Forecast performance in times of terrorism

FBA seminar at University of Macau

Jonathan Benchimol[1] and Makram El-Shagi[2]

This presentation does not necessarily reflect the views of the Bank of Israel

December 4, 2018

What do we know ?

- Assessing the future paths of inflation and exchange rate : essential for decision makers and market players in a small open economy.
- Expert and market-based forecasts : main tools used by these decision makers.
- Financial instabilities : change expectations.
- Terrorism : change expectations too.

Why is it important ?

- **The impact of terrorism on forecasting has not been analyzed in the literature.**
- How reliable are forecasts made in times of terrorism ? Financial instability ?
- As a policymaker in times of terrorism or crisis, is it better to believe expert or market-based forecasts ?
- Terrorism is now important for **Europe** and **UK**.

What do we do ?

- We test expert and market-based forecast accuracy, **conditioned** on financial instability and terrorism periods.

What do we find ?

- Expert forecasts are better than market-based forecasts, especially during instability.
- Terrorism variables have a **strong explanatory power** of both forecasts' predictive ability.

Literature

- Giacomini and White (2006) develop **test of conditional predictive ability** and compare to unconditional ones (Diebold and Mariano, 1996).
- Giacomini and Rossi (2010) present **relative local forecasting performance tests** of two models (Fluctuation and One-Time Reversal tests). This **forecast comparison in unstable environments** essentially uses rolling window Giacomini and White (2006) tests.
- Rossi and Sekhposyan (2016) implement regression-based tests of predictive ability in unstable environments, and apply these **unbiasedness and efficiency tests** (forecast rationality tests) to survey forecasts.

In a nutshell

Unstable environment : rolling window tests.

- Unbiasedness test : is there at least one bias ?
- Fluctuation test : is there a significant difference in predictive ability ?
- One-time reversal test : is there joint (full and sub-sample) equal performance at any point in time ? Break in predictive ability ?
- Conditional relative performance test : to which indicator the forecast performance is most related ?
- Switch to the results.

Are the considered forecasts unbiased ?

- The underlying test statistic is based on a standard regression:

$$y_{t+h} = \alpha + \beta \hat{y}_{t+h,t} + \eta_{t,h} \tag{1}$$

where

  - y_{t+h} is the variable of interest at $t+h$;
  - $\hat{y}_{t+h,t}$ is the corresponding forecast made at time t;
  - $\eta_{t,h}$ is the residual of the test regression (test the joint hypothesis that $\alpha = 0$ and $\beta = 1$).

- Null hypothesis : the forecast under consideration is rational at any point in time during the sample.
- Rejection : a forecast was biased at least once ($\neq$ permanently) during the sample period.
- Rossi and Sekhposyan (2016) suggested using the maximum of rolling-window **unbiasedness tests** as the test statistic.

Fluctuation test (1)

- Test for relative forecast performance in unstable environments : the maximum of traditional (unconditional) relative forecast performance tests over a rolling window.
- Null hypothesis : the forecasts under consideration perform equally well at **any** point in time.

Fluctuation test (2)

- Exceeding the critical value :
  - does not imply that one model **constantly** outperforms the other.
  - implies that there is a meaningful difference in predictive ability for some subsample.
- The test statistic is the maximum of local Diebold and Mariano (1995) test statistics, in which the variance estimator is based on the full sample of forecasts, rather than the individual window for which the mean difference in predictive ability is computed.

Fluctuation test (3)

- Loss function for the two forecasts under consideration at time t : $L_{1,t,h}$ and $L_{2,t,h}$.
- Corresponding loss difference : $\Delta L_{t,h} = L_{1,t,h} - L_{2,t,h}$.
- Test statistic is

$$\max_{j \in \{m,\dots,P\}} \left| \hat{\sigma}^{-1} m^{-1/2} \sum_{t=j-m/2}^{j+m/2-1} \Delta L_{t,h} \right| \tag{2}$$

where $\hat{\sigma}$ is the HAC robust estimator of the standard error of the mean of $\Delta L_{t,h}$, with a sample of P forecasts and using window length m.

One-time reversal test (1)

- A potential change in forecast performance is often due to a single structural break (e.g., the introduction of a new forecasting model, or a policy that is not well understood by one forecasting agent), rather than fluctuations over time.
- Thus the fluctuation test creates an unnecessary loss in power, compared to a test that explicitly models a single structural break.
- The one-time reversal test is an entire testing procedure composed of **three separate tests**.

One-time reversal test (2)

- First test statistic : a straightforward full sample test:

$$LM_1 = \hat{\sigma}^{-2} P^{-1} \left[\sum_{t=1}^{P} \Delta L_t \right]^2 \tag{3}$$

- Second test statistic : actual structural break statistic based on the difference between loss differences in different subsamples:

$$LM_2 = \max_{j \in \{0.15P, \ldots, 0.85P\}} LM_2(j) \tag{4}$$

where $LM_2(j) =$
$\hat{\sigma}^{-2} P^{-1} (j/P)^{-1} (1 - j/P)^{-1} \left[\sum_{t=1}^{j} \Delta L_t - (j/P) \sum_{t=1}^{P} \Delta L_t \right]^2$

One-time reversal test (3)

- Third, the joint test-statistic with the null hypothesis of equal performance at any point in time:

$$\phi = LM_1 + LM_2 \tag{5}$$

- Correspondingly, if the third test statistic is rejected, we can reject equal performance at every point in time.
- Only then we assess the individual underlying statistics LM_1 and LM_2.
  - If only LM_1 is rejected, this indicates the **permanent** superiority of one model.
  - If only LM_2 is rejected, this indicates the reverse, in which one model is **superior only for** a certain subsample.

Conditional relative performance test (1)

- We now assess the **reasons** for the variation by testing for conditional forecast performance.
- Denoting the set of conditions that potentially explain the difference in performance at time t by the row vector h_t, the test statistic is given by

$$T = P \left(P^{-1} \sum_{t=1}^{P} h_t \Delta L_{t,h} \right) \hat{\Omega}^{-1} \left(P^{-1} \sum_{t=1}^{P} h_t \Delta L_{t,h} \right)' \qquad (6)$$

- In this standard statistic the individual coefficients are bilateral correlations between the elements of h and ΔL.
- Null hypothesis : forecast performance is not related to any of the indicators collected in h.

