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Abstract

We assess the efficiency of monetary policy to guide inflation expectations in high and low regimes. Using quantile regression we analyze the persistence of inflation expectations from the Consensus Economics Survey at different quantiles. We find a) empirical evidence that expectations are not anchored in the tails of their distribution and b) robust evidence for structural breaks for the USA and Italy. After the outbreak of the Global Financial crisis expectations become unanchored. The Fed's unconventional monetary policy at the ZLB in thus ineffective in guiding inflation expectations.

JEL classification:— C22; C32; D84; E31; E52
Keywords:— Inflation expectations; persistence; monetary policy; quantile regressions; structural breaks; quantile unit root test; zero lower bound.

Introduction

If we encounter deflation, entrepreneurs loose from falling prices and protect themselves by curbing investments and therefore lower output and employment. This danger of a vicious spiral makes deflation one of the most feared macroeconomic risks. The disruption of the chain of financial intermediation through suppressingly high real interest rates accelerates the financial fragility which is especially high in the post subprime crisis era.

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The core of this reasoning is twofold. Firstly, deflation only occurs if the central bank is not willing and/or able to take measures against the deflationary tendencies and secondly, the key mechanism driving economic reactions is the expectation of future developments rather than current data. As stated by Milton Friedman, monetary policy only acts with long and variable lags. However, expectations immediately react to policy measures or even announcements. To put in other words, modern monetary policy is the art to guide expectations.

The possibility of deflation is rooted in central bankers preference for low inflation and the de facto Zero lower bound on interest rates. A large adverse shock to the economy can cause low inflation to shift into deflation, which is likely to persist. Inflation rates in the USA and especially in the Eurozone are at a record low, although short term nominal interest rates are close to zero and can't fall any further. This further attenuates the ability of monetary policy to head off deflation.

In normal times, monetary policy has a number of instruments at stance which laggedly influence the economy via a number of transmission channels and influences expectations immediately, which in turn drive economic behavior and is influenced by economic developments due to past policy measures. In the current situation, the effectiveness of monetary policy is tackled at all three dimensions. Firstly, the standard interest rate connected instruments are not at hand at the ZLB (see Hicks (1937)) and central banks have dodged to heavily disputed unconventional policy measure (see Brendon and Corsetti (2016) for an overview of monetary policies after the crisis). Indeed, the effectivity of QE is heavily disputed and theoretically not supported so far. Neuenkirch (2016) even states that "... the returns on asset purchases are decreasing over time and with their level and that their impact on the inflation gap eventually becomes negative." Secondly, due to the crises situation and the increased and permanent uncertainty, the efficiency and effectiveness of all transmission channels is ceasing and in dispute. Thirdly, due to the long lasting ZLB situation with very low interest rates, it is unclear whether those unconventional policies are able to guide and influence the building of expectations, the last remaining important short term goal of monetary policy.

Our paper contributes to this strand of research by concentrating on the third question: Is the effectiveness of monetary policy to influence expectations diminished at the ZLB? We focus on expectation formation, because the effects of monetary policy measures and announcements on expectations is immediate and not disturbed by varying lags and the influence of expectations on economic decisions far outdates the influence of current facts.

We use an innovative data set and method to explore the guidability of inflation expectations. Using quantile regression we study the persistence of inflation expectations of participants in the Consensus Economics Survey. The degree of persistence of these expectations are crucial for the monetary authorities since the restrictions set by the Zero Lower Bound make the management of inflation expectations one of the last remaining tools to achieve price stability. To the best of our knowledge, this study is the first to directly estimate the realized effects of monetary policy on the guidability of expectations.

Persistence of inflation expectations implies ineffectiveness of monetary policy, because the expectations do not revert to their long run equilibrium. We find that inflation expectations are persistent at the outer quantiles, i.e. for high and low inflation expectations, these expectations become not sticky but immobile and policy measures fail to positively impact inflation expectations. The lags in monetary policy imply that current effects of unconventional policy measures are not positive, counterfactuals and experiences are missing. So our knowledge about the failure of monetary policy to raise inflation expectations at the ZLB is very limited. Potential reasons are due to inflation expectation heterogeneity (Armantier et al. (2015), Wiederholt (2015)) and the sluggish reaction of inflation expectations to shocks (Coibion and Gorodnichenko (2012), Coibion and Gorodnichenko (2015)). But also natural reasons such as the lack of instruments, the breakdown of transmission channels, crises effects and a too low impact of unconventional measures.

