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Financial Uncertainty in Germany and its Impact on Western European Terrorism

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Mario Jovanovic[1]

Financial Uncertainty in Germany and its Impact on Western European Terrorism

Abstract

This paper analyses the link between the VDAX as a proxy for European financial uncertainty and the number of terror incidents in Western Europe. Considering data of the Global Terrorism Database, the number of terror incidents does – on average – not affect financial uncertainty. In contrast, based on a behavioral model of terrorism motivated by Schmid and de Graaf (1982), lagged financial uncertainty contains information for the risk of terror events. Estimation results of the negative binominal quasi maximum likelihood count data model confirm an inverse impact of lagged financial uncertainty on terrorism. Furthermore, empirical evidence leads to the conclusion of average lead time for terror incidents of 6 month. These results are potentially important for terror prevention.

JEL Classification: C25, G02, Z10

Keywords: : VDAX; terror events; forecasting; count data

December 2011

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1 Introduction

Terrorism is not a phenomenon which can be reduced to the events in September 2001 in the United States, but also a real phenomenon in Europe. Attacks in European capital cities like Madrid (March 11, 2004), Amsterdam (November 2, 2004), London (July 7, 2005) and Oslo (July 22, 2011) attracted a great deal of attention in Europe. Moreover, the public discussion of neonazi attacks in Germany (November 2011) whip the political discussion about security agencies and its cooperation against terrorism. In contrast, national security agencies were able to prevent many terror attacks. For example, on December 14, 2009, a Spanish law court adjudged 11 persons for planning a terror attack, in September 2009 British citizens were adjudged for the same intention and on March 4, 2010, a German law court delivered the judgment against the so-called "Sauerland-Gruppe". Hence, committed and prevented terror events are very present in the media and provoke many discussions.

The real phenomenon of terrorism affects the society obviously in many ways. Focusing on economic consequences of terrorism, a branch of research can be identified. This literature deals with the impact of terrorism on economic growth. Gaibulloev and Sandler (2008, 2011) emphasize the potential transmission through decreasing foreign direct investments as a response to terrorism. Moreover, controlling the terrorism is costly and may cause cutbacks of public spending. Especially the government spending can be a large drain on private investment, and with it, growth (Blomberg, Hess, and Orphanides (2004)). Furthermore, fundamental terror attacks like 9/11 cause financial uncertainty shocks and lead to passivity of economic agents, which creates a downturn of economic output (Bloom (2009)). But it is at least questionable that "normal" terror events influence financial market participants, due to their focus on economic fundamentals or economic speculations. In turn, it is interesting to analyze the impact of financial uncertainty on terror events, in order to characterize a date in time as critical with respect to terror events. If a counterfactual motivated relationship between financial uncertainty and terror events is empirically stable, this could be important in terms of the prevention of terrorism (see Haverkamp (2011)). The aim of this paper is the identification of financial uncertainty in Germany as a variable with predictive power for terror events in Western Europe[1] and the rejection of the hypothesis that "normal" terror events influence financial uncertainty in this region. Institutional research on terrorism in Germany as the largest European economy is conducted by the Bundeskriminalamt

[1]The appendix shows the definition of Western Europe.

(Federal Criminal Police Office) and the Bundesamt für Verfassungsschutz (Federal Office for the Protection of the Constitution). A collection of papers - published by the Bundeskriminalamt - concerning the predictability of terrorism can be found in Kemmesies (2006).

In general, terror events are classified as domestic and transnational attacks. Domestic incidents are homegrown in which the venue, target and perpetrators are all from the same country. In case of Islamist terrorism Puschnerat (2006) emphasizes the issue of "home made terrorism", hence, domestic terrorism. Enders, Sandler, and Gaibulloev (2011) generalize this conclusion to terrorism at all and show the causality in the Granger sense of domestic for transnational terrorism. Consequently, domestic and transnational terrorism should be considered in terrorism research. Different databases are currently applied in the literature. Since the 1960er, the "International Terrorism: Attributes of Terrorist Events" (ITERATE) database lists transnational incidents. In the past, this database was frequently used, due to the former fixation on this type of terrorism. Gaibulloev and Sandler (2008) merge the ITERATE database and "Terrorism in Western Europe: Event Data" (TWEED) database of Engene (2007), thereby distinguishing transnational and domestic events for the period from 1950 to 2004. The "Global Terrorism Database" (GTD) is the first worldwide database that includes domestic and transnational incidents for the period from 1970 to 2007. Enders et al. (2011) separate the GTD of the National Consortium for the Study of Terrorism and Responses to Terrorism (START) into domestic and transnational events and calibrate the dataset.[2] As long as this paper concentrates on Western Europe, the calibrated GTD contains more recent observations than the merged ITERATE and TWEED databases.