Conditional relative performance test (2)

- We do not assess which kind of shock at $t + h$ is unforeseeable for certain forecasters
- We assess conditions at t when the forecast is made.
- We choose the preferred forecast, ex ante, that is, when the forecast is made, rather than later when the realization is known.
- Including several indicators in h does not "control" for those in the sense of regression analysis: coefficients are simple bilateral correlations rather than regression coefficients.
- We also run an ad hoc variation of this test, in which we use regression coefficients rather than correlation coefficients and the corresponding covariance matrix, and we run a Wald test on the coefficient(s) of interest only.

Data

- Forecasts :
  - 1Y Breakeven inflation, 1Y Fwd inflation, 1Y Fwd USD/ILS.
  - 1Y Professional forecasts of inflation and USD/ILS.
- Economic data :
  - Inflation rate.
  - USD/ILS exchange rate.
- Financial data :
  - TASE 100.
  - Oil (Brent)
  - Gas.
  - CRB index.
- Terrorism data :
  - GTD: text-mining based.
  - MFA: geography based.
  - NII: citizenship based.

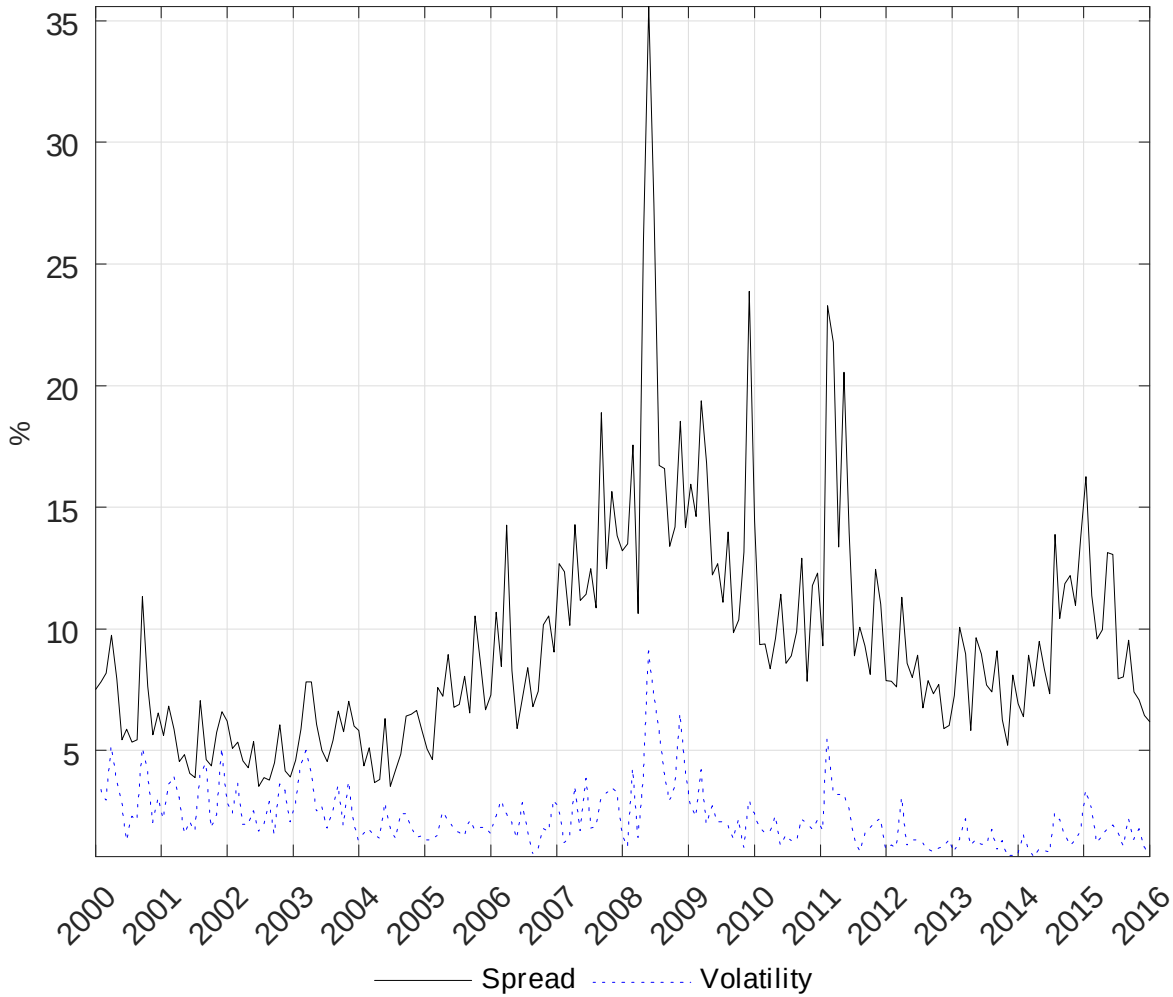


Figure: Financial uncertainty measured as the TA100's 1-month rolling window volatility (standard deviation) and the daily spread (high-low spread).