In order to access if the risk of deflation is innate the literature has developed several measures. Fisher (1933) relates over-indebtedness and the subsequent debt liquidation to deflation. Kilian and Manganelli (2007) estimate the risk of deflation using a loss function approach for the year 2002 when the fear of deflation as heralded by newspapers was utterly high, however their measure of deflation risk corroborates this assertion only for Japan. Fleckenstein et al. (2013) use a market-based approach for measuring inflation involving the prices of inflation swaps and options and find that market participants place substantial probability weight to near term deflation scenarios. Cecchetti (1992) shows that the deflation of 1930-1932 could have been anticipated based on either univariate time series properties of inflation or on the information contained in interest rates. Despite this finding Hamilton (1992) uses the price of commodities future contracts to analyze if deflation was actually anticipated by market participants during the Great Depression. He concludes that during the first year of the Great Depression deflation was mainly unanticipated, whereas the deflation in the following years was anticipated, though never as severe as had actually occurred.

This paper contributes to the identification of deflation risks by merging the literature on inflation expectations with the literature on inflation persistence (see Fuhrer (2011), Rose (1988), Ng and Perron (2001), Lee and Tsong (2009), Zhang and Clovis (2009)) to study the persistence of inflation expectations. Inflation expectations are said to be persistent if they show a tendency to stay where they recently stood in the absence of exogenous variables that force them to move. Inflation expectations are a most crucial determinant of changes in the price level. Virtually all market participants base their actions on expectations regarding the path of future prices. For example households base their consumption and saving decisions on expected long-run prices. If the households expect falling future prices they defer consumption into the future and vice versa if they expect long-run prices to increase[1]. As a result these decisions can cause booms and inflation as well as recessions and deflation.

Furthermore, a possible link between persistence of inflation expectations and persistence of inflation is via the close connection between inflation expectations and the trend in inflation, the so called *trend inflation* (see Mishkin (2007)). A de-anchoring of inflation expectations would lead to an increase in trend inflation which would in turn lead to an increase in the persistence of inflation. Empirical evidence for this mechanism is provided by the period of the Great inflation in which momentum in trend inflation caused a rise in inflation persistence (see Cogley and Sargent (2005), Mishkin (2007) and Stock and Watson (2007)). Hence any change in the persistence of inflation expectations is carried over to the actual inflation process.

We measure the persistence of shocks that hit inflation expectations at different quantiles of the distribution of inflation expectations by participants of the Consensus Economics panel using the quantile regression ap-

[1] The early empirical literature on inflation expectations and consumption propensities rejects this link (see Juster and Wachtel (1972) and Burch and Werneke (1975)). The more recent literature finds, however, that it is dependent on the information level of households. Bachmann et al. (2015) shows that the link exists for "well-informed" households that follow macroeconomic news closely. Further D'Acunto et al. (2016) find that the unexpectedly announced increase in VAT by the German administration in 2005, whose consequences on future prices after its introduction can be assumed to be understood by households, increased consumption propensities via the inflation expectation channel.

proach by Koenker et al. (1978). This allows us to distinguish these shocks by their sign and magnitude. We then use the quantile unit root test by Koenker and Xiao (2004) to study the mean-reverting behavior of the expectations process after the occurrence of such shocks.

The methodology of quantile regression has found applications in other domains such as real exchange rates (Nikolaou (2008)), nominal interest rates (Koenker and Xiao (2004)) and currency trading (Cenedese et al. (2014)) because of its flexibility. Unlike the ordinary least squares estimator which only evaluates the effect for the mean the quantile regression estimator allows to measure the effect at the different quantiles of the distribution. Hence, it gives a more detailed picture of the persistence and also allows to detect if the persistence varies across quantiles. This ability to uncover asymmetric persistence is especially useful in our applications since we do not expect the shocks, which differ in sign and magnitude, to induce the same degree of mean reversion.

A second advantage of quantile regression is that it makes no distributional assumptions which is useful for studying inflation data, since normality is rejected for price expectations by Carlson (1975), Wachtel (1977), Lahiri and Teigland (1987) and Batchelor and Orr (1988) among others.