The paper is organized as follows. Section 2 contains a counterfactual motivated behavioral model of terror incidents. Subsequently, section 3 describes the data and section 4 presents empirical results. Section 5 concludes the findings. Further explanations are relegated to the appendix.

2 Behavioral model

The understanding of terrorist behavior is an interdisciplinary issue and asks for communication between several fields of research. This is the reason why Kemmesies (2006) contains papers from diverse scientists working on social sciences, political sciences, psychology, sociology, economics, history and cultural anthropology. Understanding stable behavioral structures of terrorism is the key to the construction of forecasting models. Consequently, at the

[2]The empirical results of this paper rely on the dataset of Enders et al. (2011).

best an interdisciplinary discussion leads to the formulation of a statistical model for the purpose of prediction based on data. It is unlikely to expect that a terror event at a point in time can be predicted by a forecasting model. Hence, a point estimate should not be the goal of statistical models for terrorism. From a micro perspective it is conceivable that a statistical model evaluates the probability for a person being a terrorist. From a macro perspective it is also thinkable that the risk for terror incidents during a specific period could be calculated based on a statistical model. These predictions could help to prevent further terror attacks and would be an asset in the fight against terrorism.

In this paper the main argumentation for a specific and stable terrorist behavior relies on Schmid and de Graaf (1982). Their work is reducible to the formula "terrorism is a violent strategy of communication". Terrorists are not very much interested in attacking specific persons, but they are predominately interested in the presentation of their ideology in the media. Hence, the utility u felt by a terrorist j of a terror event E at time t, thus $u_{j,t}(E)$, is high, if the event is able to provoke much of the media attention. Media institutions will report on terror events as long as the citizens are interested in terrorism. If a considerable other event A occurs, the society's attention deviates from the terror event and the citizens would not pay their whole attention to the terror event. Therefore, the unconditional utility $u_{j,t}(E)$ would be higher than the conditional utility $u_{j,t}(E|A)$. What event A has the potential to attract the attention of many persons? Not at least the latest economic crisis underlines the deep impact of financial uncertainty on human attention. For example, the latest financial crisis causes extraordinary rescue packages of European countries to support the banking system. This financial assistance is finally paid by tax payers and affects the society as a whole. In case of the Greek-dept crisis the same mechanism holds. In line with this argumentation Bloom (2009) shows in a more elaborate model that financial uncertainty shocks lead to inactivity of the economy. Hence, economic subjects concern oneself much with the issue of financial uncertainty. This leads to the conclusion that a "rational" terrorist commits an attack during periods of low other distress - especially in the way of financial uncertainty - due to relatively high individual utility of the attack. Consider now financial uncertainty not as a single event A, but as a stochastic process A_t with numerical realizations a_t. It would be far from reality to assume that a terror attack can be committed without lead time L. The expected conditional utility of a terror attack is then $u^e_{j,t+L}(E|a_t)$. Consequently, $u^e_{j,t+L}(E|a_{1,t}) < u^e_{j,t+L}(E|a_{2,t})$ holds for $a_{1,t} > a_{2,t}$ and the dependence between $u^e_{j,t+L}$ and a_t is negative. The negative dependence implies a type of terrorist, which is avers towards financial uncertainty. In the first instance this conclusion sounds strange due

to the background of the 9/11 events. This fundamental event was intended for destabilization and for increasing financial uncertainty. But in this paper I rise the question of an "optimal" moment for a terror attack and not the question concerning the consequences of an incident.

Many hypotheses of utility functions with negative marginal effects can be formulated. Linear functions imply constant reactions of utility to uncertainty. It is likely to expect that the marginal response varies with the level of uncertainty. In a high uncertainty regime the utility of an incident is low, no matter if the uncertainty level is high or extreme high. Thus, the utility function should exhibit a lower bound. In contrast, the marginal reactions in low or intermediate uncertainty regimes are supposed to differ substantially, due to different human behavior depending on the level of uncertainty. Consequently, consider the following assumptions:

Behavioral hypothesis 1:

The percentage change of the individual expected utility of a terror event decreases with increasing financial uncertainty.