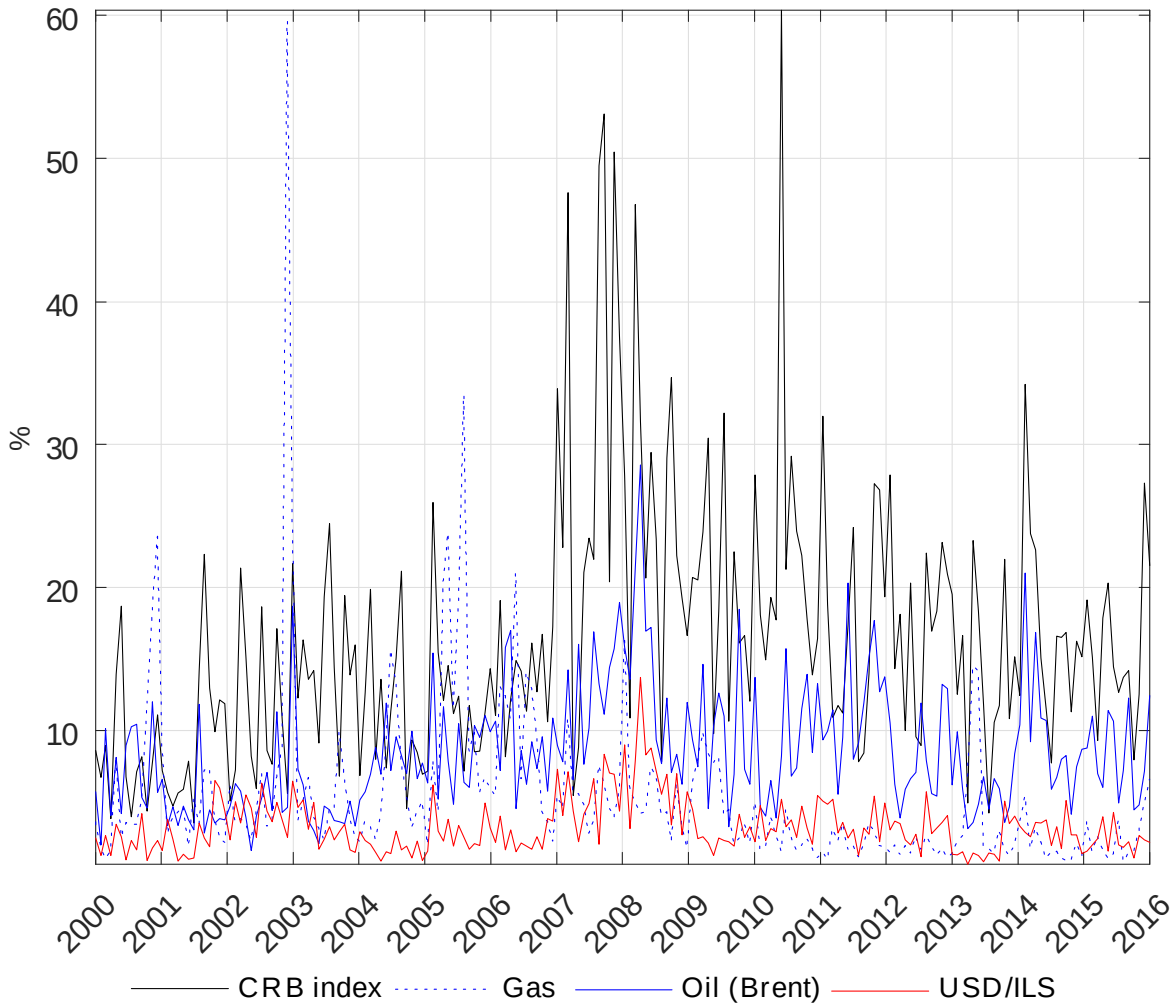


Figure: Financial uncertainty measured as the 1-month rolling window volatility (standard deviation) of the CRB index, gas and oil prices in shekel, and the USD/ILS exchange rate.

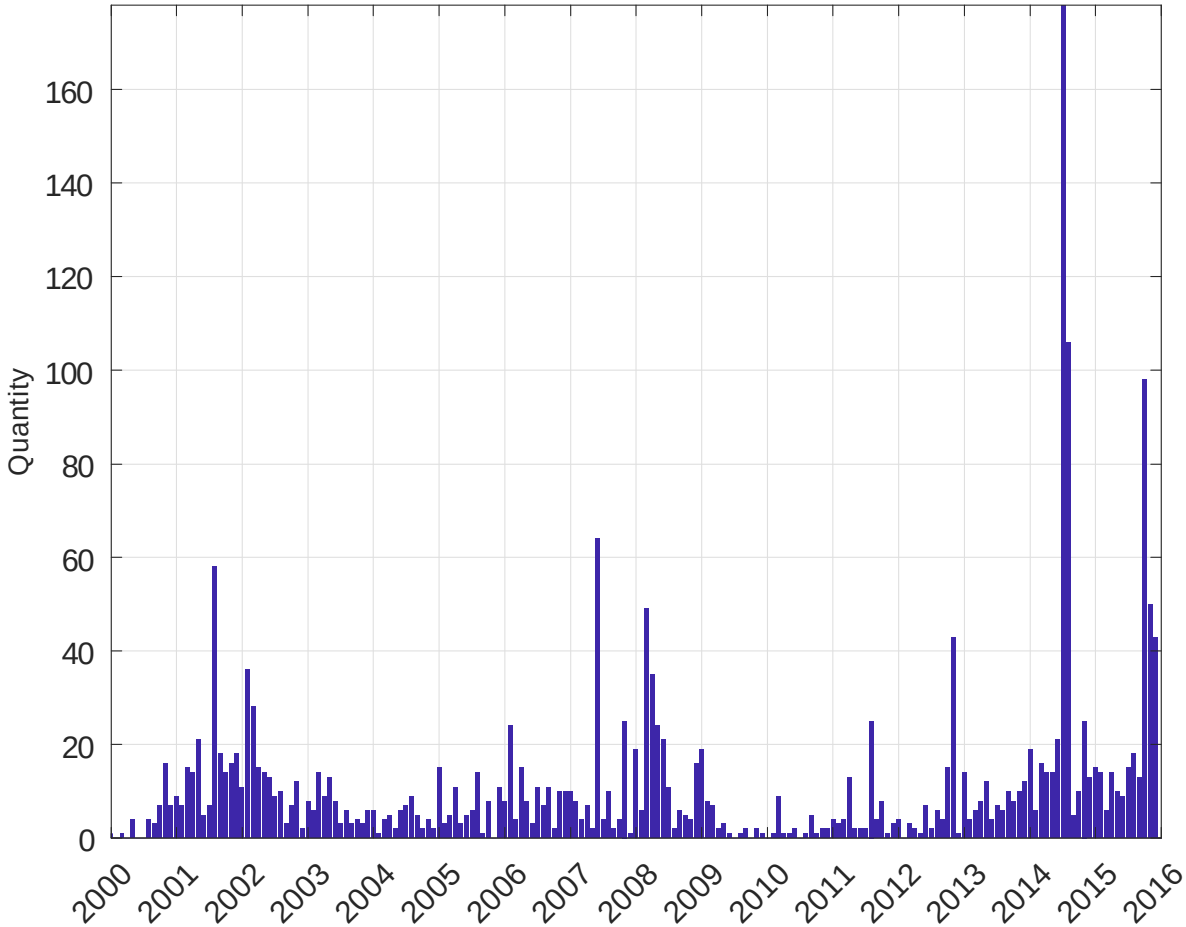


Figure: Number of terrorist attacks in Israel (2000–2016). Source: National Consortium for the Study of Terrorism and Responses to Terrorism (START). Global Terrorism Database.

