The Financial Bubble Experiment: Advanced Diagnostics and Forecasts of Bubble Terminations Volume III

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(Dated: 2 May 2011)

This is a summary of the third installment of the Financial Bubble Experiment (FBE), where we identified 27 asset bubbles in November 2010 and revealed their names on 2 May 2011. Here we provide the following original documents packaged as one in the following sequence:

1. the initial public summary document of the FBE Vol. III, uploaded on 12 November 2010 as v1 at `http://arxiv.org/abs/1011.2882` and which includes the digital fingerprint of the original *Master* document of the 27 assets (item 3 in this list);

2. the **names**, **forecast quantiles** and final analysis of the 27 bubbles released on 2 May 2011;

3. the original *Master* document identifying the 27 assets, created on 12 November 2010 and whose checksum (digital fingerprint) appears in the document of item 1).

For the purpose of verifying the checksums of the original *Master* document (item 3 in the above list), it and the rest of the contents of this summary document can be found individually online at `http://www.er.ethz.ch/fco/index`.

The checksums of the document in item 3 are:

`Document name`	
`SHA256SUM`	`4994beab18293be021d751d513b6fec0776fde9cf74c0098f7da8657487d950d`
`SHA512SUM`	`ee20582b696a2ce880870b513e7b9e7ebb67bfbe62e2cad50dd18276a5158765af6fdf88d9fef6e047526c40478a865c722cab041386aa8efdd95da24dd9239d`

TABLE I. Checksums of Financial Bubble Experiment Vol. III forecast document.

The tables on the following page list the **names** and **forecast quantiles** of the 27 assets and are reproduced from item 2 above.

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2 H1 Assets (identified bubble)				
Category	Asset	Ticker	H1	C
Index	MERVAL Buenos Aires	^MERV (Y)	1	*
Equity	AUTOZONE	AZO (Y)	1	

TABLE II. 2 H1 assets of the Financial Bubble Experiment as of 12 November 2010. All listed assets are candidates for H1 (identified bubble phase). In the Ticker column, (B) stands for Bloomberg and (Y) for Yahoo Finance. Columns 'H1' and 'H2' show a somewhat subjective score of -1 (worst), 0 or 1 (best), reflecting the quality of the forecasts. This scoring is discussed further in Section III of the main analysis document available at `http://www.er.ethz.ch/fco/index`. Column 'C' has an asterisk if an asset had a major correction within 3 days of t_2 =2010-11-10 (the last data observation used in our analysis). This correlated dynamics also is discussed in Section III of the same analysis document.

25 H1 and H2 Assets (identified bubble)							
Category	Asset	Ticker	t_c 20% - 80%	t_c 5% - 95%	H1	H2	C
Index	BSE SENSEX, Bombay	^BSESN (Y)	2010-11-03 - 2010-12-01	2010-10-27 - 2010-12-10	0	1	*
	Dow Jones-AIG Comm.	^DJC (Y)	2010-11-16 - 2010-12-04	2010-11-09 - 2010-12-10	1	1	*
	FTSE 100	^FTSE (Y)	2010-11-27 - 2010-12-26	2010-11-07 - 2011-01-03	1	1	*
	Hang Seng Index	^HSI (Y)	2010-11-09 - 2010-12-09	2010-11-07 - 2010-12-16	1	1	*
	Interactive Week Internet	^IIX (Y)	2010-11-12 - 2010-12-10	2010-11-04 - 2010-12-23	1	1	*
	NASDAQ Computer	^IXK (Y)	2010-11-13 - 2010-12-06	2010-11-07 - 2010-12-09	1	1	*
	Jakarta Composite	^JKSE (Y)	2010-11-06 - 2010-12-09	2010-10-23 - 2010-12-25	0	0	
	KOSPI Composite Index	^KS11 (Y)	2010-11-15 - 2010-12-26	2010-10-30 - 2011-01-07	1	0	*
	NASDAQ-100 (DRM)	^NDX (Y)	2010-11-05 - 2010-11-29	2010-11-03 - 2010-12-22	1	1	*
	Reuters/Jefferies CRB	CRY INDEX (B)	2010-11-11 - 2010-11-22	2010-11-07 - 2010-11-26	1	1	*
	TSEC weighted index	^TWII (Y)	2010-12-01 - 2011-01-03	2010-11-13 - 2011-01-08	1	-1	*
	Major Market Index	^XMI (Y)	2010-11-10 - 2010-11-25	2010-10-30 - 2010-12-04	1	1	*
Equity	Ishares Singapore Index	EWS (Y)	2010-11-14 - 2010-12-12	2010-11-06 - 2010-12-25	1	1	*
	Freeport McMoRan	FCX (Y)	2010-11-15 - 2010-12-17	2010-11-09 - 2010-12-27	1	1	*
	F5 NETWORKS	FFIV (Y)	2010-12-27 - 2011-03-09	2010-12-02 - 2011-04-08	1	1	
	INTUIT	INTU (Y)	2010-11-28 - 2011-01-15	2010-11-07 - 2011-02-11	0	0	*
	STARBUCKS	SBUX (Y)	2010-11-08 - 2010-11-18	2010-11-06 - 2010-11-25	1	-1	
	UNITED RENTALS INC	URI (Y)	2010-11-09 - 2010-12-13	2010-11-02 - 2011-01-08	1	-1	
Commodity	Copper future (USD)	HG1 COMB Comdty (B)	2010-11-09 - 2011-01-07	2010-10-31 - 2011-01-15	1	1	*
	Corn future (CHF)	C 1 COMB Comdty (B)	2010-11-18 - 2010-12-19	2010-11-08 - 2010-12-28	1	1	*
	Cotton future (USD)	CT1 COMB Comdty (B)	2010-11-12 - 2010-11-13	2010-11-08 - 2010-11-15	1	1	*
	Palladium future (USD)	PA1 COMB Comdty (B)	2010-11-12 - 2010-11-19	2010-11-10 - 2010-11-27	1	0	*
	Silver future (CHF)	SI1 COMB Comdty (B)	2010-11-13 - 2010-11-18	2010-11-08 - 2010-11-29	1	0	*
	Sugar future (CHF)	SB1 COMB Comdty (B)	2010-11-20 - 2010-12-09	2010-11-10 - 2010-12-17	1	1	*
Forex	AUDUSD	(B)	2010-11-12 - 2010-12-25	2010-10-30 - 2011-01-12	1	1	*

TABLE III. 25 H2 assets of the Financial Bubble Experiment as of 12 November 2010. All listed assets are candidates for H1 (identified bubble phase) and H2 (identification of end of bubble phase). Quantile windows of most likely dates of the end of the bubble phases are shown. Abbreviations (B), (Y), H1, H2 and C are described in caption of Table II.

Item 1:
Initial public summary document of
the FBE Vol. III,
as uploaded on 12 November 2010 as `v1`
at
`http://arxiv.org/abs/1011.2882`

The Financial Bubble Experiment: Advanced Diagnostics and Forecasts of Bubble Terminations Volume III–Master Document

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(Dated: 11 November 2010)

This is the third installment of the Financial Bubble Experiment. Here we provide the digital fingerprint of an electronic document [1] in which we identify 27 bubbles in 27 different global assets; for 25 of these assets, we present windows of dates of the most likely ending time of each bubble. We will provide that document of the original analysis on 2 May 2011.

I. INTRODUCTION

The Financial Bubble Experiment (FBE) aims at testing the following two hypotheses:

- **Hypothesis H1:** Financial (and other) bubbles can be diagnosed in real-time before they end.
- **Hypothesis H2:** The termination of financial (and other) bubbles can be bracketed using probabilistic forecasts, with a reliability better than chance.

In a medical context, H1 corresponds to the diagnostic of cancer and H2 to the forecast of remaining life expectancy.

The motivation of the Financial Bubble Experiment finds its roots in the failure of standard approaches. Indeed, neither the academic nor professional literature provides a clear consensus for an operational definition of financial bubbles or techniques for their diagnosis in real time. Instead, the literature reflects a permeating culture that simply assumes that any forecast of a bubble's demise is inherently impossible.

Because back-testing is subjected to a host of possible biases, we propose the FBE as a real-time advanced forecast methodology that is constructed to be free, as much as possible, of all possible biases plaguing previous tests of bubbles. In particular, active researchers are constantly tweaking their procedures, so that predicted 'events' become moving targets. Only advance forecasts can be free of data-snooping and other statistical biases of ex-post tests. The FBE aims at rigorously testing bubble predictability using methods developed in our group and by other scholars over the last decade. The main concepts and techniques used for the FBE have been documented in numerous papers [2–6] and the book [7].

In the FBE, we propose a new method of delivering our forecasts where the results are revealed only after the predicted event has passed but where the original date when we produced these same results can be publicly, digitally authenticated. Since our science and techniques involve forecasting, the best test of a forecast is to publicize it and wait to see how accurate it is, whether the wait involves days, weeks or months (we rarely make forecasts for longer time scales). We will do this and at the same time we want to delay the unveiling of our results until after the forecasted event has passed to avoid potential issues of liability, ethics and speculation. Also, we think that a full set of results showing multiple forecasts all at once is more revealing of the quality of our current methods than would be a trickle of one such forecast every month or so. We also want to address the obvious criticism of cherry picking successful forecasts, as explained below. In order to be convincing, our experiment has to report all cases, be they successes or failures.

The digital fingerprint of our first set of bubble forecasts was released on 2 November 2009 (with a hash update on 6 November 2009). We added a new bubble forecast on 23 December 2009. The original forecasts and post-analysis were presented publicly on 3 May 2010 and uploaded to the `arxiv` server on 14 May 2010. All versions are available at [8].

This third set of forecasts presents the methodology described in [8] and the digital fingerprint of a single document that identifies and analyses 27 current asset bubbles (H1). For 25 of those 27 bubbles, the document also provides windows of dates of the most likely ending time of each bubble. We will provide that original document of the analysis on 2 May 2011.

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II. DESCRIPTION OF THE METHODOLOGY OF THE FINANCIAL BUBBLE EXPERIMENT

Our method for this experiment is the following:

- We choose a series of dates with a fixed periodicity on which we will reveal our forecasts and make these dates public by immediately posting them on our University web site and on the first version of our main publication, which we describe below. Specifically, our first publication of the forecasts was issued on 3 May 2010, with successive deliveries every 6 months. The forecasts of the current document will be presented on 2 May 2011. However, we keep open the option of changing the periodicity of the future deliveries as the experiment unfolds and we learn from it and from feedback of the scientific community.
- We then continue our current research involving analysis of thousands of global financial time series.
- When we have a confident forecast, we summarize it in a simple `.pdf` document.
- We do not make this document public. Instead, we make its digital fingerprint public. We generate two digital fingerprints for each document, with the publicly available 256 and 512 bit versions of the SHA-2 hash algorithm [9] [10]. This creates two strings of letters and numbers that are unique to this file. Any change at all in the contents of this file will result in different SHA-2 signatures.
- We create the first version of our main document (this one), containing a brief description of our theory and methods, the SHA-2 hashes of our forecast and the date (2 May 2011) on which we will make the original `.pdf` document public.
- We upload this main 'meta' document to `http://arxiv.org`. This makes public our experiment and the SHA-2 hashes of our forecast. In addition, it generates an independent timestamp documenting the date on which we made (or at least uploaded) our forecast. `arxiv.org` automatically places the date of when the document was first placed on its server as 'v1' (version 1). It is important for the integrity of the experiment that this date is documented by a trusted third party.
- We continue our research until we find our next confident forecast. We again put the forecast results in a `.pdf` document and generate the SHA-2 hashes. We now update our master document with the date and digital fingerprint of this new forecast and upload this latest version of the master document to `arxiv.org`. The server will call this 'v2' (version 2) of the same document while keeping 'v1' publicly available as a way to ensure integrity of the experiment (i.e., to ensure that we do not modify the SHA-2 hashes in the original document). Again, 'v2' has a timestamp created by `arxiv.org`.
- Notice that each new version contains the previous SHA-2 signatures, so that in the end there will be a list of dates of publication and associated SHA-2 signatures.
- We continue this protocol until the future date (2 May 2011) at which time we upload our final version of the master document. For this final version, we include the URL of a web site where the `.pdf` documents of all of our past forecasts can be downloaded and independently checked for consistent SHA-2 hashes. For convenience, we will include a summary of all of our forecasts in this final document.

Note that the above method implies two aspects of the same important check to the integrity of our experiment:

1. We will reveal all forecasts, be they successful or not.
2. We will not simply 'cherry-pick' the results that we would want the community to see (with a few token, possibly, bad results). We do not have another simultaneous outlet where we are running a similar experiment, since `arxiv.org` is a very visible international platform.

III. BACKGROUND AND THEORY

Our theories of financial bubbles and crashes have been well-researched and documented over the past 15 years in many papers and books. We refer the reader to the Bibliography. In particular, broad overviews can be found in [2–6]. In short, our theories are based on positive feedback on the growth rate of an asset's price by price, return and other financial and economic variables, which lead to faster-than-exponential (power law) growth. The positive feedback is partially due to imitation and herding among humans, who are actively trading the asset. This signature is

quantitatively identified in a time series by a faster-than-exponential power law component, the existence of increasing low-frequency volatility, these two ingredients occurring either in isolation or simultaneously with varying relative amplitudes. A convenient representation has been found to be the existence of a power law growth decorated by oscillations in the logarithm of time. The simplest mathematical embodiment is obtained as the first order expansion of the log-periodic power law (LPPL) model and is shown in Eq. (1):

$$\ln P = A + B|t - t_c|^{\alpha} + C|t - t_c|^{\alpha} \cos[\omega \ln |t - t_c| + \phi] \tag{1}$$

where P is the price of the asset and t is time. There are 7 parameters in this nonlinear equation, whose relative importance and estimation are described in our previous papers [2–6]. Our past work has led to the hypothesis that the LPPL signals can be useful precursors to an ending (change of regime) of the bubble, either in a crash or a less-dramatic leveling off of the growth.

IV. METHODS

A. Bubble identification

As are our theories, our methods are documented elsewhere so we only briefly mention the general technique so that the forecasts that we make public can be better understood. In short, we scan thousands of financial time series each week and identify regions in the series that are well-fit by Eq. (1). We divide each time series into sub-series defined by start and end times, t_1 and t_2 and then fit each sub-series (t_1, t_2). We choose $\max(t_2)$ as the date of the most recent available observation. Many sub-series are created according to the following parameters: $dt_1 = dt_2 = 7$ days, $\min(t_2 - t_1) = 91$ days and $\max(t_2 - t_1) = 1092$ days.

After filtering all fits with an appropriate range of parameters, we select those assets that have the strongest LPPL signatures. To improve statistics, we can calculate the residues between the model and the observations and use the residues to create 10 synthetic datasets (bootstraps) that have similar statistics as the original time series. We fit Eq. (1) to the synthetic data and then extrapolate this entire ensemble of LPPL models to six months beyond our last observation. One of the parameters in the LPPL equation is the "crash" time t_c, which represents the most probable time of the end of the bubble and change of regime. We identify the 20%/80% and 5%/95% quantiles of t_c of the fits of the ensemble consisting of original fits and bootstrap fits. These two sets of quantiles, the date of the last observation and the number of fits in the ensemble are published in our forecasts.

B. Post-analysis

Once the `.pdf` documents with the full description of the forecasts are made public, the question arises as how to evaluate the quality of the diagnostics and how these results help falsify the two hypotheses? In a nutshell, the problem boils down to qualifying (and quantifying) what is meant by (i) a successful diagnostic of the existence of a bubble and (ii) a successful forecast of the termination of the bubble. In the end, one would like to develop statistical tests to falsify the two hypotheses stated above, using the track record that the present financial bubble experiment has the aim to construct. For instance, Chapter 9 of (Sornette, 2003) suggests a number of options, including the "statistical roulette", Bayesian inference and error diagrams. Our main goal with this FBE is to timestamp our forecasts as we simultaneously continue our search for adequate measures to qualify the quality of our forecasts.

This quantification is an active, ongoing subset of our research. We are currently developing and testing novel estimations methods that will be progressively implemented in future releases. For our previous forecasts, we quantified the quality of the forecasts with four measures that we will continue to use in the final analysis:

- **Drawdown analysis:** Drawdown analysis simply identifies the largest drawdown observed between t_2 (date of forecast) and the date of the public 'unveiling' of the original forecasts. That is, we identify the largest drawdown in all available data after t_2. A drawdown is simply defined as the largest peak-to-trough drop in price in a given region.

- **Fraction of up days in a running window:** We calculate one day close-to-close returns for each asset and mark them as positive (up) or non-positive (zero or down). The ratio of up days relative to the sum of up and down days in a running window of 30, 60 or 90 days is plotted on top of the price observations.

- **Derivative of observations:** Another measure of the change of regime is provided by an estimation of the local growth rate. We use the Savitzky-Golay smoothing algorithm to calculate the first derivative of the observations, using a third order polynomial fit centered within windows of 120 and 180 days.

- **Bubble index:** A measure we are developing that quantifies the quality of the LPPL fits to the price time series.

We are developing other measures that will be used in future analysis.

V. BUBBLE FORECASTS

The checksums of the analysis document [1] that contains the names of the 27 assets are shown in Table I. This document showing all 27 assets and 25 forecasts, as well as analysis of each identified bubble, will be uploaded to `http://www.er.ethz.ch/fco/` on 2 May 2011.

Document name	
SHA256SUM	4994beab18293be021d751d513b6fec0776fde9cf74c0098f7da8657487d950d
SHA512SUM	ee20582b696a2ce880870b513e7b9e7ebb67bfbe62e2cad50dd18276a5158765af6fdf88d9fef6e047526c40478a865c722cab041386aa8efdd95da24dd9239d

TABLE I. Checksums of Financial Bubble Experiment Vol. III forecast document.

[1] R. Woodard, D. Sornette, and M. Fedorovsky (The Financial Crisis Observatory), "The Financial Bubble Experiment: advanced diagnostics and forecasts of bubble terminations, Vol. III–assets document," (2011), to be posted at http://www.er.ethz.ch/fco/ on 2 May 2011.

[2] Z.-Q. Jiang, W.-X. Zhou, D. Sornette, R. Woodard, K. Bastiaensen, and P. Cauwels, Journal of Economic Behavior & Organization **74**, 149 (2010), ISSN 0167-2681, `http://www.sciencedirect.com/science/article/B6V8F-4YK2DY8-1/2/3e0bc3155eed4914a7987ddd9ca7789e`.

[3] A. Johansen, D. Sornette, and O. Ledoit, J. Risk **1**, 5 (1999).

[4] A. Johansen and D. Sornette, Brussels Economic Review **49** (2006), (http://arXiv.org/abs/cond-mat/0210509).

[5] D. Sornette and A. Johansen, Quant. Financ. **1**, 452 (2001).

[6] D. Sornette and W.-X. Zhou, Int. J. Forecast. **22**, 153 (2006).

[7] D. Sornette, *Why Stock Markets Crash: Critical Events in Complex Financial Systems* (Princeton University Press, Princeton, 2003).

[8] D. Sornette, R. Woodard, M. Fedorovsky, S. Reimann, H. Woodard, and W.-X. Zhou (The Financial Crisis Observatory), "The Financial Bubble Experiment: advanced diagnostics and forecasts of bubble terminations," (2009), http://arxiv.org/abs/0911.0454.

[9] `http://en.wikipedia.org/wiki/SHA_hash_functions`.

[10] `http://eprint.iacr.org/2008/270.pdf`.

Item 2:

Final analysis of the 27 bubbles,
released on 2 May 2011.

The Financial Bubble Experiment: Advanced Diagnostics and Forecasts of Bubble Terminations Volume III–Final Analysis

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(Dated: 2 May 2011)

This is the third installment of the Financial Bubble Experiment. Here we provide analysis of the 27 bubbles identified in the electronic document [1], whose digital fingerprint was published on `arxiv.org` on 12 November 2010 [2]. The abstract is purposefully succinct and without summary and conclusions in order to avoid influencing the reader and allow him/her to form his/her conclusions.

CONTENTS

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I. INTRODUCTION

We acknowledge the repetition of content both within the family of FBE III documents and among the FBE I-III documents over the past 1.5 years. The repetition is intentional and is for two reasons: 1) Since each document is posted at various times as an independent entity, we want each one to be self-contained to avoid a reader having to flip between multiple documents; 2) Each installment of the FBE that we place on the ***arxiv*** *must (by their rules) be a complete document. That is, we are not allowed to simply update one* ***arxiv*** *document every six months with our new forecast. Not wanting to wear out our welcome, we will change the format of our next public forecast.*

The Financial Bubble Experiment (FBE) aims at testing the following two hypotheses:

- **Hypothesis H1:** Financial (and other) bubbles can be diagnosed in real-time before they end.
- **Hypothesis H2:** The termination of financial (and other) bubbles can be bracketed using probabilistic forecasts, with a reliability better than chance.

In a medical context, H1 corresponds to the diagnostic of cancer and H2 to the forecast of remaining life expectancy.

The motivation of the Financial Bubble Experiment finds its roots in the failure of standard approaches. Indeed, neither the academic nor professional literature provides a clear consensus for an operational definition of financial bubbles or techniques for their diagnosis in real time. Instead, the literature reflects a permeating culture that simply assumes that any forecast of a bubble's demise is inherently impossible.

Because back-testing is subjected to a host of possible biases, we propose the FBE as a real-time advanced forecast methodology that is constructed to be free, as much as possible, of all possible biases plaguing previous tests of bubbles. In particular, active researchers are constantly tweaking their procedures, so that predicted 'events' become moving targets. Only advance forecasts can be free of data-snooping and other statistical biases of ex-post tests. The FBE aims at rigorously testing bubble predictability using methods developed in our group and by other scholars over the last decade. The main concepts and techniques used for the FBE have been documented in numerous papers [3–7] and the book [8]. The FCO research team is currently developing and testing novel estimations methods that will be progressively implemented in future releases.

In the FBE, we propose a new method of delivering our forecasts where the results are revealed only after the predicted event has passed but where the original date when we produced these same results can be publicly, digitally authenticated. Since our science and techniques involve forecasting, the best test of a forecast is to publicize it and wait to see how accurate it is, whether the wait involves days, weeks or months (we rarely make forecasts for longer time scales). We will do this and at the same time we want to delay the unveiling of our results until after the forecasted event has passed to avoid potential issues of liability, ethics and speculation. Also, we think that a full set of results showing multiple forecasts all at once is more revealing of the quality of our current methods than would be a trickle of one such forecast every month or so. We also want to address the obvious criticism of cherry picking successful forecasts, as explained below. In order to be convincing, our experiment has to report all cases, be they successes or failures.

The digital fingerprint of our first set of bubble forecasts was released on 2 November 2009 (with a hash update on 6 November 2009). We added a new bubble forecast on 23 December 2009. The original forecasts and post-analysis were presented publicly on 3 May 2010 and uploaded to the `arxiv` server on 14 May 2010. All versions are available at [9]. The digital fingerprint of the second set of forecasts was uploaded to the `arxiv` on 12 May 2010 and the names of the assets were revealed on 1 November 2010 [10].

This third set of forecasts continues using the methodology described in [9, 10]. A document with the digital fingerprint of a separate document identifying 27 asset bubbles (H1) was posted to the `arxiv` on 11 November 2010 [2] (though a minor resubmission the following morning places the `arxiv` timestamp as 12 November 2010). For 25 of those 27 bubbles, the 'sealed' document also provided windows of dates of the most likely ending time of each bubble (H2).

We now provide that document at `http://www.er.ethz.ch/fco/` and analysis of our bubble identifications and forecasts below.

II. EXECUTIVE SUMMARY OF THE RESULTS

The 2 H1 assets and 25 H2 assets (with forecast quantiles of the end of the bubbles) are shown in the following sections with quantitative results. A complete visual representation is available in the figures

in Sections V-VI.

We confirm 'bubble' by an ex-post inspection of the price times series: a major downward change in the growth rate of the price time series within the six months after our analysis indicates that the asset had been in a bubble. Because the definition of what is a "major downward change" is prone to possible subjective and a posteriori tweaking, we offer several metrics described below: (i) drawdowns, (ii) fraction of up days in running windows, and (iii) derivative of the log-price (providing an estimate of the trend). In general, our bubble theory says that a bubble ends in a change of regime, that is, when the super-exponential growth rate ends. This could range from a simple lessening of the growth rate to a large crash. One of the most frequent types of change of regime that we observed in this current experiment occurred when the price time series exhibited a well-defined correction or crash within 6 months immediately following the date of when the initial document was posted to the `arxiv` on 12 November 2010 [2].

A. H1: Identification of a bubble

We support H1 by confirming that bubbles existed in 24 of the 27 assets at the time of the last observation of our forecasts, $t_2 =$ 10 November 2010.

B. H2: Forecast of change of regime

We support H2 by confirming that 17 of the 25 H2 assets showed substantial corrections in the quantile windows that we forecast.

III. EXPLANATION OF ANALYSIS MEASURES

In the following subsections, we include figures for each asset. The figures share some common features, explained here. Details for each individual asset and measure are discussed below.

Axes and observations: Price (or value of the asset) is shown on the left vertical axis and calendar days are indicated on the bottom horizontal axis. The circles represent closing price observations on trading days. Note that the price axis shows observations in their natural units on a logarithmic scale.

Large shaded region, vertical and horizontal black lines: The large grey shaded regions that begin near the left price axis and end at the solid black vertical line near the right vertical axis represent the domain of the observations used in our analysis. The vertical line itself sits at $t_2 =$ 10 November 2010: the last observation used in the analysis. The price at t_2 is represented by the solid black horizontal line.

Small hatched, shaded regions: Two hatched shaded regions begin in the vicinity of t_2. They represent our forecast "danger" zones, where changes of regimes are most likely to occur. The inner, narrow one with diagonal hatching represents the 20-80% quantile interval and the outer, wider one with horizontal hatching represents the 5-95% quantile interval. That is, these two numbers imply a 60% (respectively, 90%) probability for the end of the bubble to be located within the diagonally (respectively, horizontally) hatched zone. The hatched shaded regions are presented for all 27 assets, even the two (MERVAL and AZO) for which we did not publish forecasts.

Drawdown analysis: Drawdown analysis figures show a solid red or green line connecting the path of the largest drawdown observed in three distinct sections:

1. between the beginning of the domain of analysis (left edge of large shaded grey region) and t_2 (red line);

2. between the 5% and 95% forecast windows (green line);

3. between the 95% quantile line and 27 April 2011 (red line).

The percentage drop and duration of each drawdown is indicated in text in the lower right corner of each figure. A drawdown is simply defined as the largest peak-to-trough drop in price in a given region. Defining the price at the peak as p_1 and at the trough as $p_2 < p_1$, we give the percent drawdown of the log return. That is, the drawdown percentage that we report on each drawdown plot is calculated as $d = 100 \log(p_1/p_2)$. Log returns are approximately equal to arithmetic returns (defined as $100(p_1-p_2)/p_1$) for small returns but are increasingly larger than the arithmetic return for larger returns.

Note that some forecast windows include dates just before t_2, such as when the change in regime started right at the end of our analysis window (obvious in hindsight but not at the time of publication!). In these cases, a drawdown can begin before t_2. Also shown in the text is the ratio of the forecast maximum drawdown to the maximum before and after drawdowns.

Fraction of up days in a running window: We calculate one day close-to-close returns for each asset and mark them as positive (up) or non-positive (zero or down). The ratio of up days relative to the sum of up and down days in a running window of 60 days is plotted on top of the price observations. The right vertical axis shows this fraction on a linear scale. Note that we do not include returns with a value of zero in the calculation of this ratio. Also, the running window *ends* at the value plotted on the time axis. That is, only present and past data is used in the running window, not future data.

Derivative of observations: Another measure of the change of regime is provided by an estimation of the local growth rate. We use the Savitzky-Golay smoothing algorithm to calculate the first derivative of the observations, using a third order polynomial fit centered within windows of 120 days (60 days past, 60 days future). The scale of the estimated derivative is shown on the right vertical axis using linear scaling. Note that this right vertical axis has different limits for each asset, to reflect the different orders of magnitude of some assets.

Scoring of forecasts (-1, 0, 1): An initial quantification of our forecasts is made with a simple scoring of -1, 0 or 1, which we use to indicate whether a major downward change in the growth rate of the price time series within the six months after t_2 occurred. Specifically:

- **-1:** No major downward change after t_2.
- **0:** Signal unclear.
- **1:** H1: Major downward change after t_2; H2: change occurred within forecast quantile windows.

Potential correlated dynamics around t_2. In 22 of 27 assets, a major downward change began within 1-3 days on either side of our last analysis date t_2 =2010-11-10. These assets are indicated with a '*' in column 'C' of Tables II-III. This striking correlated dynamics will be discussed in a future publication.

An obvious criticism arises: if many of these assets began their major downward changes around 10 November, it might appear as if we strategically waited until 12 November to confirm these major changes before publishing. Because support of our scientific hypotheses depends so much on advanced prediction, the timing of our statements is critical. Therefore, it is important that we address this potential criticism:

- Our submission to the `arxiv` on 12 November 2010 was made *before* U.S. markets opened, hence, at most, we could have used closing price data from 11 November (though we did not). In fact, we submitted on 11 November 2010 but a minor edit the next day made our 'official' timestamp 12 November 2010.
- Most of the large drawdowns that began on or before 11 November 2010 certainly had not ended by 12 November 2010. Only in hindsight can one look at a historical time series and say that "the large drawdown started on *that* date". Our point is that for an observer on 12 November 2010 looking at just the 22 price time series that include closing prices only through 11 November 2010 (though we used 10 November) and that share this correlated dynamics, it was entirely unclear whether the drops that had begun were only noisy fluctuations or the beginning of something larger. Two possible exceptions to this are DJC and Sugar Future CHF, as they both exhibited major drawdowns by 12 November. Again, though, we did not take such an observation into account in our asset selection.

IV. RESULTS OF SIMPLE TRADING STRATEGIES

The true measure of success for any theory that attempts to forecast asset price movement must be in terms of realized profit and loss using a trading strategy based on the theory. Proper trading strategies and quantification of them lie outside the scope of this paper. To give a flavor, though, of what these present results imply, we consider two of the simplest deterministic strategies using output of our analysis. We choose a date to sell short one share of each asset and a second date to buy it back and then calculate the return without any attempt to include market friction, fees, etc. We use the closing price on each of these dates.

The date we open each position, when we sell short one share, is the latter of either t_2 =10 November 2010 or the date of the 5% quantile. We choose two buy back strategies. The first is closing the position (i.e., buying back the share) at the date of the 95% quantile. The second strategy involves using some future information, so would not be easily implementable: once we calculate the maximum drawdown within the quantiles window, we choose the first day *after* the end of this drawdown to buy the share back. The results of both strategies are shown in Table I.

Admittedly, this first strategy is rather naive and, in reality, would not be implemented because it continues (stupidly) to accumulate losses when a drawdown is followed by an upward correction, as illustrated for instance by the example of Copper futures. Note that time 'passes through' the profitable strategy 2 to reach the unprofitable endpoint of strategy 1. That is, a human trader or more intelligent automatic algorithm could implement a stop-gain buy back order at, for instance, 4% profit and a stop-loss buy back order at, say -1%. This would, sadly, eliminate some of the larger gains shown in Buy Back Strategy 2 but would also eliminate the large losses, making an overall profitable process with less volatility. Further, the (assumed) 4% profit is over the holding period for each asset, which is usually (in these case) on the order of *1-2 months*. Hence, an annualized return would be larger.

	Sell		Buy Back Strategy 1			Buy Back Strategy 2		
Name	date	price	date	price	% ret	date	price	% ret
AZO	2010-11-26	259.48	2011-01-24	251.49	3.1	2011-01-07	250.67	3.5
EWS	2010-11-10	14.04	2010-12-29	13.68	2.6	2010-11-24	13.19	6.2
FCX	2010-11-10	51.95	2010-12-29	59.33	-13.3	2010-11-18	49.72	4.4
FFIV	2010-12-06	139.80	2011-04-25	105.71	28.0	2011-03-23	95.67	37.9
INTU	2010-11-10	48.83	2011-02-11	50.62	-3.6	2010-11-24	45.65	6.7
SBUX	2010-11-10	30.34	2010-11-22	30.87	-1.7	2010-11-17	29.99	1.2
URI	2010-11-10	20.38	2010-12-31	22.75	-11.0	2010-12-16	22.50	-9.9
BSESN	2010-11-10	20875.71	2010-12-10	19508.89	6.8	2010-11-29	19405.10	7.3
DJC	2010-11-10	154.19	2010-12-13	155.99	-1.2	2010-11-18	146.56	5.1
FTSE	2010-11-10	5816.90	2011-01-04	6013.90	-3.3	2010-12-01	5642.50	3.0
Hang Seng	2010-11-10	24500.61	2010-12-16	22668.78	7.8	2010-12-17	22714.85	7.6
IIX	2010-11-10	312.68	2010-12-27	310.85	0.6	2010-11-17	295.10	5.8
IXK	2010-11-10	1336.04	2010-12-13	1365.22	-2.2	2010-11-17	1278.03	4.4
JKSE	2010-11-10	3756.97	2010-12-21	3637.45	3.2	2010-12-01	3619.09	3.7
KS11	2010-11-10	1967.85	2011-01-07	2086.20	-5.8	2010-11-30	1904.63	3.3
MERV	2010-11-10	3310.97	2010-11-15	3270.78	1.2	2010-11-15	3270.78	1.2
NDX	2010-11-10	2187.74	2010-12-27	2229.86	-1.9	2010-11-17	2100.00	4.1
TWII	2010-11-15	8240.65	2011-01-10	8817.88	-6.8	2011-01-10	8817.88	-6.8
XMI	2010-11-10	1245.15	2010-12-28	1261.25	-1.3	2010-12-01	1232.80	1.0
Copper future	2010-11-10	3.97	2011-01-17	4.37	-9.8	2010-11-24	3.76	5.5
Corn future	2010-11-10	5.52	2010-12-28	5.92	-6.9	2010-11-23	5.26	5.0
Cotton future	2010-11-10	1.46	2010-11-15	1.39	4.9	2010-11-16	1.34	8.5
Palladium future	2010-11-10	696.75	2010-11-29	693.00	0.5	2010-11-17	654.85	6.2
Silver future	2010-11-10	26.18	2010-11-29	27.19	-3.8	2010-11-17	25.27	3.5
Sugar future	2010-11-10	0.32	2010-12-17	0.32	1.3	2010-11-15	0.27	18.5
AUDUSD	2010-11-10	1.00	2011-01-12	1.00	0.5	2010-11-30	0.96	4.2
RJ CRB	2010-11-10	317.11	2010-11-26	301.13	5.2	2010-11-18	302.51	4.7
Mean					-0.3			5.4
Mean (no FFIV, URI)					-1.0			4.7

TABLE I: Results of simple trading strategies: We choose the latter of the two dates, t_2 =10 November 2010 or the date of the 5% quantile. We sell short a share of the asset at the closing price of this date. For Buy Back Strategy 1, we buy back the share at the closing price of the date of the 95% quantile. Note that this first strategy is rather naive and, in reality, would not be implemented because it continues stupidly to accumulate losses when a drawdown is followed by an upward correction, as illustrated for instance by the example of Copper futures. For Buy Back Strategy 2, we buy back the share at the closing price of the day after the last day of the maximum drawdown found in the quantiles. Note that this second strategy uses *future* information in order to calculate when the maximum drawdown would be, hence such a strategy could not be automatically implemented. The bottom two rows show the simple mean values of the return columns, with the final row showing the mean with the largest gain (FFIV) and largest loss (URI) removed.

V. ANALYSIS OF H1 ASSETS

In our initial document posted to the `arxiv` on 12 November 2010 [2], we diagnosed that the 2 assets in this Section (see Table II) were in a bubble phase (H1) but we did not make forecasts of likely dates of change of regime (H2). For each asset, we present a figure showing the time series of the observations and indicate the range over which our analysis was performed (the shaded area in each figure).

2 H1 Assets (identified bubble)				
Category	Asset	Ticker	H1	C
Index	MERVAL Buenos Aires	^MERV (Y)	1	*
Equity	AUTOZONE	AZO (Y)	1	

TABLE II: 2 H1 assets of the Financial Bubble Experiment as of 12 November 2010. All listed assets are candidates for H1 (identified bubble phase). In the Ticker column, (B) stands for Bloomberg and (Y) for Yahoo Finance. Columns 'H1' and 'H2' show a somewhat subjective score of -1 (worst), 0 or 1 (best), reflecting the quality of the forecasts. This scoring is discussed further in Section III of the main analysis document available at `http://www.er.ethz.ch/fco/index`. Column 'C' has an asterisk if an asset had a major correction within 3 days of t_2 =2010-11-10 (the last data observation used in our analysis). This correlated dynamics also is discussed in Section III of the same analysis document.

We support H1 by confirming that bubbles existed in 24 of the 27 assets at the time of the last observation of our forecasts, $t_2 = 10$ November 2010. These 24 include the 2 H1-only candidates of this section and 22 of the 25 H1-H2 candidates of Section VI.

A. H1 Indexes

1. *MERVAL Buenos Aires*

H1: 1

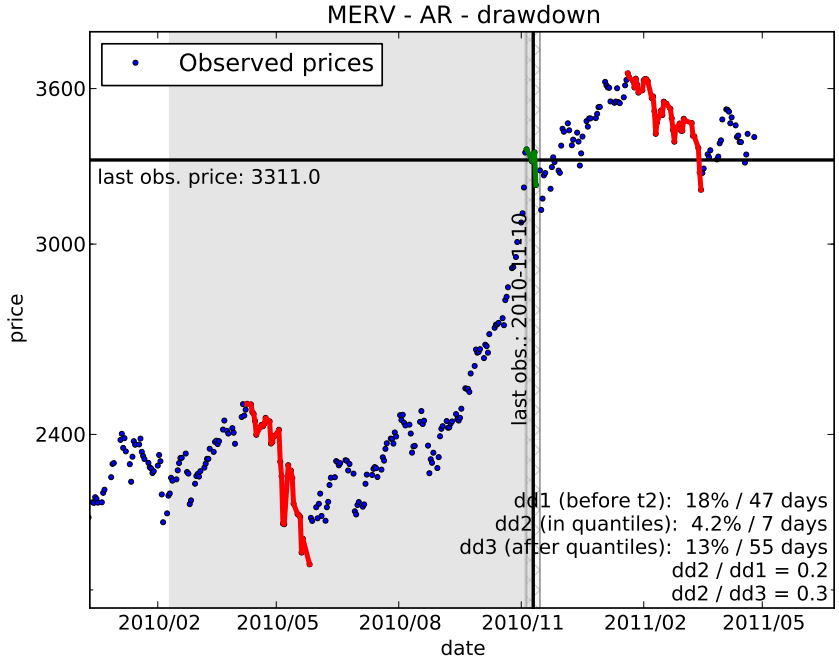


FIG. 1.

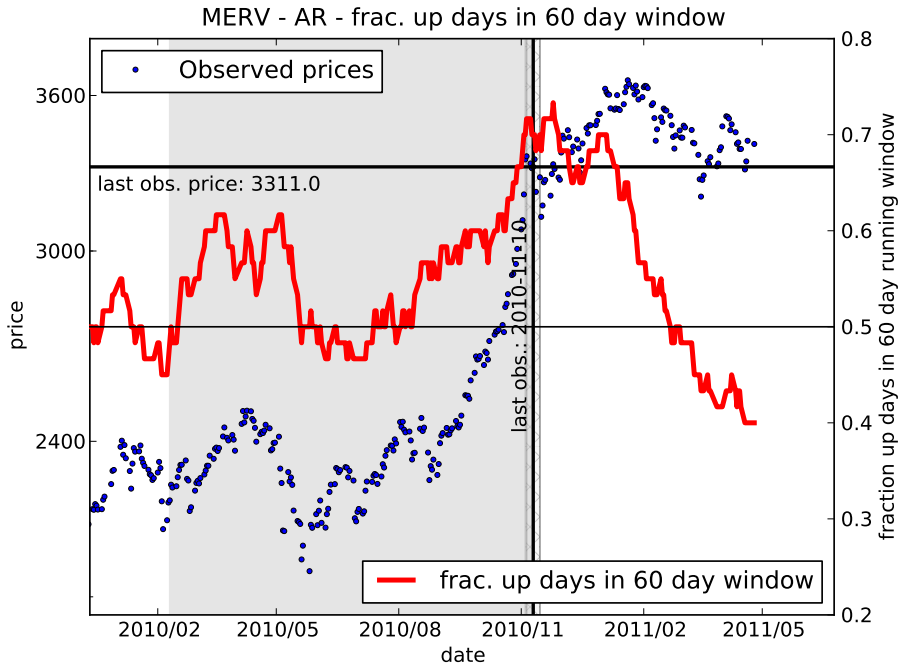


FIG. 2.