A formalization of this behavioral hypothesis leads to the marginal effect

$$\frac{\partial u^e_{j,t+L}(E|a_t)}{\partial a_t} = -\beta a_t^{-2} \tag{1}$$

with $\beta > 0$ and implies the subsequent inverse utility function

$$u^e_{j,t+L}(E|a_t) = \alpha + \beta a_t^{-1} \tag{2}$$

with the corresponding variable elasticity $-\beta/a_t u^e_{j,t+L}(E|a_t)$.

Behavioral hypothesis 2:

The number of terror incidents are proportional to individual expected utility of a terror event.

The second behavioral hypothesis accounts for the assumption that the expected utility of a terror event acts like an incentive for terror incidents. For the number of incidents i the equation

$$i_{t+L} = \gamma u^e_{j,t+L}(E|a_t) \tag{3}$$

with the proportionality factor $\gamma > 0$ holds. Combining equation (2) and (3) leads to the explanation of terror incidents by the inverse model

$$i_{t+L} = \beta_1 + \beta_2 a_t^{-1} \tag{4}$$

or equivalently

$$i_t = \beta_1 + \beta_2 a_{t-L}^{-1} \tag{5}$$

with $\beta_1 = \alpha\gamma$ and $\beta_2 = \beta\gamma$. Hence, the behavioral hypotheses suggest the dependence structure between financial uncertainty and number of terror incidents illustrated in Figure 1.

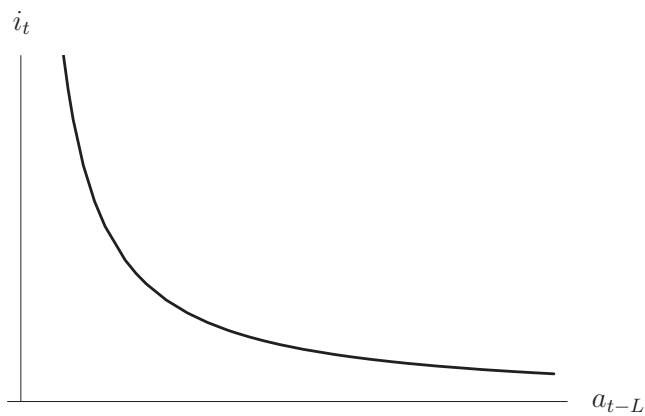

Figure 1: Hypothetical dependence between lagged financial uncertainty a_{t-L} and number of terror incidents i_t.

3 Data

The previous section emphasizes the importance of financial uncertainty for terror events. A canonical and frequently used proxy for financial uncertainty is expected stock market volatility (see e.g. Bloom (2009)). Such an uncertainty proxy is constructed by using options of a specific underlying stock market index. Prominent examples are the VIX for the S&P 500 in the USA, VFTSE for the FTSE 100 in the UK and the VDAX[3] for the DAX in Germany. The VDAX was introduced by the Deutsche Börse AG in April 2005 and is backward projected until January 1992. Although, this paper focuses on Western Europe, I will use the longer time series of the VDAX instead of the shorter European time series of the VSTOXX. As long as Germany is the largest economy in Europe, the VDAX seems to be an appropriate proxy

[3]In order to ease the notion, the new VDAX is labelled VDAX.

for European financial uncertainty. Monthly median values of daily closing prices of the VDAX[4] represents financial uncertainty during a month. Median values have two nice properties in comparison to averages: Firstly, median values are robust against outliers. Secondly, the time aggregation by a mean value introduces artificial serial correlation (see Granger (1980)), which potentially biases the estimation of time dynamics. Therefore, the application of median values is common practice (see i.e. Deutsche Bundesbank (2010)[5]). Considering monthly values for the period from January 1992 to December 2007 leads to 192 observations and allows therefore for powerful unit root tests. The ADF and GLS-ADF unit root test of the time series rejects the hypothesis of nonstationarity on the 5% level. Figure 2 illustrates the development of the monthly median VDAX.

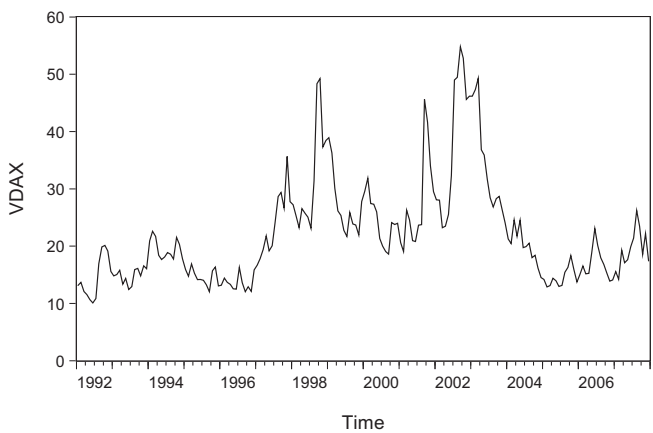

Figure 2: Monthly median of daily VDAX closing prices.