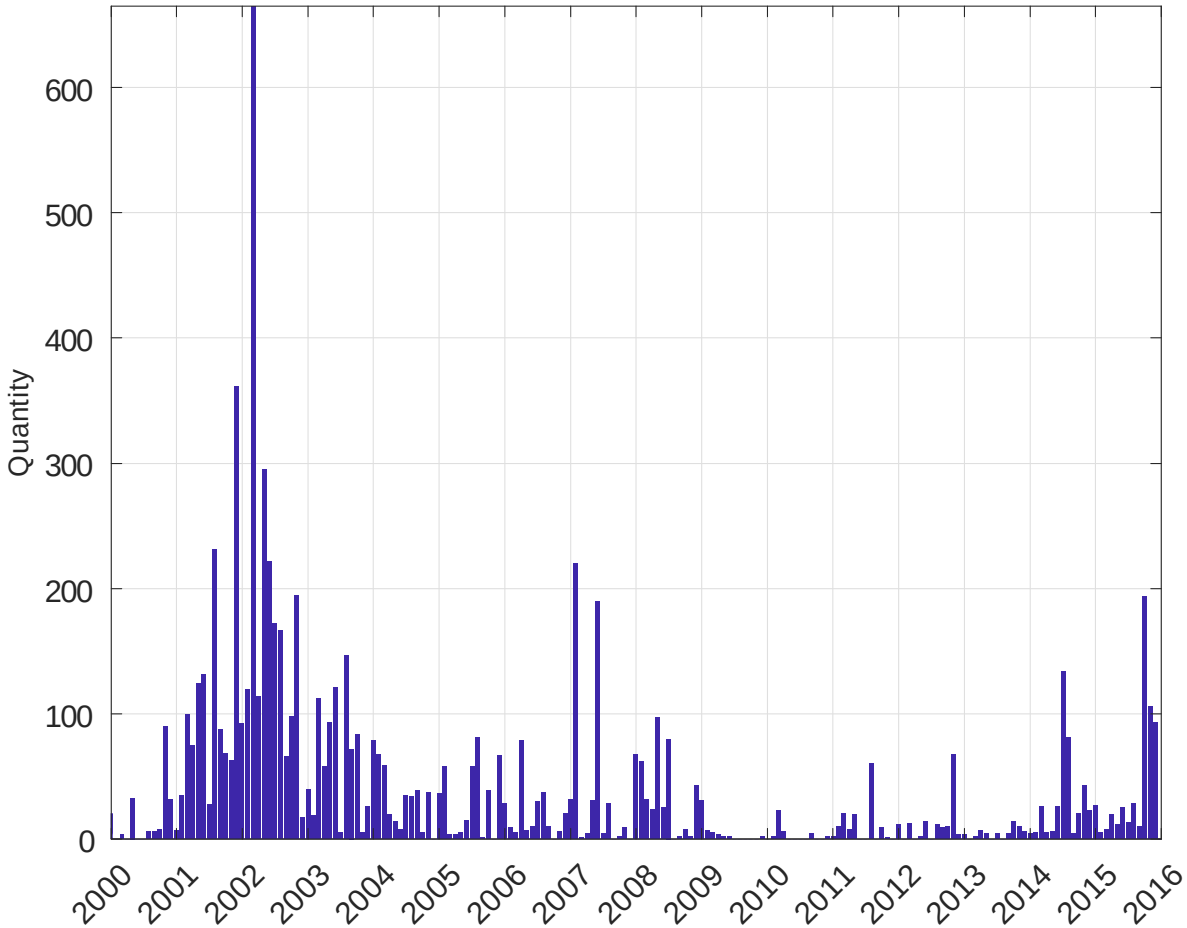
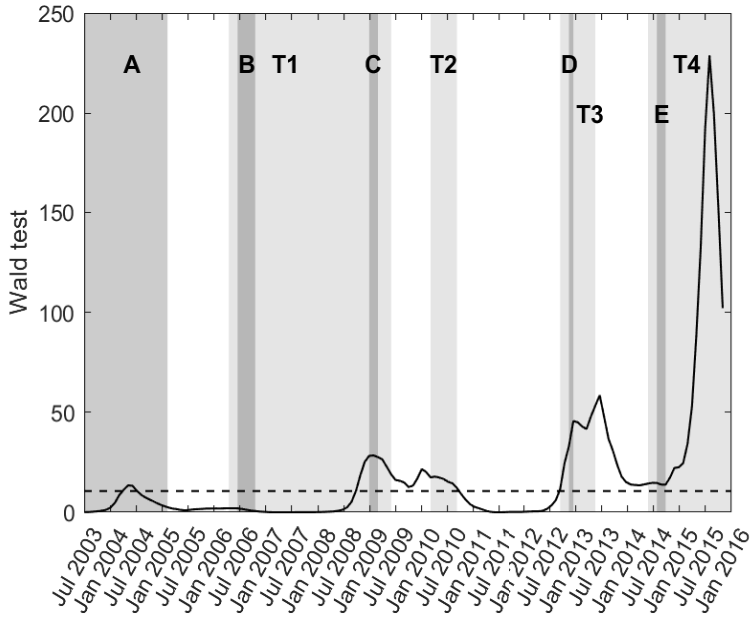
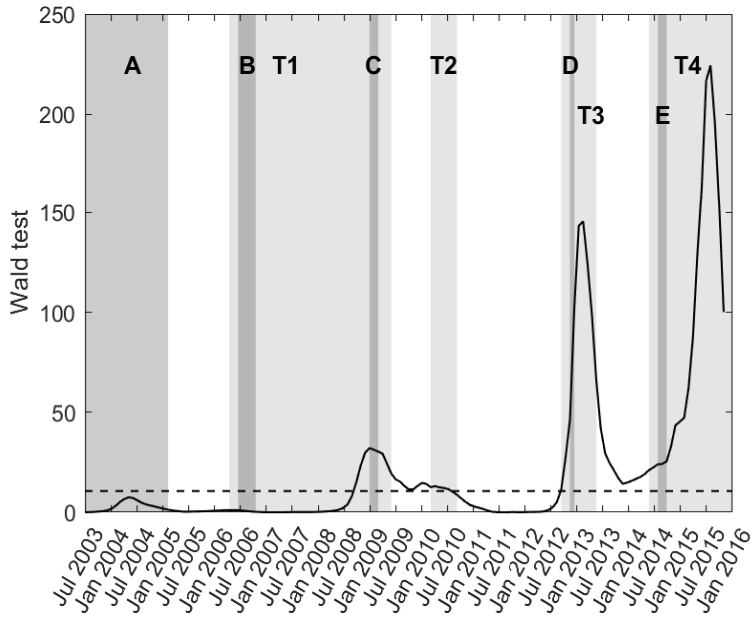


Figure: Number of killed and wounded during terrorist attacks in Israel (2000–2016). Source: National Consortium for the Study of Terrorism and Responses to Terrorism (START). Global Terrorism Database.



