coincide with the peak phase in liquidity conditions. An indication that this may hold can be found in Berger and Bouwman (2008), who showed that liquidity transformation was significantly above its trend before the onset of the 2007 financial crisis. Moreover, Fecht and Weber (2011) find that equity prices are directly affected by changes in liquidity transformation, even after controlling for the term spread and economic growth. Helbling and Terrones (2003), who investigate whether there are common macroeconomic patterns for boom and bust cycles in equity markets worldwide, find that credit and money growth[4] are the two key variables which increased significantly before an equity market peak, followed by a significant decline in these variables thereafter.

In summary, the term spread, the liquidity risk/liquidity transformation of the baking system and asset prices show different aspects of the financial system but they are interrelated. A peak in liquidity transformation may be the trigger event for a liquidity spiral: once the aggregate deleveraging of liquidity risks of the banking sector starts, liquidity is drawn out of the economic system, leading to overall tighter funding liquidity constraints of financial and non-financial agents. The start of the drying up of liquidity on an aggregate level puts immediate pressure on asset prices and leads to a decline in business and consumer confidence and ultimately to lower economic growth. The decrease in confidence will lead to a feedback effect, putting pressure on the term spread which will reduce the incentive for banks to take on funding liquidity risks even more and therefore leads to further downward pressure for liquidity transformation[5]. The decline in the term spread is most likely to happen due to lower interest

[4]Note that liquidity transformation can be regarded as a unified measure of money and credit growth.

[5]There is by now a huge literature on amplifying effects with respect to balance sheet quantity feedback effects: an initially small shock within the financial system may have a large negative consequence for the whole financial system and possibly for the real economy (see e.g. Krishnamurthy [2010], Brunnermeier and Pedersen [2008]).

rates at the long end of the yield curve because of lower expected inflation rates in the future due to the expected decline in the economic activity. The relationships around the peak phase of the asset market are graphically depicted in Figure 1. This diagram is an oversimplification of reality and there are various ways how feedback effects may be transmitted. For example, equity prices are certainly influenced by economic growth in the long-run but are likely to be negligible for the time period under consideration in this paper[6]. Moreover, the successive decline in asset prices is certainly driven by more complex dynamics which cannot be disentangle on an aggregate level. Note however, that the aim of this paper is to provide a financial fragility condition which is valid for a short time frame and not to provide insights into the interrelations and dynamics of the subsequent decline in asset prices[7].