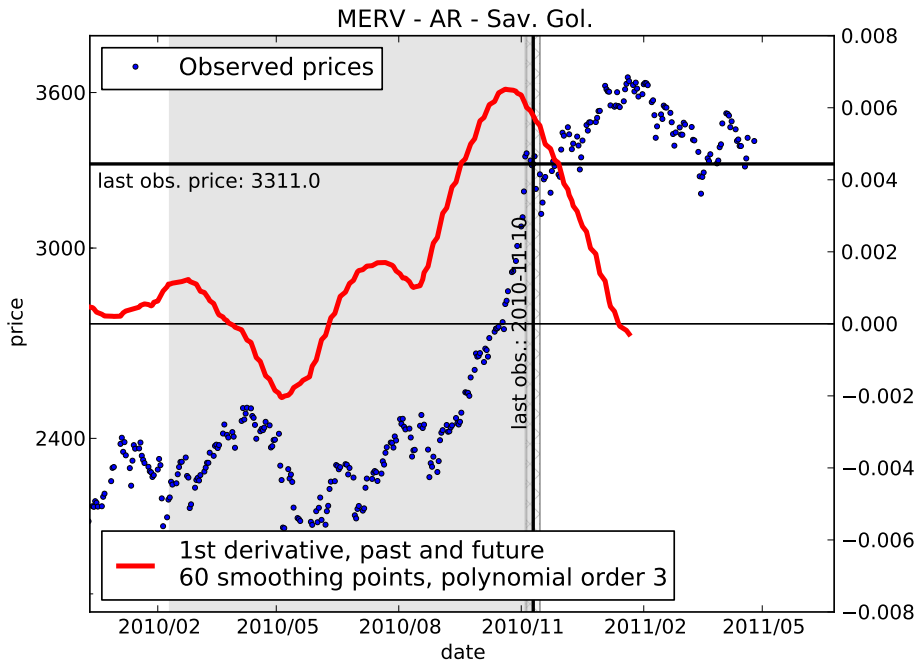

MERV - AR - Sav. Gol.
Observed prices
last obs. price: 3311.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
3600
3000
2400
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 3.

B. H1 Equities

1. *AUTOZONE*

H1: 1

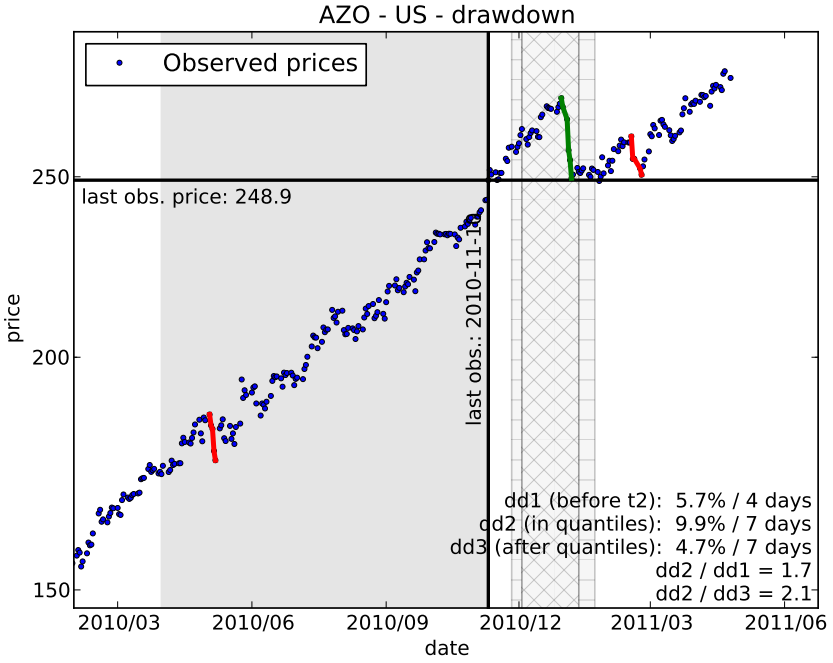


FIG. 4.

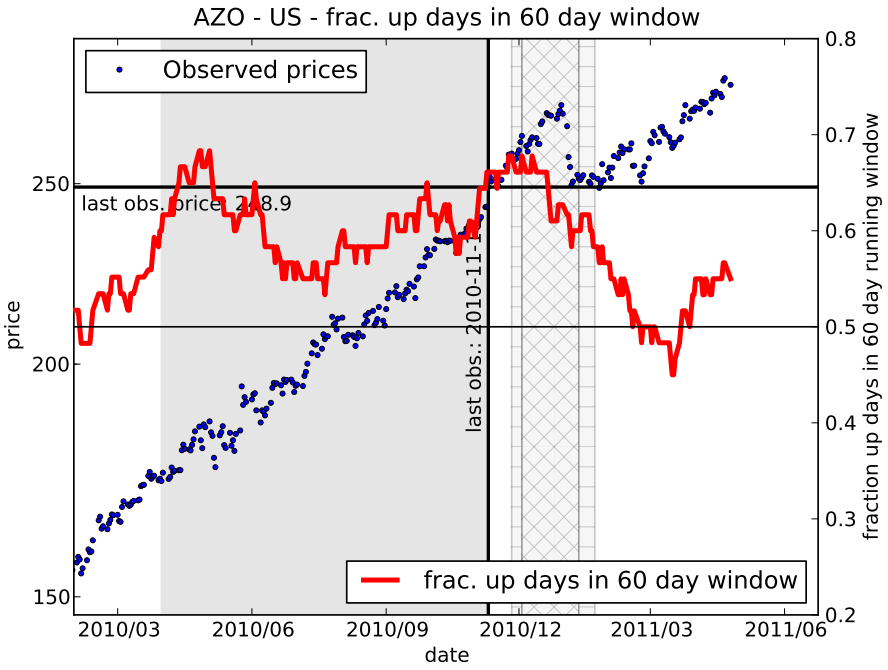


FIG. 5.

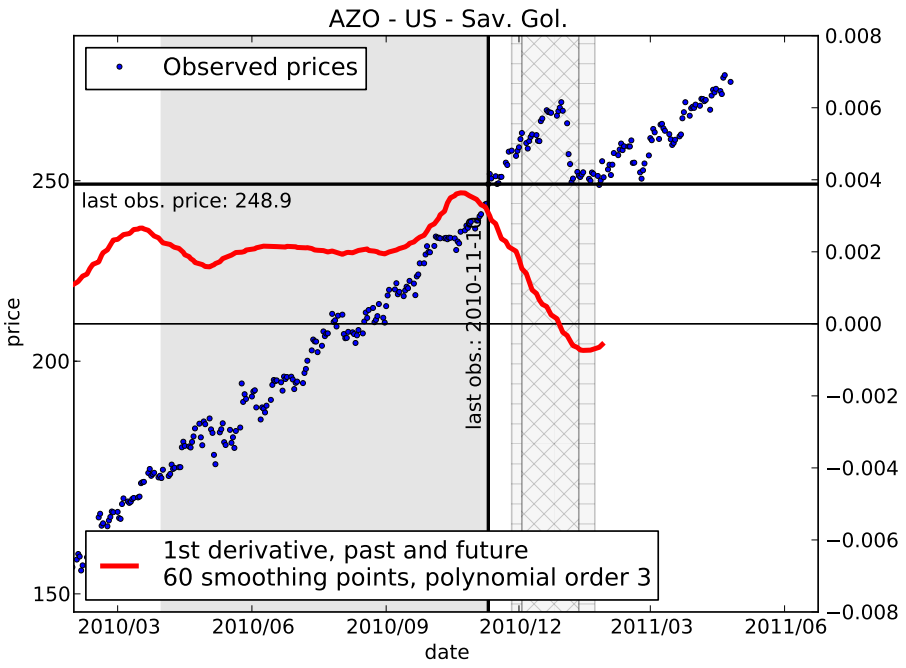

AZO - US - Sav. Gol.
Observed prices
last obs. price: 248.9
last obs.: 2010-11-15
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
250
200
150
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/03
2010/06
2010/09
2010/12
2011/03
2011/06

FIG. 6.

VI. ANALYSIS OF H1 & H2 ASSETS

In our initial document posted to the `arxiv` on 12 November 2010 [2], we diagnosed that the 25 assets in this Section (see Table III) were all in a bubble phase (H1) and were likely to end within the quantile ranges indicated in Table III (H2).

25 H1 and H2 Assets (identified bubble)							
Category	Asset	Ticker	t_c 20% - 80%	t_c 5% - 95%	H1	H2	C
Index	BSE SENSEX, Bombay	^BSESN (Y)	2010-11-03 - 2010-12-01	2010-10-27 - 2010-12-10	0	1	*
	Dow Jones-AIG Comm.	^DJC (Y)	2010-11-16 - 2010-12-04	2010-11-09 - 2010-12-10	1	1	*
	FTSE 100	^FTSE (Y)	2010-11-27 - 2010-12-26	2010-11-07 - 2011-01-03	1	1	*
	Hang Seng Index	^HSI (Y)	2010-11-09 - 2010-12-09	2010-11-07 - 2010-12-16	1	1	*
	Interactive Week Internet	^IIX (Y)	2010-11-12 - 2010-12-10	2010-11-04 - 2010-12-23	1	1	*
	NASDAQ Computer	^IXK (Y)	2010-11-13 - 2010-12-06	2010-11-07 - 2010-12-09	1	1	*
	Jakarta Composite	^JKSE (Y)	2010-11-06 - 2010-12-09	2010-10-23 - 2010-12-25	0	0	
	KOSPI Composite Index	^KS11 (Y)	2010-11-15 - 2010-12-26	2010-10-30 - 2011-01-07	1	0	*
	NASDAQ-100 (DRM)	^NDX (Y)	2010-11-05 - 2010-11-29	2010-11-03 - 2010-12-22	1	1	*
	Reuters/Jefferies CRB	CRY INDEX (B)	2010-11-11 - 2010-11-22	2010-11-07 - 2010-11-26	1	1	*
	TSEC weighted index	^TWII (Y)	2010-12-01 - 2011-01-03	2010-11-13 - 2011-01-08	1	-1	*
	Major Market Index	^XMI (Y)	2010-11-10 - 2010-11-25	2010-10-30 - 2010-12-04	1	1	*
Equity	Ishares Singapore Index	EWS (Y)	2010-11-14 - 2010-12-12	2010-11-06 - 2010-12-25	1	1	*
	Freeport McMoRan	FCX (Y)	2010-11-15 - 2010-12-17	2010-11-09 - 2010-12-27	1	1	*
	F5 NETWORKS	FFIV (Y)	2010-12-27 - 2011-03-09	2010-12-02 - 2011-04-08	1	1	
	INTUIT	INTU (Y)	2010-11-28 - 2011-01-15	2010-11-07 - 2011-02-11	0	0	*
	STARBUCKS	SBUX (Y)	2010-11-08 - 2010-11-18	2010-11-06 - 2010-11-25	1	-1	
	UNITED RENTALS INC	URI (Y)	2010-11-09 - 2010-12-13	2010-11-02 - 2011-01-08	1	-1	
Commodity	Copper future (USD)	HG1 COMB Comdty (B)	2010-11-09 - 2011-01-07	2010-10-31 - 2011-01-15	1	1	*
	Corn future (CHF)	C 1 COMB Comdty (B)	2010-11-18 - 2010-12-19	2010-11-08 - 2010-12-28	1	1	*
	Cotton future (USD)	CT1 COMB Comdty (B)	2010-11-12 - 2010-11-13	2010-11-08 - 2010-11-15	1	1	*
	Palladium future (USD)	PA1 COMB Comdty (B)	2010-11-12 - 2010-11-19	2010-11-10 - 2010-11-27	1	0	*
	Silver future (CHF)	SI1 COMB Comdty (B)	2010-11-13 - 2010-11-18	2010-11-08 - 2010-11-29	1	0	*
	Sugar future (CHF)	SB1 COMB Comdty (B)	2010-11-20 - 2010-12-09	2010-11-10 - 2010-12-17	1	1	*
Forex	AUDUSD	(B)	2010-11-12 - 2010-12-25	2010-10-30 - 2011-01-12	1	1	*

TABLE III: 25 H2 assets of the Financial Bubble Experiment as of 12 November 2010. All listed assets are candidates for H1 (identified bubble phase) and H2 (identification of end of bubble phase). Quantile windows of most likely dates of the end of the bubble phases are shown. Abbreviations (B), (Y), H1, H2 and C are described in caption of Table II.

We support H2 by confirming that 17 of the 25 H2 assets showed substantial corrections in the quantile windows that we forecast.

A. H1 & H2 Indexes

1. *BSE SENSEX, Bombay*

H1/H2: 0/1

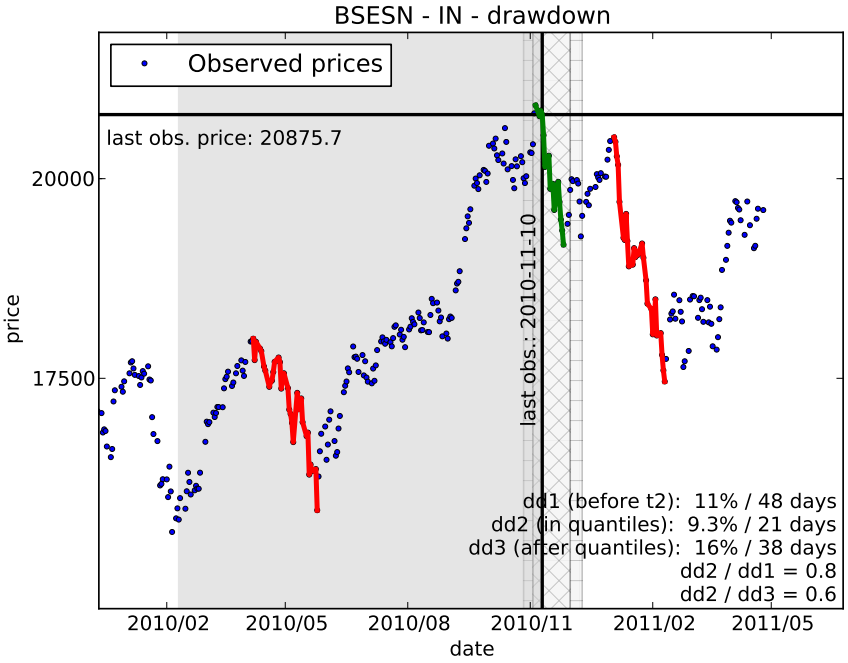


FIG. 7.

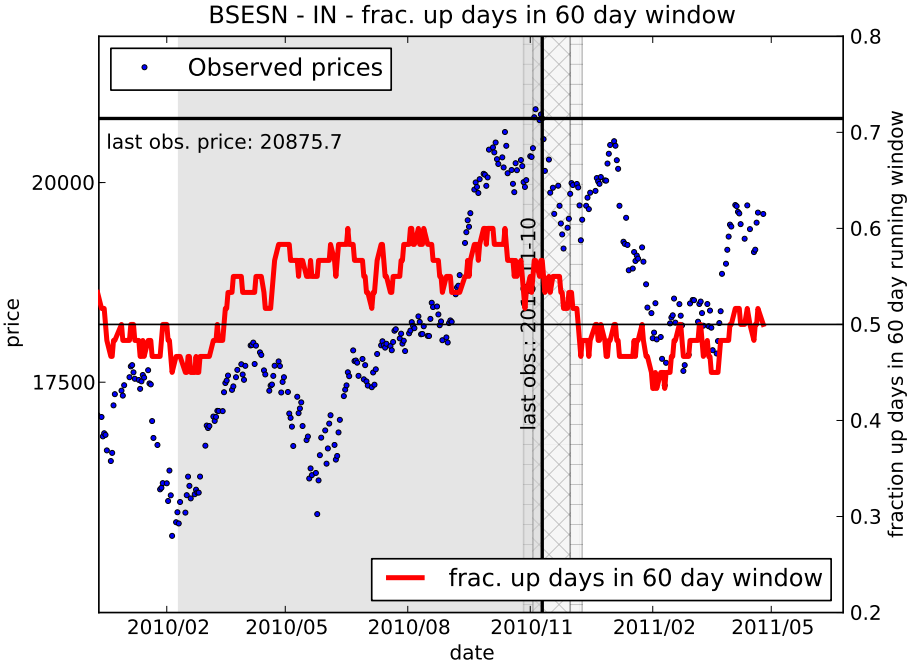


FIG. 8.

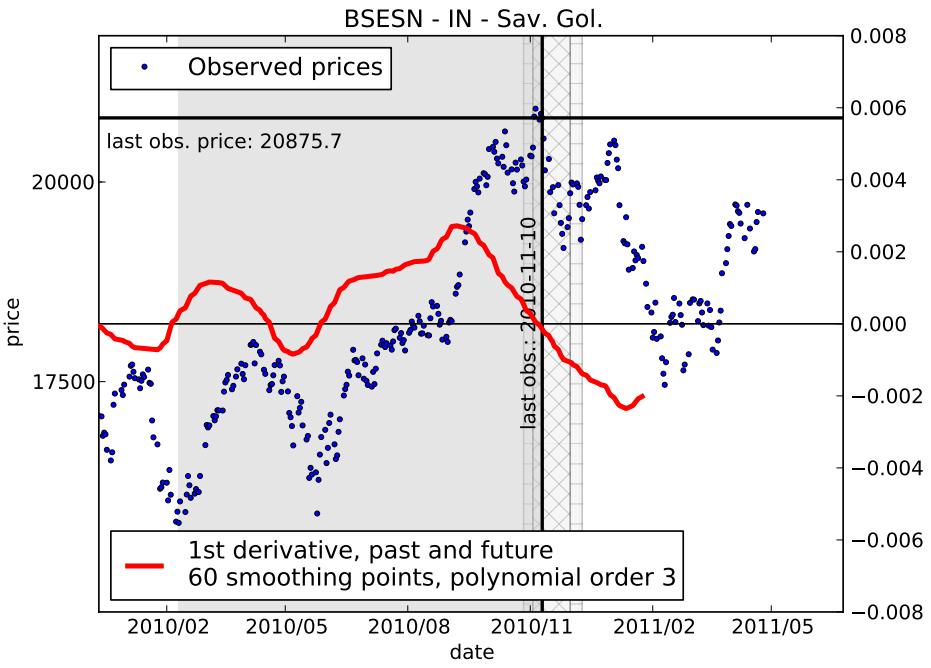

BSESN - IN - Sav. Gol.
Observed prices
last obs. price: 20875.7
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
20000
17500
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 9.

H1/H2: 1/1

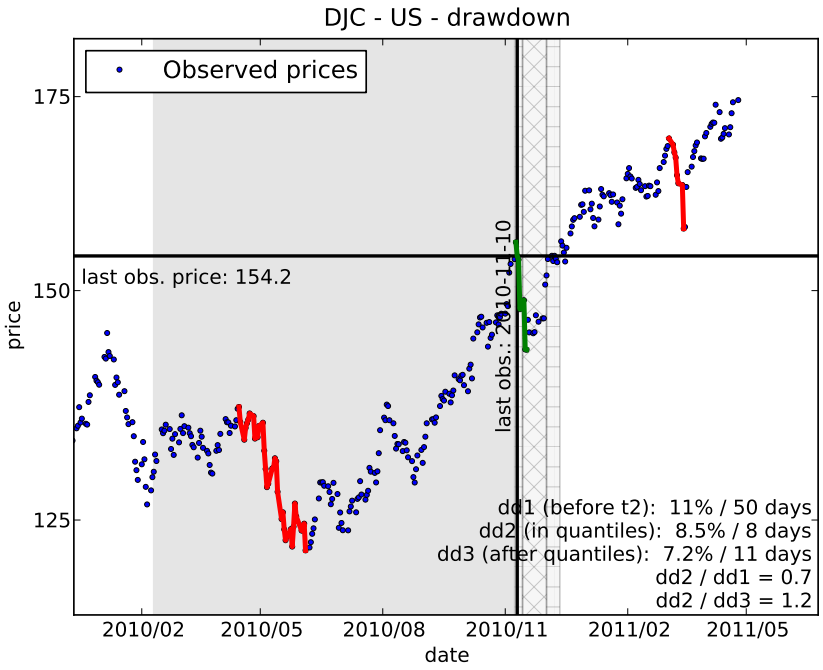


FIG. 10.

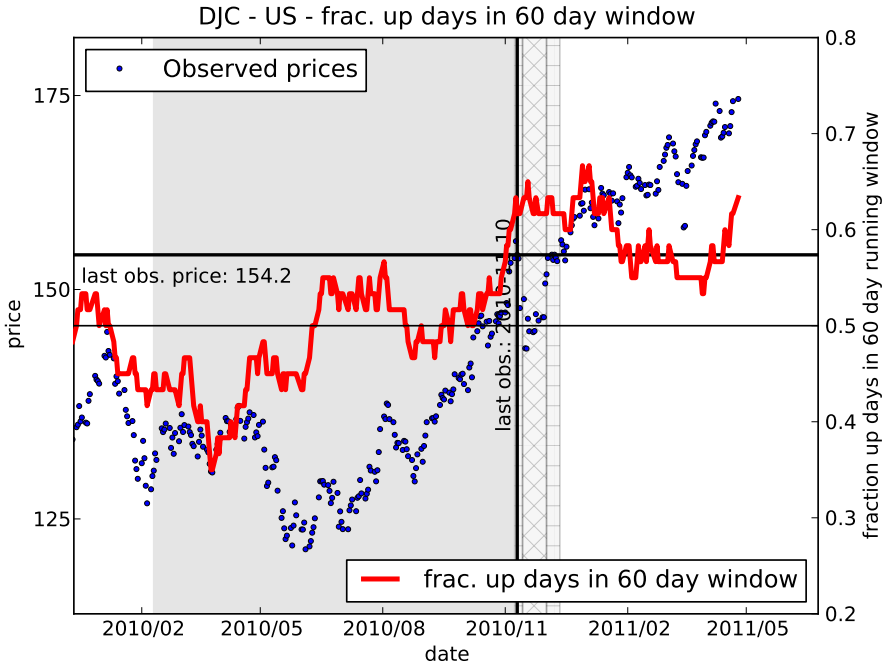


FIG. 11.

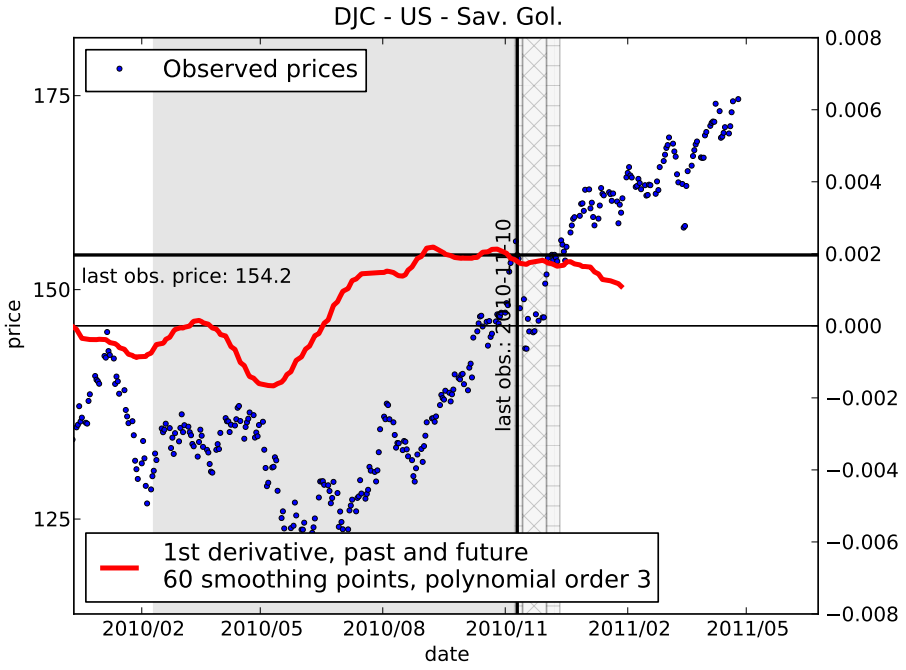

DJC - US - Sav. Gol.
Observed prices
last obs. price: 154.2
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
175
150
125
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 12.

H1/H2: 1/1

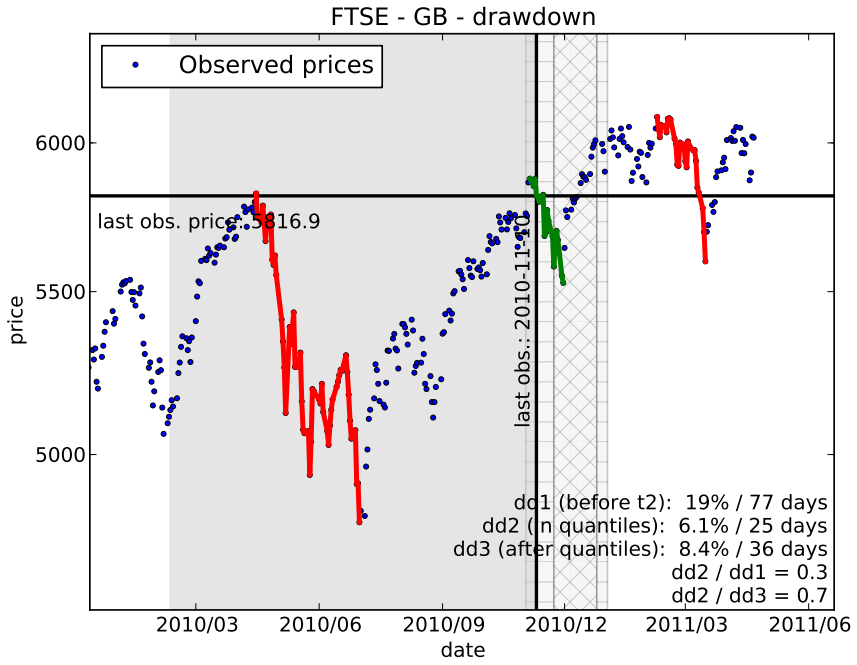


FIG. 13.

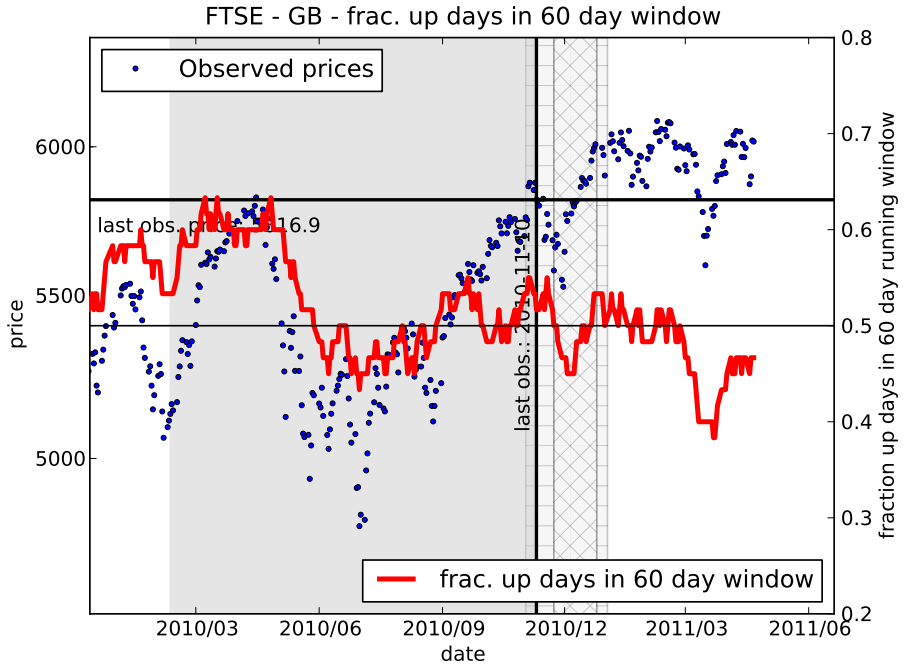


FIG. 14.

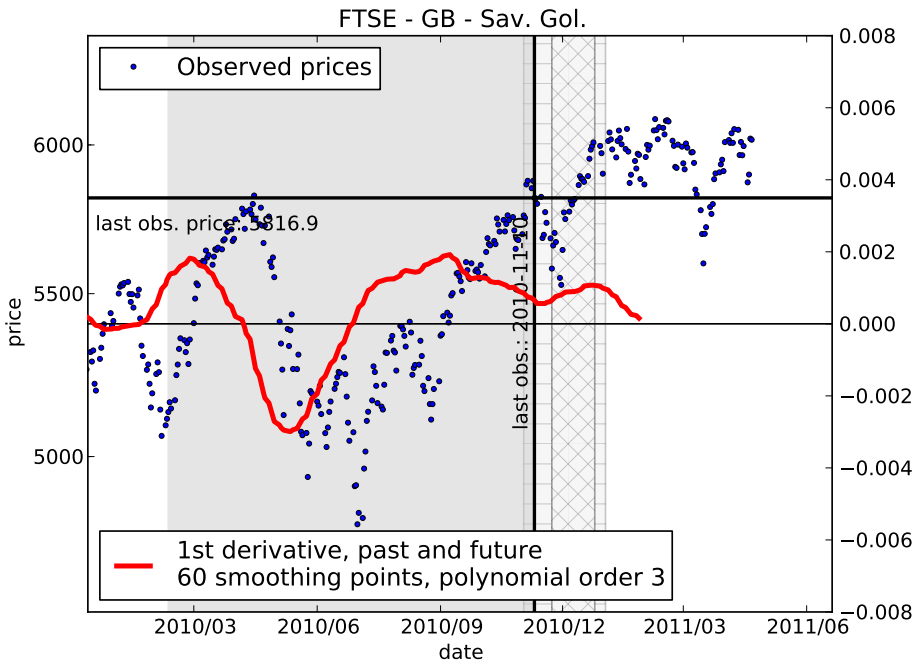

FTSE - GB - Sav. Gol.
Observed prices
last obs. price: 5816.9
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
6000
5500
5000
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/03
2010/06
2010/09
2010/12
2011/03
2011/06

FIG. 15.

H1/H2: 1/1

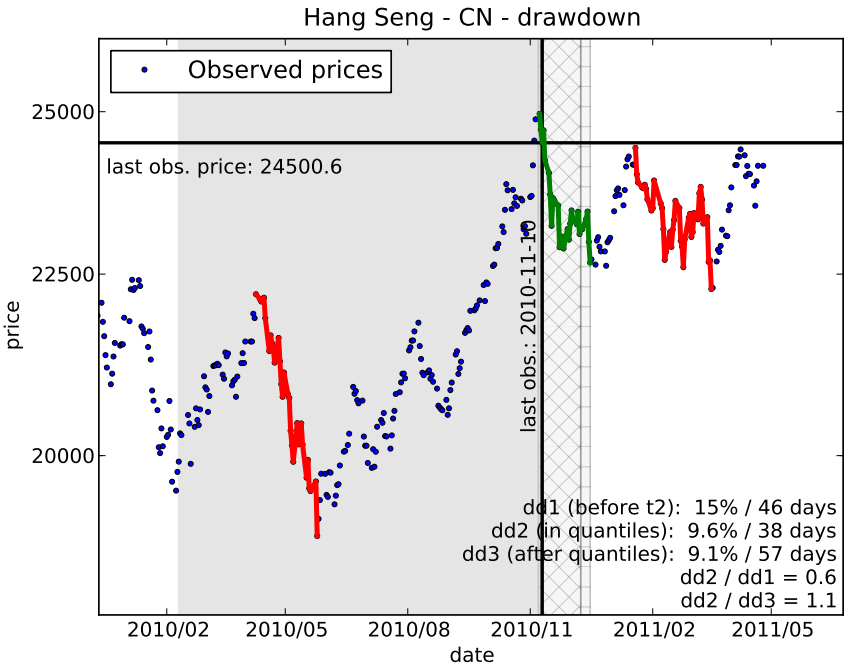


FIG. 16.

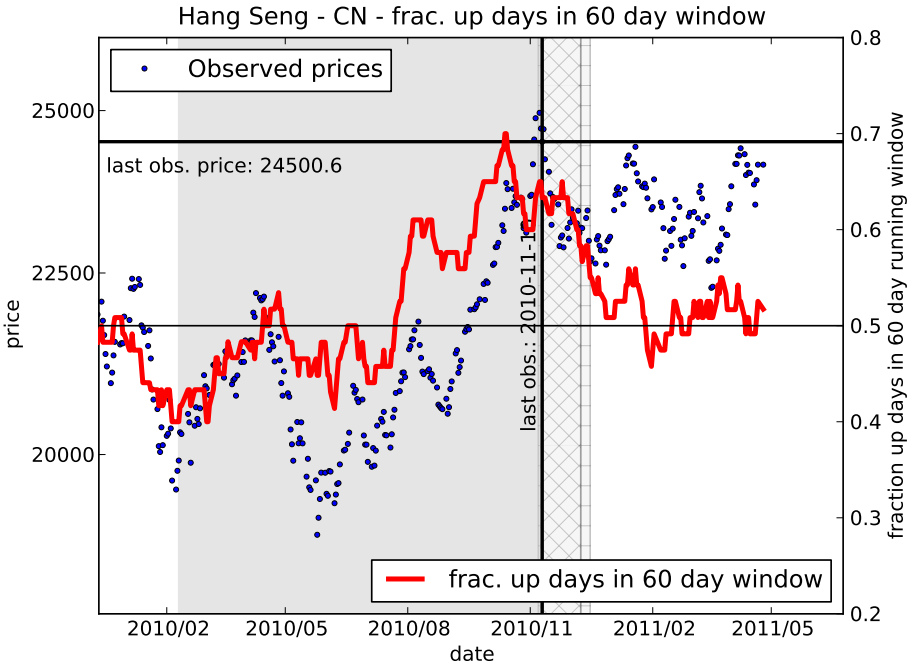


FIG. 17.

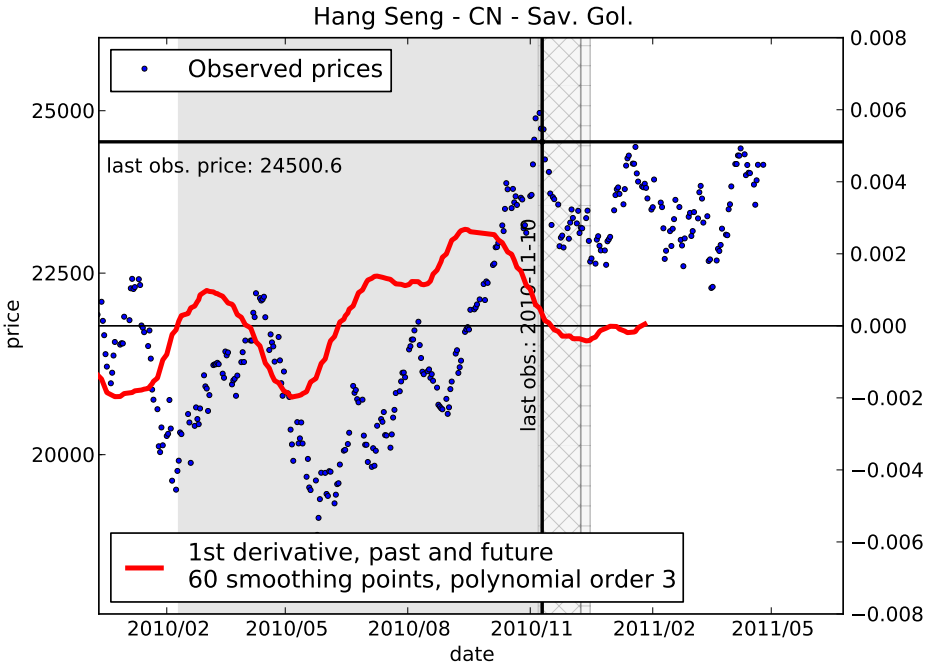

Hang Seng - CN - Sav. Gol.
Observed prices
last obs. price: 24500.6
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
25000
22500
20000
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 18.

H1/H2: 1/1

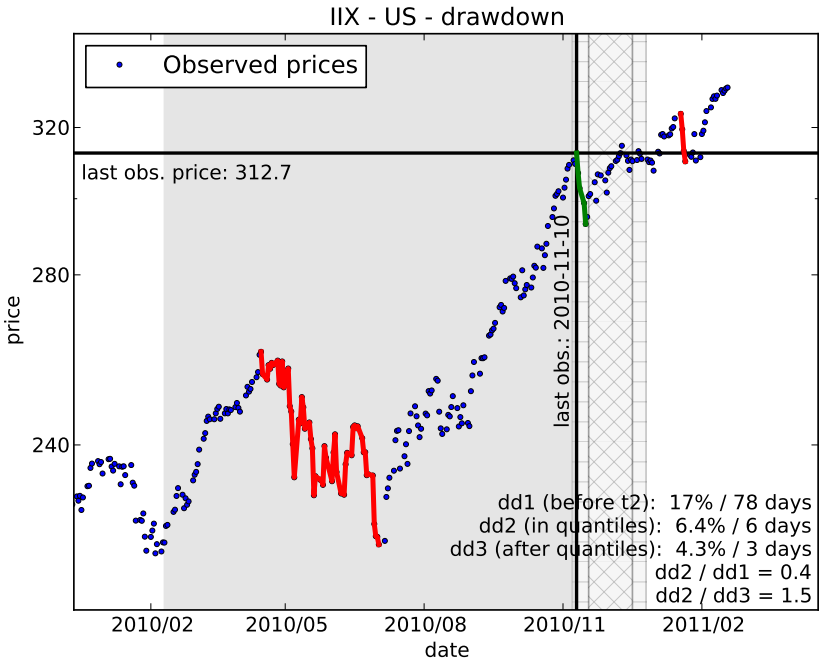


FIG. 19.

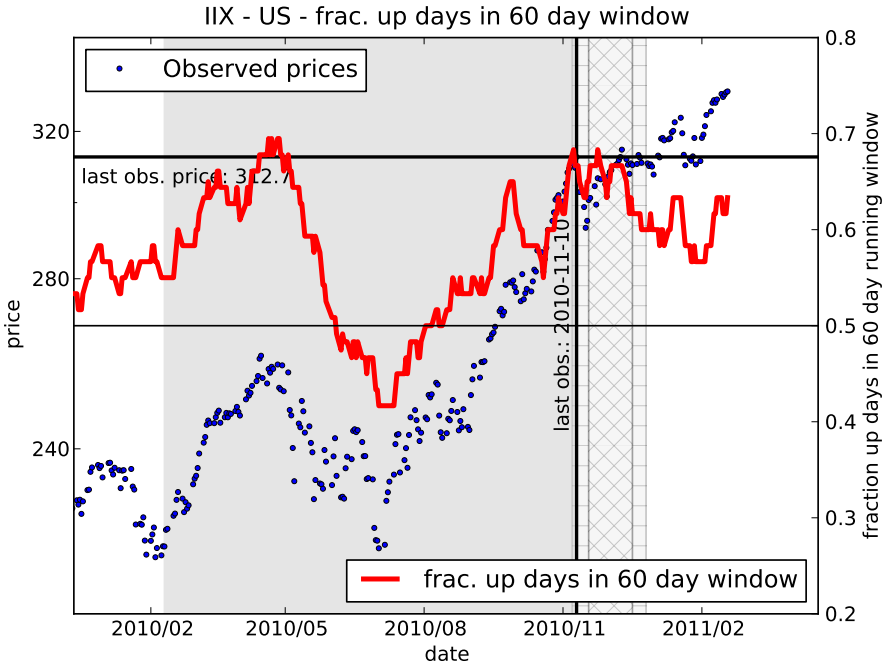


FIG. 20.