The following construction of a time series of terror events uses calibrated GTD data of Gaibulloev and Sandler (2011). They define terrorism in style of the US Department of State as premediated use or threat to use violence by individuals or subnational groups against noncombatants in order to obtain a political or social objective through the intimidation of a large audience beyond that of the immediate victims. The major advantage of the

[4]The time series code for the daily VDAX closing prices in Euro is "VDAXNEW" (Thompson Datastream).

[5]The Deutsche Bundesbank calculates median values of credit default swap premiums of all financial institutes in a financial system as a proxy for the risk of a financial system.

Table 1: Numbers and ratios of incidents

Terror type	World	Europe	World terror type ratio in %	European terror type ratio in %
Domestic	18871	1733	71	51
Transnational	5280	1502	20	44
Unknown	2525	179	9	5
Sum	26676	3414	100	100

Sample: January 1992 to December 2007

GTD database is the large collection of domestic and transnational terror incidents worldwide. Domestic incidents are homegrown in which the venue, target and perpetrators are all from the same country. Therefore, domestic terrorism influences directly the venue country in several ways (institutions, citizen, property, politics). Table 1 allows for an overview of the data. If the counterfactual argumentation of Puschnerat (2006) and the empirical confirmation of the hypothesis that domestic terrorism causes transnational terrorism (see Gaibulloev and Sandler (2011)) is neglected, the number of European incidents would decrease by a half. Assigning every European incident to the month of the realization of the incident leads to the time series

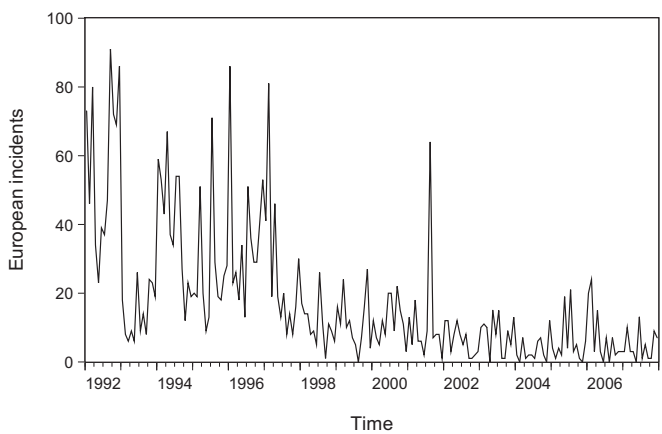

Figure 3: Monthly numbers of terror incidents in Europe (overall 3414).

of European overall incidents (i.e. domestic, transnational and unknown). Figure 3 illustrates the development of the incidents. On every plausible level of significance the ADF and GLS-ADF unit root test rejects the hypothesis of nonstationarity of incidents. In fact, a trend stationary process is indicated, which is not very surprising. During the first years of the 1990er a lot of terror events occurred in Europe because of the Irish Republican Army (IRA), Red Army Faction (RAF) and Euskadi Ta Askatasuna (ETA). During the subsequent years the number of incidents decreased due to strategy changes of terror organizations and lead to a negative trend of European incidents.

Interpret now monthly median values of daily VDAX closing prices as German financial uncertainty in month t and denote them by VDAX_t. EI_t stands for the number of European incidents in month t. The cross correlogram between EI_t and VDAX_{t-l}, $l = 1, 2, \ldots$, shows the largest negative correlation for $l = 6$. In line with the behavioral model in equation (5) the corresponding lead time of a terror attack seems to be $L = 6$ month. Figure 4 shows the scatter plot between EI_t and VDAX_{t-6} and serves as a stylized fact of the validity of the behavioral model, due to the similarity of the scatter plot to the hypothetical dependence structure illustrated in Figure 1.