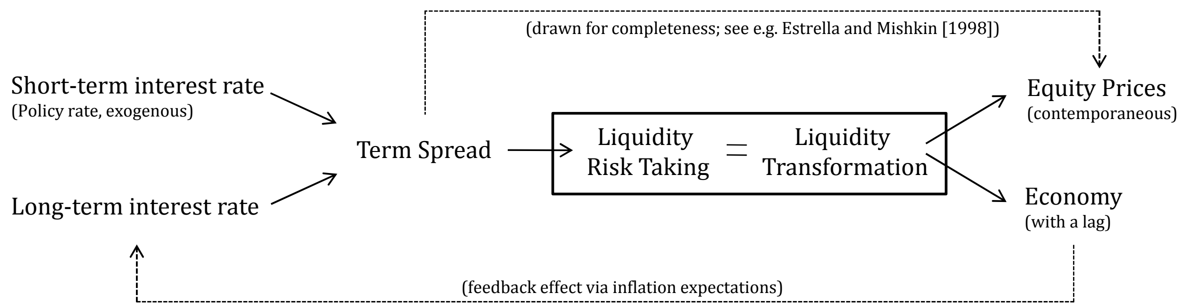

Figure 1: The Interrelations during the Asset Price Peak Phase

3 Data and Methodology

A. Data Description and Construction

All data was collected from the Deutsche Bundesbank for the end of the month, including the monthly bank balance sheet data which is the only source for constructing the liquidity transformation indicator. In total there are 445 observations for each time-series on a monthly basis for a period from January 1973 to January 2010. For constructing the financial fragility indicator, three variables are used: the term spread, the German equity market index DAX 30, and the liquidity transformation of the German banking sector. The term spread is defined as the difference between the German five-year government bond rate and the one-year government bond rate. The DAX 30 is used as a proxy for the general development of asset prices and the state of the financial markets. To construct the liquidity creation indicator, a three step methodology which as proposed by Berger and Bouwman (2009) is applied: First, all assets and liabilities of the bank balance sheet are classified as liquid (li), semi-liquid (sl), and illiquid (il). In the second step, weights are attached to each of these three classes, where a weight to 0.5, 0, -0.5 is given to illiquid, semi-liquid and liquid assets and a weight of 0.5, 0, -0.5 is given to liquid, semi-liquid and illiquid liabilities. Hence, only balance sheet positions which provide

[6]Section 4 shows that the average duration of the fragility condition is 3.2 months.

[7]In the context of a dynamical systems analysis, this paper describes a bifurcation point but disregards the description (and determinants) of the trajectories in the regime before and after that point.

liquidity to economic agents have a positive weight. In the final step, all assets and liabilities are summed up. Double counting is prevented by attaching weights of one-half to each balance sheet position. Balance sheet positions which are weighted by zero do neither create nor destroy liquidity for the economy and drop out of the calculation. A detailed derivation of the the bank liquidity transformation indicator can be found in Berger and Bouwman (2009).

Since the goal of this paper is to derive a financial fragility condition, a binary financial fragility indicator instead of a probability model is used. For this purpose, liquidity transformation and the term spread are transferred to binary indicators and subsequently combined multiplicatively into a binary financial fragility indicator. The approach of transforming variables into binary signals is similar to the idea of Kaminsky and Reinhart (1999), who transferred distress variables into binary signals by defining a threshold value above which the variable is in *State 1* and if it is below the threshold value it is in *State 0*. It is usual to search the threshold value by using a grid search. However, in this paper, no grid search is conducted in order to prevent over-fitting. Instead an ad-hoc value of 24 months for the endogenous threshold value was chosen. Moreover, except for the cumulative sum measures, all other input parameters are fixed at six months.

B. Identification and Dating of Equity Market Peaks

A decline in the DAX of at least 15% from peak-to-trough is defined as an indication of financial fragility which corresponds to a distress frequency of 3.5 years (or 11 distress cases over 37 years). We believe that this frequency and size of the decline is sufficiently high enough to be interpreted as distress[8]. Peaks and troughs are identified endogenously using a minimum reversal percentage of 15%. To identify a peak, the DAX has to decline by at least 15% from its peak, without closing above the high price of the peak date during the decline. The time period from the highest price level since the beginning of the decline until the lowest price level is then identified as a declining state and the date at with the high price was identified is defined as the peak date which the financial fragility indicator ought to predict. The market is defined to be in the declining state as long as it does not rise by at least 15% from the lowest point. This methodology will ensure that peaks and troughs alternate. Although this is a backward looking algorithm, for the purpose of dating peaks it is sufficient. Since we do not have data on the highest high price of each month, the peak date has a precision of approximately ± 1 month.

C. Construction of the Binary Liquidity Creation Indicator

First, the relative change of liquidity transformation over a three months horizon is considered. Essentially, this is to capture the loss of momentum of liquidity transformation when the

[8]Defining 10% as the threshold would lead to a huge amount of distress cases which are unlikely to be all real distress for the financial and economic system, whereas a threshold value of 20% would miss out on some important macroeconomic events. Hence, 15% seems to be a good compromise.

term spread starts to decline (see Section 2). Moreover, the idea is that a peak does not emerge suddenly but instead build up over some period of time. LIQ_t^{cum}, at time t, is given by

$$LIQ_t^{cum} = \left(\frac{LIQ_t}{LIQ_{t-2}}\right) - 1.$$

Note that LIQ_t has a unit root[9] and LIQ_t^{cum} is a stationary time-series. In order to smooth and better extract the cyclical nature of the time-series, we use a simple 6 months moving average which is calculated on a rolling basis[10]. Therefore, LIQ_t^{cycle} is given by