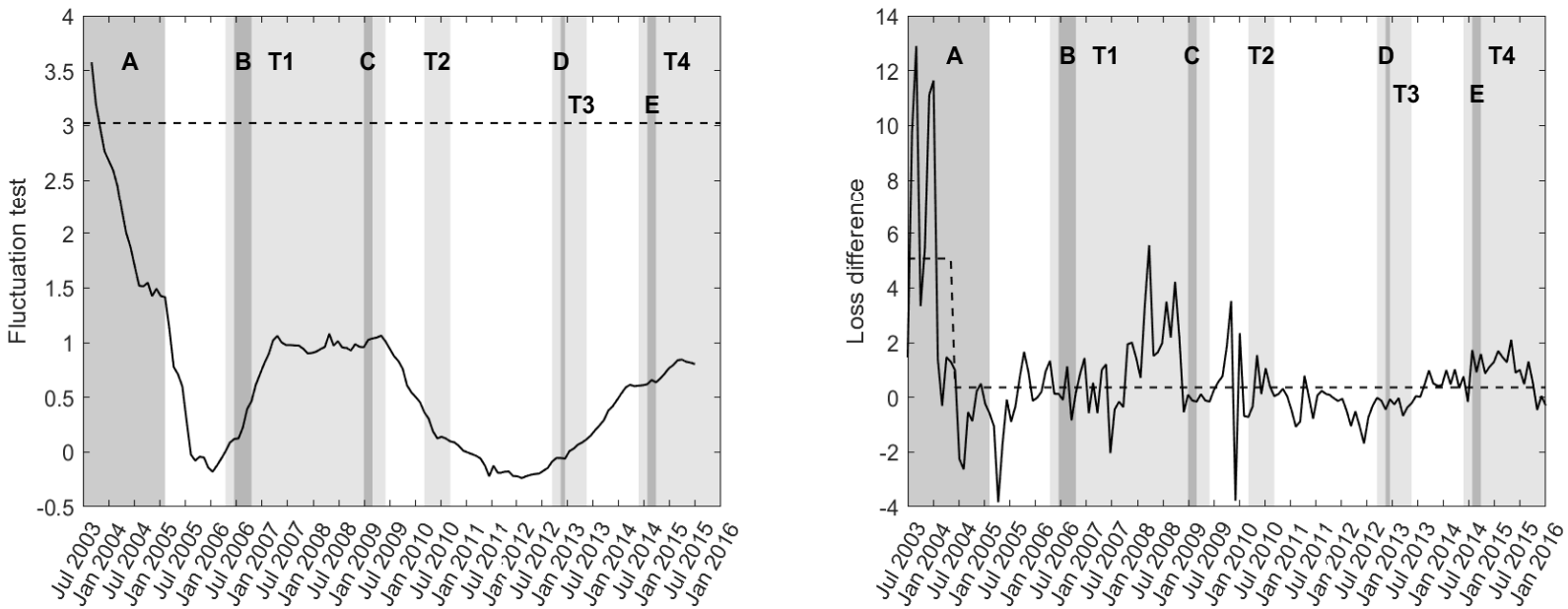
(a) Expert forecast



(b) Market-based forecast

Figure: Value (plain) and critical value (dashed) of the unbiasedness test for CPI inflation. Note: Significance level: 5%. Short warfare (dark gray): Second Intifada (A), Lebanon war (B), Operation Cast Lead (C), Operation Pillar of Defense (D), Operation Protective Edge (E). Relatively long terrorism period (light gray): rockets from Gaza and Lebanon (T1), mortars and rockets from Gaza, Flotilla episode and terrorist attacks (T2), terrorism attacks (including abroad), mortar and rockets from Gaza (T3), and Stabbing Intifada mixed with periods of rockets and mortars from Gaza (T4).

Cannot exclude a reversal in 2004



(a) Fluctuation test

(b) One-time reversal test

Figure: Value (plain) and critical value (dashed) of the fluctuation and one-time reversal tests for CPI inflation. Note: Significance level: 5%.

		Inflation forecasts (1Y)								
		GTD			*MFA*			*NII*		
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Killed		0.02			0.01			0.02		
	TA100 vol.	0.03	1.34	2.47	0.03	1.92	2.34	0.03	1.32	2.46
	TA100 spread	0.03	2.87	0.85	0.02	3.33	1.07	0.03	2.94	1.03
	USD/ILS vol.	0.03	2.23	0.82	0.03	2.93	0.95	0.04	2.47	0.96
	Oil* (WTI) vol.	0.03	1.41	2.51	0.03	1.75	2.29	0.04	1.14	2.43
	Gas* vol.	0.04	1.93	2.12	0.03	2.57	1.82	0.04	1.70	2.05
	CRB* vol.	0.03	3.02	1.64	0.03	3.21	1.60	0.03	2.80	1.63
	Oil (WTI) vol.	0.03	1.54	2.22	0.03	2.32	2.14	0.04	1.48	2.21
	Gas vol.	0.04	1.93	2.14	0.03	2.58	1.86	0.04	1.71	2.08
	CRB vol.	0.03	2.52	1.20	0.03	2.98	1.26	0.03	2.61	1.32
Wounded		0.01			0.01			0.01		
	TA100 vol.	0.03	1.86	2.32	0.03	1.81	2.37	0.02	3.01	2.72
	TA100 spread	0.03	3.18	0.99	0.03	3.29	1.07	0.02	3.02	0.84
	USD/ILS vol.	0.03	2.70	0.82	0.03	2.88	0.95	0.02	2.98	0.84
	Oil* (WTI) vol.	0.03	2.02	2.34	0.03	1.64	2.32	0.02	1.97	2.48
	Gas* vol.	0.04	2.66	2.09	0.03	2.45	1.87	0.02	2.50	1.89
	CRB* vol.	0.03	3.06	1.63	0.03	3.18	1.61	0.02	3.20	1.62
	Oil (WTI) vol.	0.03	2.35	2.11	0.03	2.16	2.15	0.02	2.38	2.26
	Gas vol.	0.04	2.68	2.11	0.03	2.46	1.90	0.02	2.49	1.91
	CRB vol.	0.03	2.83	1.20	0.03	2.94	1.27	0.02	2.89	1.14

Table: Breakeven and expert inflation forecasts predictive ability tests (1)