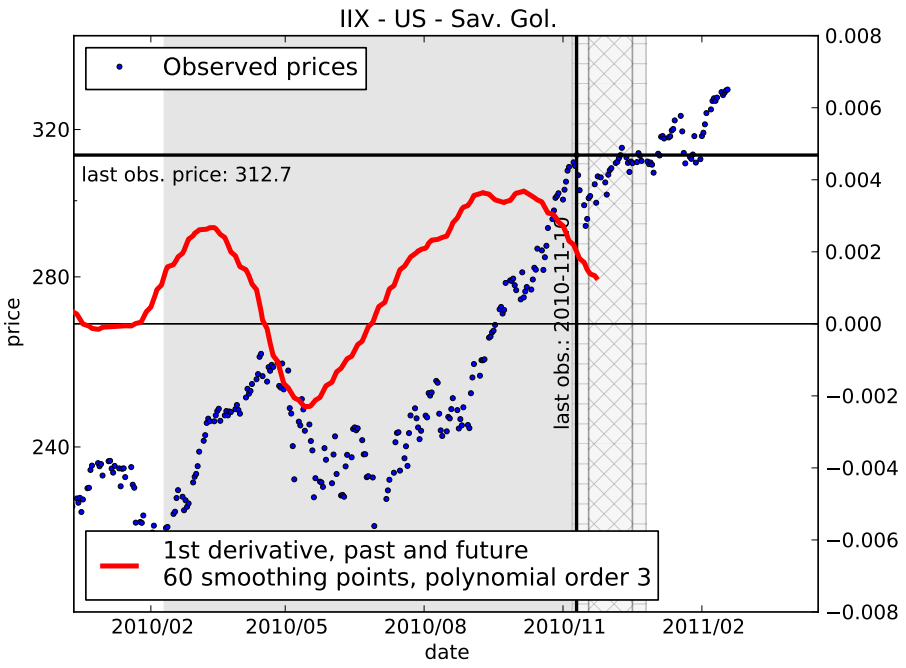

IIX - US - Sav. Gol.
Observed prices
last obs. price: 312.7
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
320
280
240
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02

FIG. 21.

H1/H2: 1/1

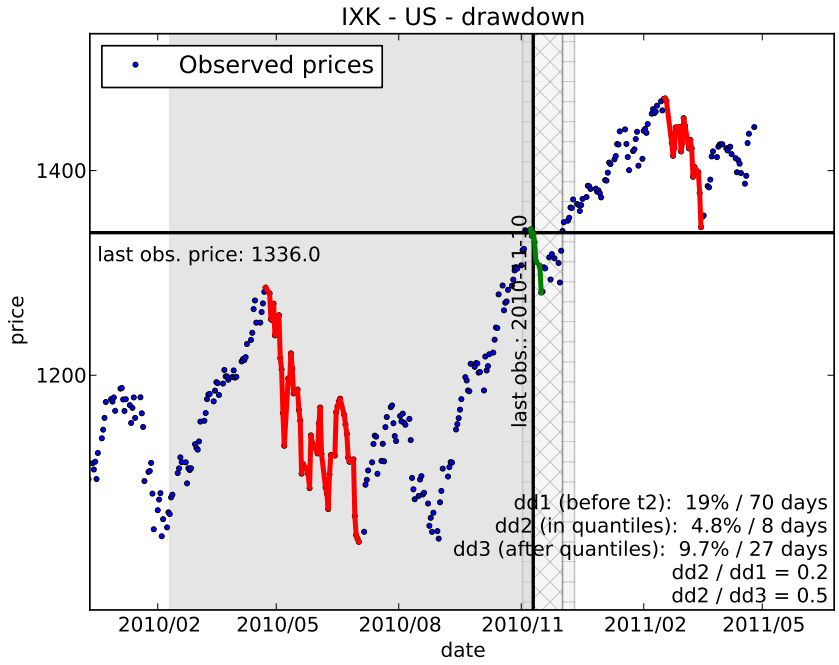


FIG. 22.

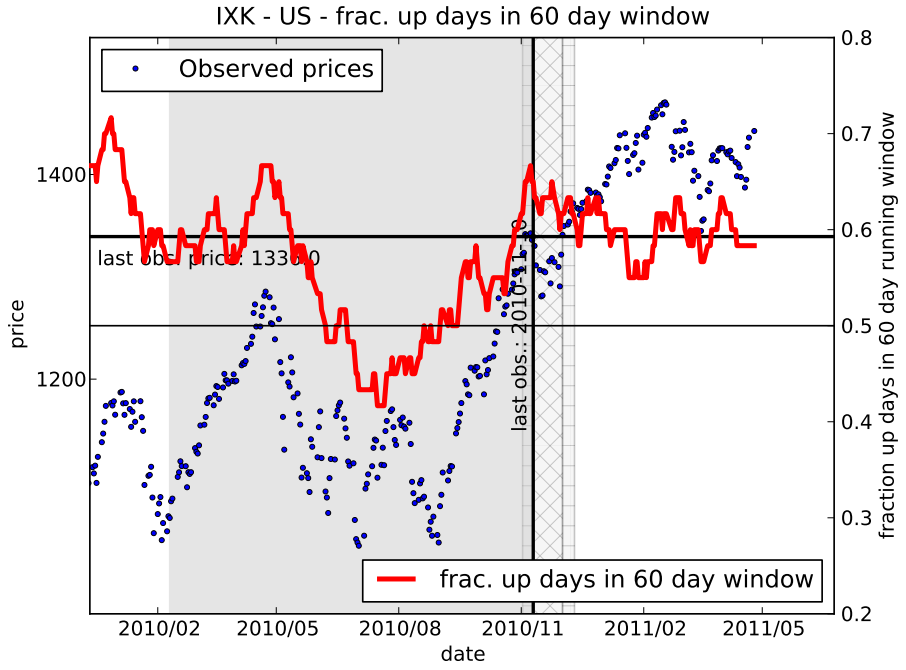


FIG. 23.

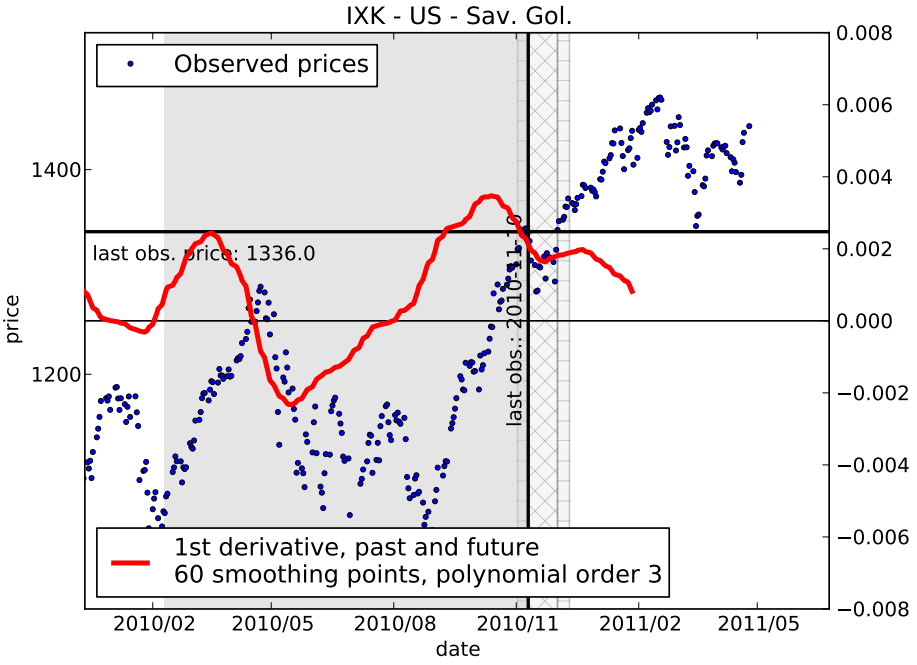

IXK - US - Sav. Gol.
Observed prices
last obs. price: 1336.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
1400
1200
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 24.

H1/H2: 0/0

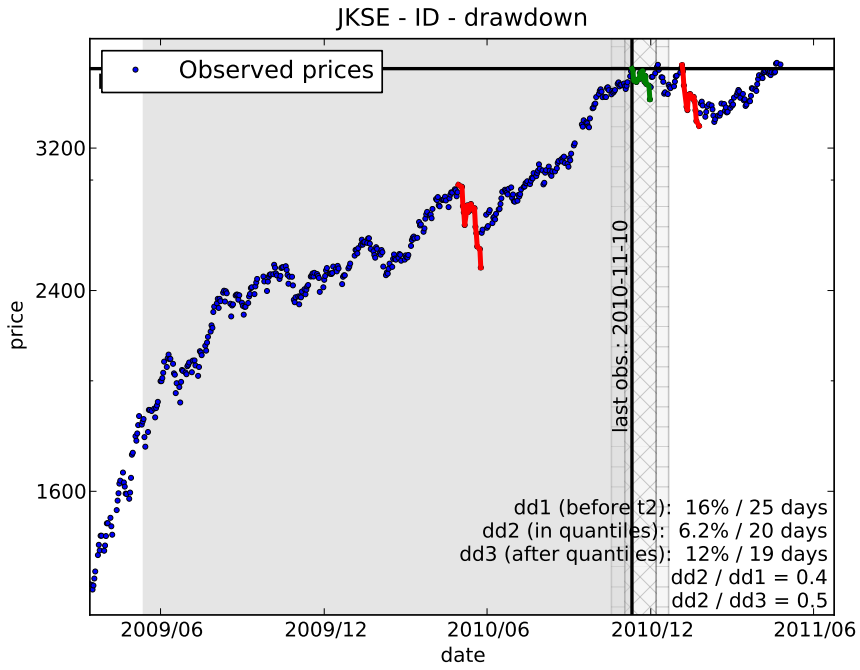


FIG. 25.

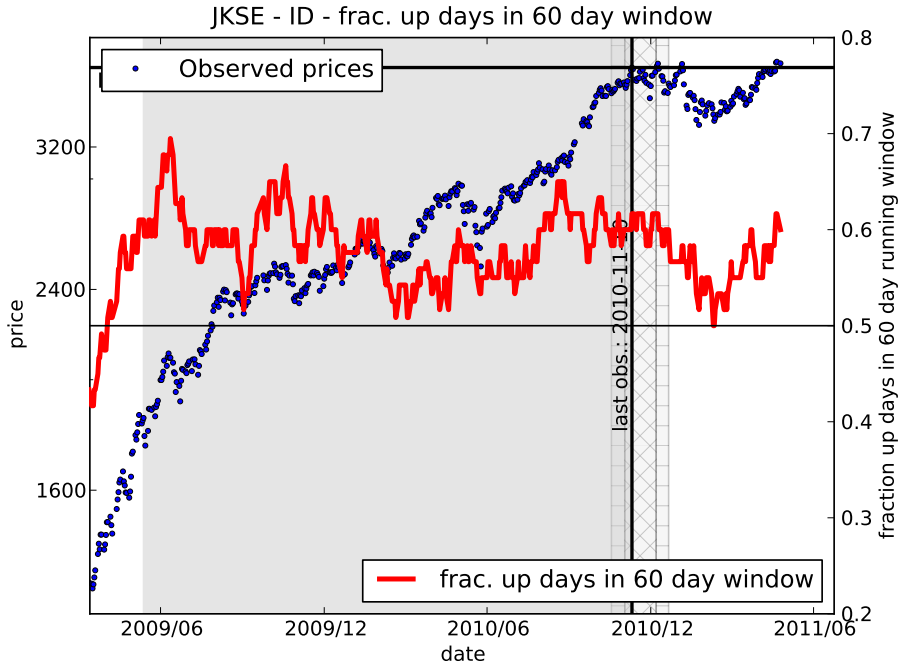


FIG. 26.

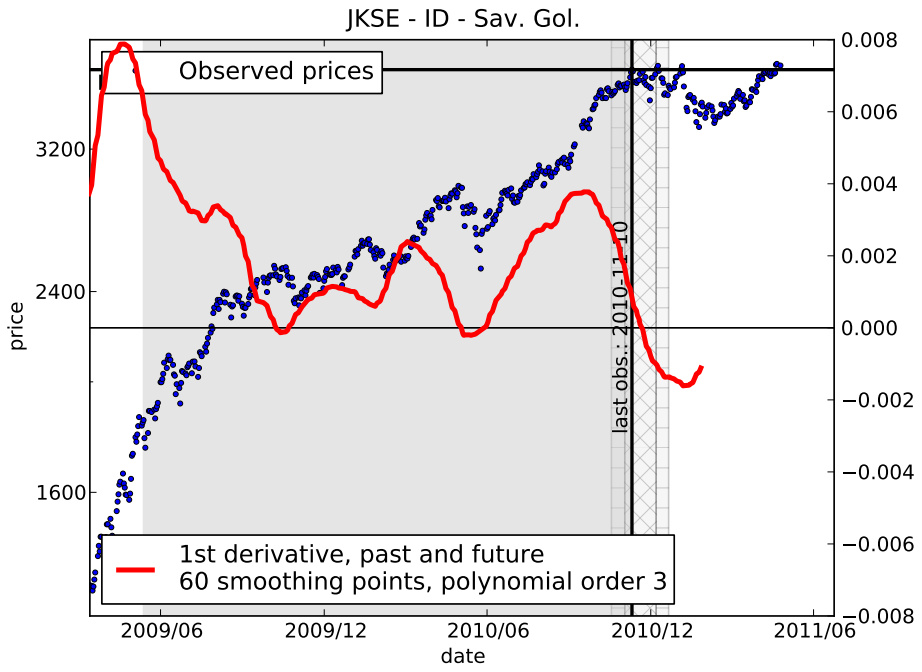

JKSE - ID - Sav. Gol.
Observed prices
1st derivative, past and future
60 smoothing points, polynomial order 3
last obs.: 2010-11-10
price
date
3200
2400
1600
2009/06
2009/12
2010/06
2010/12
2011/06
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008

FIG. 27.

H1/H2: 1/0

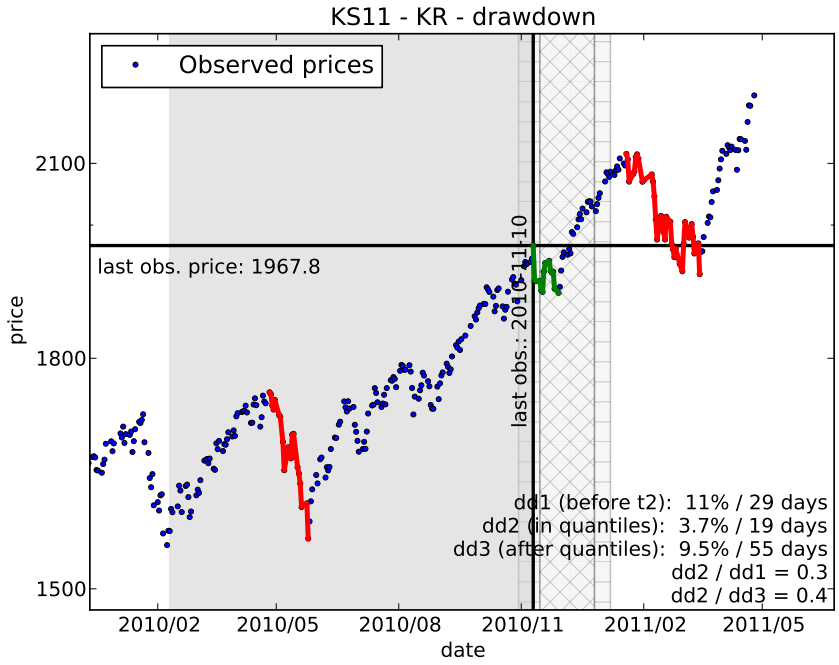


FIG. 28.

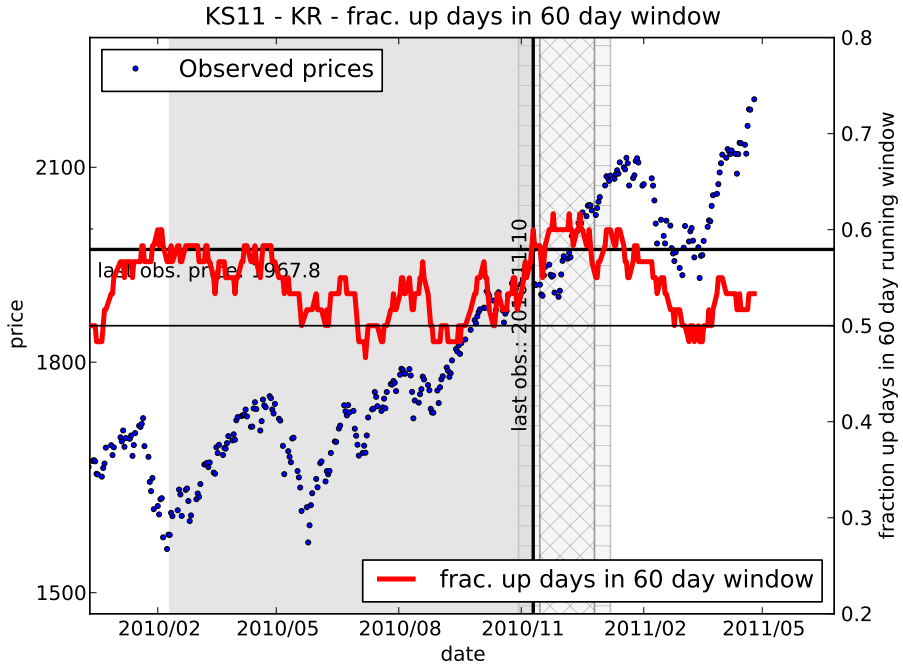


FIG. 29.

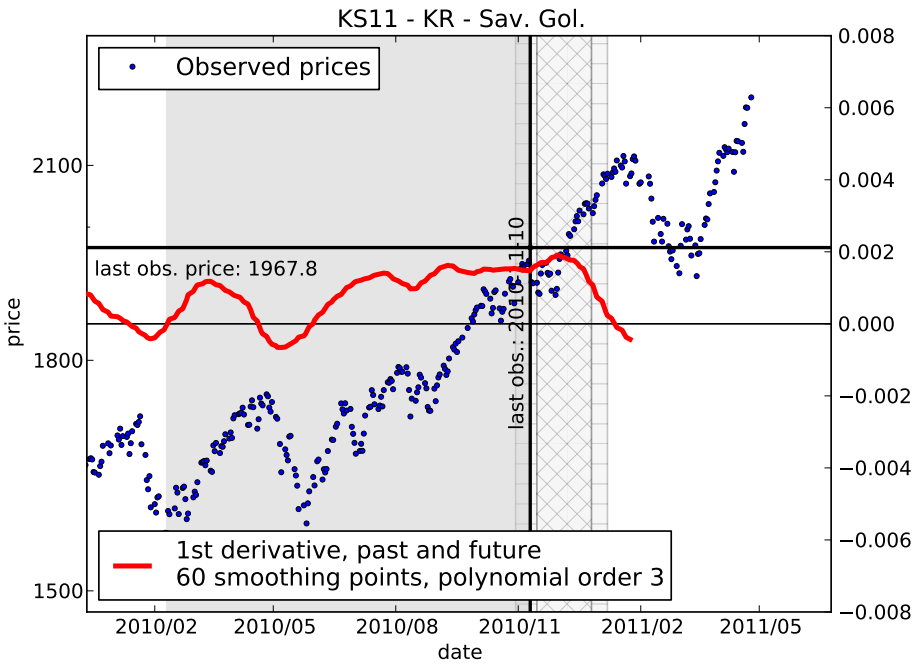

KS11 - KR - Sav. Gol.
Observed prices
last obs. price: 1967.8
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
2100
1800
1500
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008

FIG. 30.

H1/H2: 1/1

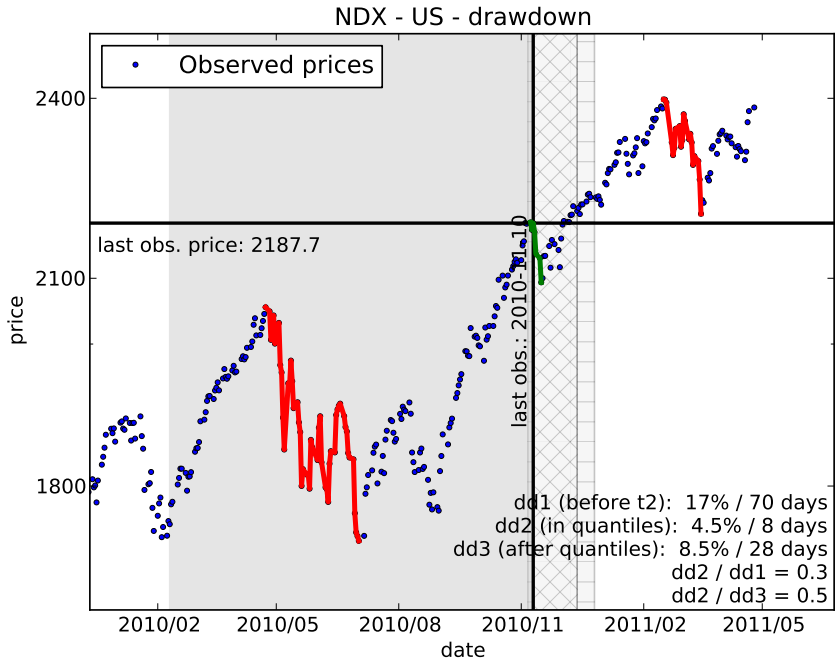


FIG. 31.

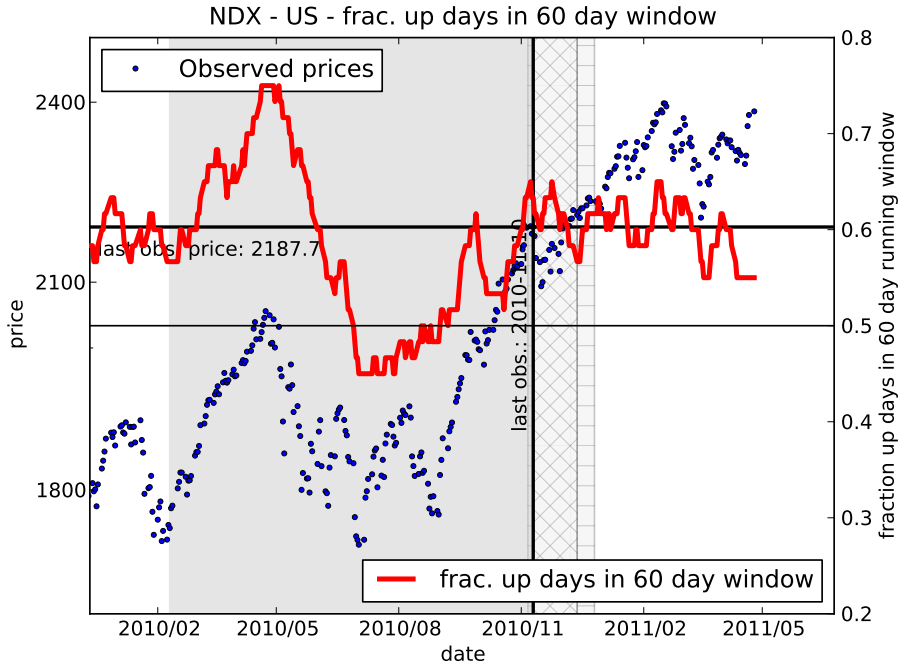


FIG. 32.

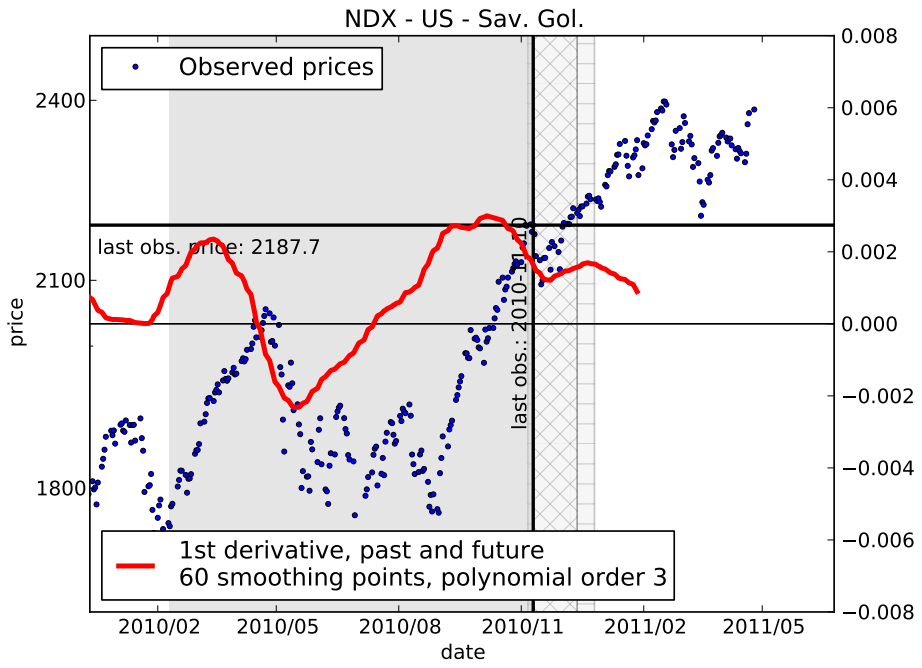

NDX - US - Sav. Gol.
Observed prices
last obs. price: 2187.7
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
2400
2100
1800
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 33.

H1/H2: 1/1

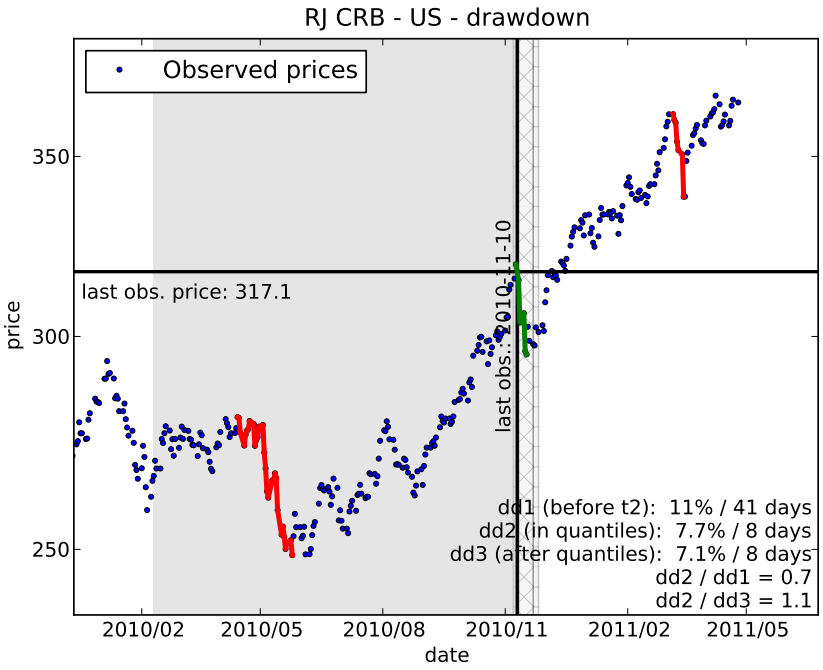


FIG. 34.

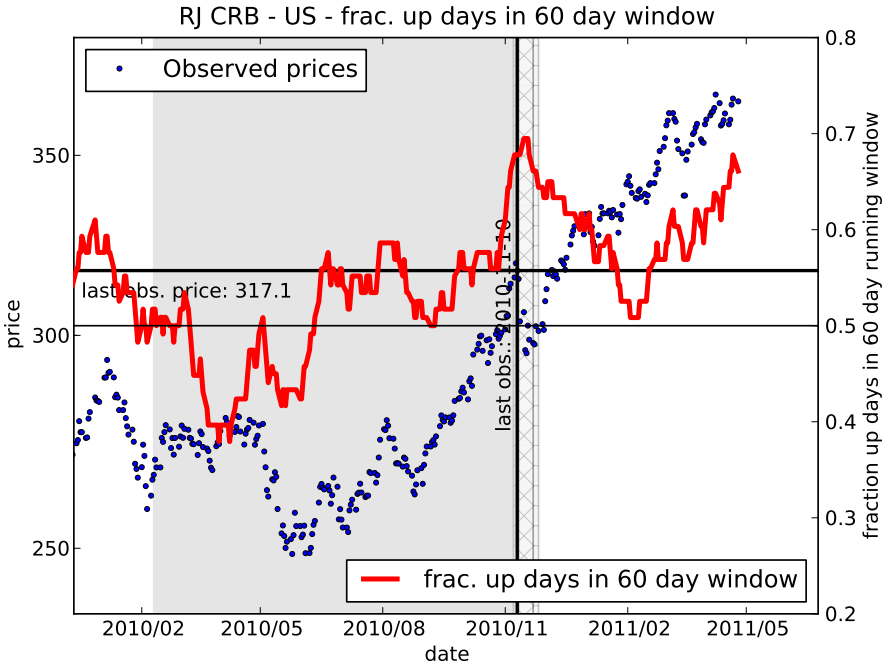


FIG. 35.

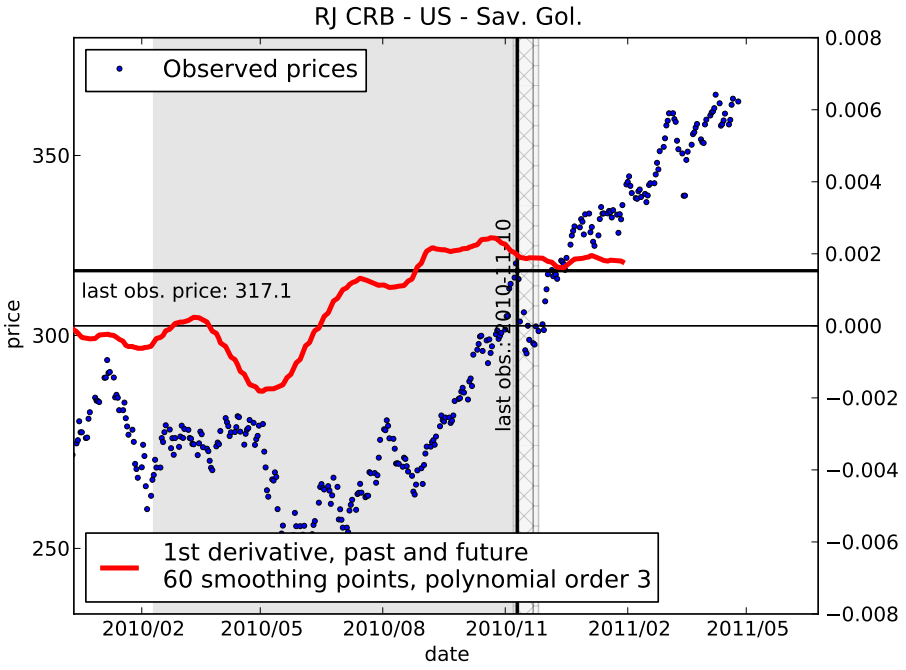

RJ CRB - US - Sav. Gol.
Observed prices
last obs. price: 317.1
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
350
300
250
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 36.

H1/H2: 1/-1

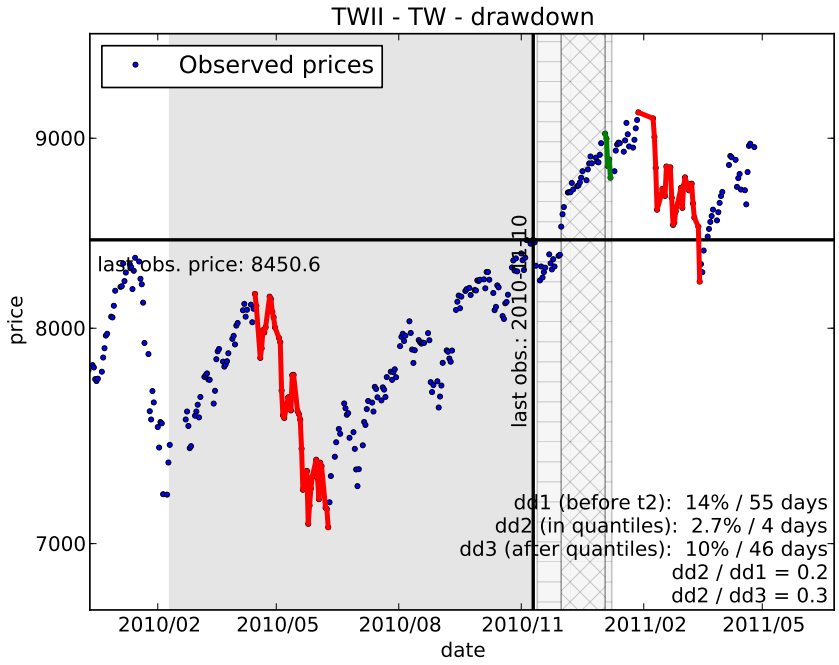


FIG. 37.

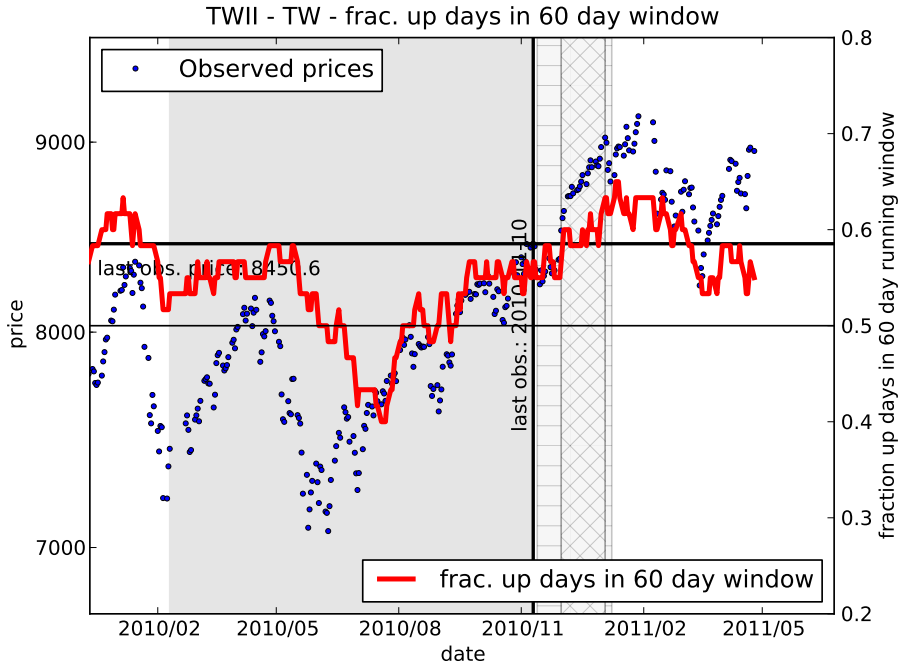


FIG. 38.

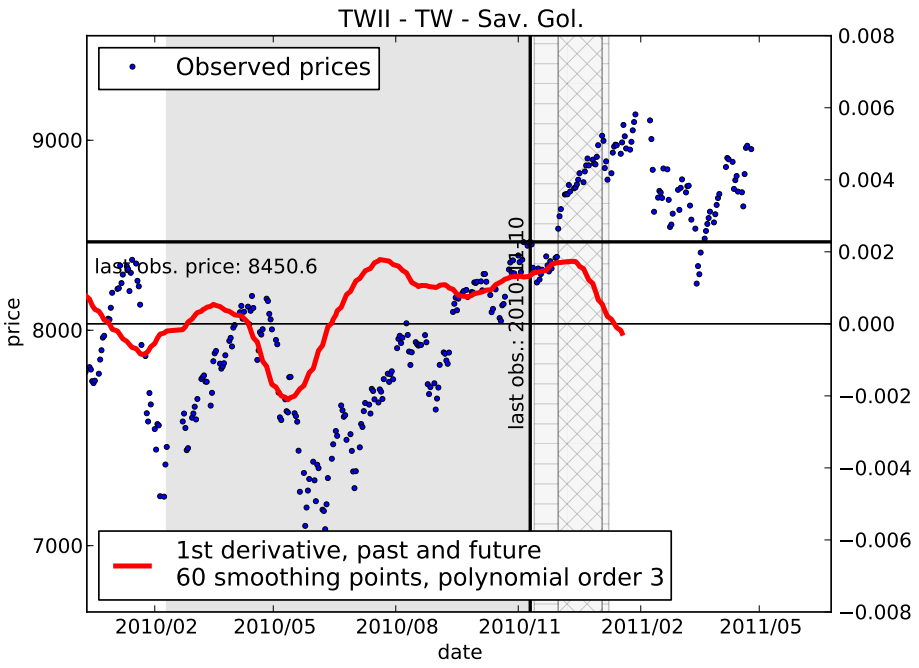

TWII - TW - Sav. Gol.
Observed prices
last obs. price: 8450.6
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
9000
8000
7000
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 39.

H1/H2: 1/1

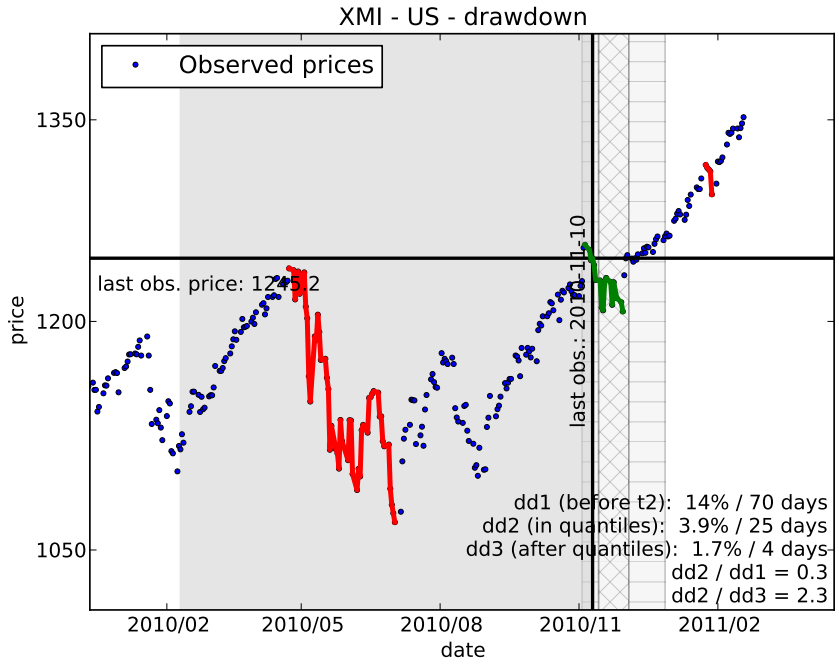


FIG. 40.