$$LIQ_t^{cycle} = \left(\frac{\sum_{t=1}^{6} LIQ_t^{cum}}{6}\right).$$

More sophisticated filtering approaches would have been feasible but in order to keep the derivation of the binary liquidity transformation indicator as simple and transparent as possible, a moving average procedure is used. A peak phase in liquidity creation is identified if LIQ_t^{cycle} is above its endogenous threshold value which is specified as a simple 24 months moving average (MA) on a rolling basis[11]. If LIQ_t^{cycle} is above this threshold, the binary indicator is equal to 1 and signals an upcoming peak in the liquidity transformation time-series. Therefore, the binary liquidity transformation indicator, $D(LIQ_t^{cycle})$, is given by

$$D(LIQ_t^{cycle}) = \begin{cases} 1 & \text{if } LIQ_t^{cycle} > MA(LIQ_t^{cycle}) \\ 0 & \text{if } LIQ_t^{cycle} < MA(LIQ_t^{cycle}) \end{cases}, \quad (1)$$

where D is the binary indicator taking the value 1 and 0. Therefore, the liquidity transformation cycle enters its peak phase at time t, if $D(LIQ_{t-1}^{cycle}) = 0$ and $D(LIQ_t^{cycle}) = 1$. The signal is valid (i.e. the binary indicator remains 1) until LIQ_t^{cycle} falls below the threshold value.

D. Construction of the Binary Term Spread Indicator

The binary distress indicator for the term spread, $D(TS_t)$, is given by

$$D(TS_t) = \begin{cases} 1 & \text{if } TS_t < TS_{t-6} \\ 1 & \text{if } TS_t \leq 0 \\ 0 & \text{if } TS_t > TS_{t-6} \end{cases}. \quad (2)$$

[9]Using an ADF test ($\Delta LIQ_t = \mu + \beta t + \gamma LIQ_{t-1} - \sum_{j=1}^{p} \Delta LIQ_{t-j} + \epsilon_t$) with automatic lag-length selection (AIC), the Null Hypothesis is accepted at the 1% level, independent of specifying a trend and/or intercept term.

[10]Note that selection of sensible higher MA values would have not dramatically changed the results, however, it would have reduced the peak-to-peak amplitude in absolute hight.

[11]Note, that the average period length of LIQ_t^{cycle} is below 24 months. The peak-to-peak amplitude varies significantly but is sufficiently captured by the 24 months MA, so that *every peak* of the liquidity transformation time-series is captured. The 24 months MA has a similar hight as the Root Mean Square amplitude.

Hence, $D(TS_t)$ is in a "declining state" if either the slope of the term spread is negative or its level is zero or below. The latter case is included to account for the fact that liquidity transformation becomes unprofitable if the term spread is zero. Even if the term spread is rising in this region, banks have no incentive to take on funding liquidity risks.

D. Construction of the Binary Equity Market Indicator

A regularity condition is set to ensure that a fragility signal only occurs if the equity market is above its long-term trend which makes sure that equity prices are still considered strong by market participants when a financial fragility signal is triggered. Again, a simple 24 months MA is used as a threshold value to determine the market state. The binary DAX indicator, $D(I_t)$, is given by

$$D(I_t) = \begin{cases} 1 & \text{if } DAX_t > MA(DAX) \\ 0 & \text{if } DAX_t < MA(DAX) \end{cases}. \tag{3}$$

E. Construction of the Financial Fragility Indicator

To construct the binary fragility indicator, the binary liquidity creation indicator, the binary term spread and the binary DAX indicator are multiplicatively combined. Therefore, only if all three dummy variables are equal to 1 (i.e. $D(\cdot) = 1$ for all binary indicator variables), a fragility signal is triggered. Constructing the early warning indicator multiplicatively has the advantage that there is no need to weight the dummy variables and that the indicator can explicitly capture the set of conditions for an asset price peak. Hence, the financial fragility indicator, y_t^{crisis}, is given by combining equation (1) to (3) which yields

$$y_t^{\text{crisis}} = D(I_t) * [D(TS_t) * D(LIQ_t^{cycle})],$$

and which will have the following cases

$$D(y_t^{\text{crisis}}) = \begin{cases} \text{Crisis} & \text{if } y_t^{\text{crisis}} = 1 \\ \text{No crisis} & \text{if } y_t^{\text{crisis}} = 0 \end{cases}. \tag{4}$$

Figure 2 outlines the construction process for the fragility indicator and summarizes the conditions laid down for it in Section 2. As it can be seen, there were two instances where the equity market was above its long-term trend (Subgraph a), the term spread has been declining for some time (Subgraph b), and the liquidity transformation indicator was above its threshold level (Subgraph c). All three dummy variables were therefore equal to 1 and the fragility indicator send a signal of a pending peak in the equity market (the binary stress indicator is equal to 1 in Subgraph d). The construction of the indicator makes a real-time use possible.