The degree of mean-reversion is crucial for policy makers for a number of reasons. Firstly, a low degree of inflation expectation persistence is desirable for the monetary authorities because it makes monetary policy easier. If the persistence is low the expectations are quickly returning to the desired target level without much stabilization by the policy maker needed. Secondly, with nominal interest rates close to zero managing inflation expectations is crucial for the monetary authority's ability to achieve price stability. If the persistence of deflationary shocks to inflation expectations exhibit a unit root behavior the ongoing actual inflation process can without stabilization by the authorities turn into low inflation or deflation.

The econometric evidence for the degree of persistence in the actual inflation rate is mixed. Several studies find that inflation is exhibiting near unit root persistence during the post-war period (see Nelson and Plosser (1982), Barsky (1987), Ball and Cecchetti (1990), Fuhrer, Jeffrey C. and Moore (1995)).

The most recent literature, however, stresses that inflation persistence has undergone a significant change and has fallen considerably over the last three decades. Taylor (2000) finds that the persistence in the USA has dropped after the Great Inflation and with the start of the Volcker era. These findings are confirmed by Clark (2006) and Levin and Piger (2004). In contrast to that Cecchetti and Debelle (2006) find for a large sample of developed economies that the decline in persistence of the inflation process is much less pronounced than previously found in the literature once one allows for changes in the mean of inflation. Further for the Eurozone O'Reilly and Karl (2004) corroborate the stability of the unit root property of the inflation process.

We contribute to this literature by studying the changing dynamics of persistence across quantiles. For this purpose, we use the structural change methodology for regression quantiles by Qu (2008) and Oka and Qu (2011) to detect breaks at unknown dates at single quantiles. Our paper is closely related to other studies on evaluating the inflation persistence on different quantiles such as Tsong and Lee (2011), Wolters and Tillmann (2015) and Manzan and Zerom (2015). We deviate, however, in analyzing the inflation expectations of survey participants instead of actual inflation rates.

Our results suggest that - contrary to the existing literature that studies the actual inflation process - persistence in inflation expectations is not just prevalent for large positive, hence inflationary shocks, but also for large negative, i.e. deflationary shocks. These findings are especially clear for the Netherlands, Norway, Sweden and Switzerland.

The pattern of persistence is stable over time when applying the structural change test or allowing for effects following the Euro changeover. An exception are inflation expectations for the USA. Structural changes coincide with the outbreak of the Global Financial Crisis. For the period thereafter that covers unconventional monetary policy actions conducted by the Fed inflation expectations are de-anchored at both tails of the distribution. This indicates that the Fed's unprecedented unconventional monetary policy is not effective in managing inflation expectations.

The remaining part of this chapter is as follows. Section 1 presents the survey data. Section 2 covers our measurement of persistence. Section 3 presents the results for the full sample, whereas section 4 studies structural changes. Section 5 studies the effect of the Euro changeover on persistence, whereas section 6 presents results for the inflation expectation gap. Section 7 concludes.

1 Data

We focus our empirical analysis on inflation expectations rather than realized inflation rates. Our data set is drawn from the forecasts of consumer price changes of participants in the Consensus Economics panel. We study the forecasts of financial institutions for the USA, Japan, Germany, France, UK, Italy, Canada, the Eurozone, the Netherlands, Norway, Spain, Sweden and Switzerland. For each month and country the survey consists of pairs of inflation forecasts for the respective current year and the respective next calendar year. I convert these two fixed-event forecasts to fixed 12-month horizon forecasts according to a weighted average of both:

$$\hat{\pi}_{t+12|t} = \frac{(k-1)}{12}\hat{\pi}_{t+k|t} + \frac{(13-k)}{12}\hat{\pi}_{t+12+k|t} \quad (1)$$

in which $\hat{\pi}_{t+k|t}$ is the k month ahead forecast of inflation based on information available at time t, i.e. the forecast for the current calendar year, whereas $\hat{\pi}_{t+12+k|t}$ is the k month ahead forecast of inflation for the next calendar year based at time t. k denotes the remaining months of the year.

For example a 12 month ahead forecast made in February 2013, with $k = 11$ month left in the year, implies a weighted average of $\hat{\pi}_{\text{December 2013}|\text{February 2013}}$ and $\hat{\pi}_{\text{December 2014}|\text{February 2013}}$ with the weights being 10/12 and 2/12, respectively. A similar approach to convert fixed-event forecasts to fixed-horizon forecasts is adopted by Gerlach (2007), Kortelainen et al. (2011), Siklos (2013) and Bauer and Neuenkirch (2015).