		Inflation forecasts (1Y)								
		GTD			*MFA*			*NII*		
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Total		0.01			0.01			0.01		
	TA100 vol.	0.03	1.78	2.35	0.03	1.81	2.37	0.02	2.90	2.66
	TA100 spread	0.03	3.21	0.97	0.03	3.29	1.07	0.02	3.24	0.91
	USD/ILS vol.	0.03	2.68	0.82	0.03	2.88	0.95	0.02	3.13	0.86
	Oil* (WTI) vol.	0.03	1.93	2.38	0.03	1.64	2.32	0.02	1.97	2.43
	Gas* vol.	0.04	2.61	2.10	0.03	2.45	1.87	0.03	2.62	1.89
	CRB* vol.	0.03	3.10	1.64	0.03	3.18	1.61	0.02	3.39	1.64
	Oil (WTI) vol.	0.03	2.23	2.13	0.03	2.16	2.15	0.02	2.42	2.22
	Gas vol.	0.04	2.63	2.12	0.03	2.46	1.90	0.03	2.61	1.91
	CRB vol.	0.03	2.84	1.20	0.03	2.94	1.27	0.02	3.07	1.17
Number		0.02						0.01		
	TA100 vol.	0.09	1.14	2.86				0.05	3.45	2.31
	TA100 spread	0.09	0.67	0.47				0.05	3.93	1.09
	USD/ILS vol.	0.08	0.34	0.77				0.05	3.52	0.66
	Oil* (WTI) vol.	0.08	0.06	2.84				0.05	2.68	1.63
	Gas* vol.	0.04	0.69	2.21				0.04	3.68	1.82
	CRB* vol.	0.09	0.94	1.52				0.05	4.10	1.73
	Oil (WTI) vol.	0.07	-0.38	2.52				0.05	2.76	1.50
	Gas vol.	0.04	0.70	2.23				0.04	3.67	1.80
	CRB vol.	0.08	0.40	1.12				0.05	3.51	0.96

Table: Breakeven and expert inflation forecasts predictive ability tests (2)

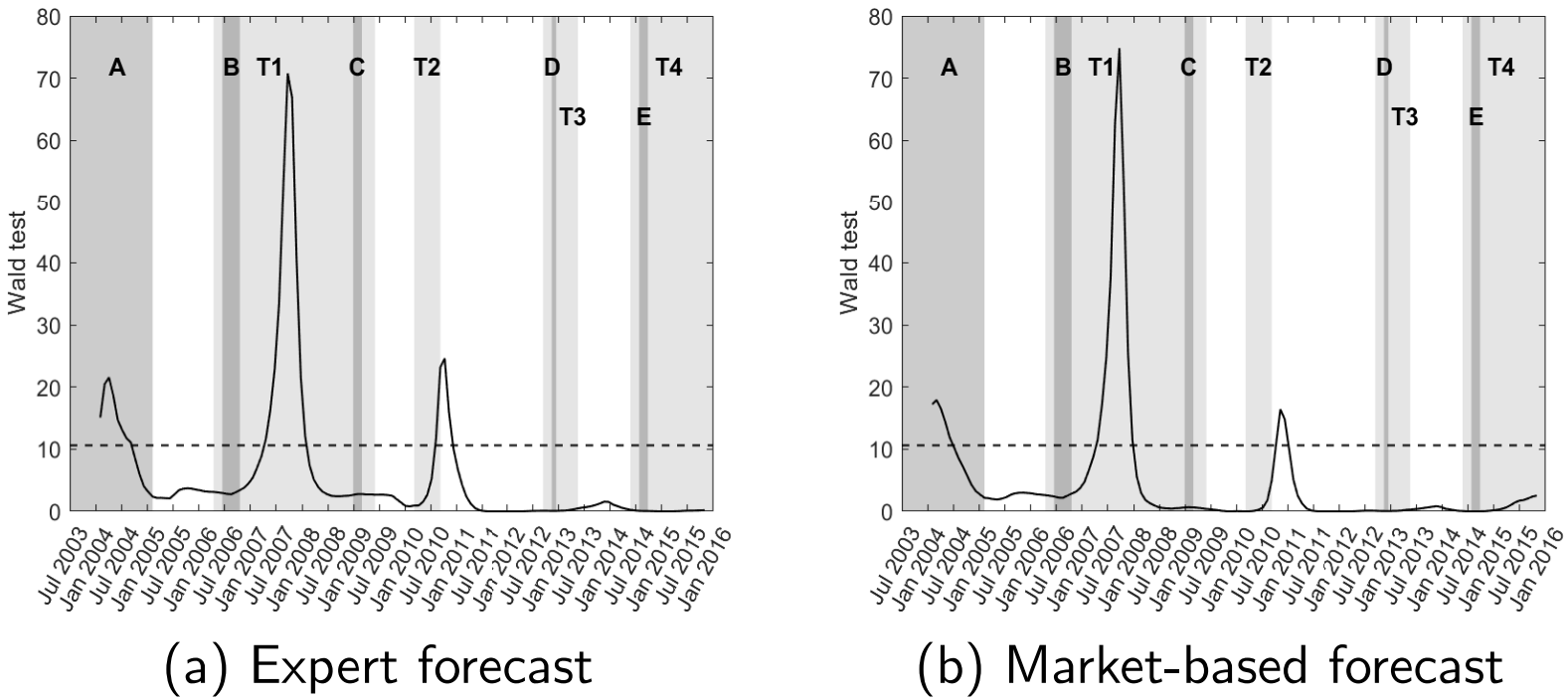
		Inflation forecasts (1Y)								
		GTD			*MFA*			*NII*		
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Killed		0.05			0.06			0.05		
	TA100 vol.	0.01	3.01	0.50	0.01	2.61	0.68	0.01	2.76	0.58
	TA100 spread	0.00	3.05	-0.37	0.00	2.69	-0.02	0.00	2.86	0.18
	USD/ILS vol.	0.00	3.08	-1.30	0.00	2.62	-0.72	0.00	2.76	-0.64
	Oil* (WTI) vol.	0.04	2.99	0.25	0.04	2.59	0.21	0.04	2.75	0.15
	Gas* vol.	0.08	3.03	2.26	0.08	2.56	2.10	0.08	2.74	2.07
	CRB* vol.	0.01	3.01	-0.62	0.01	2.63	-0.74	0.01	2.77	-0.63
	Oil (WTI) vol.	0.03	2.97	0.40	0.03	2.59	0.46	0.03	2.75	0.46
	Gas vol.	0.08	3.02	2.29	0.07	2.55	2.14	0.07	2.73	2.12
	CRB vol.	0.00	3.05	-0.88	0.00	2.64	-0.45	0.00	2.78	-0.35
Wounded		0.04			0.04			0.01		
	TA100 vol.	0.01	3.35	-0.16	0.01	3.08	0.20	0.02	2.62	1.40
	TA100 spread	0.00	3.40	-0.24	0.00	3.16	-0.11	0.00	2.59	-0.96
	USD/ILS vol.	0.00	3.41	-1.49	0.00	3.10	-0.90	0.01	2.54	-1.35
	Oil* (WTI) vol.	0.04	3.30	-0.08	0.04	3.06	-0.09	0.03	2.54	0.29
	Gas* vol.	0.08	3.40	2.20	0.08	3.06	1.80	0.05	2.47	1.91
	CRB* vol.	0.01	3.34	-1.10	0.01	3.10	-1.19	0.01	2.56	-1.31
	Oil (WTI) vol.	0.03	3.26	0.12	0.03	3.05	0.32	0.02	2.56	0.55
	Gas vol.	0.08	3.40	2.26	0.08	3.05	1.86	0.05	2.45	1.96
	CRB vol.	0.00	3.38	-1.18	0.00	3.11	-0.89	0.01	2.58	-1.42