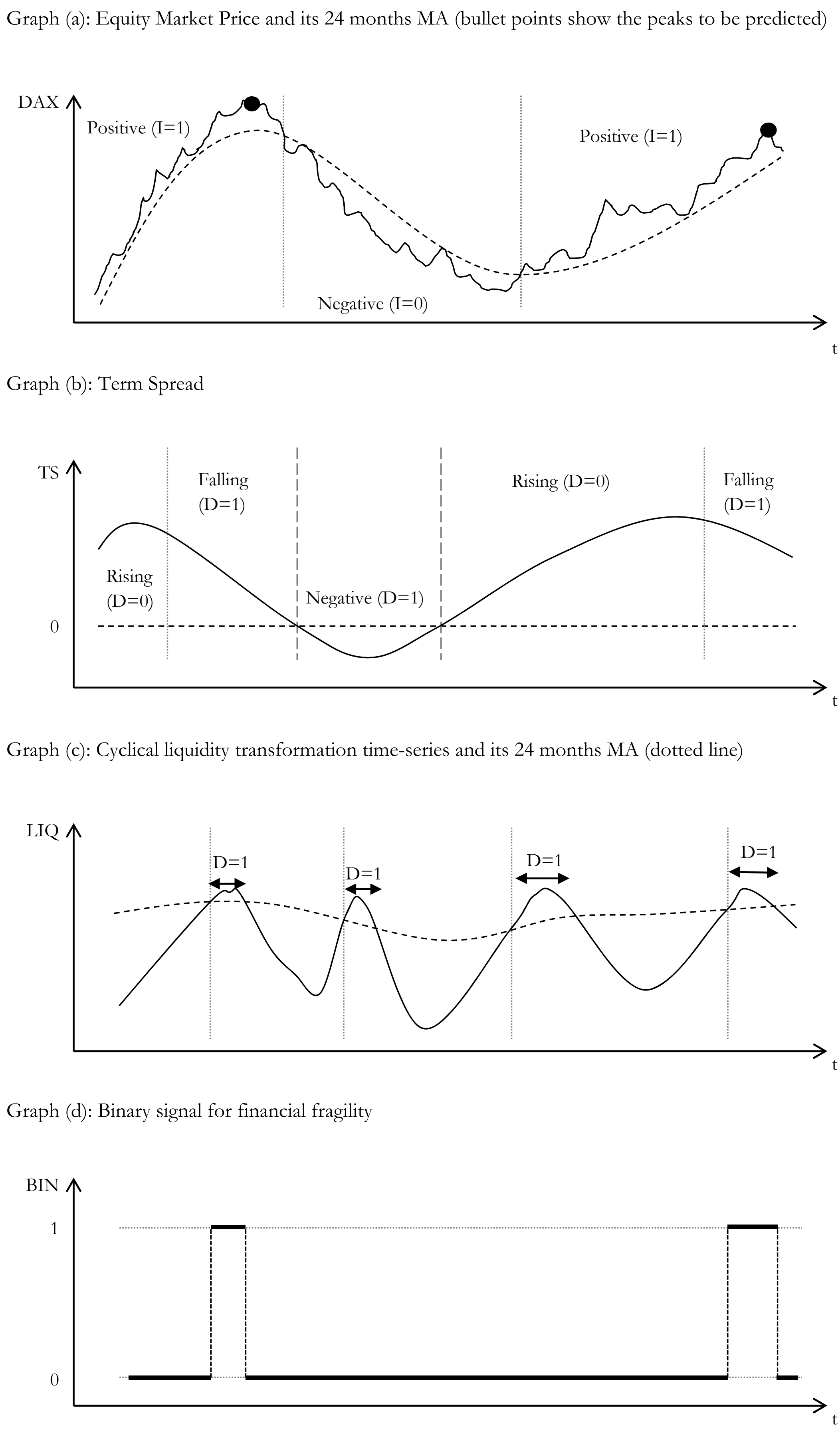

Figure 2: The Real-Time Signal for Financial Fragility: Idealized Presentation of two Distress Signals