All the resulting time series of inflation expectations end in February 2015 and start in January 1990 for the USA, Japan, Germany, France, UK, Italy and Canada. Norway and Switzerland start in June 1998, Sweden, Spain, the Netherlands in January 1995 and the Euro in December 2002.

Figures 11-14 in the appendix show the evolution of the mean inflation expectation for the different countries over time. In all countries the inflation expectation dropped sharply around 2008, the beginning of the Subprime-crisis.

Table 1 on page 9 presents the starting point of the sample for each country, number of observations, mean, standard deviation, skweness, kurtosis and the test statistic of the Jarque-Bera-test, its p-value as well as the order of integration. The mean of the inflation expectation range from 0.5032 for Japan up to 3.0075 for the UK. The Jarque-Bera-test shows that normality is reject for the majority of the countries. This further fosters the rationale to employ quantile autoregression. The augmented Dickey-Fuller test is used to determine the order of integration of the series under consideration. Evaluating the unit root property at the mean of the respective series serves as a benchmark when further studying the unit root property at the different quantiles. The last column of table 1 on page 9 indicates that the majority of series are not stationary. This should not come as a surprise since Stock and Watson (2007) advocates that the inflation rate is best modeled as a time varying parameter integrated moving average process. This nonstationarity in the actual inflation rate is unlikely without the expectation series also containing the unit root property.

2 Measuring Persistence

As a first step, we estimate the persistence of shocks occurring at different quantiles of the distribution of inflation expectations using the quantile autoregression methodology by Koenker et al. (1978) and Koenker and Xiao (2006). This method allows the persistence to differ across the quantiles and to detect possible asymmetric behavior. The speed of mean reversion is evaluated in the context of the quantile unit root inference by Koenker and Xiao (2004).

Consider the regression model given by:

$$Q_\tau(y_t \mid y_{t-1},\ldots,y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau)y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau)\Delta y_{t-j}. \quad (2)$$

which resembles the classical augmented Dickey Fuller regression framework for unit root testing (Said and Dickey (1984)). In (2) $y_t = \pi_t - \mu$ is the expected inflation rate at time t, π_t, minus its unconditional mean μ. The autoregressive coefficient $\alpha_1(\tau)$ measures the persistence of y_t at the different quantiles τ. If $\mid \alpha_1(\tau) \mid = 1$ inflation follows a unit root process at quantile τ, if $\mid \alpha_1(\tau) \mid < 1$ the inflation process exhibits a mean reverting tendency. The lags $\sum_{j=1}^{q} \Delta y_{t-j}$ with $\Delta y_{t-j} = y_{t-j} - y_{t-j-1}$ account for remaining serial correlation in the error term $\varepsilon_t(\tau)$. We measure the persistence at the quantiles $\tau = (0.1, 0.2, \ldots, 0.8, 0.9)$.

3 Empirical Part

Since a quantile autoregressive (QAR) process of order p has the same dependence structure as the corresponding autoregressive (AR) process of order p (see Rao et al. (2012, p. 221)), we select the lag order of the $QAR(p)$ process with standard selection criteria applied to the AR counterpart process of the inflation expectation series under consideration. For equation (2) we set the maximal number of lags $\sum_{j=1}^{q} \Delta y_{t-j}$ to the rule of thumb proposed

Table 1: Summary Statistics of the Inflation Expectations

Country	Start. point	Obs.	Mean	Std.dev	Skew.	Kurt.	Jarque Bera (p-val.)	Integration
USA	Jan. 1990	302	2.5354	0.85	0.0385	1.7192	38.6388 (0.000)	I(0)
Japan	Jan. 1990	302	0.5032	1.0259	0.7774	-0.2192	31.226 (0.000)	I(0)
Germany	Jan. 1990	302	1.9549	0.8086	0.8899	0.0931	40.4206 (0.000)	I(1)
France	Jan. 1990	302	1.7822	0.6641	0.7975	0.5456	36.4115 (0.000)	I(1)
UK	Jan. 1990	302	3.0075	1.1147	1.974	5.1891	544.0648 (0.000)	I(0)
Italy	Jan. 1990	302	2.7256	1.4821	1.0658	0.046	57.8005 (0.000)	I(1)
Canada	Jan. 1990	302	2.1424	0.9458	2.4881	6.475	852.5966 (0.000)	I(0)
Euro	Dec. 2002	147	1.7109	0.5045	-0.4887	0.4743	7.6407 (0.022)	I(1)
Netherlands	Jan. 1995	242	2.0072	0.6186	0.1823	-0.2753	2.0013 (0.368)	I(1)
Norway	Jun. 1998	201	2.0095	0.4823	0.6453	-0.3482	15.024 (0.000)	I(0)
Spain	Jan. 1995	242	2.4262	0.9324	-0.1677	0.5888	5.0076 (0.082)	I(1)
Sweden	Jan. 1995	242	1.6714	0.7512	0.5131	0.1084	10.9315 (0.004)	I(0)
Switzerland	Jun.1998	201	0.8371	0.4789	-0.2798	0.4777	4.8618 (0.088)	I(1)