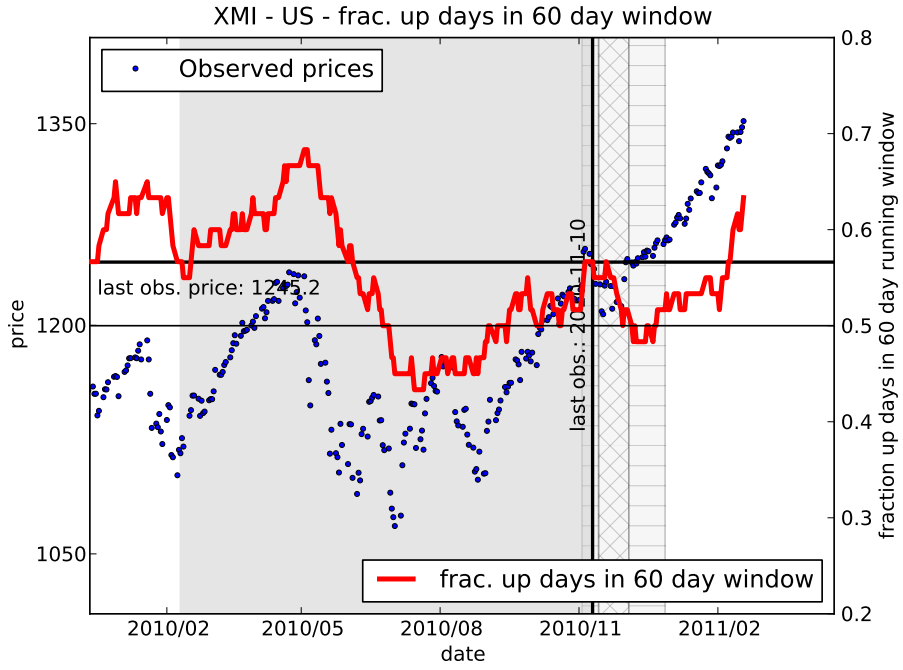


FIG. 41.

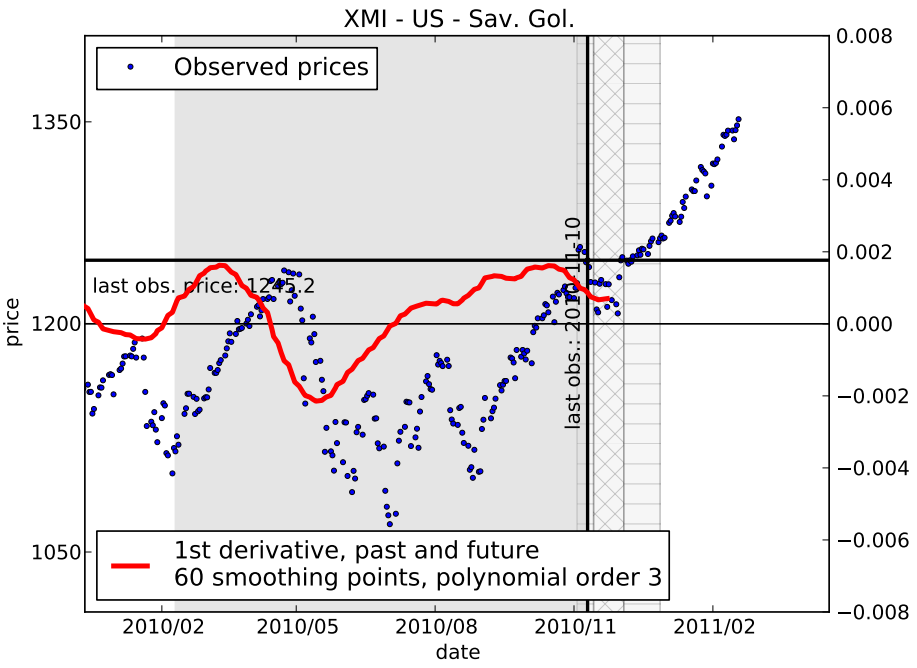

XMI - US - Sav. Gol.
Observed prices
last obs. price: 1245.2
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
1350
1200
1050
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02

FIG. 42.

B. H1 & H2 Equities

1. *Ishares Singapore Index*

H1/H2: 1/1

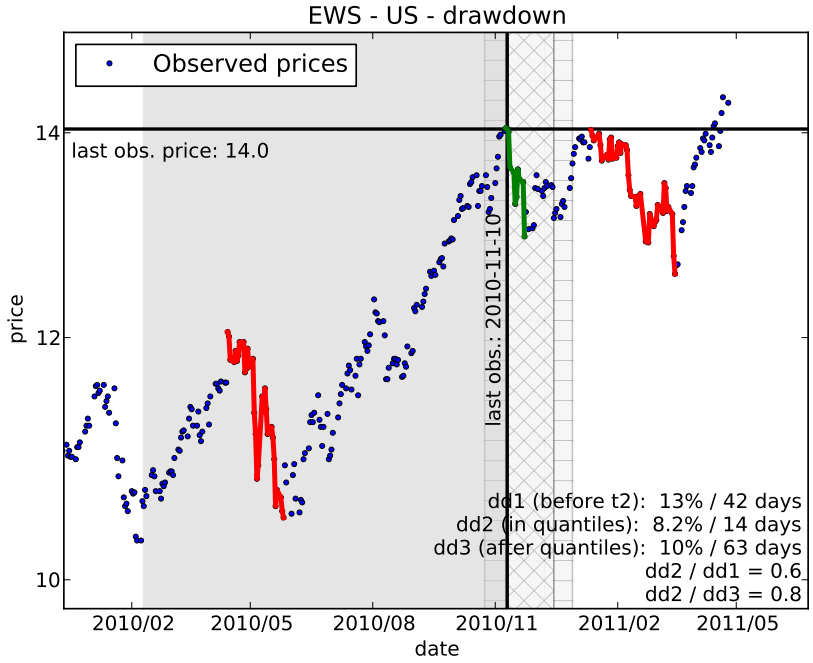


FIG. 43.

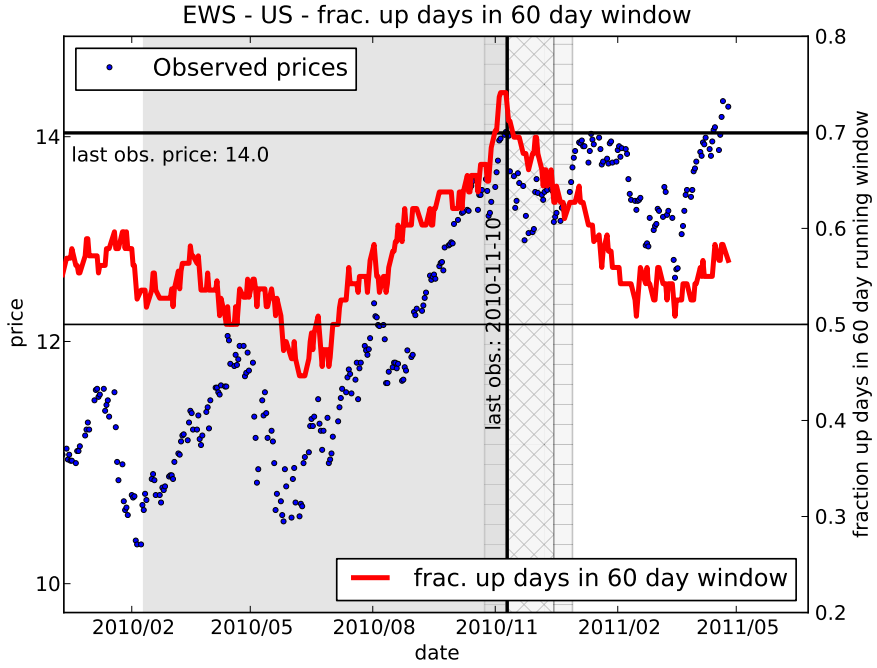


FIG. 44.

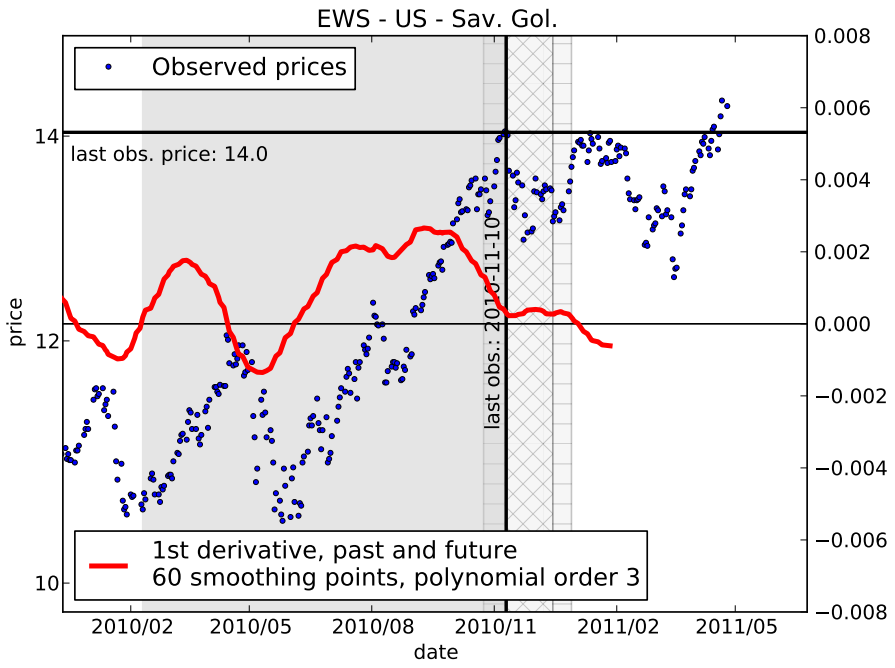

EWS - US - Sav. Gol.
Observed prices
last obs. price: 14.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
14
12
10
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008

FIG. 45.

H1/H2: 1/1

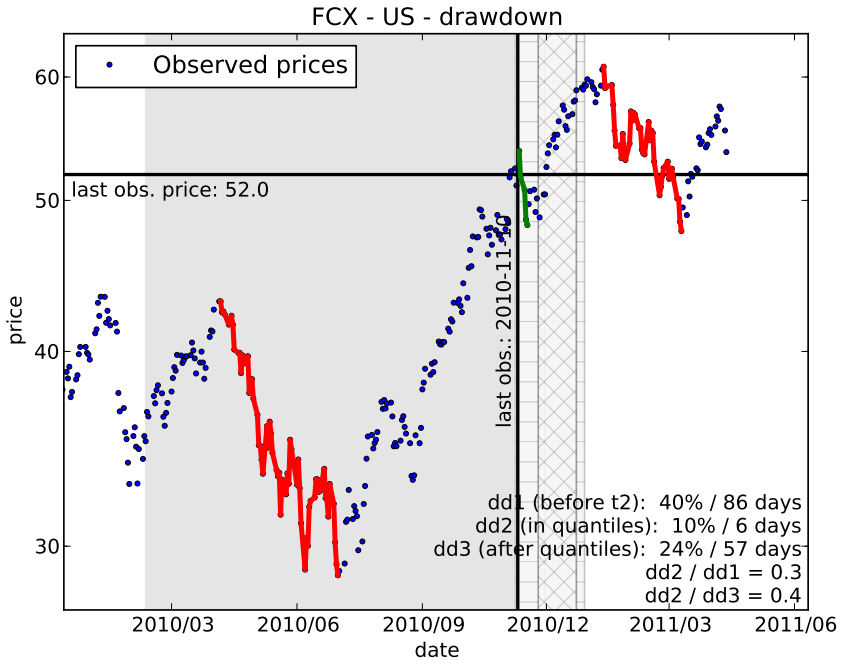


FIG. 46.

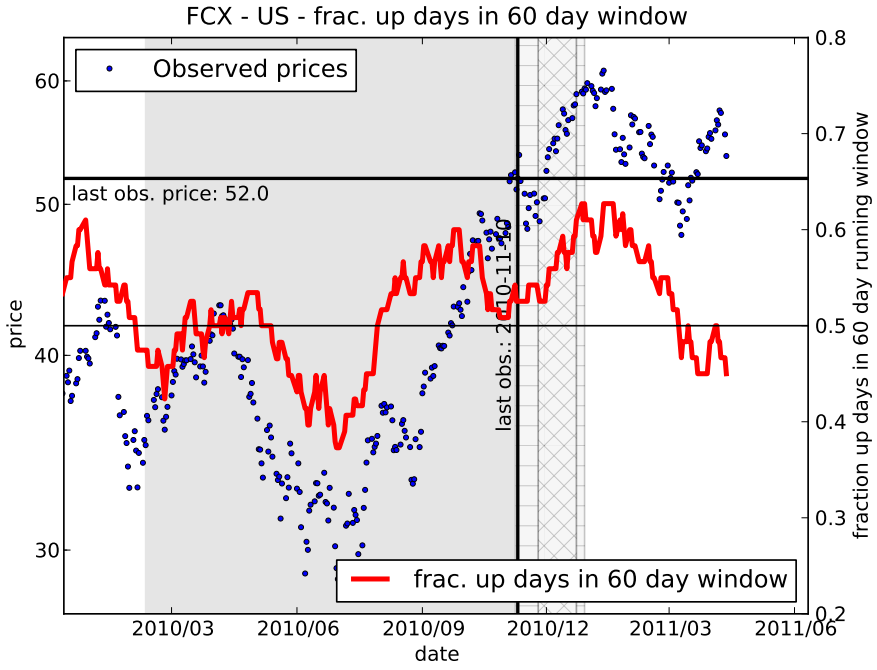


FIG. 47.

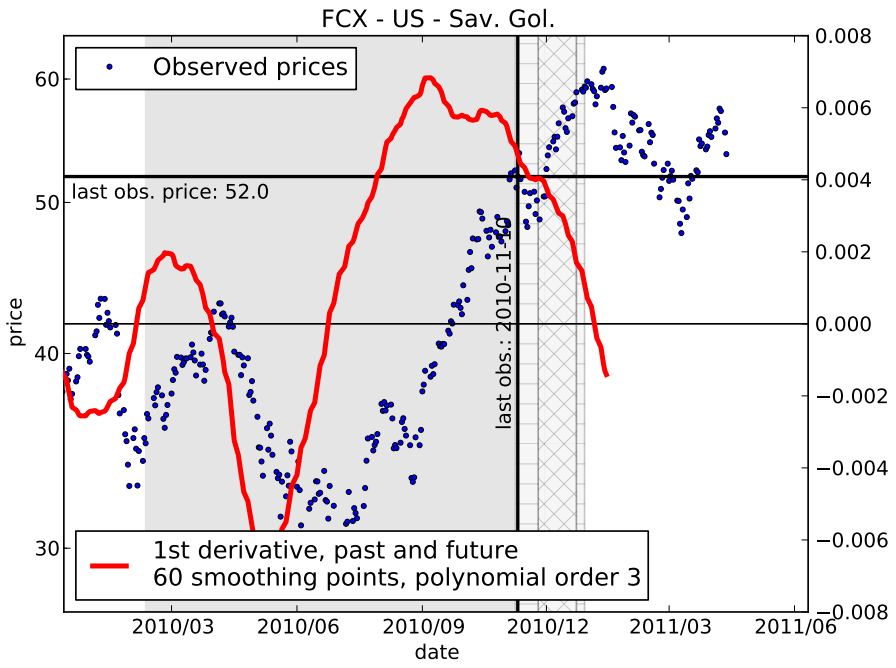

FCX - US - Sav. Gol.
Observed prices
last obs. price: 52.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
60
50
40
30
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/03
2010/06
2010/09
2010/12
2011/03
2011/06

FIG. 48.

H1/H2: 1/1

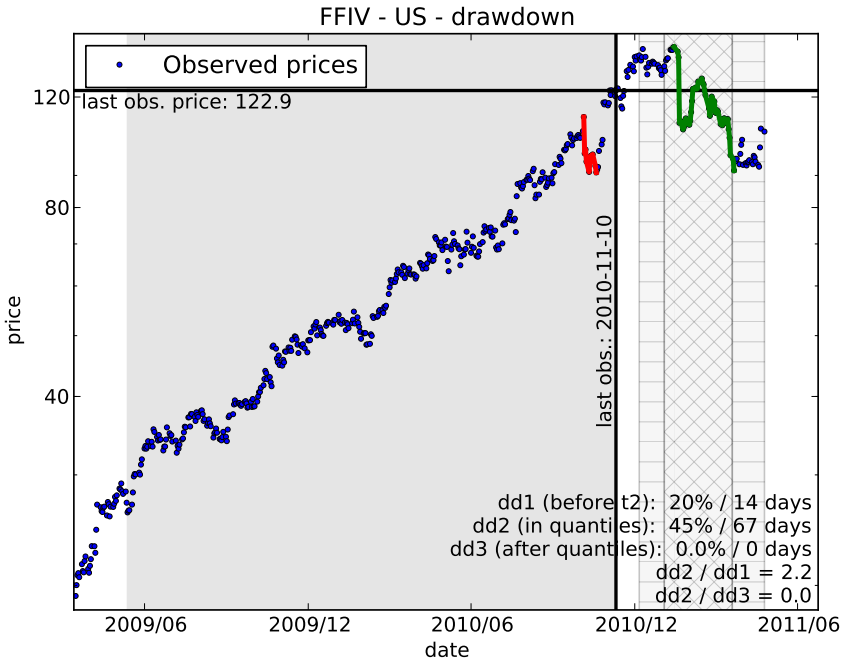


FIG. 49.

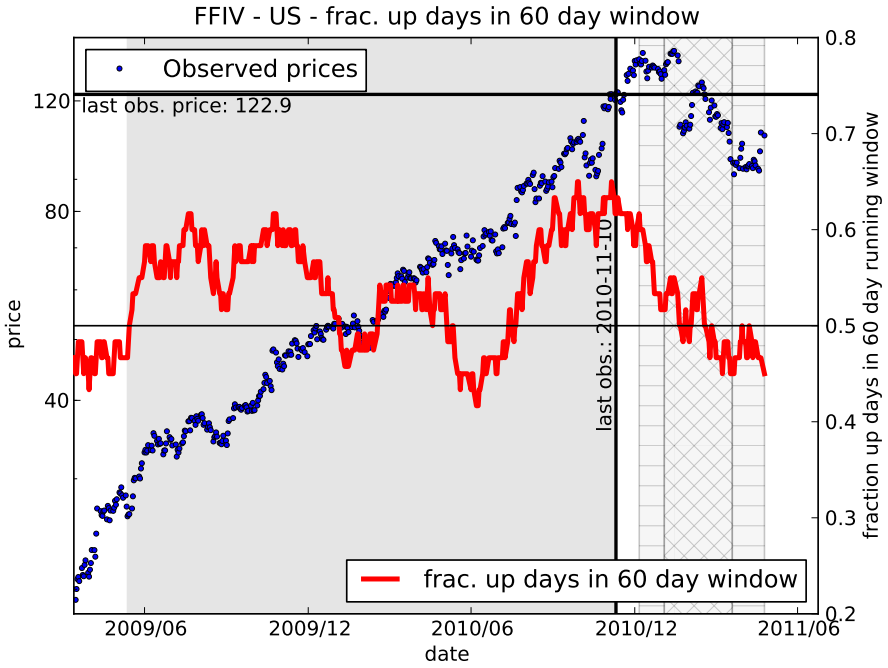


FIG. 50.

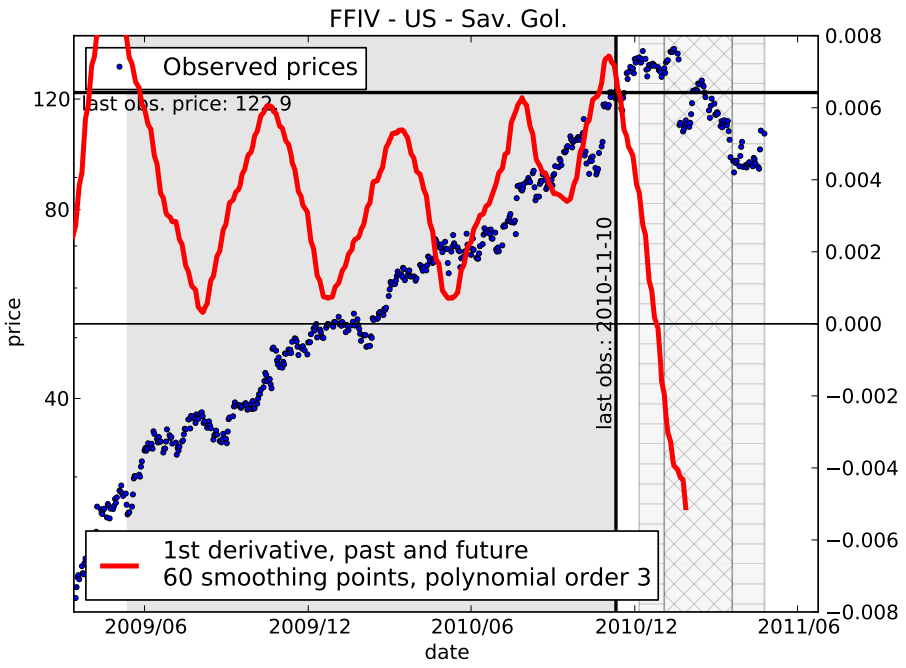

FFIV - US - Sav. Gol.
Observed prices
last obs. price: 122.9
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
120
80
40
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2009/06
2009/12
2010/06
2010/12
2011/06

FIG. 51.

H1/H2: 0/0

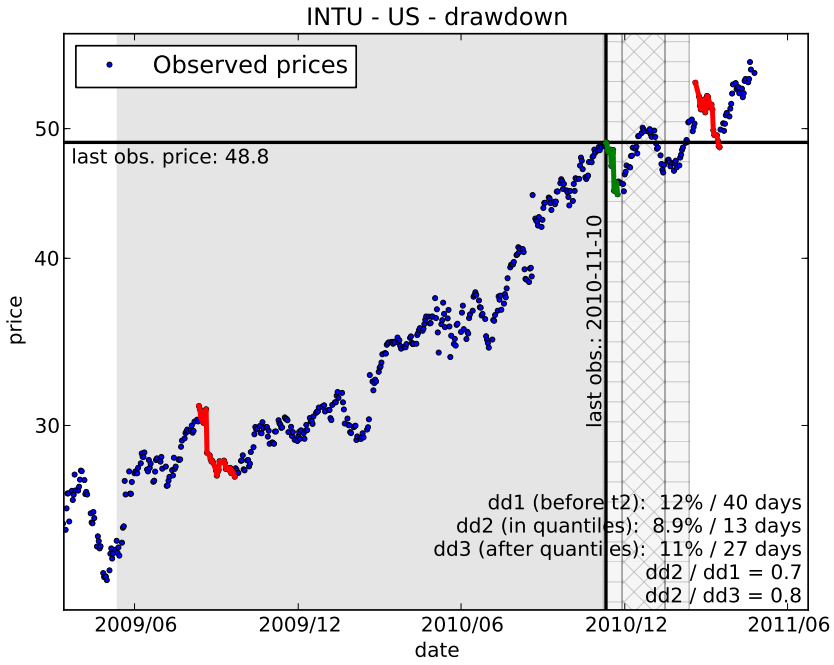


FIG. 52.

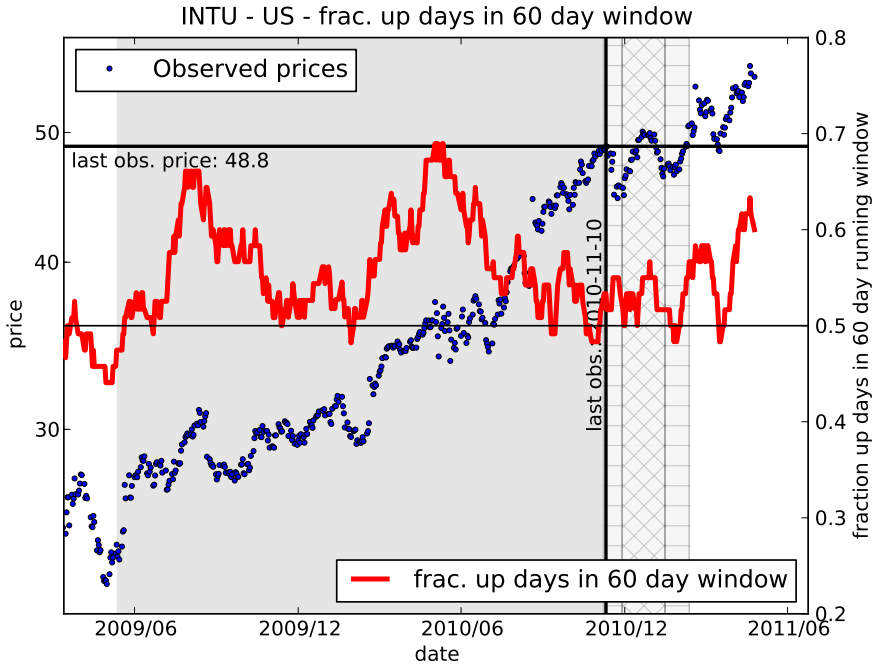


FIG. 53.

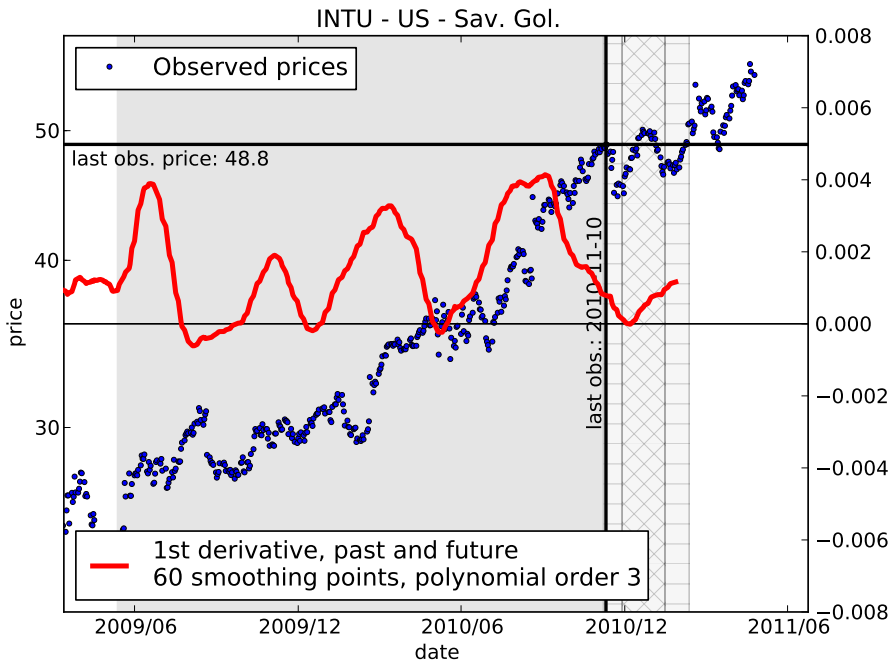

INTU - US - Sav. Gol.
Observed prices
last obs. price: 48.8
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
50
40
30
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2009/06
2009/12
2010/06
2010/12
2011/06

FIG. 54.

H1/H2: 1/-1

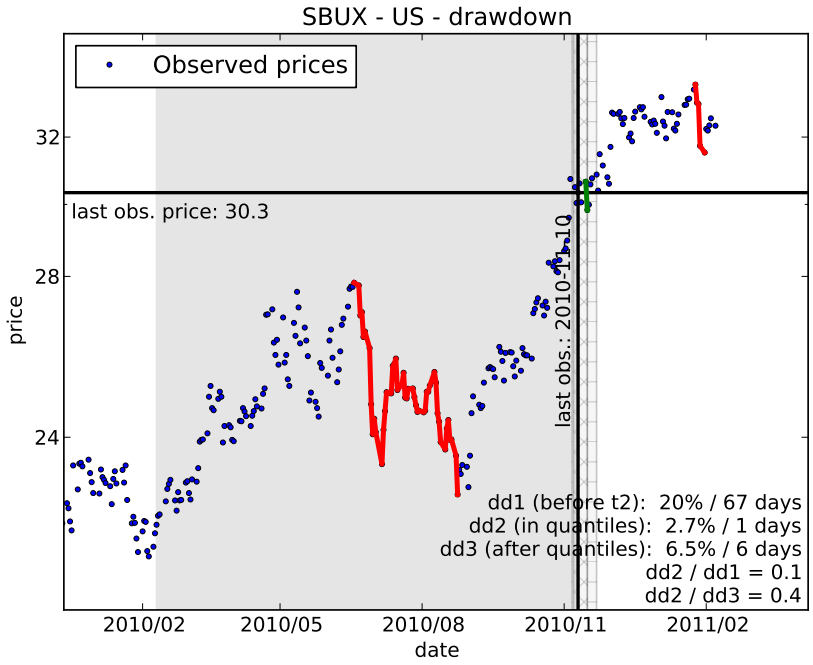


FIG. 55.

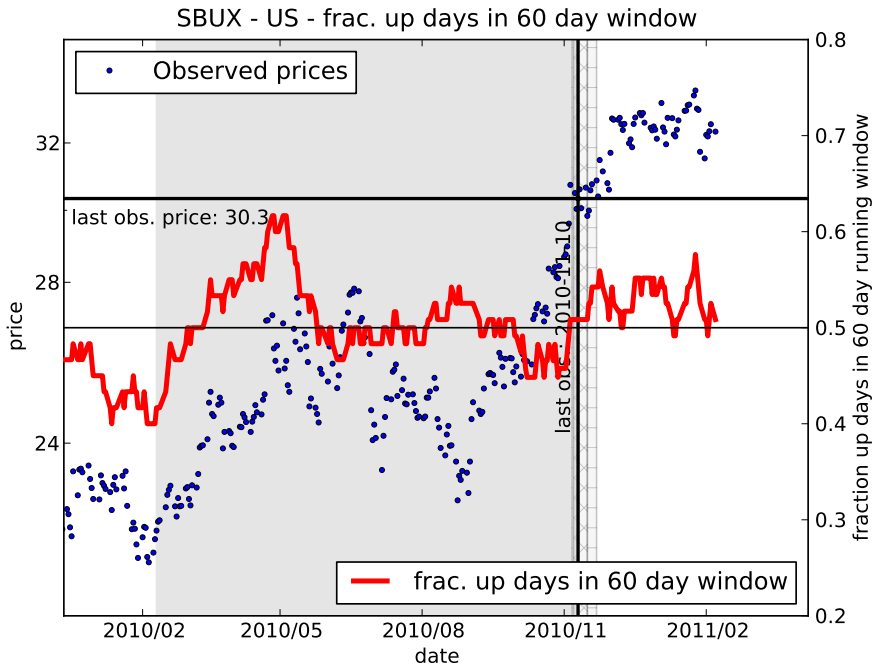


FIG. 56.

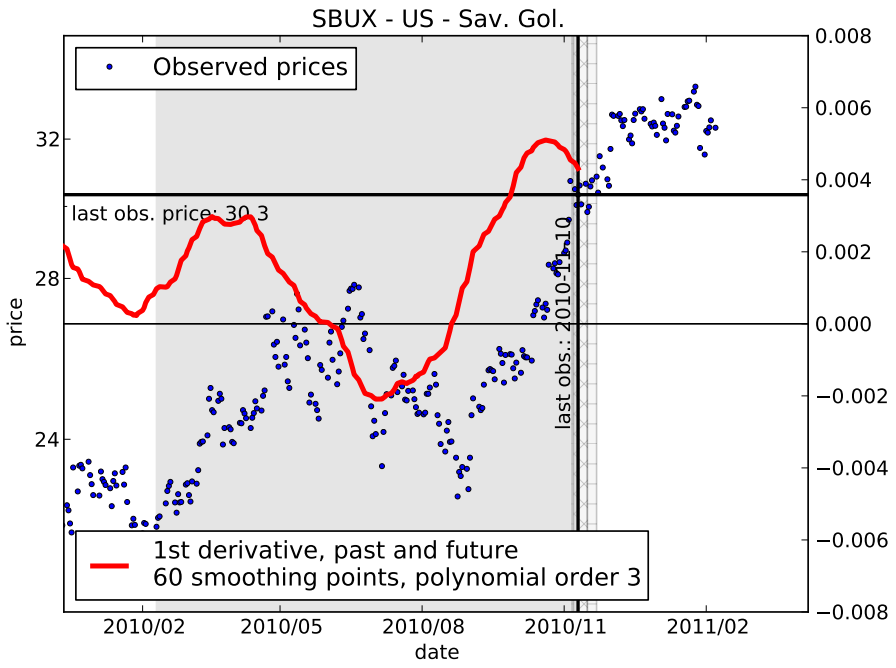

SBUX - US - Sav. Gol.
Observed prices
last obs. price: 30.3
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
32
28
24
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02

FIG. 57.

H1/H2: 1/-1

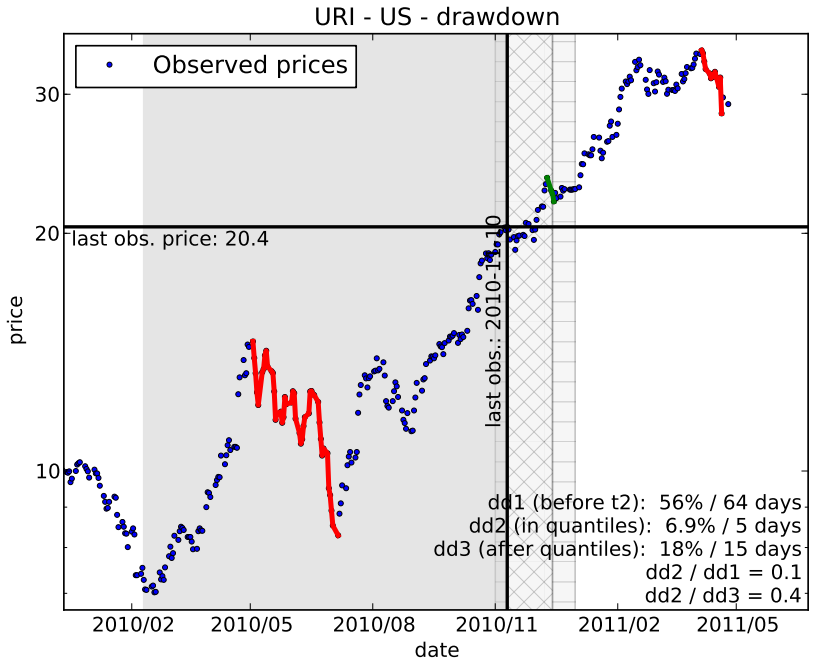


FIG. 58.

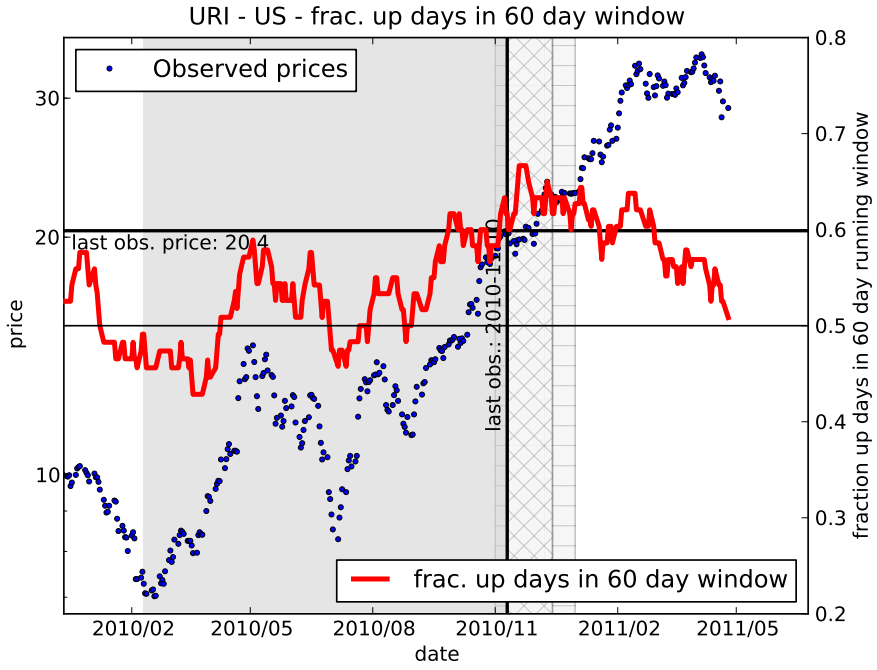


FIG. 59.

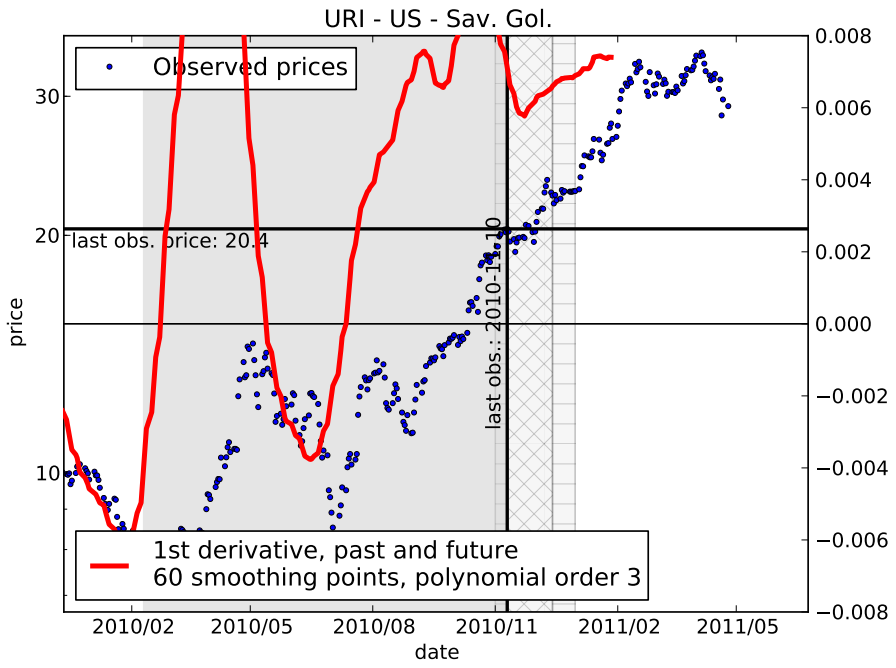

URI - US - Sav. Gol.
Observed prices
last obs. price: 20.4
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
30
20
10
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 60.

C. H1 & H2 Commodities

1. *Copper future (USD)*

H1/H2: 1/1

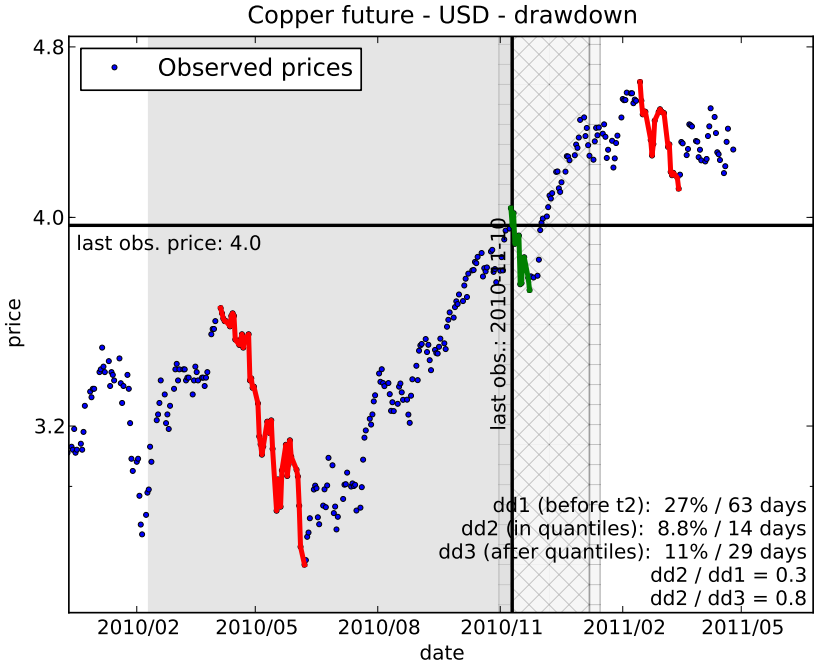


FIG. 61.