Table: Forward and expert inflation forecasts predictive ability tests (1)

		Inflation forecasts (1Y)								
		GTD			*MFA*			*NII*		
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Total		0.04			0.04			0.01		
	TA100 vol.	0.01	3.31	-0.03	0.01	3.04	0.27	0.02	2.77	1.31
	TA100 spread	0.00	3.36	-0.25	0.00	3.12	-0.05	0.00	2.75	-0.76
	USD/ILS vol.	0.00	3.37	-1.45	0.00	3.05	-0.86	0.01	2.71	-1.26
	Oil* (WTI) vol.	0.04	3.27	-0.01	0.04	3.01	-0.05	0.03	2.69	0.22
	Gas* vol.	0.08	3.36	2.22	0.08	3.01	1.85	0.06	2.67	1.90
	CRB* vol.	0.01	3.31	-0.98	0.01	3.06	-1.09	0.01	2.72	-1.15
	Oil (WTI) vol.	0.03	3.24	0.18	0.03	3.01	0.34	0.03	2.71	0.50
	Gas vol.	0.08	3.36	2.27	0.08	3.00	1.91	0.06	2.65	1.95
	CRB vol.	0.00	3.34	-1.11	0.00	3.07	-0.80	0.01	2.74	-1.29
Number		0.00						0.01		
	TA100 vol.	0.01	1.55	1.36				0.02	4.79	0.11
	TA100 spread	0.00	1.42	-1.55				0.00	4.88	-1.00
	USD/ILS vol.	0.01	1.63	-1.92				0.01	5.40	-2.91
	Oil* (WTI) vol.	0.01	1.40	0.49				0.03	4.71	-1.12
	Gas* vol.	0.01	1.50	2.24				0.04	4.91	1.86
	CRB* vol.	0.01	1.36	-1.72				0.01	4.82	-1.63
	Oil (WTI) vol.	0.01	1.32	0.53				0.03	4.70	-1.00
	Gas vol.	0.01	1.52	2.28				0.04	4.93	1.89
	CRB vol.	0.01	1.52	-1.81				0.01	5.14	-2.47

Table: Forward and expert inflation forecasts predictive ability tests (2)

Both forecasts are biased

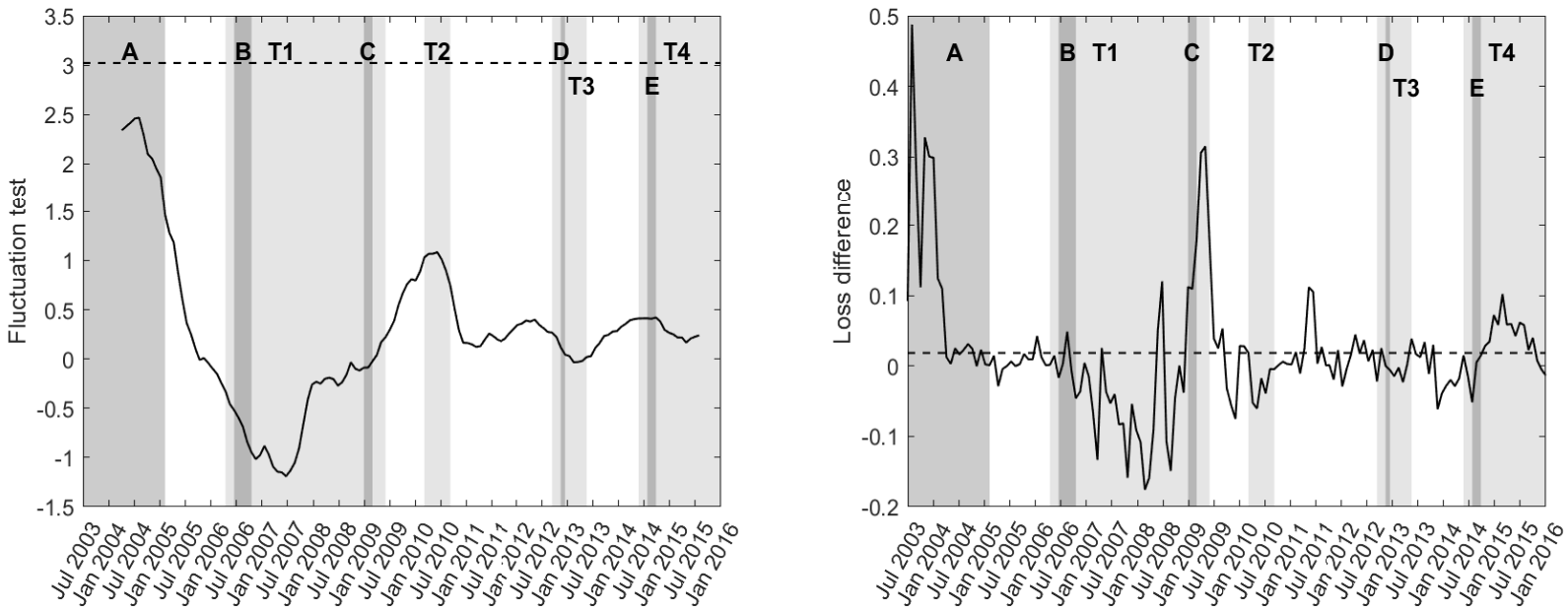


(a) Expert forecast

(b) Market-based forecast

Figure: Value (plain) and critical value (dashed) of the unbiasedness test for USD/ILS. Note: Significance level: 5%.

Forecast performances fairly similar



(a) Fluctuation test

(b) One-time reversal test

Figure: Value (plain) and critical value (dashed) of the fluctuation and one-time reversal tests for USD/ILS. Note: Significance level: 5%.