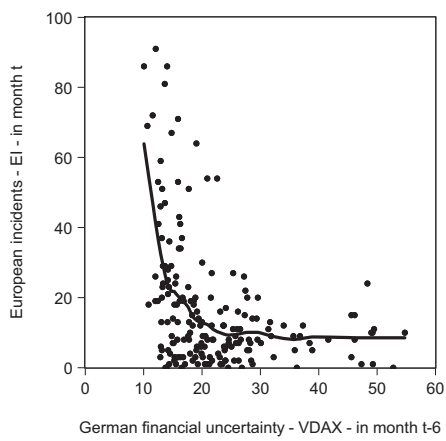

Figure 4: Scatter plot between European incidents - EI - and lagged German financial uncertainty - VDAX. The solid line shows the nearest neighbor fit.

4 Empirical results

Concerning the question whether financial uncertainty responses to terrorism consider the following regression:

$$\begin{aligned} \text{VDAX}_t = \alpha_1 + \alpha_2 \text{VDAX}_{t-1} + \alpha_3 d_{asia} + \alpha_4 d_{russia} + \alpha_5 d_{9/11} \\ + \alpha_6 d_{enron} + \alpha_7 d_{gulf} + \alpha_8 d_{crunch} + \varepsilon_t \end{aligned} \tag{6}$$

Included dummy variables d are explained in more detail in Table 2 of the appendix. These dummy variables reflect fundamental shocks to financial uncertainty in Germany. In Table 3 of the appendix specification a) shows amongst others the regression results. Financial uncertainty exhibits relatively high persistence due to significant autoregressive dependence expressed in the estimate $\widehat{\alpha}_2$. An effect of terror on uncertainty is only evident for the fundamental shocks on 9/11. The augmentation of equation (6) by EI_{t-l}, $l = 0, 1, \ldots$, leads to highly insignificant corresponding coefficient estimates. Hence, terror has only an effect in case of very fundamental events. "Normal" terrorism in Europe is not able to influence financial uncertainty systematically.

The argumentation of section 2 that lagged financial uncertainty influences the number of terror events is the counterfactual basis of the following regression model:

$$\text{EI}_t = \beta_1 + \beta_2 t + \beta_3 \text{EI}_{t-1} + \beta_4 \text{VDAX}_{t-L}^{-1} + \beta_5 d_{august\ 2001} + \epsilon_t \tag{7}$$

Due to decreasing number of terror events (see section 3) the time trend augments the specification. $d_{august\ 2001}$ symbolizes the dummy variable for August 2001. EI_{t-1} accounts for the persistence of incidents. Hence, the time trend t and EI_{t-1} model the time dynamics of the process EI_t and $d_{august\ 2001}$ absorbs a shock during the previous month of 9/11. As suggested by the cross correlogram between EI_t and VDAX_{t-l}, $l = 1, 2, \ldots$, the final efficient estimation results identify $L = 6$ as the appropriate lag. Since EI_t stands for the number of terror incidents, the efficient methodological estimation framework must be a count data model. Therefore, the initial estimation of the regression is a Poisson model. Results are documented in approach b) of Table 3 (see appendix). In order to test for overdispersion in the Poisson model according to Cameron and Trivedi (1990) consider the test regression

$$(\text{EI}_t - \widehat{\text{EI}}_{t,poisson})^2 - \text{EI}_t = \gamma_1 \widehat{\text{EI}}_{t,poisson}^2 + e_{t,1} \quad , \tag{8}$$

where $\widehat{\text{EI}}_{t,poisson}$ stands for the forecasts of EI_t based on the coefficients of the Poisson regression of equation (7). Table 3 contains the OLS results

for γ_1 and indicates significant overdispersion of the residuals. In order to check the robustness of this test result, the alternative test of Wooldridge (1997) is considered. With $\widehat{\epsilon}_{t,standard}$ as standardized residuals of the Poisson regression of equation (7), we obtain the test regression

$$\widehat{\epsilon}^2_{t,standard} - 1 = \gamma_2 \widehat{\mathrm{EI}}_{t,poisson} + e_{t,2} \quad . \tag{9}$$

In line with the previous test, Wooldridge's test suggests the presence of overdispersion (positive estimate for γ_2, see Table 3). Given the rejection of the Poisson restriction, the two step negative binomial QMLE (quasi-generalized pseudo-maximum likelihood estimation) with the QML parameter $\widehat{\gamma}_2$ of the OLS estimation of equation (9) will be applied according to Gourieroux, Monfort, and Trognon (1984a, 1984b). The corresponding estimation results are available in approach c) of Table 3. If VDAX^{-1}_{t-6} is neglected in equation (7), significant serial correlation of the standardized residuals und residual squares is introduced into the model. This leads to the conclusion that financial uncertainty contains information for the explanation of terror events. Less financial uncertainty increases the probability for a terror event ($\widehat{\beta}_4 = 11.028$). Furthermore, the lead time of a terror attack seems to be 6 month on average. The negative sign of the trend coefficient estimate $\widehat{\beta}_2$ indicates decreasing terror events during the sample. It is interesting to note, that during the previous month of 9/11 a significant hike of terror events occurs in Europe ($\widehat{\beta}_5 = 1.869$).