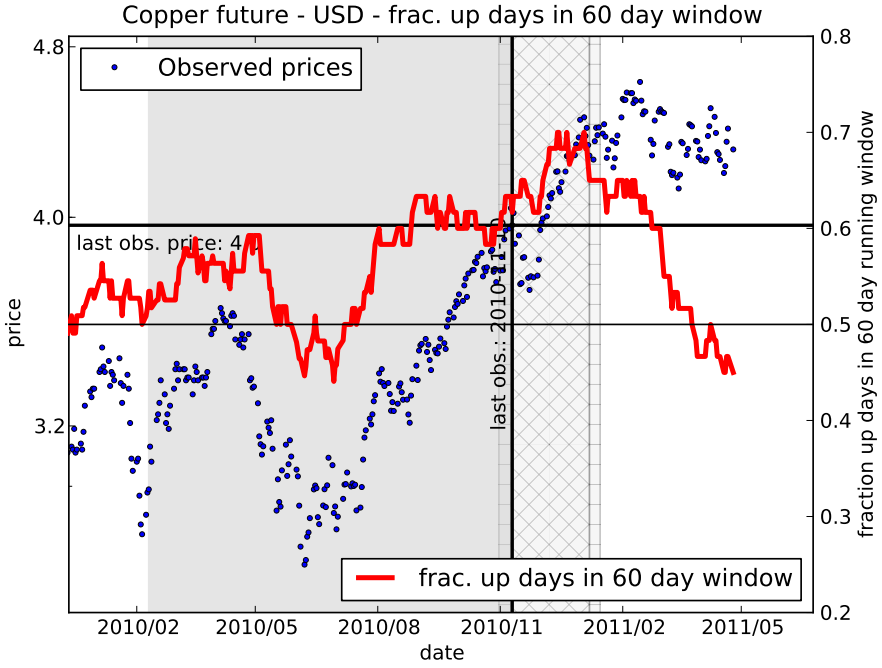


FIG. 62.

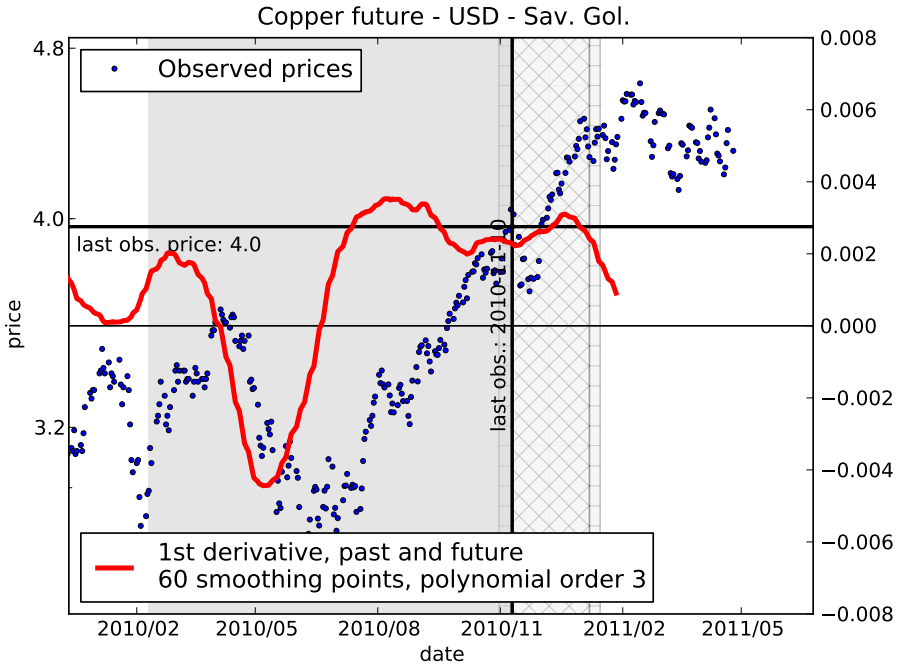

Copper future - USD - Sav. Gol.
Observed prices
last obs. price: 4.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
4.8
4.0
3.2
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 63.

H1/H2: 1/1

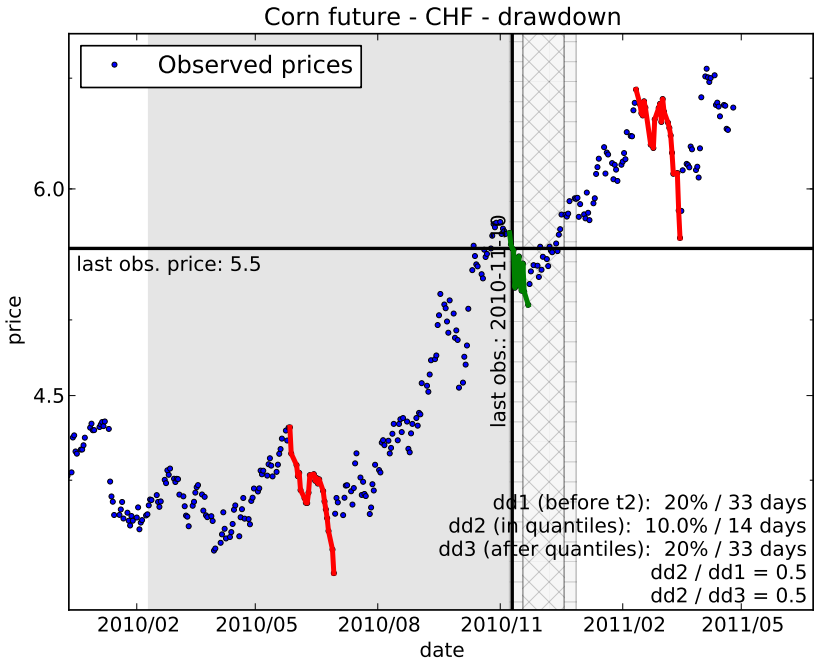


FIG. 64.

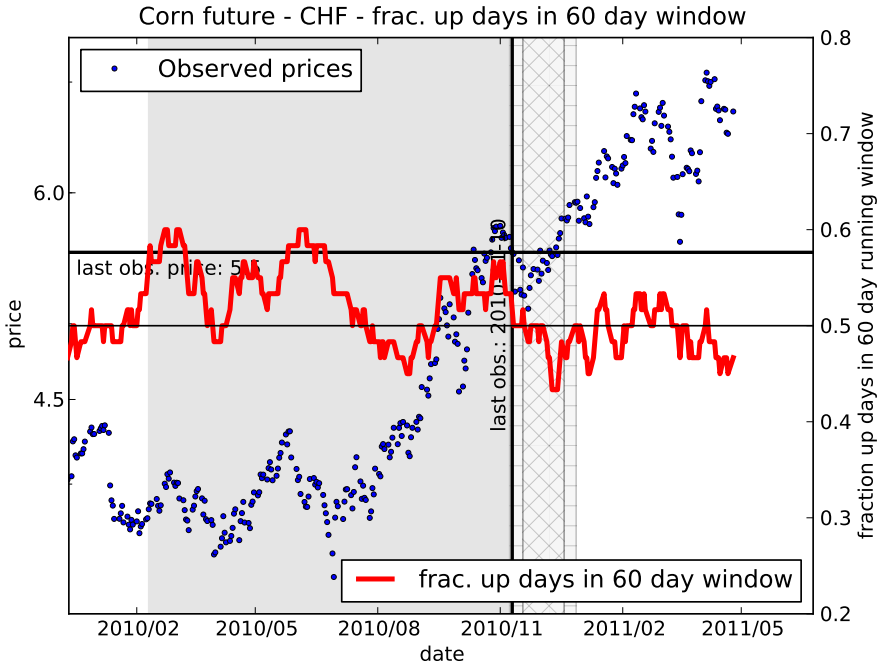


FIG. 65.

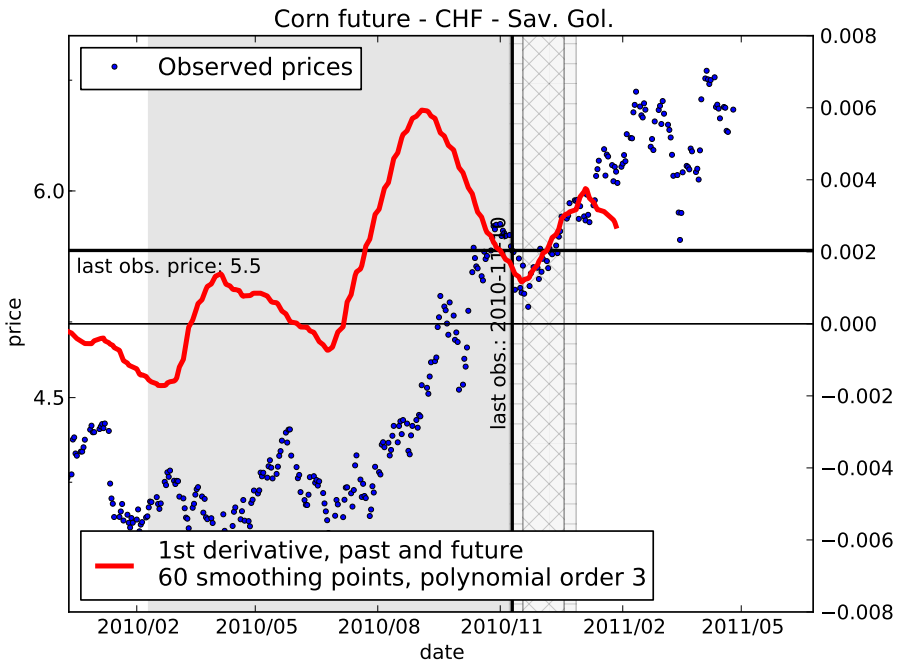

Corn future - CHF - Sav. Gol.
Observed prices
last obs. price: 5.5
last obs.: 2010-11-19
1st derivative, past and future
60 smoothing points, polynomial order 3
price
6.0
4.5
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05
date

FIG. 66.

H1/H2: 1/1

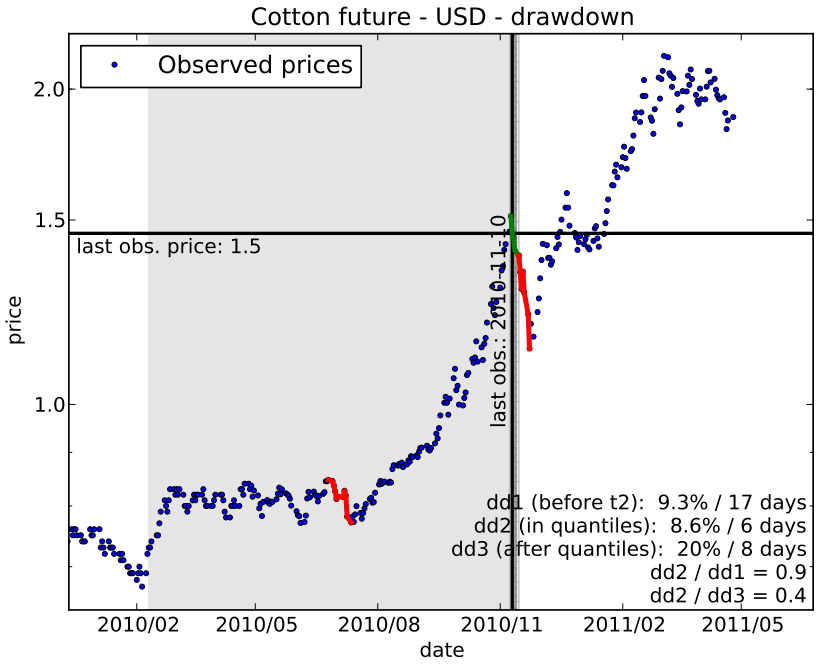


FIG. 67.

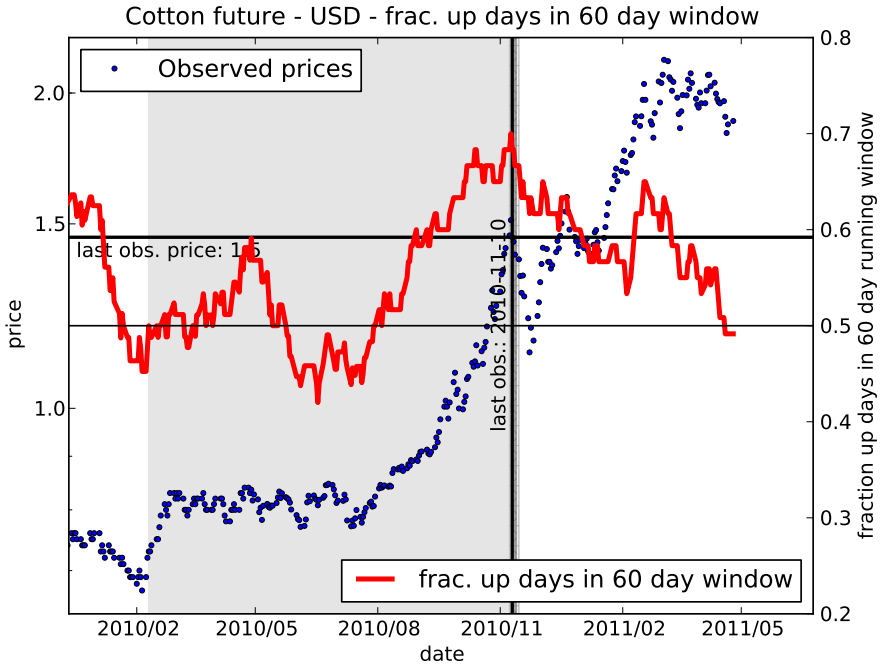


FIG. 68.

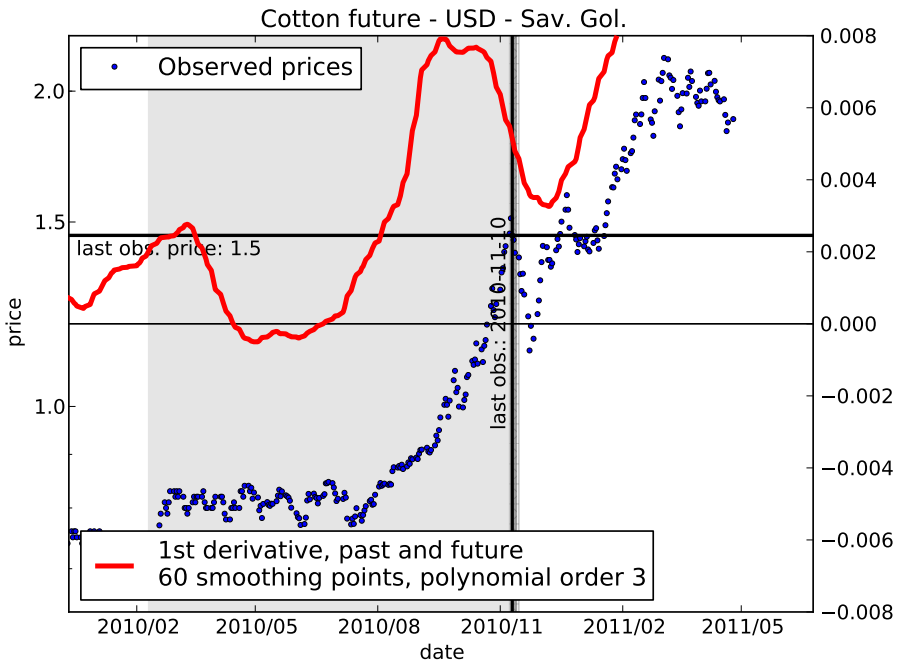

Cotton future - USD - Sav. Gol.
Observed prices
last obs. price: 1.5
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
2.0
1.5
1.0
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 69.

H1/H2: 1/0

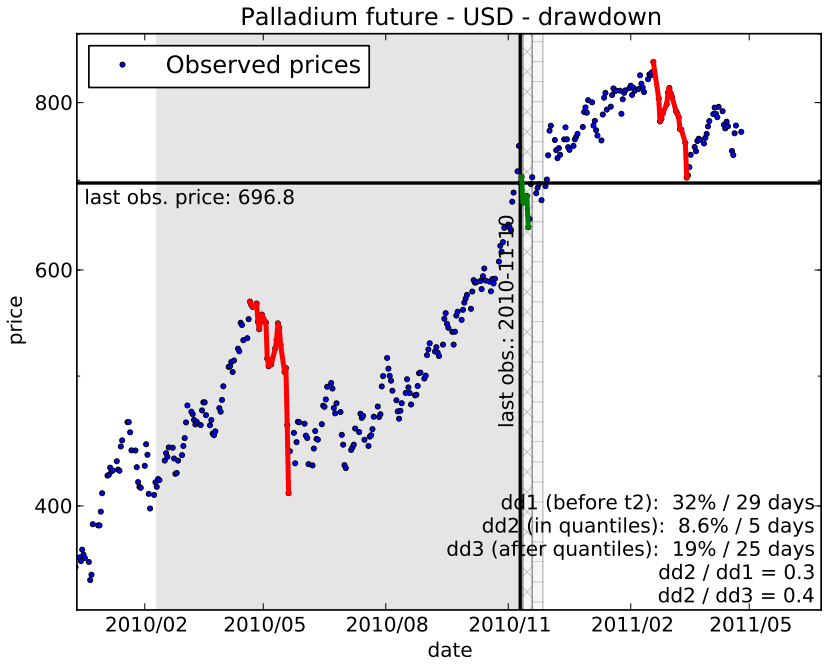


FIG. 70.

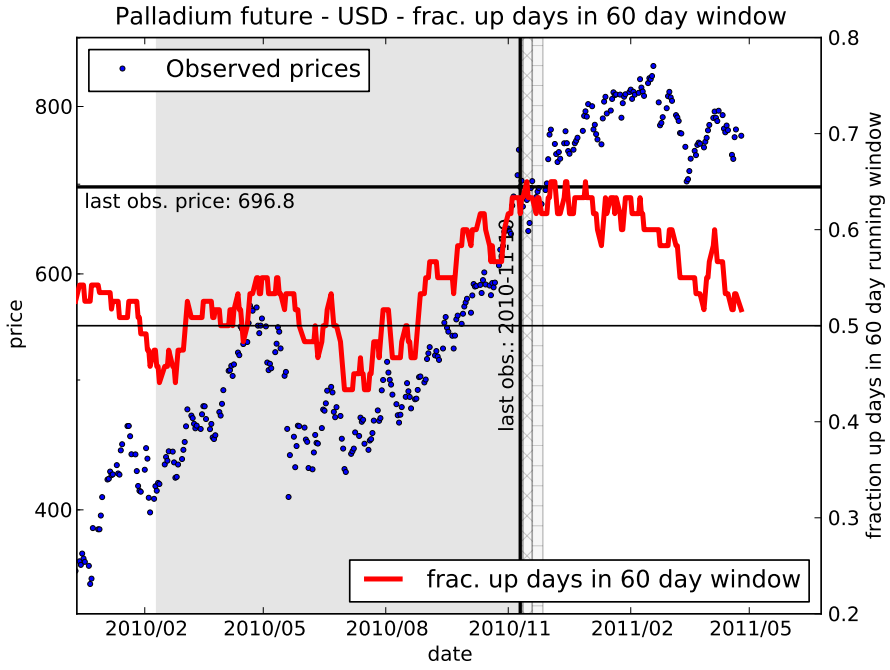


FIG. 71.

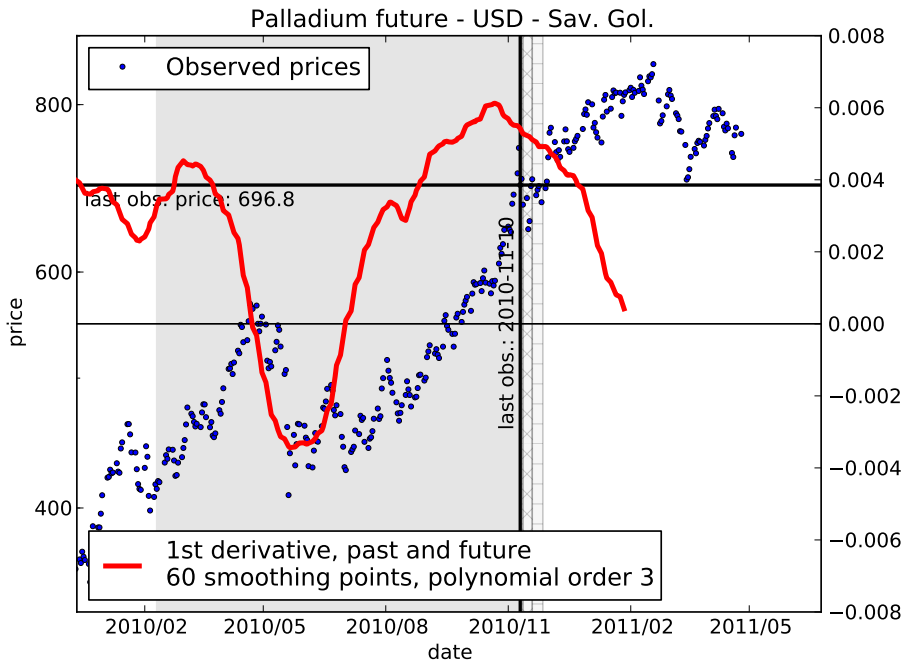

Palladium future - USD - Sav. Gol.
Observed prices
last obs.: price: 696.8
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
800
600
400
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 72.

H1/H2: 1/0

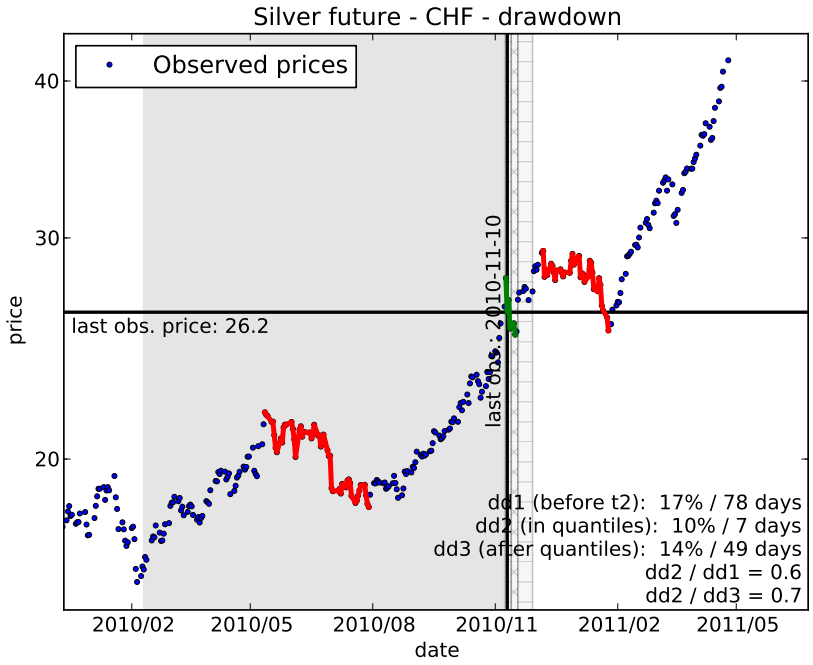


FIG. 73.

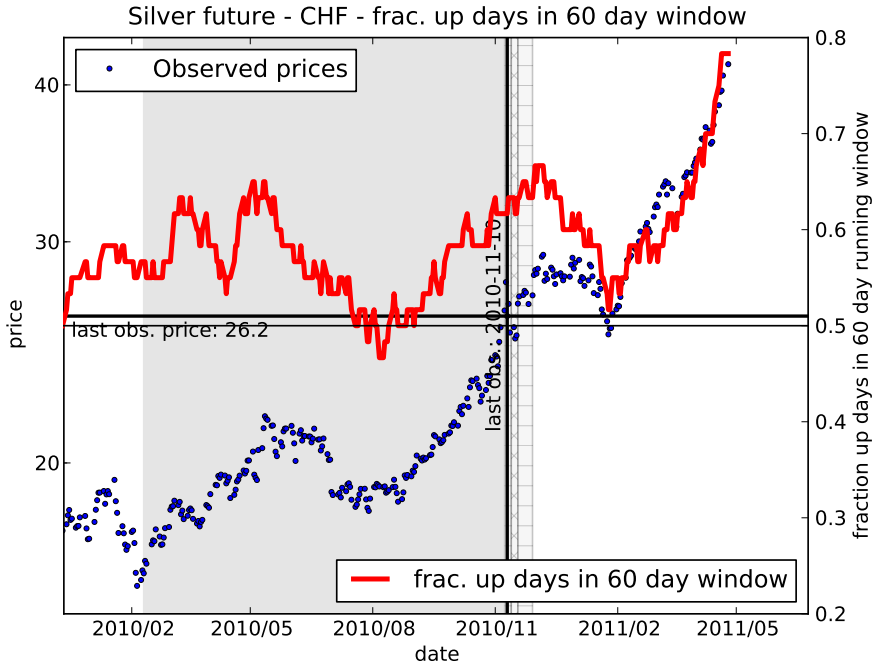


FIG. 74.

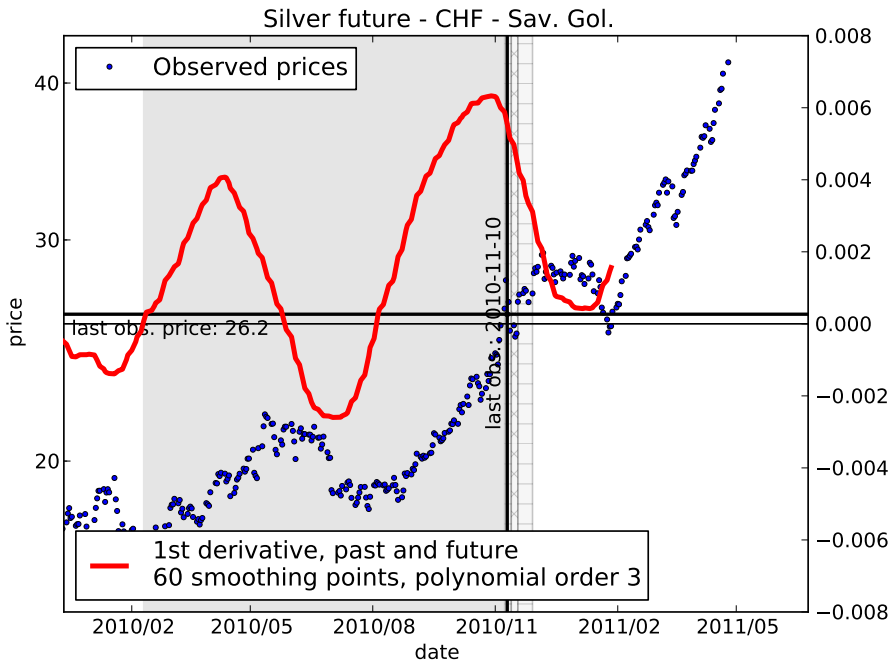

Silver future - CHF - Sav. Gol.
Observed prices
last obs. price: 26.2
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
40
30
20
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 75.

H1/H2: 1/1

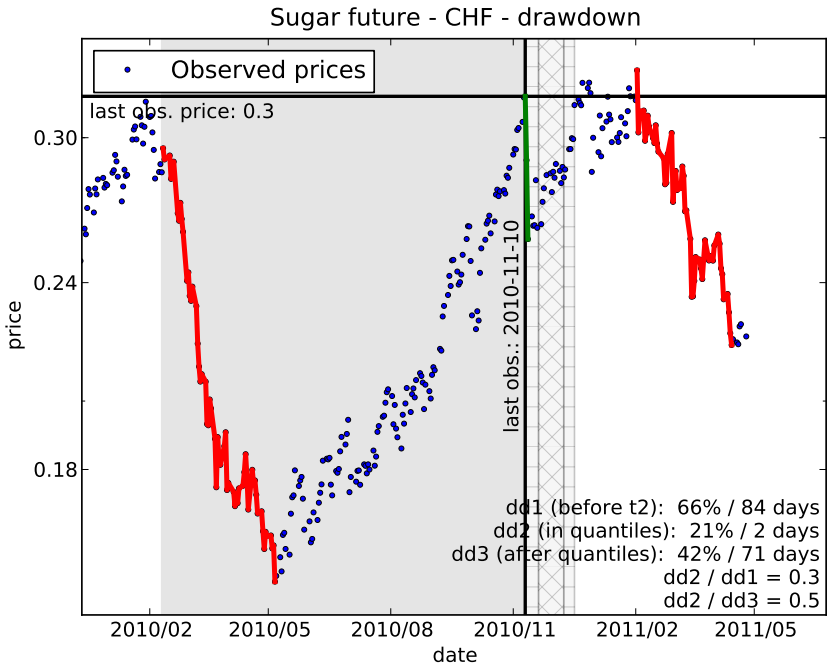


FIG. 76.

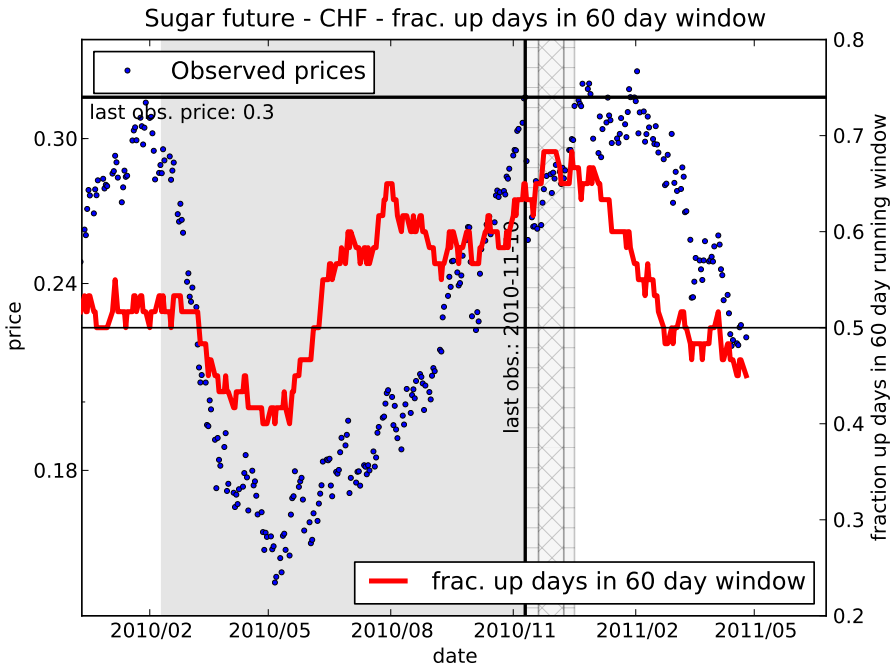


FIG. 77.

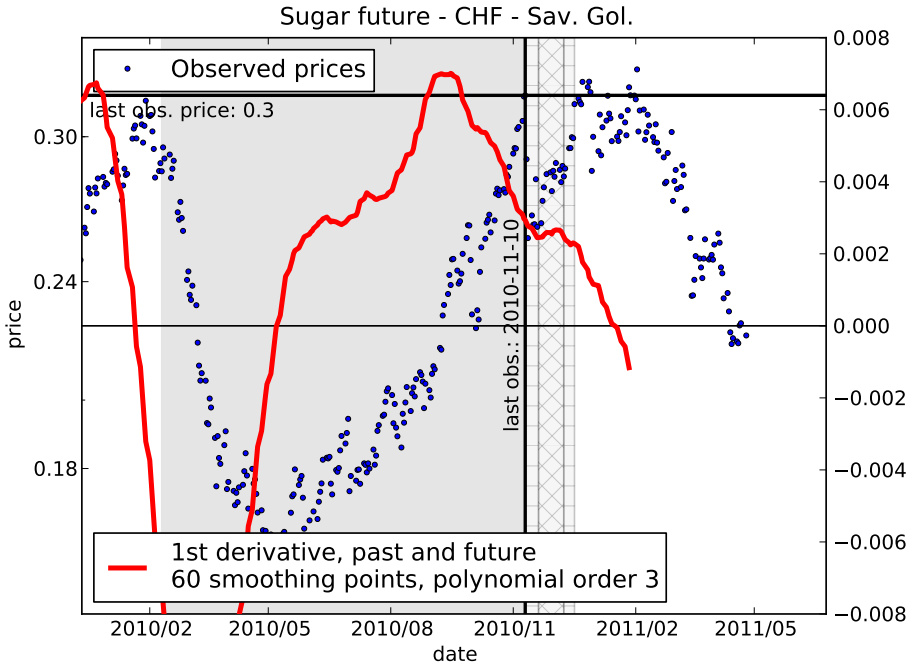

Sugar future - CHF - Sav. Gol.
Observed prices
last obs. price: 0.3
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
0.30
0.24
0.18
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 78.

D. H1 & H2 Foreign Exchange

1. *AUDUSD*

H1/H2: 1/1

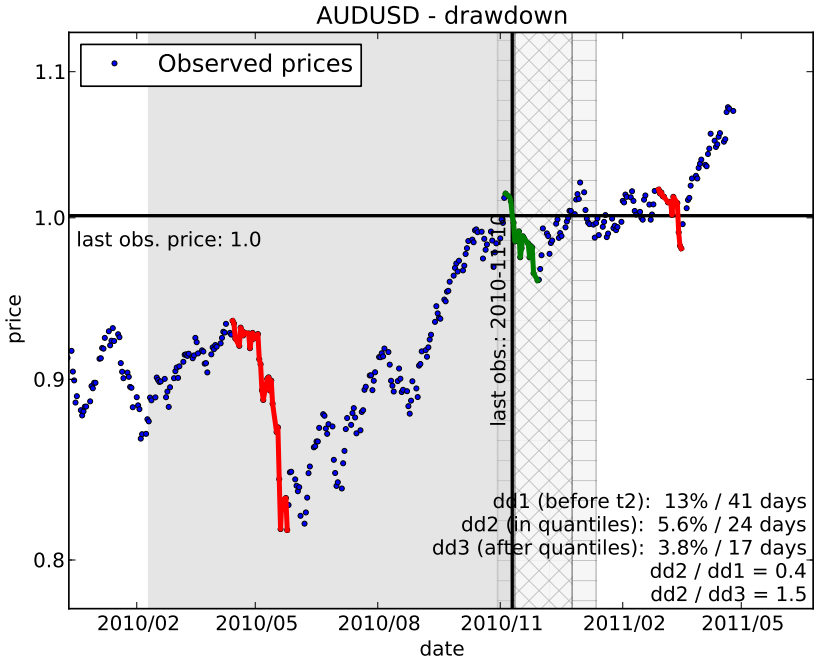


FIG. 79.

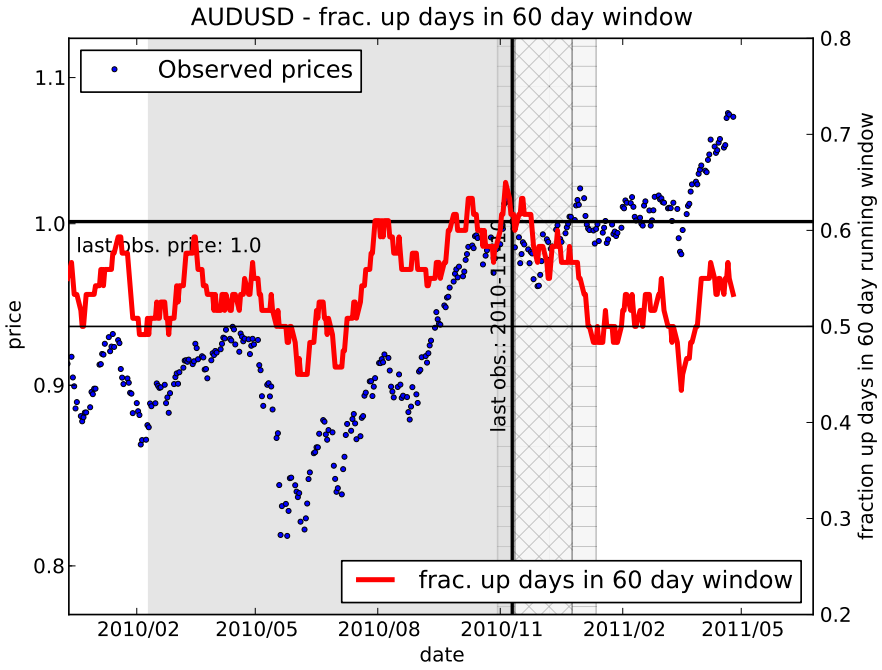


FIG. 80.

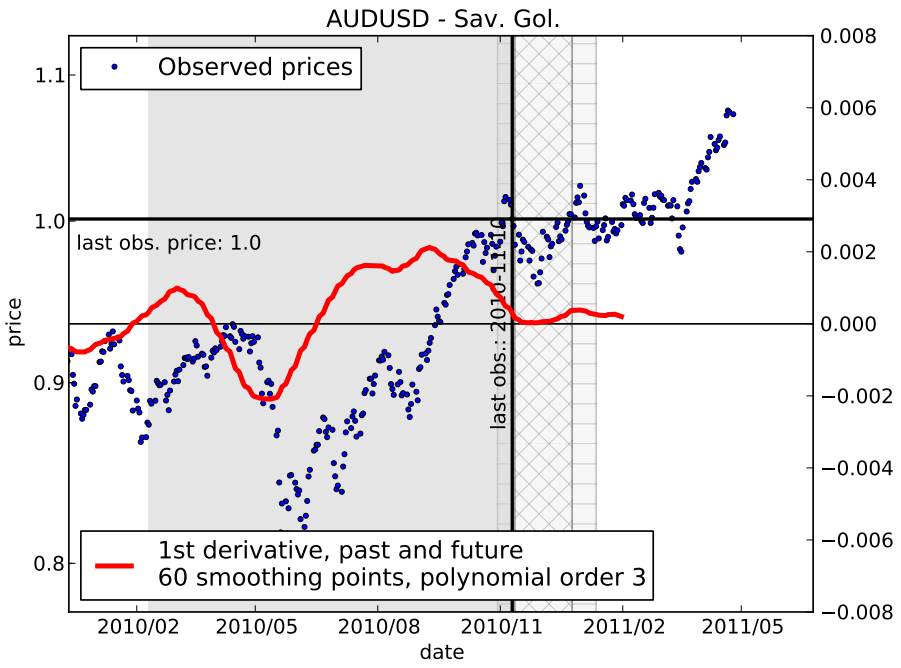

AUDUSD - Sav. Gol.
Observed prices
last obs. price: 1.0
last obs.: 2010-11-10
1st derivative, past and future
60 smoothing points, polynomial order 3
price
date
1.1
1.0
0.9
0.8
0.008
0.006
0.004
0.002
0.000
−0.002
−0.004
−0.006
−0.008
2010/02
2010/05
2010/08
2010/11
2011/02
2011/05

FIG. 81.

VII. STATE OF THE MARKET AT TIME OF ANALYSIS (NOVEMBER 2010)

Please see next page.

MERVAL

The Argentinian Merval index is the most important index of the Buenos Aires stock exchange serving as a measure for Argentina's business climate. In 2010 the Heritage Foundation Index of Economic Freedom[i] awarded Argentina only a 45 percent score for the factor "Investment Freedom" amid its uncertain creditor situation and doubts over contract and property rights. Argentina is experiencing high inflation and political uncertainties. In 2010, investors started to discuss concerns on a potential future default risk. The MERVAL index increased by 41 percent from September 1st to November 4th 2010.

Autozone (AZO)

Autozone is an auto parts retailer. Investors recommend these industry stocks as recession proof, as in economically hard times consumers tend to delay new auto purchases, which in turn increases demand for do-it-yourself repairs. In September 2010, Autozone reported a 14 percent jump in fiscal Q4 earnings. Afterwards, the share price rose substantially higher.

BSESN - BSE SENSEX, Bombay (Index)

According to the Bombay Stock Exchange, the SENSEX index is the barometer of the Indian Capital Markets. India encourages foreign investment and provides export and tax incentives to foreign investors. Nevertheless, it regulates the industry sectors and conditions for foreign investments. India has been a hotspot for emerging market investors. With its large population and still developing markets it provides a substantial potential for further growth.