		USD/ILS forecasts (1Y)								
		GTD			*MFA*			*NII*		
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Killed		0.09			0.11			0.12		
	TA100 vol.	0.23	4.68	-0.29	0.25	3.46	-0.05	0.25	3.12	-0.04
	TA100 spread	0.23	4.62	0.44	0.26	3.66	0.80	0.27	3.26	0.67
	USD/ILS vol.	0.21	4.56	1.16	0.22	3.75	1.47	0.22	3.38	1.47
	Oil* (WTI) vol.	0.23	4.91	-1.87	0.28	3.71	-1.99	0.29	3.34	-1.92
	Gas* vol.	0.25	4.74	0.12	0.30	3.59	0.08	0.31	3.24	0.11
	CRB* vol.	0.24	4.63	0.66	0.27	3.49	0.51	0.28	3.15	0.46
	Oil (WTI) vol.	0.24	4.78	-1.57	0.28	3.57	-1.39	0.29	3.21	-1.16
	Gas vol.	0.25	4.74	0.08	0.30	3.59	0.05	0.31	3.24	0.09
	CRB vol.	0.23	4.62	0.79	0.24	3.66	0.99	0.25	3.30	0.97
Wounded		0.10			0.17			0.39		
	TA100 vol.	0.24	4.37	-0.73	0.28	2.06	-0.09	0.16	0.24	0.65
	TA100 spread	0.25	4.26	0.15	0.35	2.11	-0.27	0.55	0.09	-1.40
	USD/ILS vol.	0.21	4.16	0.97	0.26	2.22	1.20	0.24	0.24	1.09
	Oil* (WTI) vol.	0.26	4.69	-2.50	0.36	2.26	-2.05	0.25	0.26	-0.84
	Gas* vol.	0.28	4.41	0.17	0.39	2.17	0.15	0.39	0.17	0.76
	CRB* vol.	0.26	4.27	0.08	0.35	2.12	-0.21	0.31	0.22	-0.71
	Oil (WTI) vol.	0.27	4.48	-1.84	0.37	2.16	-0.97	0.32	0.24	-0.22
	Gas vol.	0.28	4.40	0.14	0.39	2.17	0.12	0.40	0.18	0.70
	CRB vol.	0.24	4.24	0.52	0.30	2.16	0.61	0.29	0.23	0.45

Table: Forward and expert USD/ILS forecasts predictive ability tests (1).

		USD/ILS forecasts (1Y)								
			GTD			*MFA*			*NII*	
Terror	Control variable	CPA	terror	control	CPA	terror	control	CPA	terror	control
Total		0.10			0.16			0.33		
	TA100 vol.	0.24	4.50	-0.66	0.28	2.29	-0.10	0.21	0.50	0.62
	TA100 spread	0.24	4.39	0.23	0.33	2.36	-0.07	0.52	0.37	-1.32
	USD/ILS vol.	0.21	4.30	1.00	0.25	2.48	1.24	0.26	0.52	1.08
	Oil* (WTI) vol.	0.25	4.80	-2.37	0.35	2.52	-2.10	0.32	0.53	-0.98
	Gas* vol.	0.27	4.54	0.15	0.37	2.42	0.12	0.42	0.45	0.66
	CRB* vol.	0.25	4.40	0.20	0.33	2.35	-0.09	0.35	0.48	-0.56
	Oil (WTI) vol.	0.26	4.60	-1.82	0.35	2.40	-1.06	0.37	0.51	-0.31
	Gas vol.	0.27	4.54	0.12	0.38	2.42	0.09	0.43	0.45	0.61
	CRB vol.	0.23	4.37	0.58	0.29	2.40	0.67	0.32	0.50	0.47
Number		0.12						0.14		
	TA100 vol.	0.28	1.11	0.63				0.29	1.45	0.22
	TA100 spread	0.26	1.08	-1.24				0.33	1.47	-1.17
	USD/ILS vol.	0.27	0.88	0.93				0.28	1.30	0.62
	Oil* (WTI) vol.	0.27	1.12	-1.16				0.32	1.61	-1.60
	Gas* vol.	0.29	1.08	0.81				0.34	1.45	0.63
	CRB* vol.	0.26	1.03	-0.56				0.33	1.49	-0.67
	Oil (WTI) vol.	0.29	1.12	-0.59				0.35	1.58	-0.84
	Gas vol.	0.29	1.08	0.76				0.34	1.46	0.58
	CRB vol.	0.29	1.04	0.29				0.33	1.46	0.01

Table: Forward and expert USD/ILS forecasts predictive ability tests (2).

Summary

- Expert and market-based forecasts are **strongly** impacted by terrorism.
- Inflation and USD/ILS expert forecasts are **superior** to market-based forecasts during high uncertainty periods.
- Strong evidence that terrorism, rather than other phenomena (e.g., commodity price fluctuations and financial distress), **triggers the changes** in forecast performance.

Interpretation (1)

- The impact of terrorism affects the:
  - **perception** of market players and forecasters, which in turn impact their implied forecasts.
  - predictive ability of these forecast providers and their **updates** following the events.
  - predictive ability of **market** participants considerably more than **professional** forecasters.
- Financial uncertainty is **not** significant when controlling for terrorism.

Interpretation (2)

- Terrorism remains robustly **significant** when controlling for financial risks.
- Exchange rate forecasts are significantly impacted by terrorist attacks, but also by natural gas price volatility.
- USD/ILS forecasts are more strongly impacted by the number of fatalities from terrorist attacks, whatever the quantitative methodology accounting for them.
- Our finding that terrorism impacts market-based inflation forecasts remains **robust** when controlling for inflation risk.

Policy implications

- Interpreting these forecasts without considering the current terrorism situation could lead decision makers to **erroneous interpretations**.
- Market-based and expert forecasts have to be interpreted differently **conditional** on the current level of terrorism.

Conclusion (1)

- The consequences of terrorist attacks on expert as well as market-based forecasts are **absent** from the literature.
- Inflation and exchange rate forecast errors in Israel were **significantly** impacted by terrorism over the last 15 years.
- Inflation expert forecasts are generally better than market-based (breakeven and forward) inflation forecasts.
- When considering the number of terrorist attacks, the picture is very clear: whatever the type of inflation forecast, the number of terrorist attacks has the **best explanatory power** for the relative predictive ability of the considered forecasts.
- Market-based inflation forecasts as well as its risk premium are **both** impacted by terrorism.

Conclusion (2)

- Oil and TASE100 control variables are sometimes found to matter, although this finding depends strongly on the terrorism indicator.
- External market participants in the forex market give higher weight to attacks in which human lives are lost.
- Uncertainty in general and terrorism in particular affects **market** participants much more than **professional** forecasters.
- Policymakers should pay attention to market-based forecasts and **prefer** expert forecasts during terrorism periods.

Thank you