5 Conclusions

This paper analysis the link between the VDAX as a proxy for European financial uncertainty and the number of terror incidents in Western Europe. Based on data of the Global Terrorism Database, the number of terror incidents contains no significant explanatory information for financial uncertainty. Hence, "normal" terrorism does not affect financial uncertainty. Contrary, extraordinary terror events like 9/11 have a deep impact on financial uncertainty.

The presented counterfactual model of terror incidents rely on two behavioral assumptions. Firstly, the percentage change of the expected utility of a terror event decreases with increasing financial uncertainty. Secondly, the number of terror incidents are proportional to the expected utility of a terror event. The underlying argument for the first hypothesis accounts for the statement of Schmid and de Graaf (1982) that "terrorism is a violent strategy of communication". In face of economic turbulence expressed in financial uncertainty terror events attract less attention. Hence, the expected

utility of communication via terrorism decreases. Dependent on the level of expected terror utility for the perpetrator the incentive for an incident varies proportional.

The two step negative binomial quasi-generalized pseudo-maximum likelihood estimation efficiently estimates the count model for European terror incidents during 1992 to 2007 on the bases of monthly data. Accounting for dynamics of the time series a trend and lagged incidents are included in the count data model. The significantly estimated negative trend shows decreasing terror events in Western Europe and positive dependence between current and lagged incidents implies terror persistence. Moreover, in August 2001 (previous month to 9/11) significantly more incidents occurred. Estimation results confirm the behavioral model and lead to the conclusion of the importance of financial uncertainty for terror events. Furthermore, it can be concluded that on average 6 month are necessary to plan an incident. Based on the results of this paper, the level of financial uncertainty contains information concerning the risk of a terror event. This result is potentially important for terror prevention.

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Appendix

Definition of Western Europe according GTD:
Andorra, Austria, Belgium, Corsica, Denmark, Finland, France, Germany, Gibraltar, Great Britain, Greece, Iceland, Isle of Man, Ireland, Italy, Luxembourg, Malta, Netherlands, Northern Ireland, Norway, Portugal, Spain, Sweden, Switzerland

Table 2: Fundamental stock market uncertainty shocks

Event	Date	Type	Dummy
Asian crisis	November 1997	Economic	d_{asia}
Russian, LTCM default	September 1998	Economic	d_{russia}
9/11 terrorist attack	September 2001	Terror	$d_{9/11}$
Worldcom and Enron	July 2002	Economic	d_{enron}
Gulf war II	February 2003	War	d_{gulf}
Credit crunch	August 2007	Economic	d_{crunch}

The dummy variables contain the value 1 at the appropriate dates and 0 elsewhere.

Table 3: Regression results

a) Equation (6): VDAX, Method: OLS, $R^2 = 0.92$

α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8
2.095	0.889	9.856	18.364	22.397	18.206	0.978	5.082
(0.680)	(0.030)	(0.313)	(0.453)	(0.240)	(0.482)	(0.353)	(0.198)

b) Equation (7): EI, Method: Poisson count, $R^2 = 0.54$

β_1	β_2	β_3	β_4	β_5
2.726	-0.010	0.006	12.710	1.831
(0.239)	(0.001)	(0.003)	(3.484)	(0.348)

c) Equation (7): EI, Method: Negative binomial count, $R^2 = 0.52$

β_1	β_2	β_3	β_4	β_5
2.832	-0.010	0.008	11.028	1.869
(0.246)	(0.001)	(0.004)	(3.368)	(0.667)

d) Test equation (8) and (9): Method: OLS

γ_1	γ_2
0.217	0.308
(0.033)	(0.049)

Sample: 1992:1-2007:12. Standard errors in brackets. a) shows heteroskedasticity-consistent standard errors. Furthermore, the Breusch-Godfrey test of the residuals does not reject the hypotheses of no serial correlation on any plausible level of significance and lag order. b) and c) show GLM robust standard errors. All coefficients are significant at least on the 5% level. The correlogram of the standardized residuals and residual squares of c) leads to the conclusion of no serial correlation on any plausible level of significance.