"The growth of the equity market in India has been phenomenal in the present decade. Right from early nineties, the stock market witnessed heightened activity in terms of various bull and bear runs. In the late nineties, the Indian market witnessed a huge frenzy in the 'TMT' sectors. More recently, real estate caught the fancy of the investors. SENSEX has captured all these happenings in the most judicious manner. One can identify the booms and busts of the Indian equity market through SENSEX. As the oldest index in the country, it provides the time series data over a fairly long period of time (from 1979 onwards). Small wonder, the SENSEX has become one of the most prominent brands in the country." (bseindia.com) The SENSEX enjoyed an 18 percent rally from end of October to November 4, 2010.

The Dow Jones - AIG Commodity Index

The Dow Jones - AIG Commodity Index is a benchmark for the commodity futures market. The index consists of a diversified portfolio of commodities composed of futures contracts on 19 physical commodities listed at U.S. exchanges and the London Metal Exchange. It tracks non-related commodities such as energy, precious metals, livestock and grains with a weighting between 2 and 15 percent.

FTSE - FTSE 100 (Index)

The FTSE 100 index comprises the 100 most highly capitalized blue chip companies in the UK, representing approximately 81% of the UK market. It is used extensively as a basis for investment products, such as derivatives and exchange-traded funds, listed at the London Stock Exchange. The index rose more than 12 percent from September to November, after it had been falling dramatically during the financial crisis of 2007-2010 to a low of below 3,500. The FTSE 100 index recovery from the financial crisis took some set-backs in 2010 amid the emergence of the European crisis.

Hang Seng - Hang Seng Index Hong Kong (Index)

The Hang Seng index serves investors as a barometer for the Hong Kong economy. It is a free float-adjusted market capitalization-weighted stock market index of the largest companies of the Hong Kong stock market . In 2010 investors believed the Hang Seng Index to have profited from uncertainties in Europe and the US, which strengthened China's role within the global economic picture.

IIX - Interactive Week Internet Index (Index)

The Interactive Week Internet Index is a modified capitalization-weighted index of companies involved with providing digital interactive services, developing and marketing digital interactive software, and manufacturing digital interactive hardware. The index had risen around 40 percent from July 2010 to November 4th 2010.

JKSE - Jakarta Composite (Index)

The Jakarta Stock Price Index is a modified capitalization-weighted index of equities listed on the Indonesia Stock Exchange known as the Jakarta Stock Exchange.

In 2010 the Index experienced a low in May, but then recovered. A volcano eruption in August 2010 not only was causing disruptions in Indonesia but was also causing worldwide disruptions to aviation and apparently new uncertainties to investors into Indonesian markets. Nevertheless the index growth continued as the situation improved. The index had gained around 40 percent from its lows in June to its highs in November 2010.

KS11 - KOSPI Composite Index Composite, Seoul (Index)

The KOSPI Index is an index of all common shares on the Korean Stock Exchanges. South Korea's economy is closely linked to China and the US. Its economic development is threatened by the ongoing border conflicts with North Korea. South Korea is very active in high tech electronics and the automotive industry. Samsung is a key player in this industry and represents the main equity component of many indices and ETFs tracking the Korean Stock Market. Foreign investments had been reported to be a main driver for 2010 stock market fluctuations. Amid the high inflation, the Korean Central bank was amongst the first central banks reported to increase its gold reserves in the aftermath of the recent financial crisis.

NDX - NASDAQ-100 (DRM) (Index)

According to NASDAQ, the NASDAQ-100 Index includes 100 of the largest domestic and international non-financial securities listed on the Nasdaq Stock Market based on market capitalization. The Index reflects companies across major industry groups including computer hardware and software, telecommunications, retailers and biotechnology companies. It does not contain securities of financial companies or investment companies. Investors see the NASDAQ 100 as a barometer for the innovative capacity of the US economy as well as for the demand for innovative products.

RJ CRB - Reuters/Jefferies CRB index (Index)

According to Thomson Reuters the Jefferies CRB Index serves as a benchmark to commodity investors and is designed to provide timely and accurate representation of a long-only, broadly diversified investment in commodities. During 2010 investors were recommended to invest in commodities as a hedge to inflation and to protect their portfolios from a potential decline of the

USD. Other reasons for commodity investments were the ongoing economic recovery in the US and the continued growth of the Chinese economy.

TWII - TSEC weighted index (Index)

The TSEC Taiwan Technology Index is a market-cap weighted index of stocks which are the technology sector members of the TW50 and TWMC indices. Taiwan's economy is closely related to Asian economies and in 2010 Taiwan started to invest in mainland China.

XMI - Major Market Index (Index)

The NYSE Major Market Index is a price-weighted index of 20 blue-chip stocks representative of major US industrial corporations. The XMI rose by 13 percent from September to November 2010.

EWS - Ishares Singapore Index (ETF)

The iShares MSCI Singapore Index Fund is an exchange-traded fund incorporated in the USA allowing investors to invest in a tool which corresponds to the performance to the MSCI Singapore Index. The Fund invests in a representative sample of index stocks using a "portfolio sampling" technique. EWS gained nearly 40 percent from July to November 2010.

FCX - Freeport McMoRan Copper & Gold (Equity)

Freeport is one of the world's leading copper and gold producers. Freeport is often referred to as the "lowest cost" copper producer. In its guidance for 2010 Freeport reported an expected lower demand for copper in 2010 amid China growth concerns. After a significant reduction in debt, Moody's raised[ii] Freeport's bond rating from Junk to Baa3, after which the stock rose.

FFIV - F5 NETWORKS (Equity)

F5 Networks provides technology that optimizes the delivery of network-based applications and the security, performance and availability of servers, data storage devices and other network resources. F5 Networks is a major supplier for many of the top 50 of the Fortune 500 companies, online video services and internet search companies.

Investors investing in F5 networks seemingly seek to benefit from increasing internet traffic and large corporations' needs to optimize component utilization and traffic. Its fiscal Q3 2010 profit rose by 77.5% and in August 2010 F5 Networks announced it would provide "cloudbusting" solutions to its clients. Cloud Computing had become the technology buzz-word in 2010.

INTU – INTUIT (Equity)

Intuit Inc. is the provider of business and financial management solutions focused on small and medium-sized businesses and consumers. It provides well known financial software applications such as Quicken and Quick books. In 2010 Intuit was ranked 94 on the Forbes top-100 best companies to work for.

In August 2010 Intuit reported an 11 percent increase in revenues resulting in a 31 percent increased EPS in fiscal year 2010 compared to fiscal year 2009.

URI - UNITED RENTALS INC (Equity)

United Rentals is a world leading rental and leasing company. According to Reuters it offers approximately 2,900 classes of equipment for rent. Its main customers include construction and

industrial companies, utilities and municipalities. United Rentals had been suffering from the downturn in construction but its business started to normalize with the ongoing recovery in 2010.

Copper, HG1 COMB Comdty

On the Supply side Chile, the US, Peru, China and Australia act as the world's largest copper producers. Scrap copper is another source of copper and plays an important role in smoothing the effect of physical demand and supply gaps.

Demand in 2010 also was fueled by ETFs, allowing investors to have an easy tool to invest in this commodity. The demand for Copper was mainly driven by China's strong construction growth in 2010. Copper is used in many goods, but mainly in construction and electrical products.

Corn, C 1 COMB Comdty

Corn is an agricultural commodity with increasing importance as a potential to produce ethanol as a fuel substitute. For 2010 the USDA expected a record production of corn amid new biotechnological advances. Corn future prices reflect the uncertainties in demand for traditional corn in the agricultural and food sector as well as in the bio-fuel industry. Prices in the future markets also depend on supply side issues such as droughts or other adverse weather conditions.

In summer 2010 droughts had led to severe fires in Russia, causing disturbances in the wheat markets to which the corn future markets is related as the USDA cut its forecast for wheat production in Russia by 15 percent.

Palladium, PA1 COMB Comdty

Palladium is used in catalysts. Its main demand rises from car manufacturers and the chemical industry. Electronics (autos, PCs, digital TV, for example) is the second largest use for palladium. In 2010 the Nobel Prize in Chemistry was awarded for palladium catalyzed reactions. According to the GFMS world palladium supply had fallen by 1 percent in 2009.

Silver, SI1 COMB Comdty, Silver, SI1 COMB Comdty

Silver is an industrial metal and is used in many applications such as electronics and photography products. Beside its industrial use it is used in jewelry and as currency in form of medals and collection coins.

In 2010 silver supply was reported by the GFMS to have increased by 5 percent, which was exceeded by demand across all sectors. Industrial demand was reported to have increased by 18 percent and coin minting by 23 percent.

Sugar, SB1 COMB Comdty

Sugar is an agricultural commodity which is also closely linked to the price of oil as it can be used to generate ethanol. Brazil, which has the highest per capita production of sugar, is widely using ethanol produced from sugar in fuel-mixtures to substitute gasoline. Rising oil prices in 2010 had led to an increase in sugar prices. Cane harvests in Brazil and India, the biggest sugar producing countries, were hurt by adverse weather conditions.

The 2010 Market Situation

For investors the year 2010 was the year of uncertainty and the start of strategic portfolio repositioning. After the dreadful emergence of the financial crisis in 2008, investors had experienced a fantastic stock market rebound in 2009 carried by low interest rates and capital injections by governments around the world. In 2010 those capital injections started to raise first concerns.

The aftermaths of the crisis manifested with the emergence of the Dubai World crisis[iii] in late 2009 and the European crisis in early 2010[iv]. While an immediate global system meltdown had been averted, there was contagion amongst sovereign states as a consequence.

World leaders had acted and taken unprecedented steps in 2008 after the Lehman collapse, by expanding and eventually bending the current regulation framework in order to avoid a breakdown of the global banking system. The primary effects had spanned from the US, where regulators decided on seizing large firms including AIG and GM and to inject large sums of money into the banking system under the TARP program, to other countries around the globe. Secondary effects led for example to an expectation of bank runs in Germany, which had ultimately to be avoided by providing guarantees, without legal parliamentary support as Germany's former finance minister Peer Steinbrueck admitted during a public speech in early 2011[v].

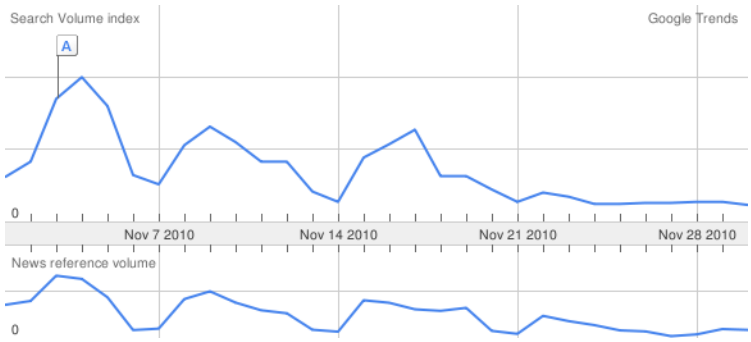
While those actions had not been questioned at the time of emergency, the public started to question in hindsight the validity and impact of those actions with the emergence of the sovereign debt crisis in 2010.

In 2010 the crisis started to raise concerns over Greece, Ireland and Portugal, which required another set of emergency regulations as a new threat to the financial system. This was a clear sign to investors that markets had not yet fully recovered and needed support beyond the current level of recovery. With the end of the FED's QE program, discussions arose on the scope of QE2 and its future impact[vi]. Some investors anticipated a continuation of the dollar devaluation: "*The U.S. has gotten itself into a bind. To emerge from this recession successfully over the long term, it will have no choice but to inflate its currency and monetize its debt and entitlement burden*."[vii]

Therefore expectations in Q4 2010 were either set to disappoint stock market or dollar investors and in the worst case, both.

Market's anticipation of the FED's QE2 Program in Q4 2010

When the FED issued its press release[viii] on its QE2 Program on 3rd of November 2011, it was no longer a large surprise to investors, but its scope and impact were discussed during the following weeks as an analysis of Google Trends indicates (picture 1).



picture 1 - Google Trends analysis of search phrase "QE2" for November 2010 (US)

Already before the announcement of QE2, the investment community had arrived to the consensus that the FEQ will maintain its accommodating low interest rates and continue with further capital injections under a renewal of the quantitative easing program. These expectations had lifted stock markets in the weeks prior to the official QE2 announcement.

Especially emerging stock and commodity markets had risen amid the inflationary expectations and in consequence some investors[ix] seemingly had gained the impression of a world of bubbles, which soon could burst.

Bubble formations ahead of the FED meeting

Uncertainty over the impact of the QE2 program had supported speculative moves in industrial commodities such as copper, palladium, silver and the Dow Jones-AIG Commodity Index as well as agricultural commodities such as cotton and sugar. The anticipation of a weakening dollar[x] as a consequence of QE2 had also fueled speculation in currency markets. ECB president Jean-Claude Trichet had described the risk of a *"currency war"*[xi] and warned of competitive currency devaluations. Japan reportedly had criticized Korea for its intervention policy.[xii]

The reaction to the FED's QE renewal had put central banks around the globe into difficult position as on one side they were holding US Dollars and on the other side they feared a rising domestic currency. On November 5th Citi's Steven Englander stated in an interview[xiii] by Joe Weisenthal that Central banks would start dumping Dollars in the coming weeks.

LPPL as an indicator for speculative bubbles in the context of the FED decision

The context of the upcoming FED decision seems to explain the formation of bubbles in commodities and emerging markets, as well as Forex pairs such as the AUS/USD ratio. With the FED's release of its QE2 efforts and the public announcement of its scope, remaining uncertainty was removed from the markets. Investors who had fled into save havens such as agricultural commodities like sugar and cotton or who shifted to emerging markets before the FED's announcement were now reconsidering their investments. At that point the expectations of QE2 had been priced in and some investors were starting to lock in profits in early November, before the FED's bond purchasing program actually was able to fuel markets with further liquidity.

The flight from the Dollar before the announcement of QE2 had led to investments in emerging markets which has been detected by LPPL in several indices, including MERVAL Buenos Aires, BSE SENSEX, Bombay, HangSeng, Hang Seng Index Hong Kong, Jakarta Composite, KOSPI Composite

Index, but also ETFs, such as EWS. Alternatively bubbles were detected in the FTSE and the NASDAQ indices, as well as several sub-indices such as the NASDAQ Computer index.

Beside those, LPPL helped to detect further bubbles in "recession proof"[xiv] equity investments, such as the automotive replacement parts and accessories company AutoZone (AZO) as well as United Rentals (URI) a company with focus equipment rentals.

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[i] Heritage Foundation, "2010 Index of Economic Freedom: Argentina," 2010. Available from Heritage Foundation website. Accessed on September 8, 2010. (HF 2010)

[ii] John Detrixhe (*13.10.2010) "H*Freeport-McMoRan Bonds Rise to Record After Moody's Raises GradeH", Bloomberg

[iii] Patrick Hosking and David Robertson (27.11.2009) H"Dubai in deep water as ripples from debt crisis spread"H, The Times

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[v] Peer Steinbrueck (19.01.2011) *„Bankenkrise, Wirtschaftskrise, Eurokrise - Peer Steinbrück zieht Bilanz Vortrag von Peer Steinbrück (Bundesfinanzminister a.D.)",* Phoenix

[vi] Nassim Taleb, (12.11.2010), "Inside Track" Interview, HBloombergH

[vii] Frank Berlage (1.11.2010) *"THE REAL CRISIS",* source: Hhttp://new.gloomboomdoom.com

[viii] Federalreserve (03.11.2010), HPress ReleaseH, Federalreserve

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Item 3:
Original *Master* document
identifying the 27 assets,
created on 12 November 2010.
The checksums (digital fingerprint)
of following document
appear in document of item 1
(reproduced here for convenience):

Document name	
SHA256SUM	4994beab18293be021d751d513b6fec0776fde9cf74c0098f7da8657487d950d
SHA512SUM	ee20582b696a2ce880870b513e7b9e7ebb67bfbe62e2cad50dd18276a5158765af6fdf88d9fef6e047526c40478a865c722cab041386aa8efdd95da24dd9239d

Standalone version of following document
(to verify checksum)
available as

`fbe_20110502_assets_3.pdf`

at

`http://www.er.ethz.ch/fco/index`

The Financial Bubble Experiment: Advanced Diagnostics and Forecasts of Bubble Terminations Volume III–Assets Document

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(Dated: 11 November 2010)

This is the third installment of the Financial Bubble Experiment. We identify 27 bubbles in 27 different global assets; for 25 of these assets, we present windows of dates of the most likely ending time of each bubble. This current document, which will be made public on 2 May 2011 is the one whose digital fingerprint is provided in the accompanying master document [1], made public on 11 November 2010.

I. INTRODUCTION

The Financial Bubble Experiment (FBE) aims at testing the following two hypotheses:

- **Hypothesis H1:** Financial (and other) bubbles can be diagnosed in real-time before they end.
- **Hypothesis H2:** The termination of financial (and other) bubbles can be bracketed using probabilistic forecasts, with a reliability better than chance.

In a medical context, H1 corresponds to the diagnostic of cancer and H2 to the forecast of remaining life expectancy. These are embedded hypotheses, in that H1 includes H2 and we test them here separately. The "end of a bubble" is interpreted in terms of dynamical systems as a "change of regime" or "turning point". This qualitative terminology is supported by quantitative measures [3].

We began this experiment in November 2009 with the publication of diagnoses of three distinct bubbles in three distinct assets, followed in December 2004 with a fourth. We only published the digital fingerprints of electronic documents containing our forecasts in November and December 2009. On 3 May 2010 we revealed the four assets and published the original documents. In each of the four original documents, we presented a range of dates of the most likely end of the bubbles. In the follow-up report in May 2010, we presented quantitative analysis measuring the quality of our forecasts. The background theory and methodology, as well as these previous results—the original documents, the digital fingerprints and the follow-up analysis—are publicly available online at the URL given in [3]. We continued the FBE with 7 more assets, whose key was published in May 2010 and revealed in November 2010 [2].

This report is a continuation of the FBE in that we offer the digital fingerprint of an electronic document containing 27 assets that we find to be in bubbles at the time of writing. We published the original document itself on 11 November 2010. As in the second installment, we create only a single document containing the information on the 27 assets. We continue with testing separately H1 by itself and H1 in combination with H2.

We present a collection of 27 assets that our methods indicate support H1 (Sections II-III, Tables I-II). For 25 of these assets, we also provide forecast windows of the most likely ending of the bubbles, which would support H2 (Section III, Table II). Further, we categorize the assets by type: Index, Equity, Commodity and Foreign Exchange. Note that in our Equity category, we mean products that can be traded on an exchange. This is why, for instance, Ishares Singapore Index, with ticker symbol EWS appears under our Equity category and not under the Index category.

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2 H1 Assets (identified bubble)		
Category	Asset	Ticker
Index	MERVAL Buenos Aires	^MERV (Y)
Equity	AUTOZONE	AZO (Y)

TABLE I. 2 H1 assets of the Financial Bubble Experiment as of 11 November 2010. All listed assets are candidates for H1 (identified bubble phase). In the Ticker column, (B) stands for Bloomberg and (Y) for Yahoo Finance.

25 H1 and H2 Assets (identified bubble)				
Category	Asset	Ticker	t_c 20% - 80%	t_c 5% - 95%
Index	BSE SENSEX, Bombay	^BSESN (Y)	2010-11-03 - 2010-12-01	2010-10-27 - 2010-12-10
	Dow Jones-AIG Commodity Index	^DJC (Y)	2010-11-16 - 2010-12-04	2010-11-09 - 2010-12-10
	FTSE 100	^FTSE (Y)	2010-11-27 - 2010-12-26	2010-11-07 - 2011-01-03
	Hang Seng Index Hong Kong	^HSI (Y)	2010-11-09 - 2010-12-09	2010-11-07 - 2010-12-16
	Interactive Week Internet Index	^IIX (Y)	2010-11-12 - 2010-12-10	2010-11-04 - 2010-12-23
	NASDAQ Computer	^IXK (Y)	2010-11-13 - 2010-12-06	2010-11-07 - 2010-12-09
	Jakarta Composite	^JKSE (Y)	2010-11-06 - 2010-12-09	2010-10-23 - 2010-12-25
	KOSPI Composite Index, Seoul	^KS11 (Y)	2010-11-15 - 2010-12-26	2010-10-30 - 2011-01-07
	NASDAQ-100 (DRM)	^NDX (Y)	2010-11-05 - 2010-11-29	2010-11-03 - 2010-12-22
	Reuters/Jefferies CRB index	CRY INDEX (B)	2010-11-11 - 2010-11-22	2010-11-07 - 2010-11-26
	TSEC weighted index	^TWII (Y)	2010-12-01 - 2011-01-03	2010-11-13 - 2011-01-08
	Major Market Index	^XMI (Y)	2010-11-10 - 2010-11-25	2010-10-30 - 2010-12-04
Equity	Ishares Singapore Index	EWS (Y)	2010-11-14 - 2010-12-12	2010-11-06 - 2010-12-25
	Freeport McMoRan Copper & Gold	FCX (Y)	2010-11-15 - 2010-12-17	2010-11-09 - 2010-12-27
	F5 NETWORKS	FFIV (Y)	2010-12-27 - 2011-03-09	2010-12-02 - 2011-04-08
	INTUIT	INTU (Y)	2010-11-28 - 2011-01-15	2010-11-07 - 2011-02-11
	STARBUCKS	SBUX (Y)	2010-11-08 - 2010-11-18	2010-11-06 - 2010-11-25
	UNITED RENTALS INC	URI (Y)	2010-11-09 - 2010-12-13	2010-11-02 - 2011-01-08
Commodity	Copper future (USD)	HG1 COMB Comdty (B)	2010-11-09 - 2011-01-07	2010-10-31 - 2011-01-15
	Corn future (CHF)	C 1 COMB Comdty (B)	2010-11-18 - 2010-12-19	2010-11-08 - 2010-12-28
	Cotton future (USD)	CT1 COMB Comdty (B)	2010-11-12 - 2010-11-13	2010-11-08 - 2010-11-15
	Palladium future (USD)	PA1 COMB Comdty (B)	2010-11-12 - 2010-11-19	2010-11-10 - 2010-11-27
	Silver future (CHF)	SI1 COMB Comdty (B)	2010-11-13 - 2010-11-18	2010-11-08 - 2010-11-29
	Sugar future (CHF)	SB1 COMB Comdty (B)	2010-11-20 - 2010-12-09	2010-11-10 - 2010-12-17
Forex	AUDUSD	(B)	2010-11-12 - 2010-12-25	2010-10-30 - 2011-01-12

TABLE II. 25 H2 assets of the Financial Bubble Experiment as of 11 November 2010. All listed assets are candidates for H1 (identified bubble phase) and H2 (identification of end of bubble phase). Quantile windows of most likely dates of the end of the bubble phases are shown. In the Ticker column, (B) stands for Bloomberg and (Y) for Yahoo Finance.

[1] R. Woodard, D. Sornette, M. Fedorovsky. The financial bubble experiment: advanced diagnostics and forecasts of bubble terminations, Vol. III. (Specific URL `http://arxiv.org` unavailable at time of digital signature), November 2010.

[2] D. Sornette, R. Woodard, M. Fedorovsky, S. Reimann, H. Woodard, and W. X. Zhou The Financial Crisis Observatory. The Financial Bubble Experiment: advanced diagnostics and forecasts of bubble terminations, Vol. II–Master document. URL `http://arxiv.org/abs/1005.5675`. 2010.

[3] D. Sornette, R. Woodard, M. Fedorovsky, S. Reimann, H. Woodard, and W.-X. Zhou. The financial bubble experiment: advanced diagnostics and forecasts of bubble terminations. URL `http://arxiv.org/abs/0911.0454`, May 2010.

II. H1 ASSETS

We diagnose that the 2 assets in this Section (see Table I) are in a bubble phase (H1) but we do not make forecasts of likely dates of change of regime (H2). For each asset, we present a figure showing the time series of the observations and indicate the range over which our analysis was performed (the shaded area in each figure).

A. H1 Indexes

1. *MERVAL Buenos Aires*

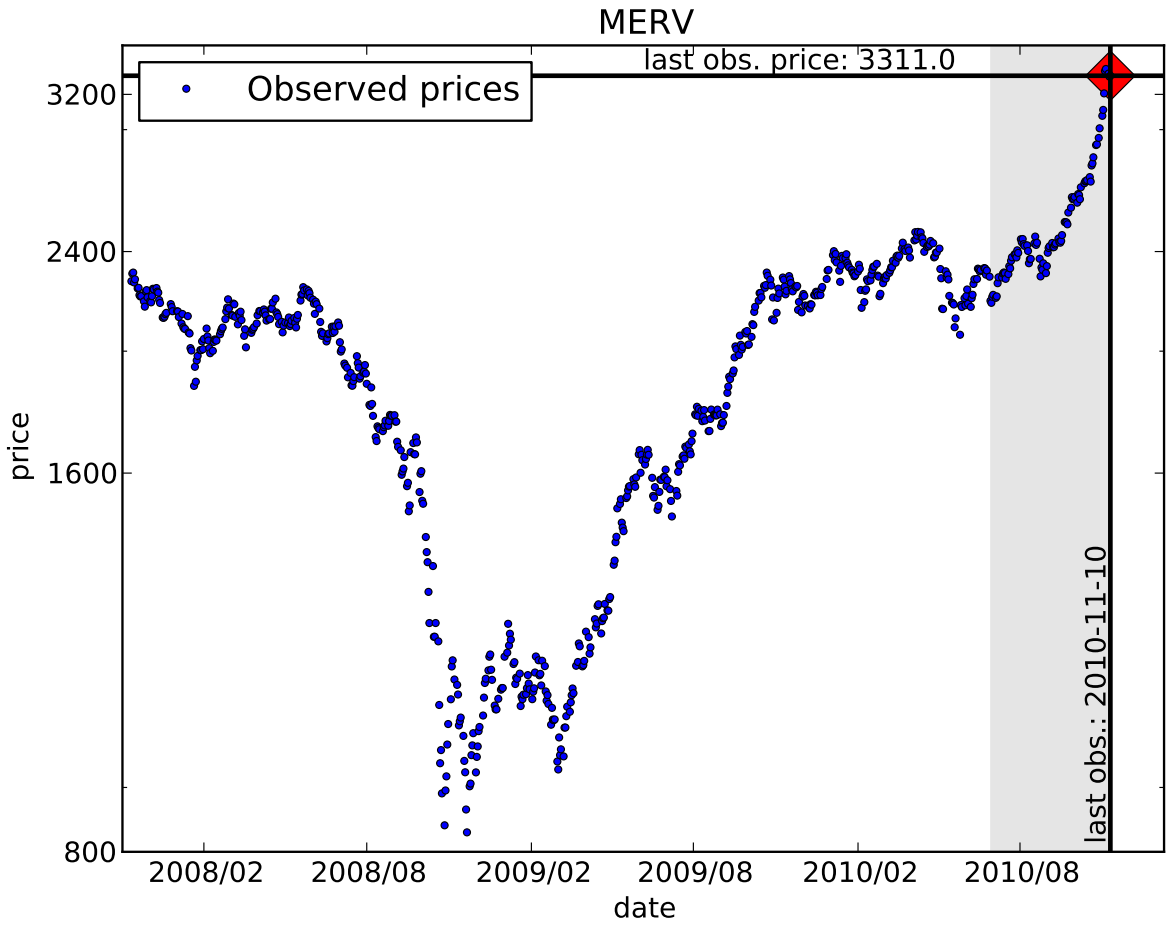

FIG. 1. MERVAL Buenos Aires: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

B. H1 Equities

1. *AUTOZONE*

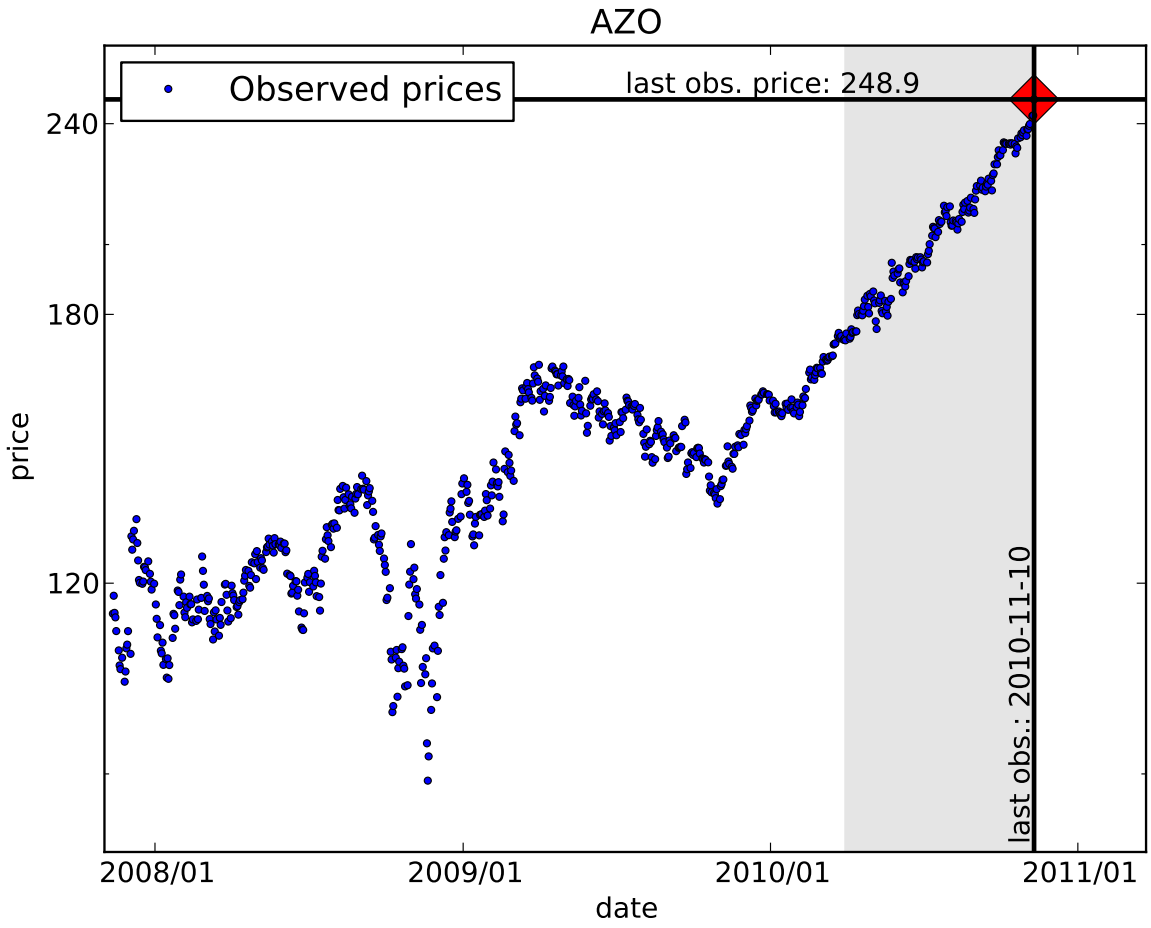

FIG. 2. AUTOZONE: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

III. H1 & H2 ASSETS

We hypothesize that the 25 assets in this Section (see Table II) are all in a bubble phase (H1) and are likely to end within the quantile ranges indicated in Table II (H2).

A. H1 & H2 Indexes

1. *BSE SENSEX, Bombay*

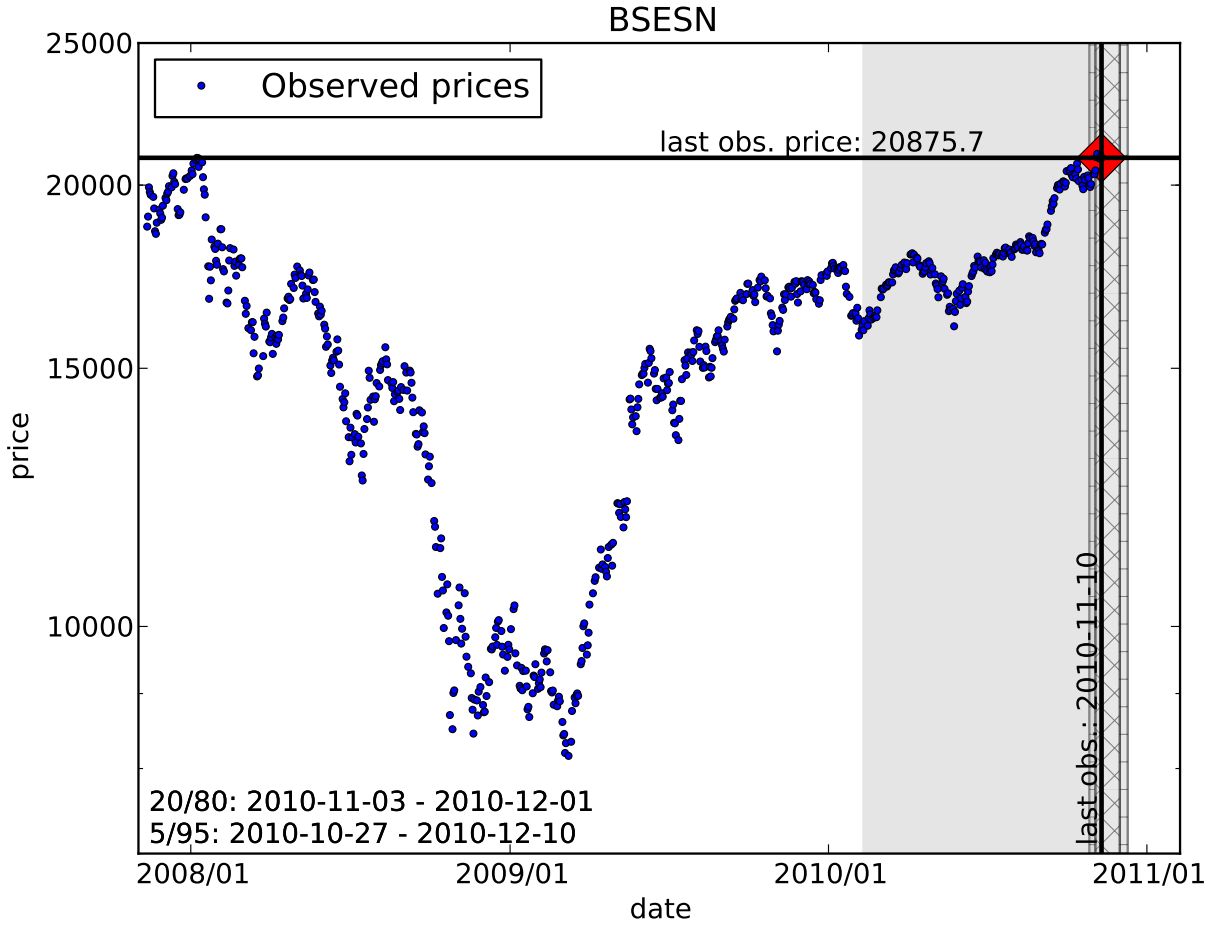

FIG. 3. BSE SENSEX, Bombay: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

2. Dow Jones-AIG Commodity Index

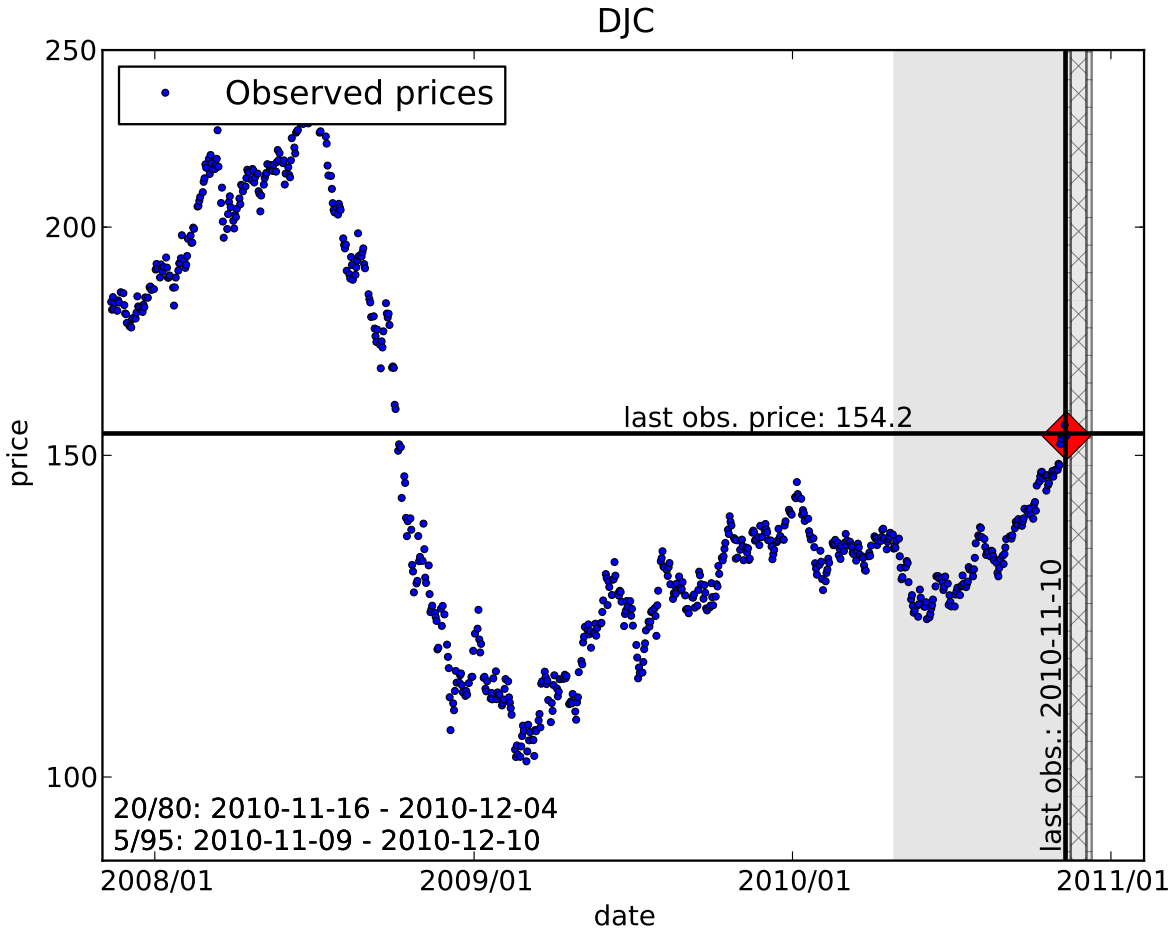

FIG. 4. Dow Jones-AIG Commodity Index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