4 Empirical Results

Table 1 summarizes the empirical results. In total, there have been eleven instances, where the DAX declined at least 15% and all eleven cases were predicted correctly. The fragility indicator triggered a total of 20 signals for financial distress, leaving nine potentially false signals. Two instances, where the DAX declined by only 11%/12% are considered borderline cases which are counted as correct predictions. In the first case (1984-01), a severe German recession occurred three months after the fragility signal: Industrial Production lost 10% within one month, the most severe decline ever observed over the 37 year time horizon. In the second case (2000-10), the equity market rebounded from its initial decline which started in February 2000. Since the major decline in the equity market occurred after October 2000, we count the signal 2000-02 as a borderline signal, although the absolute peak actually occurred in 2000-02. The seven remaining signals were not associated with a decline which would be significant enough to be an indication of distress for the equity market and should be interpreted as false positive signals.

The duration of the fragility signal is driven nearly entirely by the duration of the peak phase of liquidity transformation which was on average 3.2 months (see DUR^1). On average, the equity market reached its peak 2.9 months after the fragility signal was initially triggered (see $4-2$). In fact, in over 80% of all cases, the peak in the equity market realized within the time frame where the fragility signal was valid. The average decline resulted in a loss of about 31% and had a duration of about one year. In 80% of all cases where an equity market peak formed, an economic recession occurred[12]. On average, the economic activity started to decline nine months after the financial fragility signal (see $11-2$) and five months after the equity market peak. This indicates that a peak in liquidity transformation may indeed have real economic effects, for instance via a lower supply of credit, as suggested by Adrian, Estrella, and Shin (2010).

This paper demonstrates that the peak phase of the liquidity creation cycle can serve as a timing signal for the end of an upwards movement in equity prices and therefore finds empirical evidence for the financial fragility condition outlined in Section 2. The results also support Berger and Bouwman (2008), who argue that "... the subprime lending crisis was preceded by a dramatic build-up of positive abnormal liquidity creation,..." [p. 30] and that too much liquidity transformation may lead to financial fragility. Although the indicator captured all significant equity market peaks, there still remain some false positive signals. It should be noted that during the derivation of the financial fragility condition, some rather ad-hoc assumptions about the time lag for the input parameters were made (24 months for the threshold values and 6 months for all other values). The performance figure with respect to the Type II errors may further be improved if a grid search that minimizes the noise-to-signal ratio is conducted.

[12] An economic recession is defined if Industrial Production is lower today than it was 12 months ago. The date at which the economic decline started is identified as the peak data.

Table 1: Signals from the Financial Fragility Indicator 1973 - 2010

	Financial Fragility Indicator							**Economic (ECO) Implications**					
	No.	Signal Data	DUR[1]	DAX Peak	(4-2)	Loss (%)	DUR[2]	Macroeconomic Event	ECO Crisis	ECO Peak	(11-2)	Loss (%)	DUR[3]
Correct Signals	1	1975-10	1	1976-03	4	17%	8	——	No	——	–	–	–
	2	1977-11	3	1978-09	9	22%	29	Second Oil Price crisis	Yes	1979-12	24	13%	36
	5	1986-03	3	1986-04	0	15%	4	——	Yes	1986-07	3	5%	7
	6	1986-12	1	1987-08	7	39%	6	Stock Market Crash	No	——	–	–	–
	8	1989-12	2	1990-03	2	32%	6	German Reunification	Yes	1990-12	11	8%	9
	9	1992-01	5	1992-05	3	19%	5	ERM Crisis	Yes	1992-02	0	16%	17
	11	1993-11	2	1993-12	0	15%	16	ERM Crisis	Yes	1994-12	12	4%	11
	13	1996-12	6	1997-07	6	16%	4	——	No	——	–	–	–
	14	1998-01	4	1998-06	4	24%	4	Russian Default	Yes	1998-07	5	4%	5
	17	2000-10	2	2000-10	0	66%	29	New Economy Bubble	Yes	2001-02	3	6%	10
	20	2007-08	6	2007-12	3	52%	14	Subprime Crisis	Yes	2008-02	5	25%	14
Boarderline	3	1984-01	1	1984-01	0	12%	7	German Recession	Yes	1984-05	3	10%	1
	16	2000-02	1	2000-02	0	11%	8	Stock Market Crash	No	——	–	–	–
False Signals	4	1984-12	5	–	–								
	7	1988-12	5	–	–								
	10	1993-02	5	–	–								
	12	1995-11	1	–	–								
	15	1998-11	3	–	–								
	18	2004-06	2	–	–								
	19	2005-06	6	–	–								