Notes: The table presents the starting point, number of observations mean, standard deviation, skweness, kurtosis and the test statistic of the Jarque-Bera-test its p-value as well as the order of integration for the countries under consideration.

by Schwert (1989)[2] and then select the best model judged by the Akaike information criterion (AIC) by Akaike (1973).

Thereby we include 13 lags in the case of the USA, 9 for Japan, 2 for Germany, Sweden and the Euroarea, 14 for France, 3 for the UK, Italy, the Netherlands, Norway and Switzerland, 11 for Canada and 7 for Spain.

Figures 1 on page 12 to 4 on page 15 visualize the estimated degree of persistence, i.e. $\alpha_1(\tau)$ in equation (2). The shaded areas represent the 95% confidence intervals using bootstrap standard errors with 3000 replications.

Contrary to previous empirical findings involving quantiles of the realized inflation such as Tsong and Lee (2011), Wolters and Tillmann (2015) and Manzan and Zerom (2015) we find that the degree of persistence is not increasing from the lower to the upper quantiles. For countries such as the USA, Germany, France, Canada, Spain and Sweden the persistence at the lower quantiles is actually higher than at the median of the process. This asymmetric pattern is especially pronounced for the USA and Spain for which the persistence is higher at the lower quantiles than at the upper quantiles, indicating that in the presence of deflationary shocks the inflation expectations do not revert to their long-run equilibrium but instead gain momentum.

Table 2 on page 16 summarizes the results of the quantile unit root test. It reports a **Yes** if a unit root is detected at the respective quantile and a **No** if this is not the case. For Italy, Canada and the UK the lower quantiles do not contain a unit root and deflationary shocks are therefore short lived, whereas, for the upper quantiles the unit root hypothesis is not rejected for these countries. For the Netherlands, Norway, Sweden and Switzerland the results indicate that a unit root is present in the lower and the upper quantiles. This U-shaped pattern along the quantile indicates that large negative and positive shocks are equally long lasting in their effect on the ongoing inflation expectations. This means that the tails of the distribution of inflation expectations are not anchored, i.e. they respond heavily to incoming new data. These results therefore are a first indication for a lack of efficiency of monetary policy at the zero lower bound and in times of high inflation. I.e. market participants do not deem the monetary authorities credible to counter deflationary and inflationary shocks.

Some countries like Germany and France depict the unit root property at every quantile of the distribution. This is not surprising since as the last column in table 1 on the previous page reveals the inflation expecta-

[2]The proposed rule of thumb is $\lfloor 12 \cdot (T/100)^{0.25} \rfloor$ in which T is the number of observations.

tion series are not stationary when applying the augmented Dickey-Fuller test at the mean of the distribution. The results indicate, however, that this nonstationarity is not caused by just some parts of the distribution. For example could only the upper quantiles induce this non-stationarity. Instead besides inflationary shocks, deflationary shocks also contribute to this non-stationarity.

Table 3 augments the findings of the quantile unit root test. It shows the estimated coefficients $\alpha_0(\tau)$ and $\alpha_1(\tau)$ of equation (2), which represent the size of the shock and the persistence, respectively. Further the test statistic and critical value of the quantile unit root test and the half live, measured as $\ln(0.5)/\ln(\alpha_1(\tau))$. If a unit root is detected the half life is set to ∞ to highlight that the process at the quantile under consideration is not returning to its long-run equilibrium. The half-lives range for the 10% quantile from 10.480 in the case of the UK up to 20.514 for Italy. This implies that though no unit root is detected in this lower quantile the inflation process needs between 11 and 21 month to return to its long-run equilibrium after hit by large deflationary shocks.