3. FTSE 100

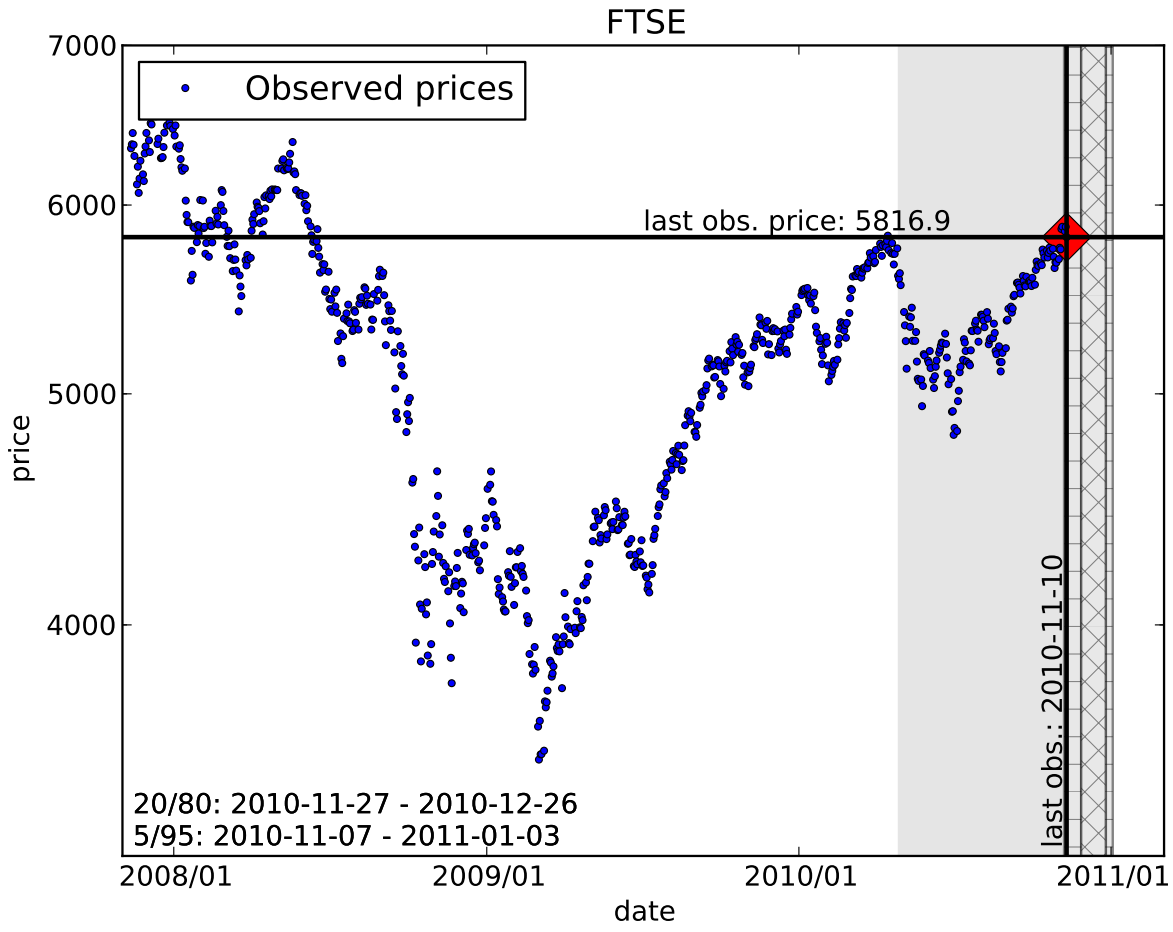

FIG. 5. FTSE 100: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

4. Hang Seng Index Hong Kong

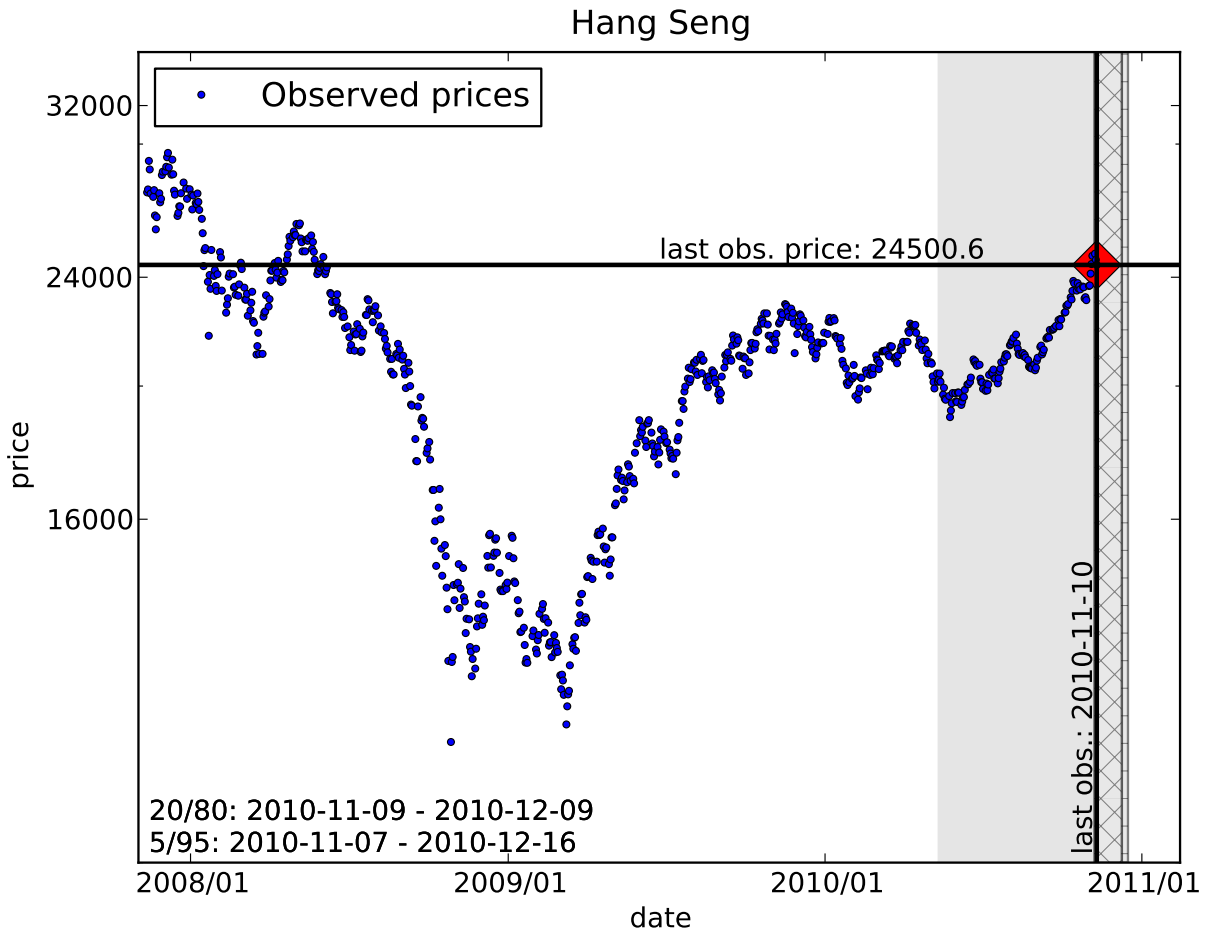

FIG. 6. Hang Seng Index Hong Kong: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

5. Interactive Week Internet Index

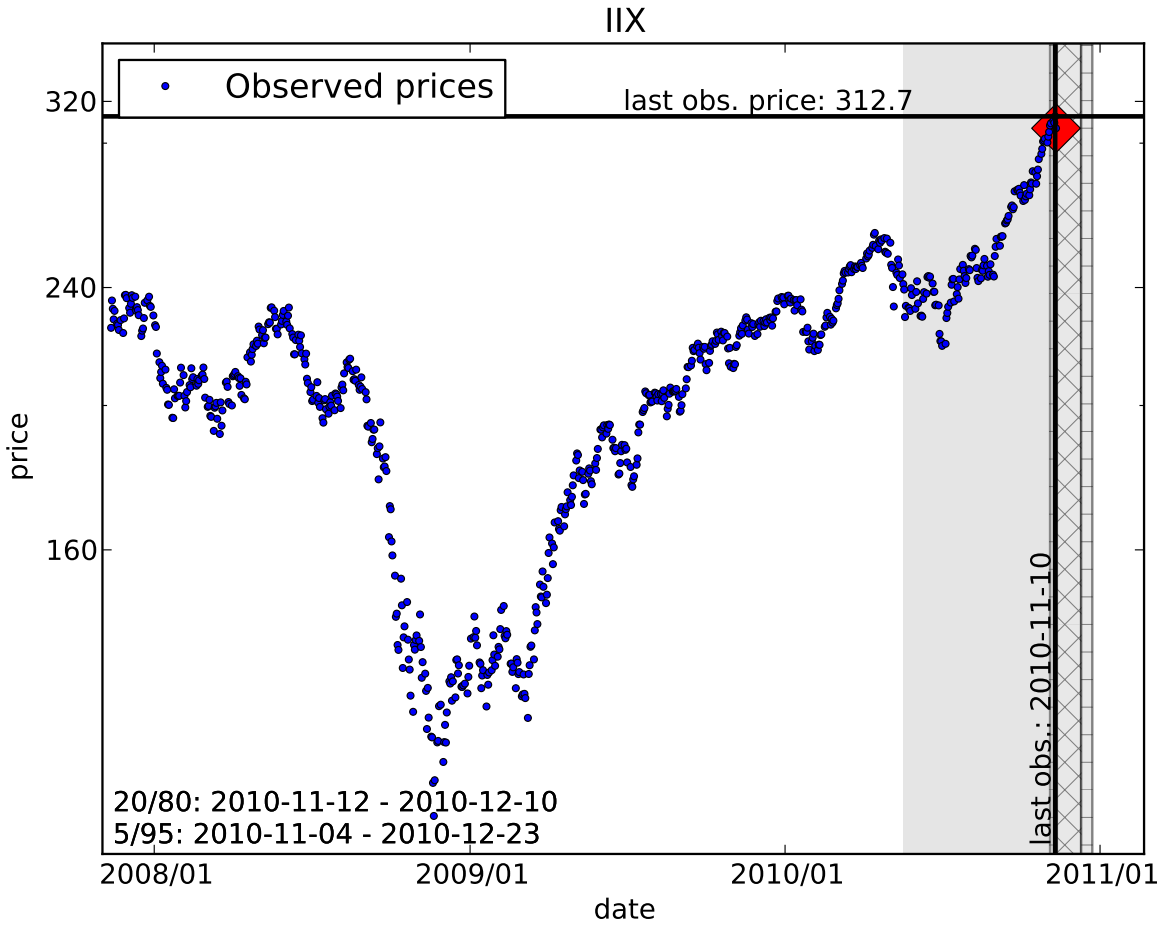

FIG. 7. Interactive Week Internet Index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

6. NASDAQ Computer

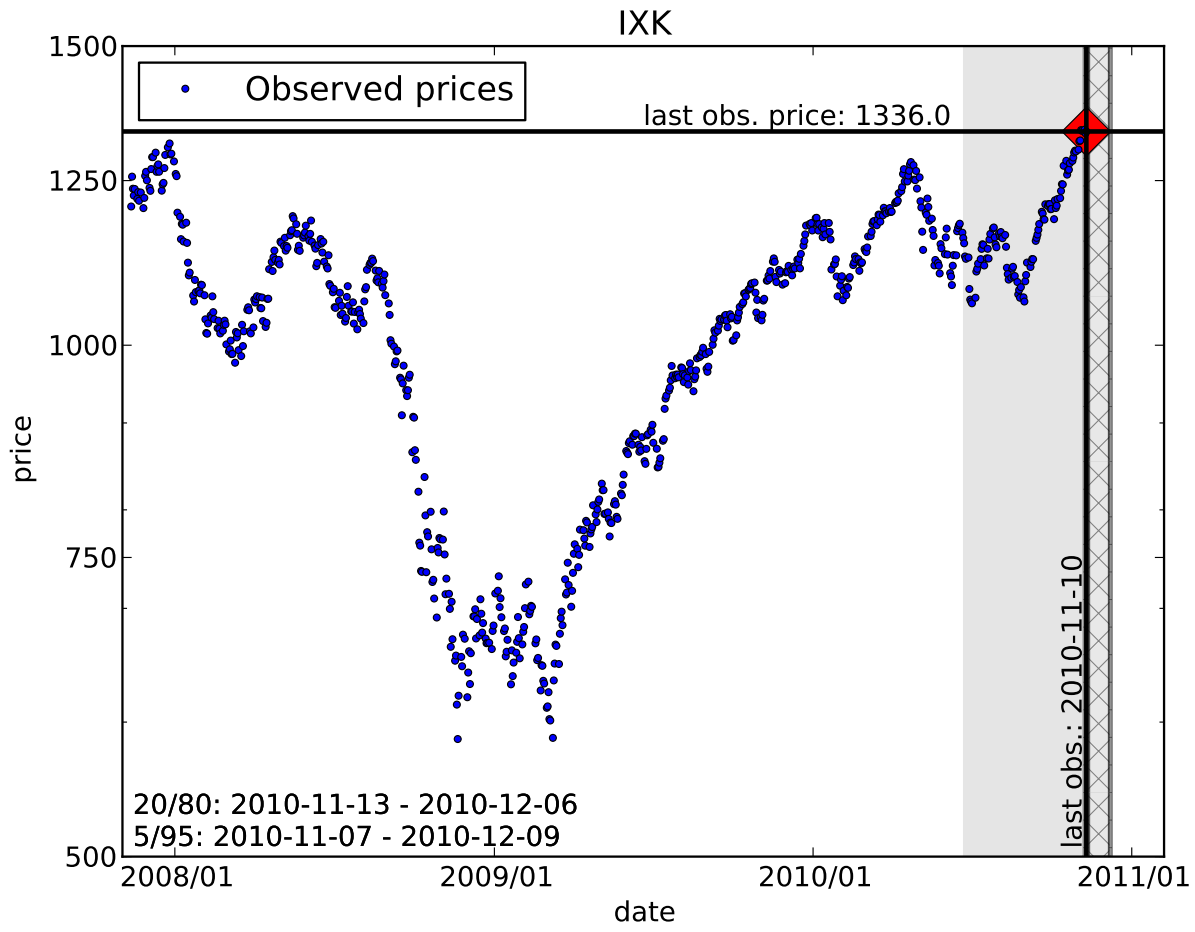

FIG. 8. NASDAQ Computer: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

7. *Jakarta Composite*

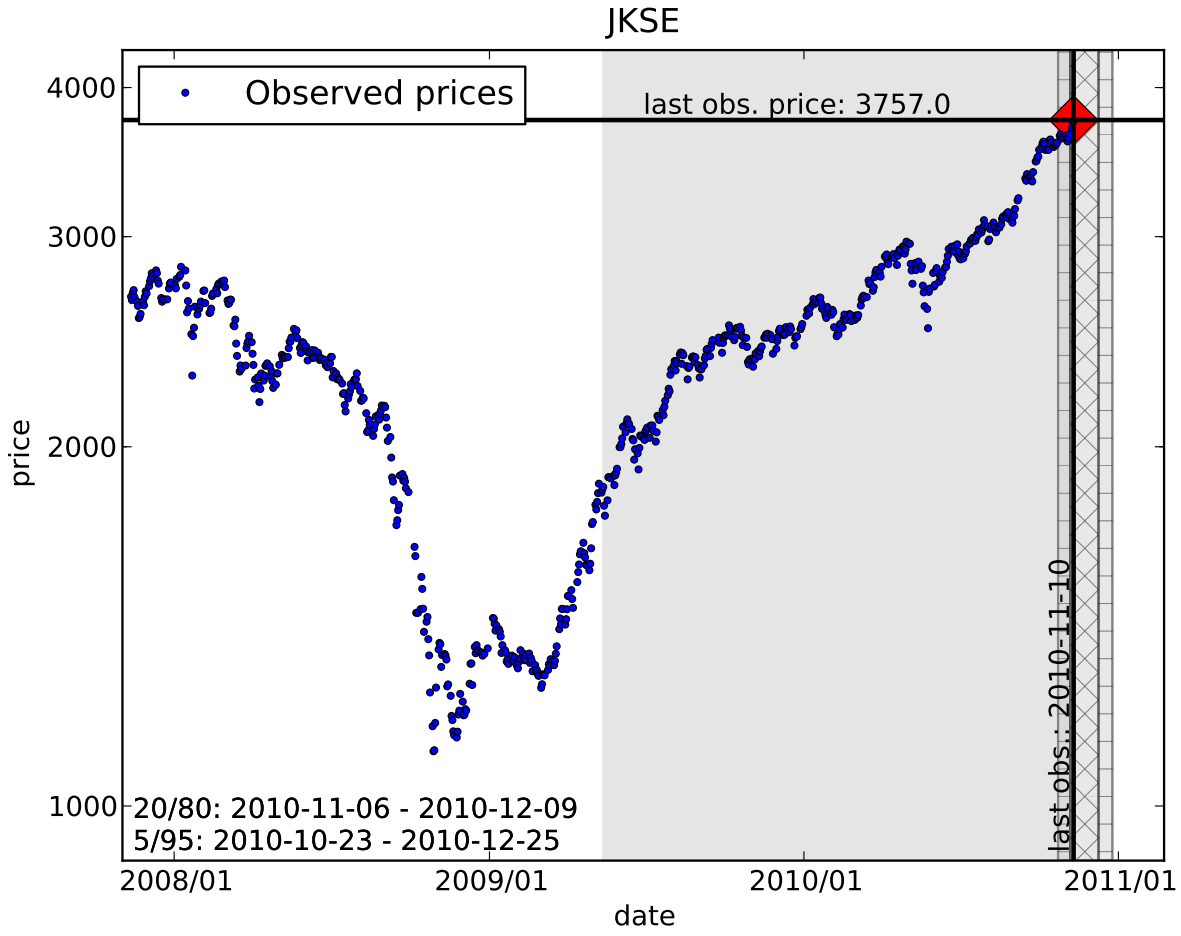

FIG. 9. Jakarta Composite: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

8. KOSPI Composite Index, Seoul

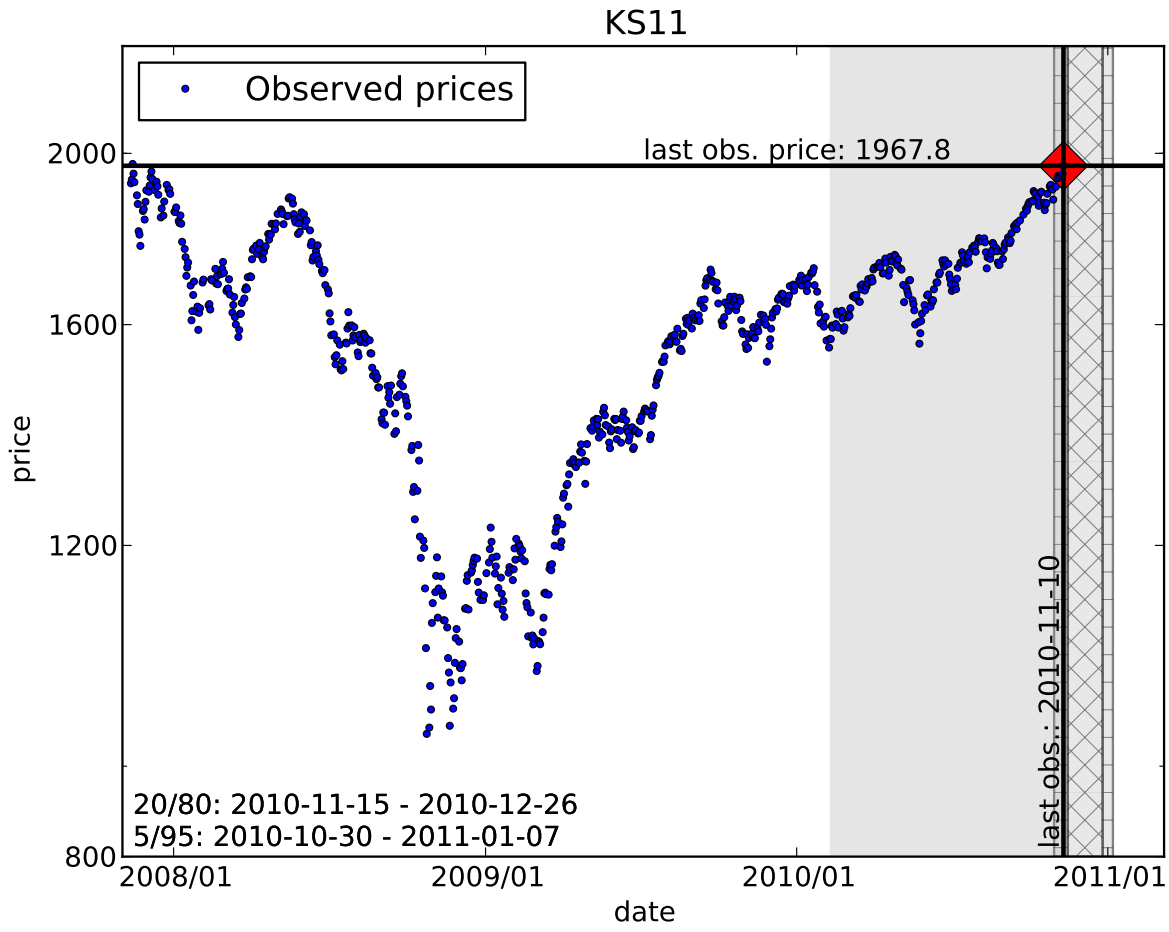

FIG. 10. KOSPI Composite Index, Seoul: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

9. NASDAQ-100 (DRM)

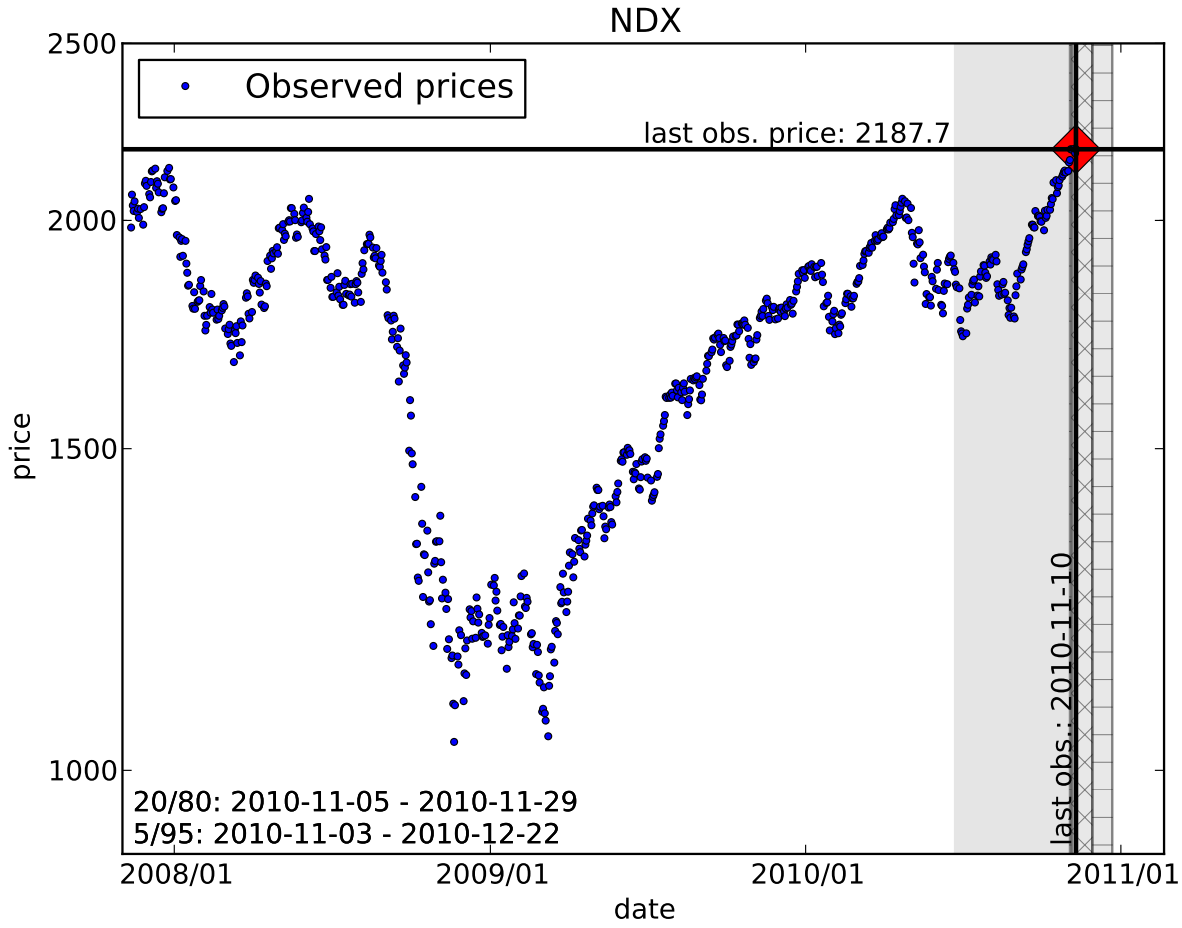

FIG. 11. NASDAQ-100 (DRM): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

10. Reuters/Jefferies CRB index

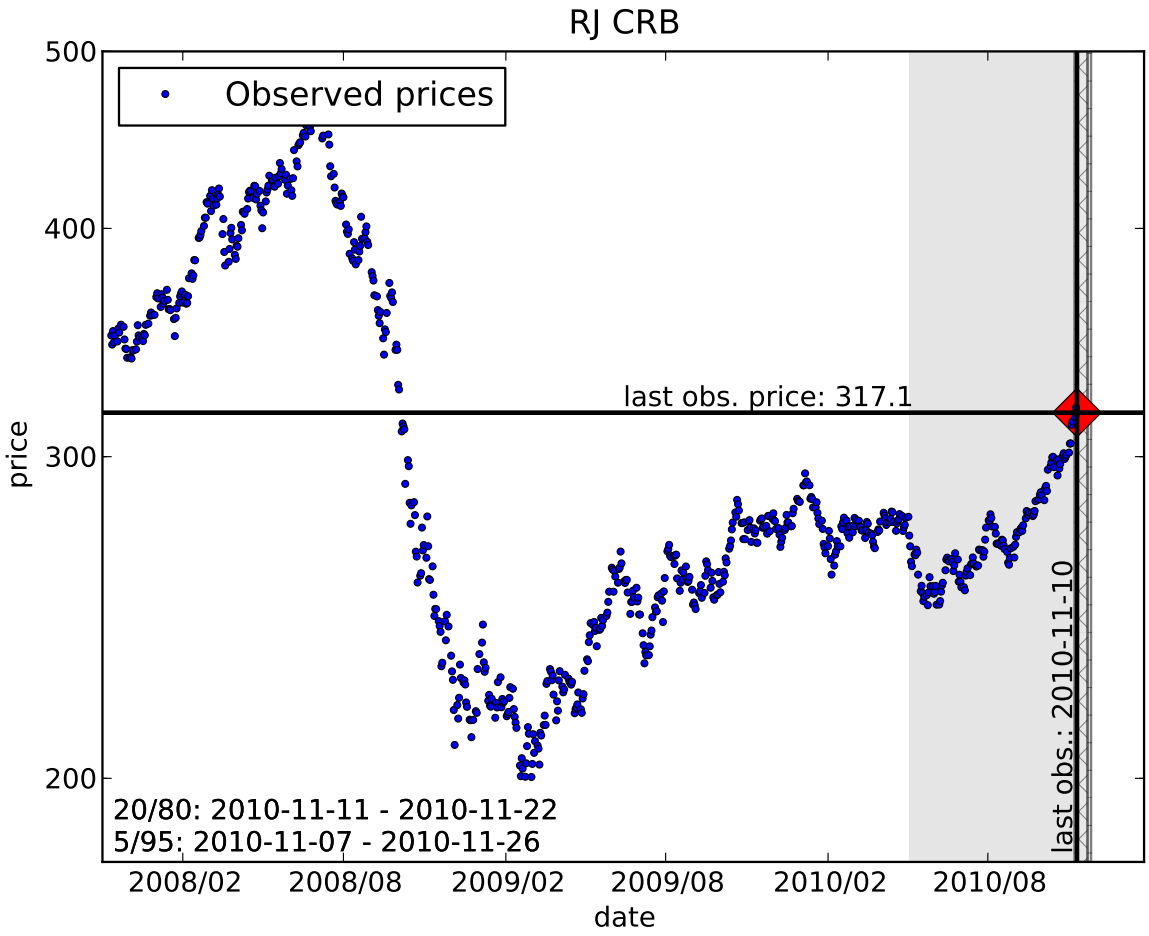

FIG. 12. Reuters/Jefferies CRB index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

11. TSEC weighted index

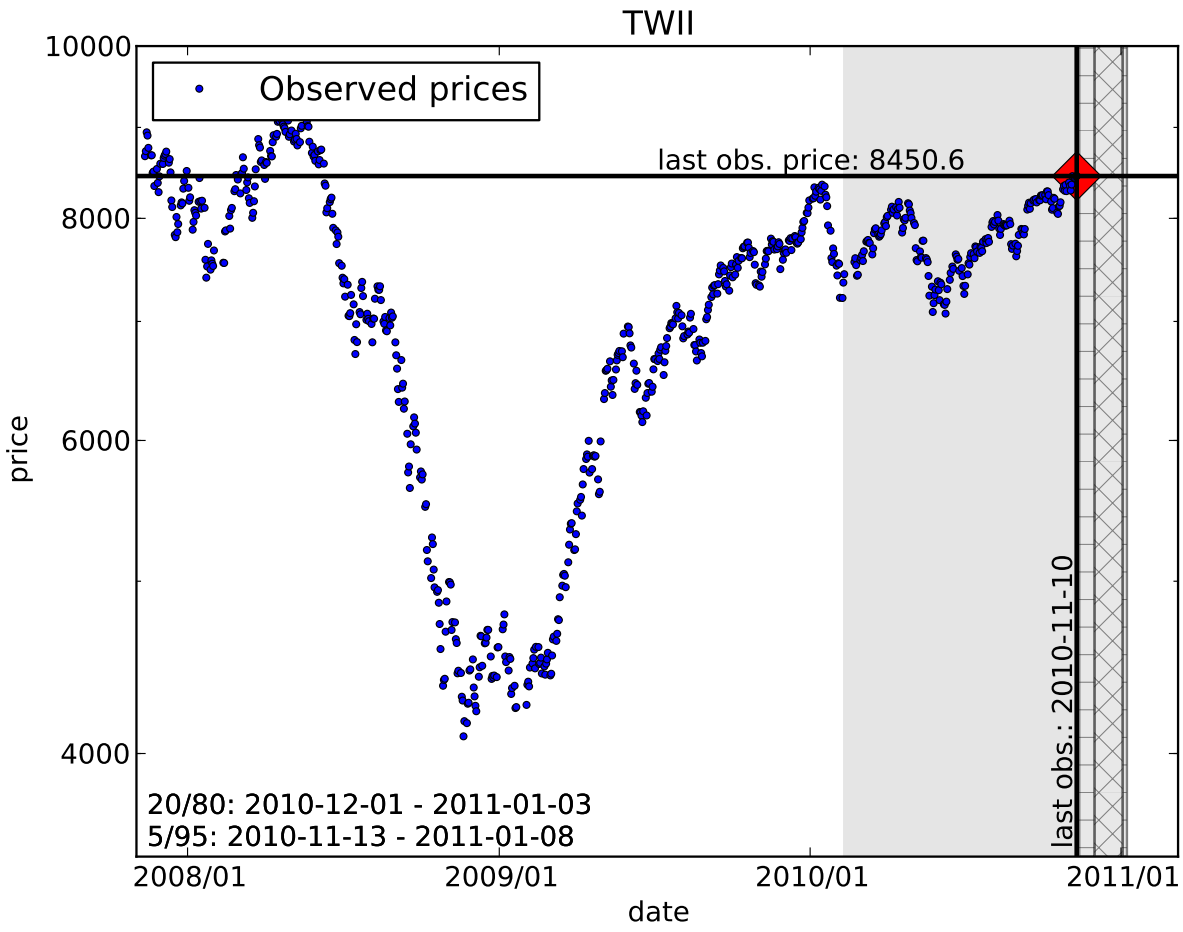

FIG. 13. TSEC weighted index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

12. Major Market Index

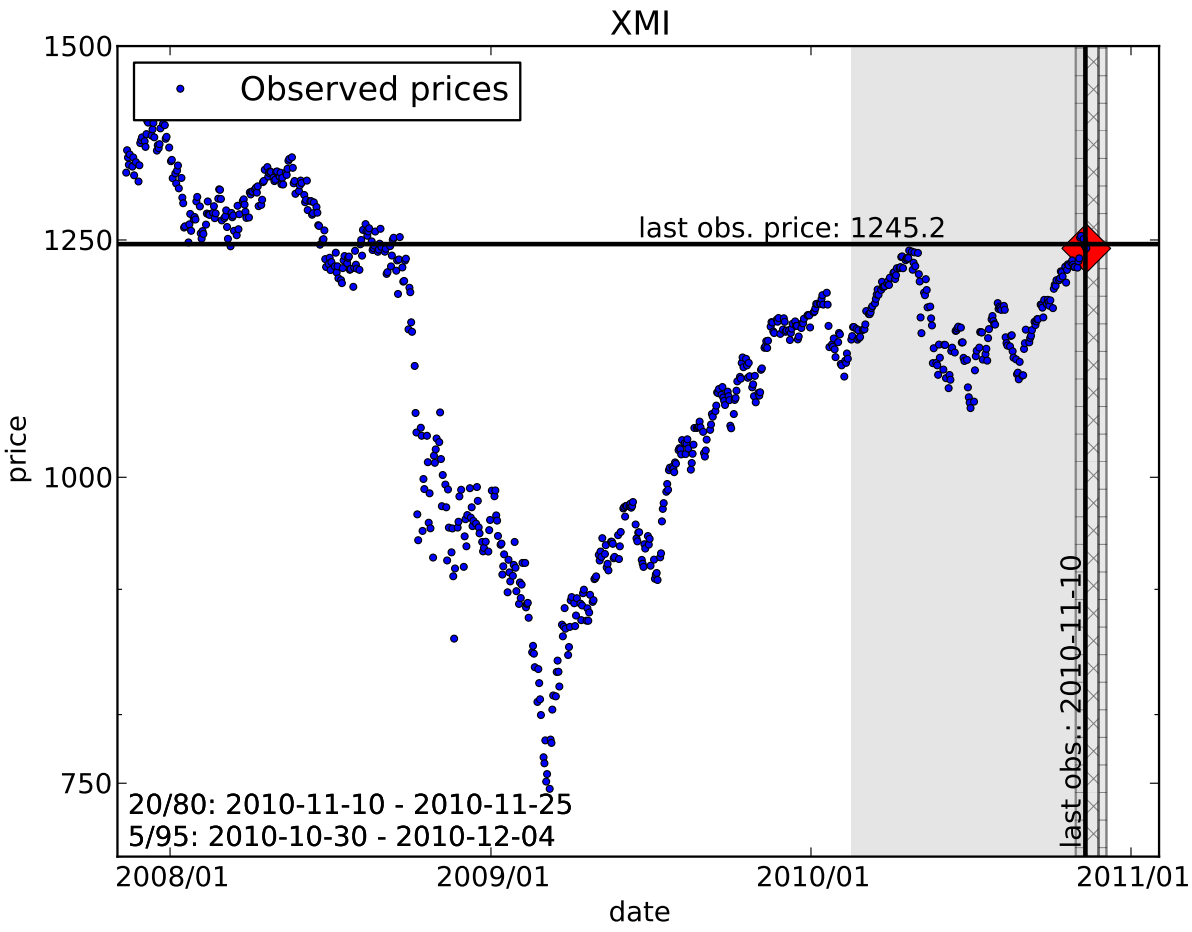

FIG. 14. Major Market Index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

B. H1 & H2 Equities

1. *Ishares Singapore Index*

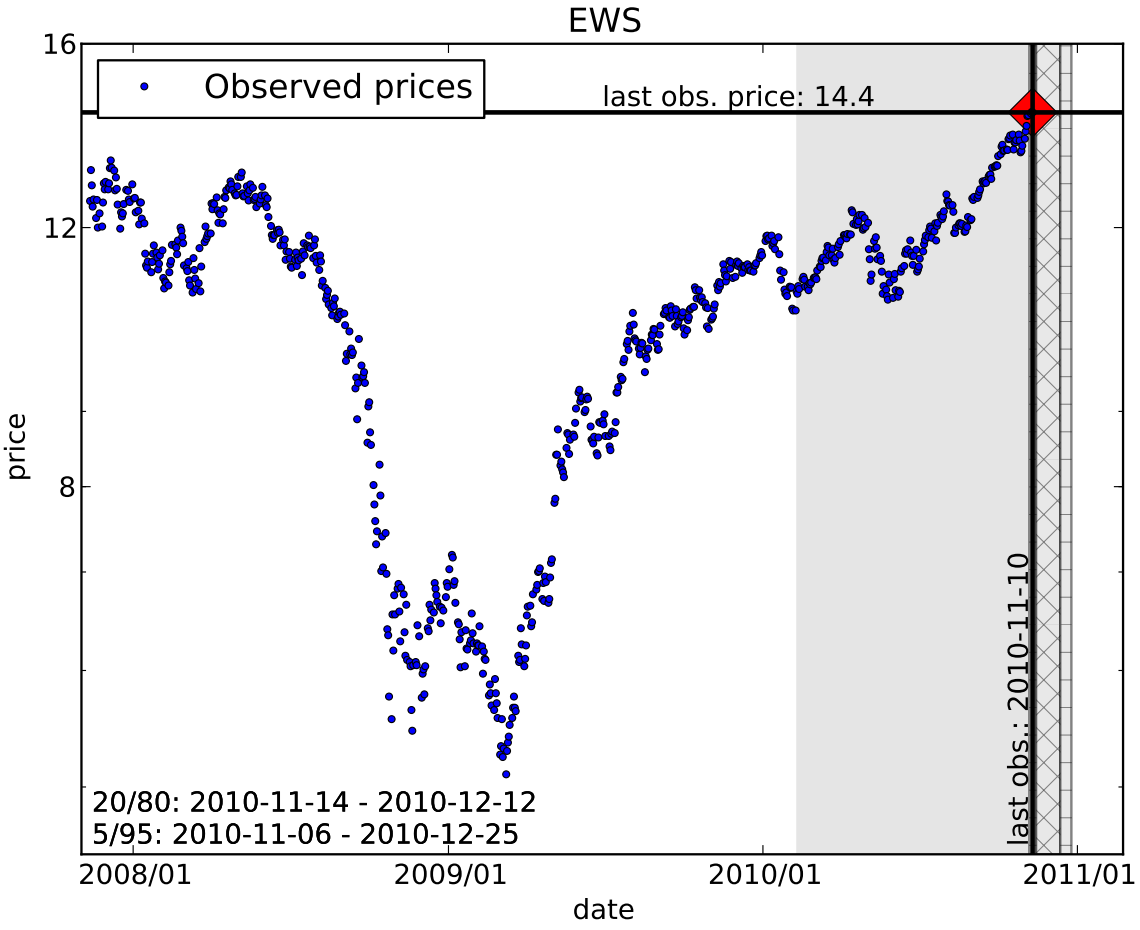

FIG. 15. Ishares Singapore Index: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

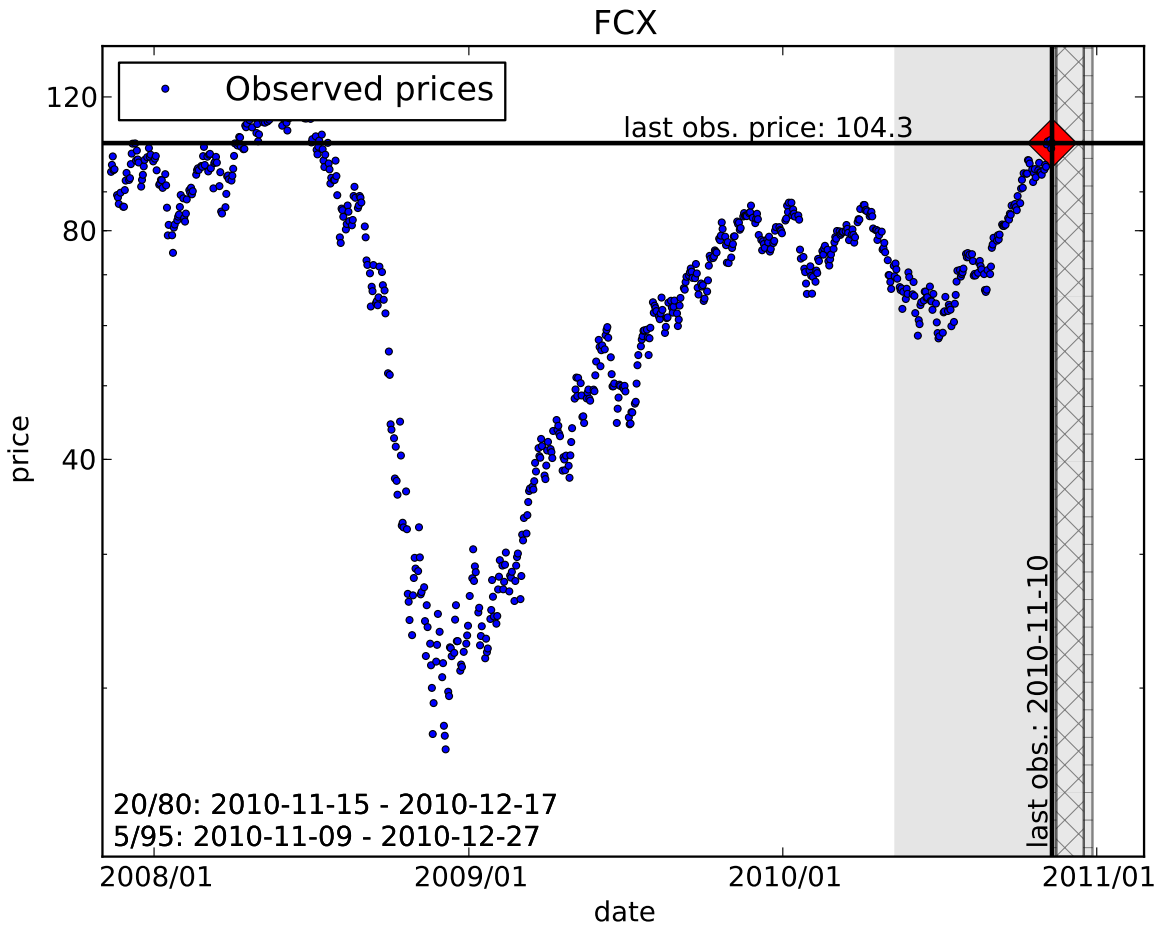

FIG. 16. Freeport McMoRan Copper & Gold: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