Financial Fragility Indicator: *No.* refers to the signal generation of the fragility indicator in chronological order; *Signal Date* is the year and month in which the signal was generated for the first time and DUR^1 refers to the signal duration (i.e. how long the binary indicator was equal to 1); *DAX Peak* of the observed date of the peak in the equity market; *(4-2)* calculates the time length between the Signal date and the DAX Peak date; *Loss(%)* refers to the percentage decline in the DAX from the DAX Peak date to the low value of the subsequent decline, rounded to the nearest integer; DUR^2 refers to the duration of the DAX decline, including the months where the low and high were established.

Economic (ECO) Implications: *ECO Peak* refers to the date at which the Industrial Production peaked; *(11-2)* calculates the time length between the Signal date and the Economic Peak date; *Loss(%)* refers to the percentage loss of the Industrial Production from the ECO Peak date to the low value of the subsequent decline, rounded to the nearest integer; DUR^3 refers to the duration of the economic decline, including the months where the low and high were established.

5 Conclusion

This paper was motivated by observing that the liquidity risk management actions of financial intermediaries spilled over to asset markets during the subprime crisis which started in 2007. The next step was to incorporate the term spread in the analysis which can be regarded as a natural measure of the marginal profitability of bank liquidity transformation and the incentive for funding liquidity risk-taking of banks. The goal of this paper was then to empirically test if a unification of the term spread and the liquidity risk cycle of the banking system into a financial fragility indicator can time a certain point (in this paper: the peak phase) of the asset price cycle. It was found that the financial fragility indicator predicted all major equity market downturns for Germany over the past 37 years. Moreover, 80% of the equity market peaks were followed by peaks in economic activity. Therefore, if a policymaker observes a fragility signal and the formation of an equity market peak, the probability for an economic recession is very high. In this context, future research may investigate whether monetary policy needs to account for financial stability, given that liquidity transformation has financial and real effects. Moreover, it would be interesting to analyze the usability of liquidity transformation and the resulting funding liquidity risks of banks within the monetary analysis process and comparing its performance to standard money and credit aggregates.

Instead of trying to describe the whole asset price cycle, this paper focused on the question if it is possible to predict the peak phase of asset prices (in this paper: the peak phase of equity markets). Accordingly the statements are only valid for the peak phase in the asset price cycle. This paper did not attempt to describe the size or the duration of the subsequent asset price decline. In principle, this indicator can be used as an early warning indicator for financial and real economic distress. However, the suitability and performance of the indicator will depend on how precisely liquidity transformation of the financial sector can be measured: Germany has a bank dominated financial system and the size of the shadow banking sector is comparatively small, so the official bank balance sheet statistics are sufficient. For the United States, Berger and Bouwman (2008) find that a liquidity transformation indicator which includes off-balance sheet elements of banks is preferred. If the indicator works well in a system where most liquidity is provided outside the banking system is therefore a question of data availability. Finally, it must be stressed that this paper explicitly refrains from assessing the optimality of bank funding liquidity risk-taking. The growth enhancing properties of liquidity transformation were not discussed and it was not the subject of this paper to investigate whether bank risk-taking is socially desirable.

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