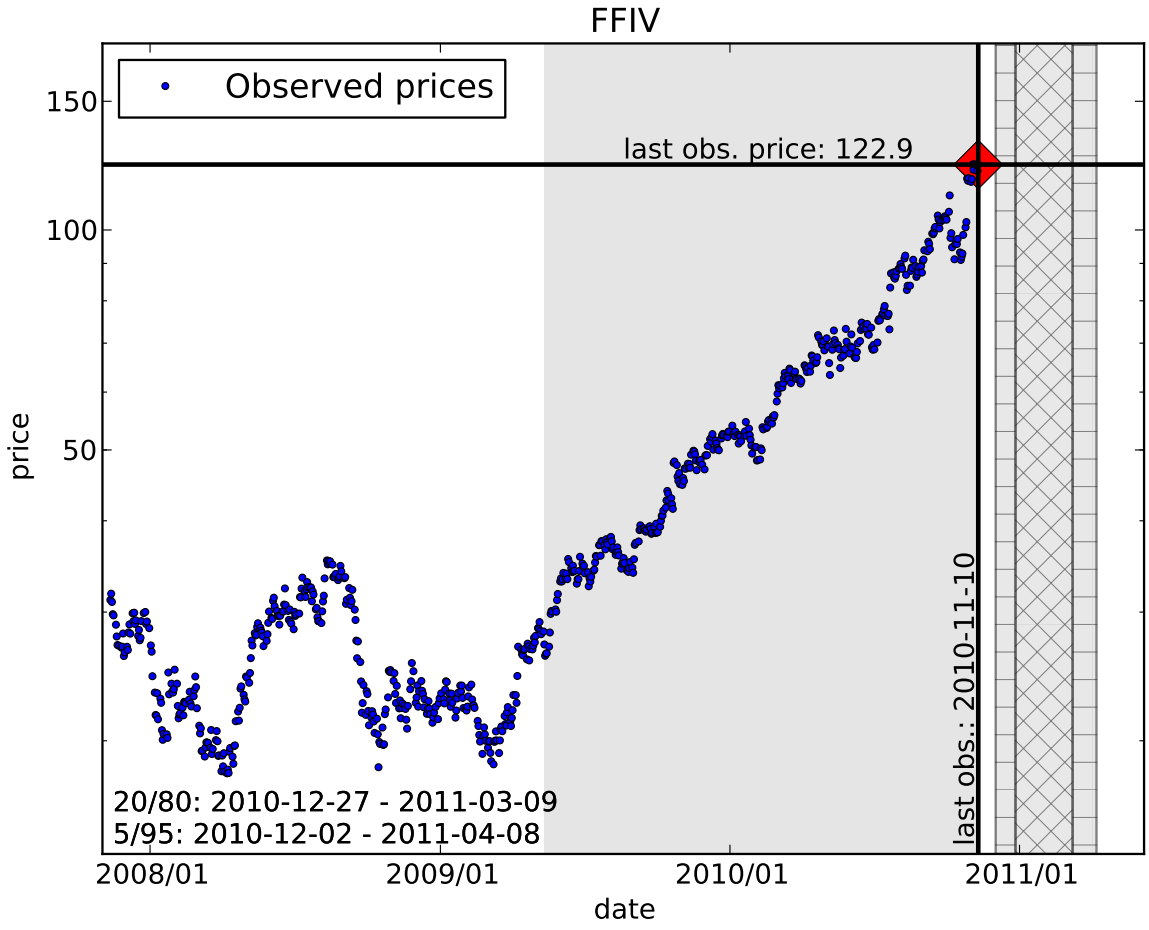

FIG. 17. F5 NETWORKS: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

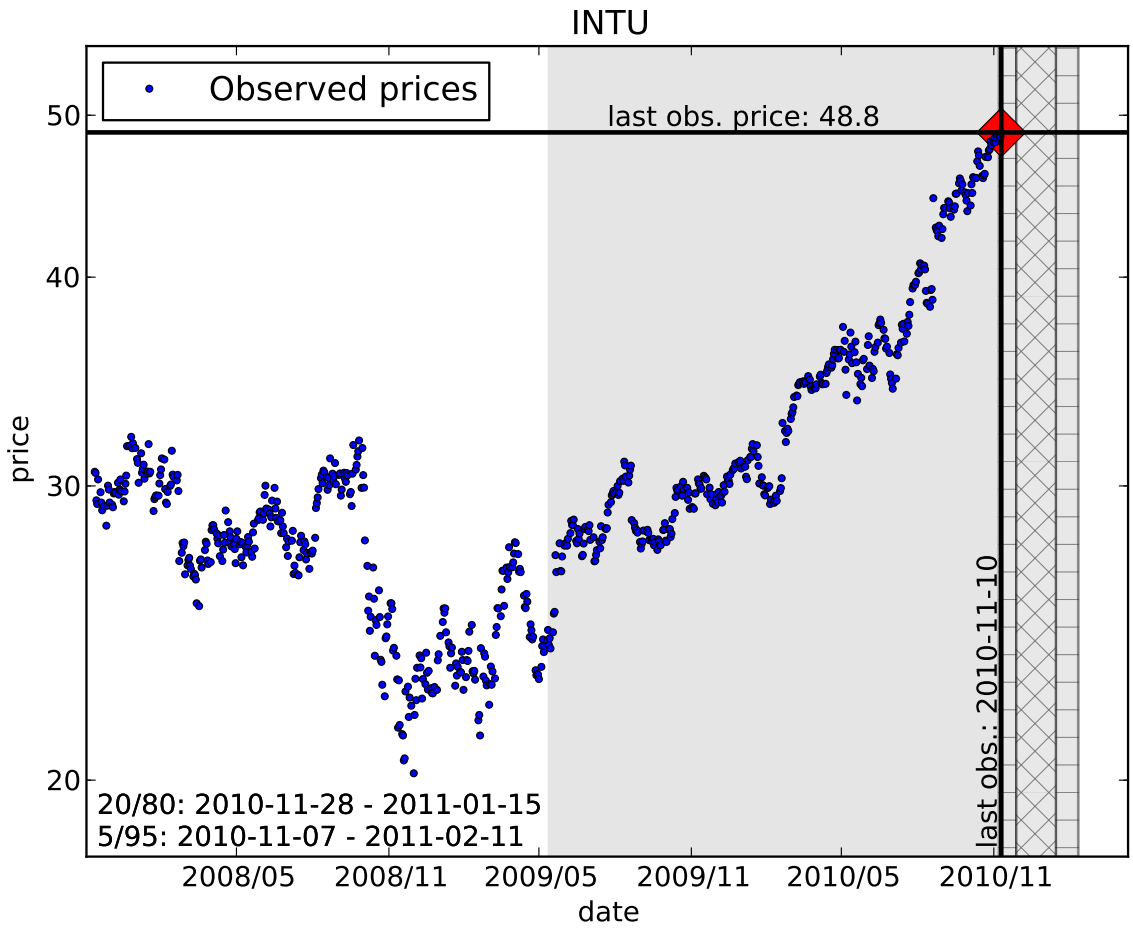

FIG. 18. INTUIT: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

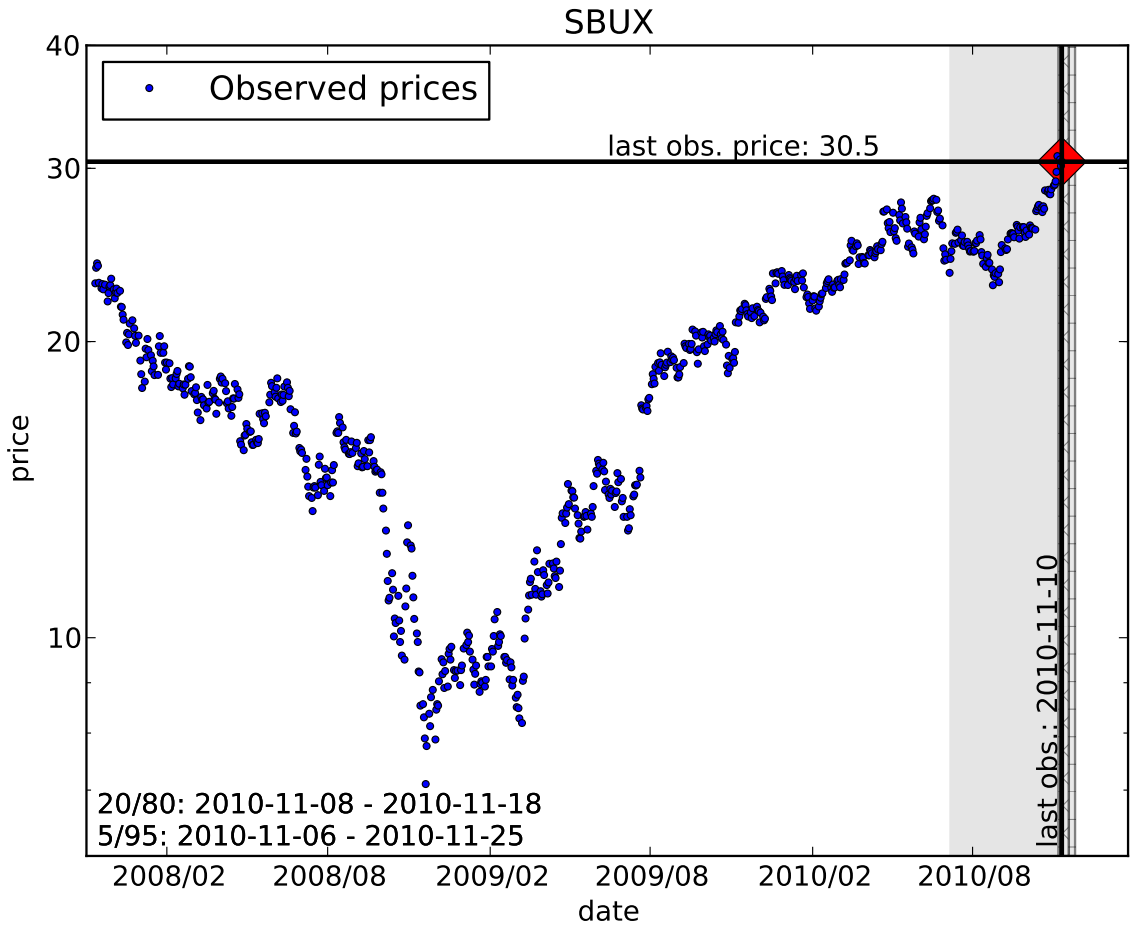

FIG. 19. STARBUCKS: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

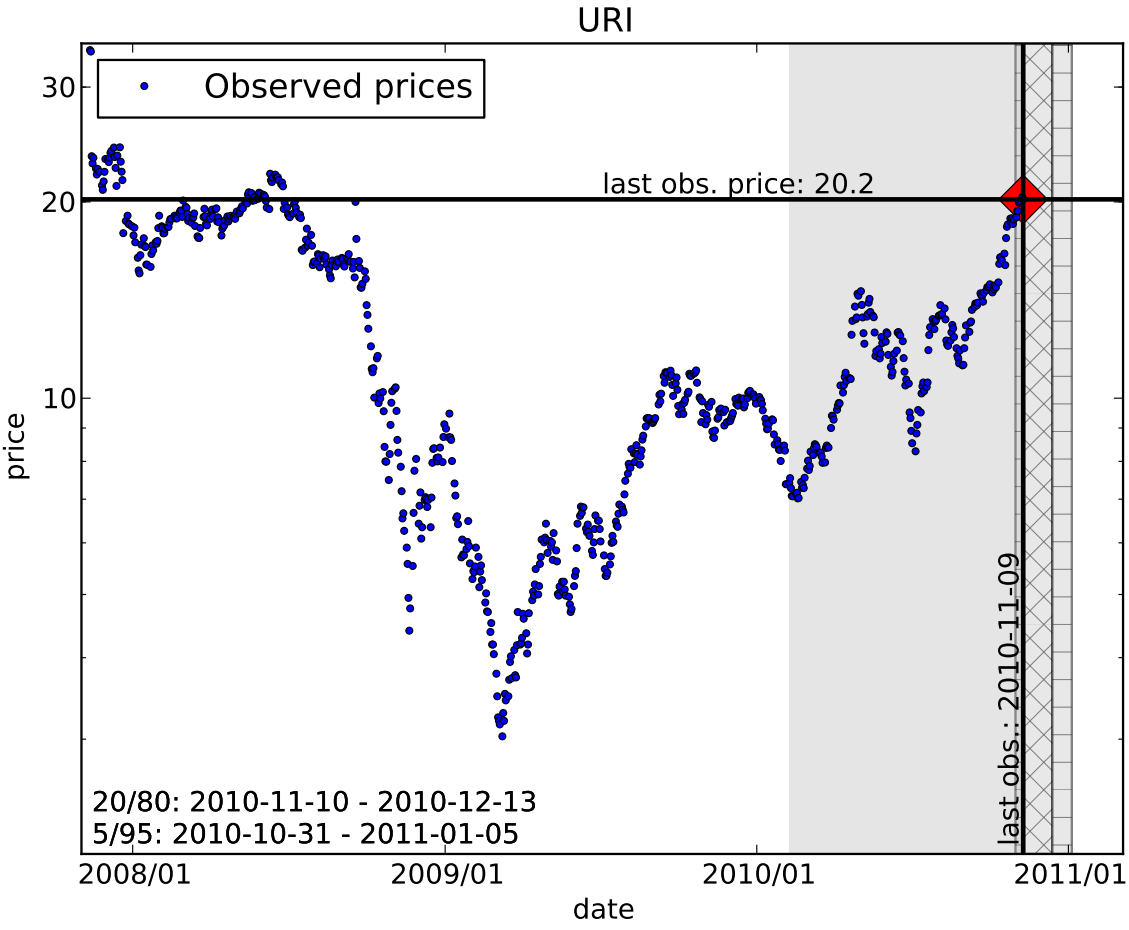

FIG. 20. UNITED RENTALS INC: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

C. H1 & H2 Commodities

1. *Copper future (USD)*

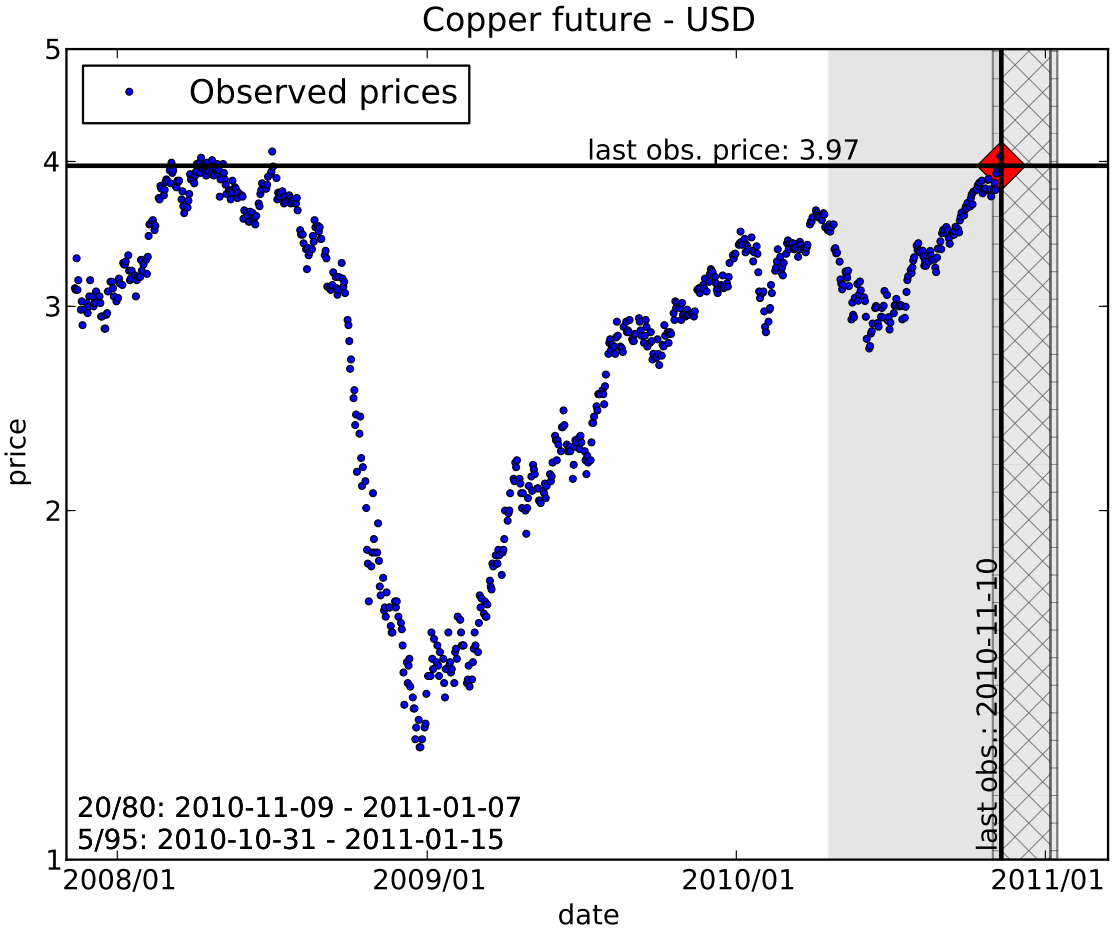

FIG. 21. Copper future (USD): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

2. Corn future (CHF)

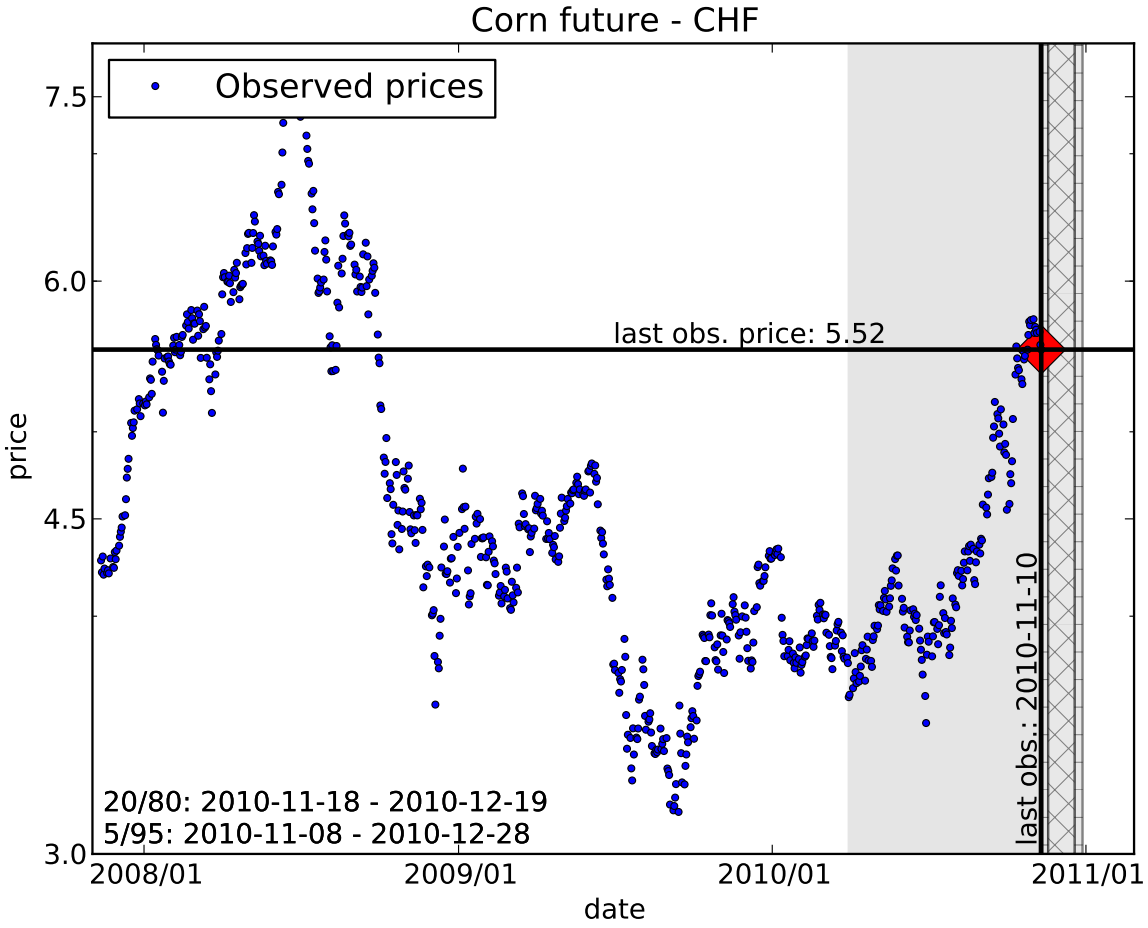

FIG. 22. Corn future (CHF): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

3. Cotton future (USD)

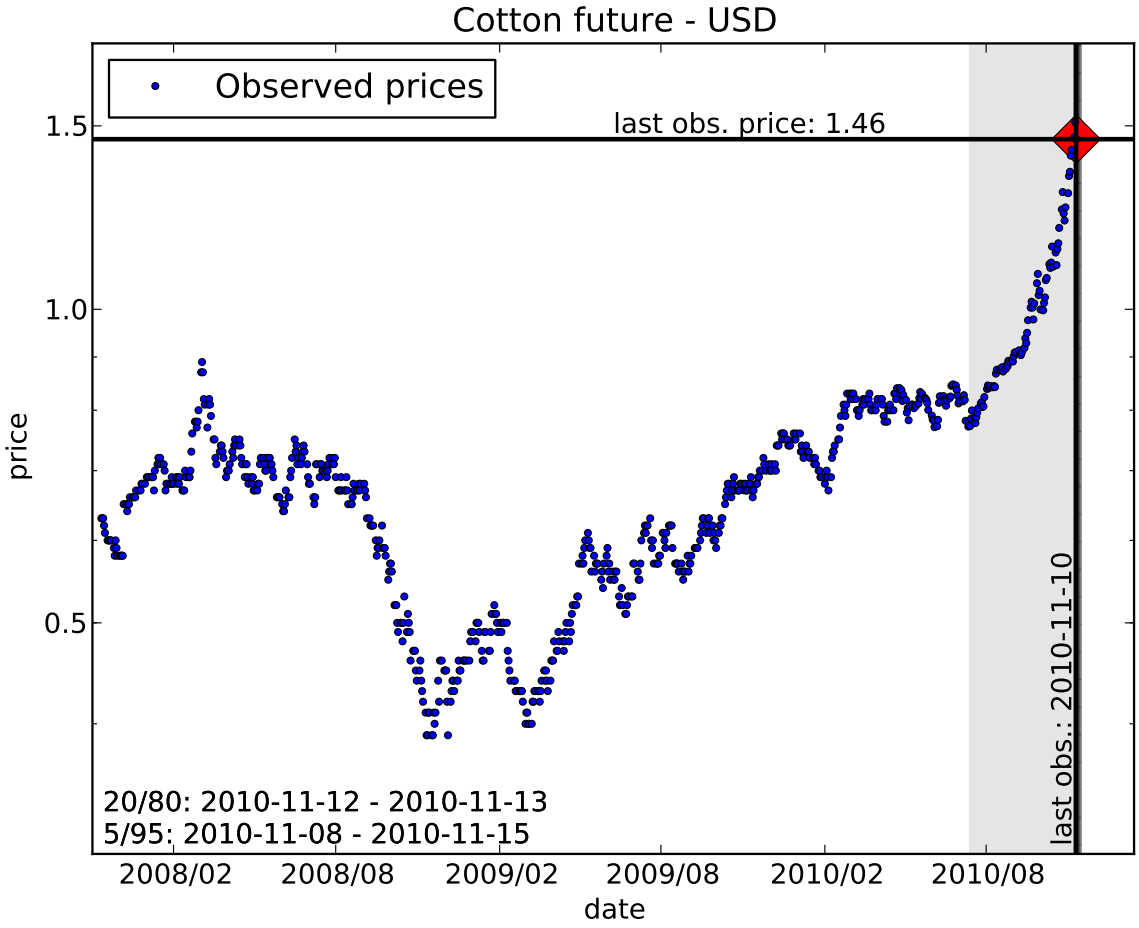

FIG. 23. Cotton future (USD): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

4. Palladium future (USD)

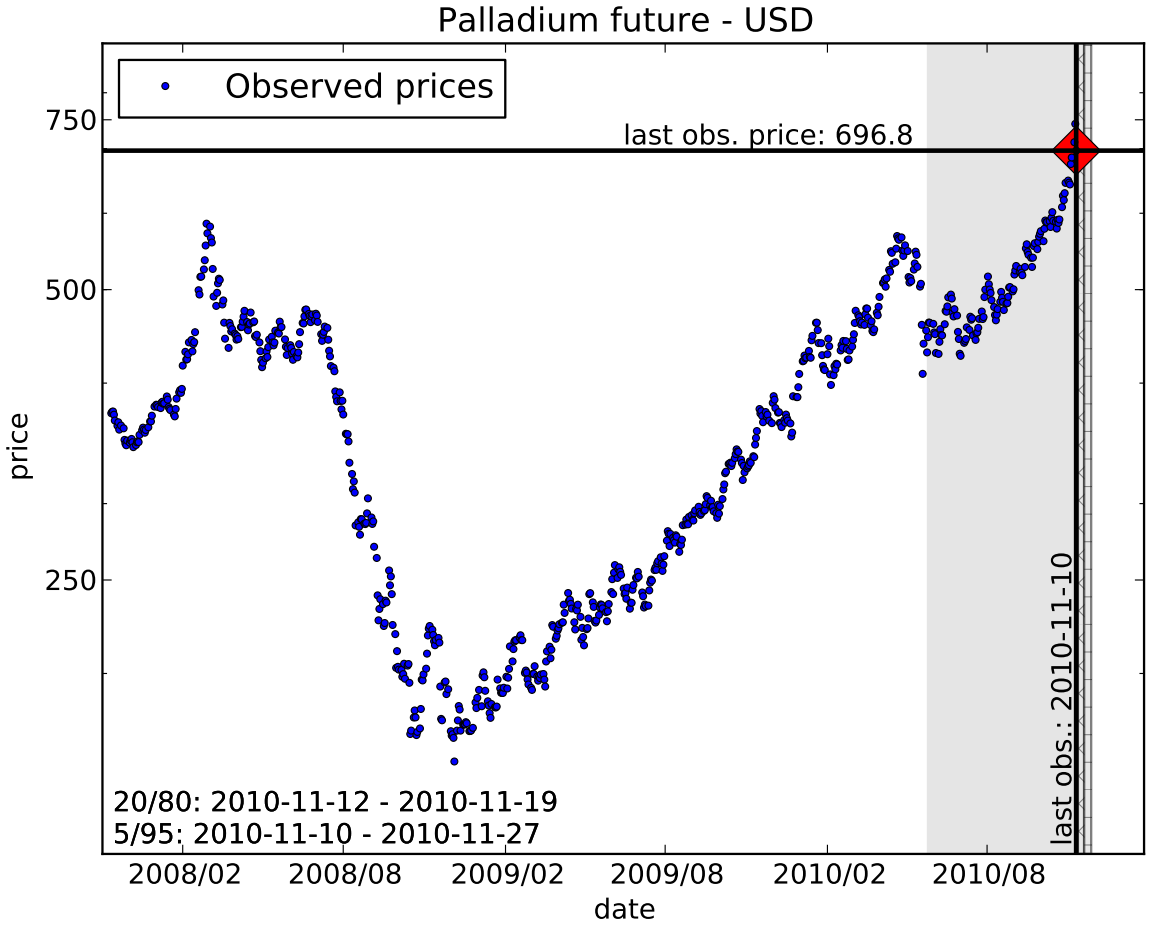

FIG. 24. Palladium future (USD): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

5. Silver future (CHF)

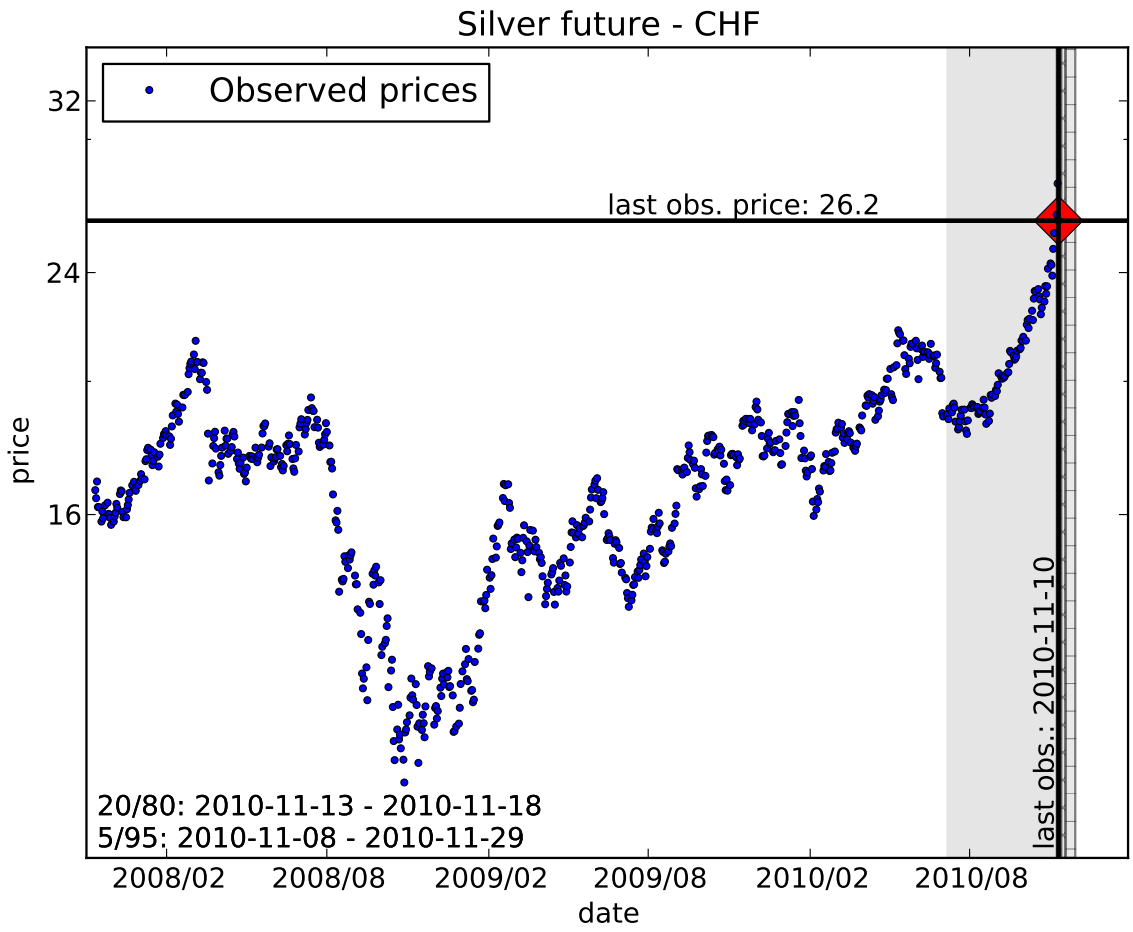

FIG. 25. Silver future (CHF): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

6. Sugar future (CHF)

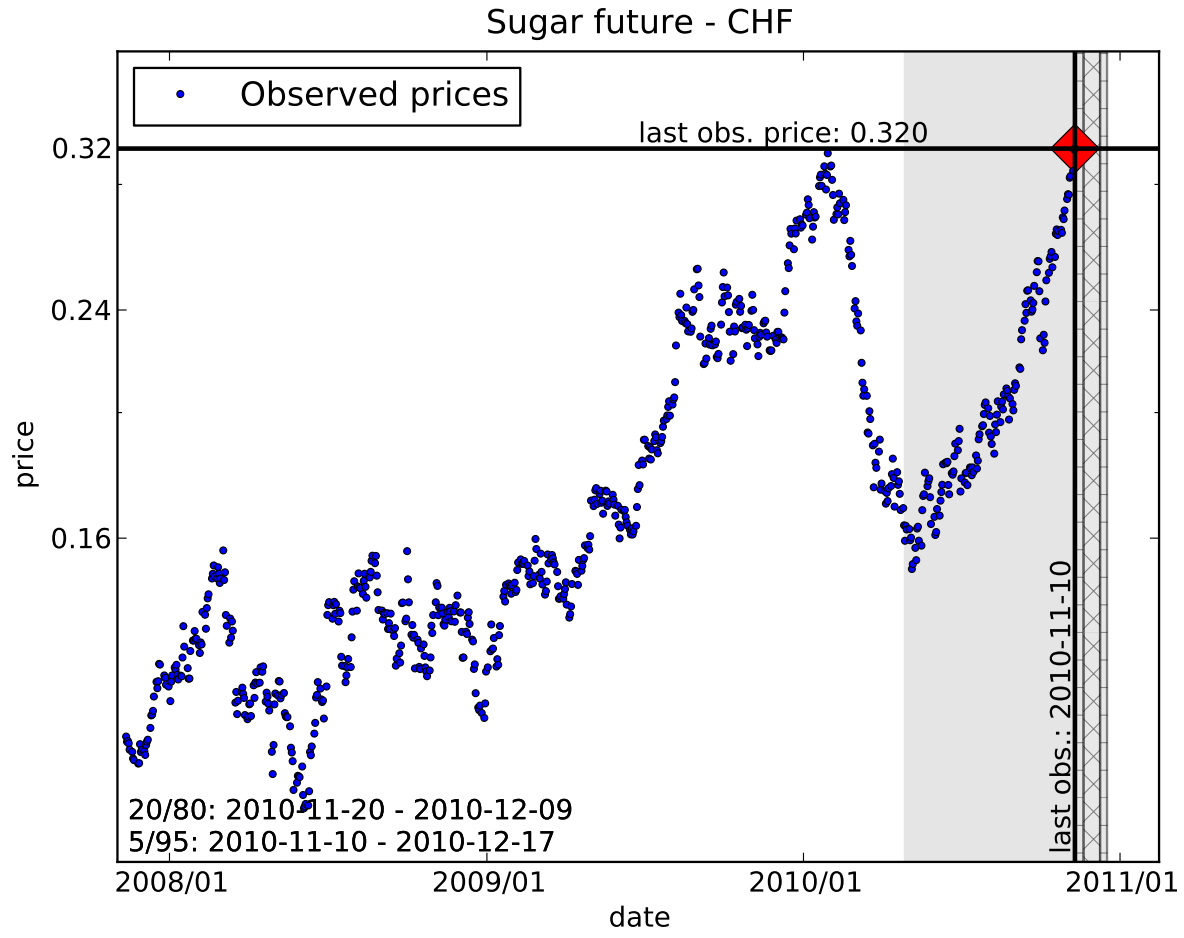

FIG. 26. Sugar future (CHF): Time series of observations (filled circles) and range over which our analysis was performed (shaded region).

D. H1 & H2 Foreign Exchange

1. AUDUSD

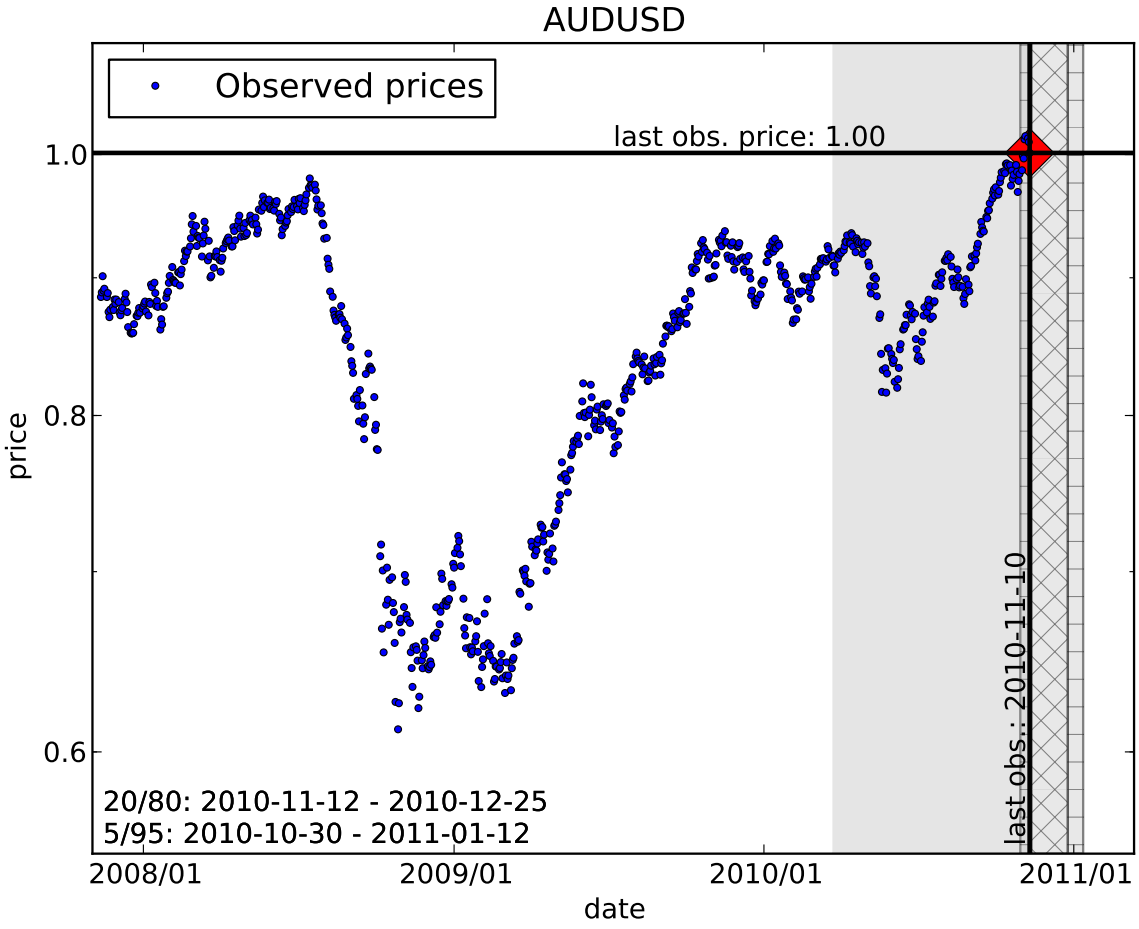

FIG. 27. AUDUSD: Time series of observations (filled circles) and range over which our analysis was performed (shaded region).