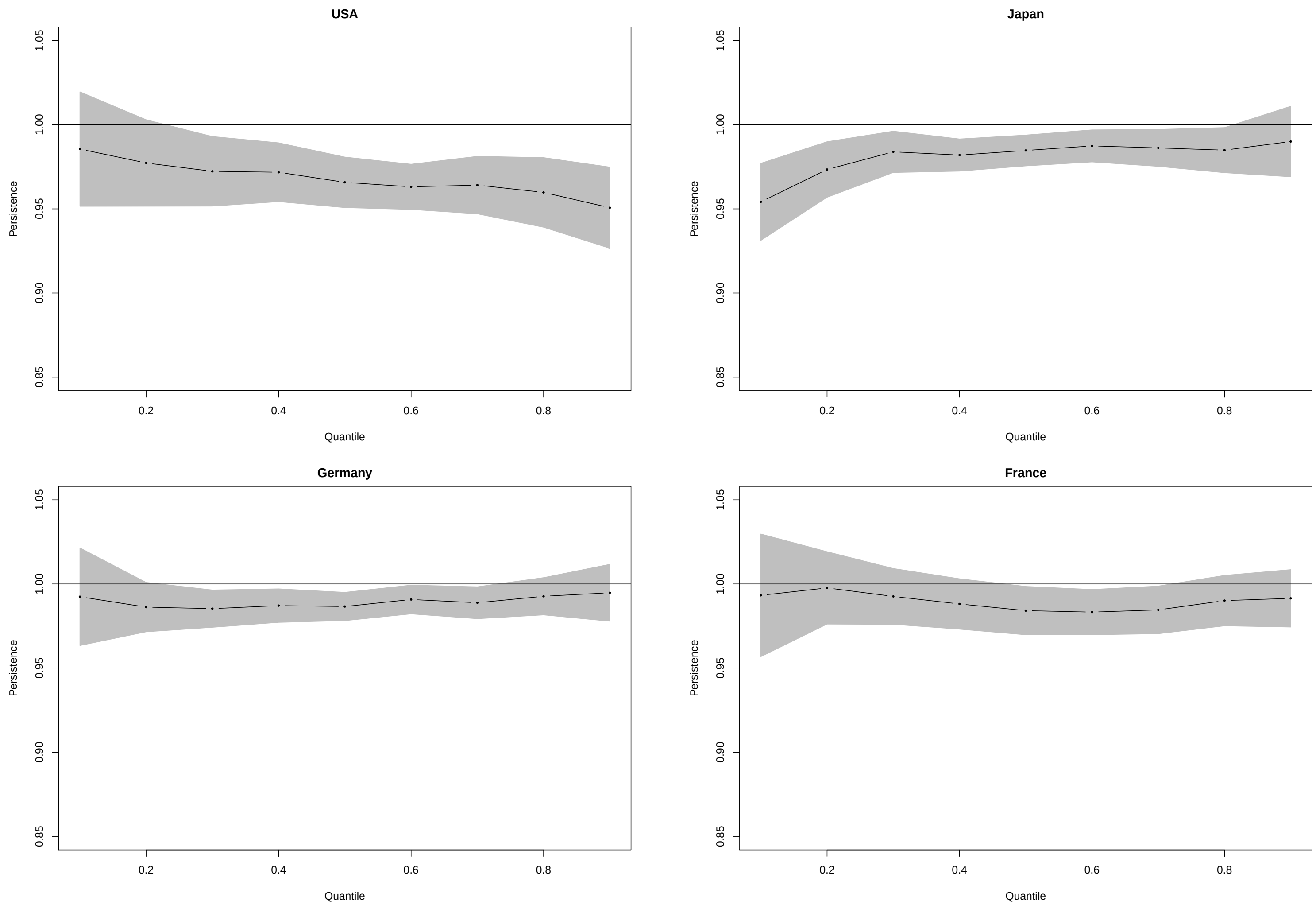

Figure 1: The Degree of Persistence

Notes: The figures visualize the estimated degree of persistence, i.e. $\alpha_1(\tau)$ in $Q(y_t \mid y_{t-1},\ldots,y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau)y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau)\Delta y_{t-j}$. The shaded areas represent the 95% confidence intervals using bootstrap standard errors with 3000 replications.

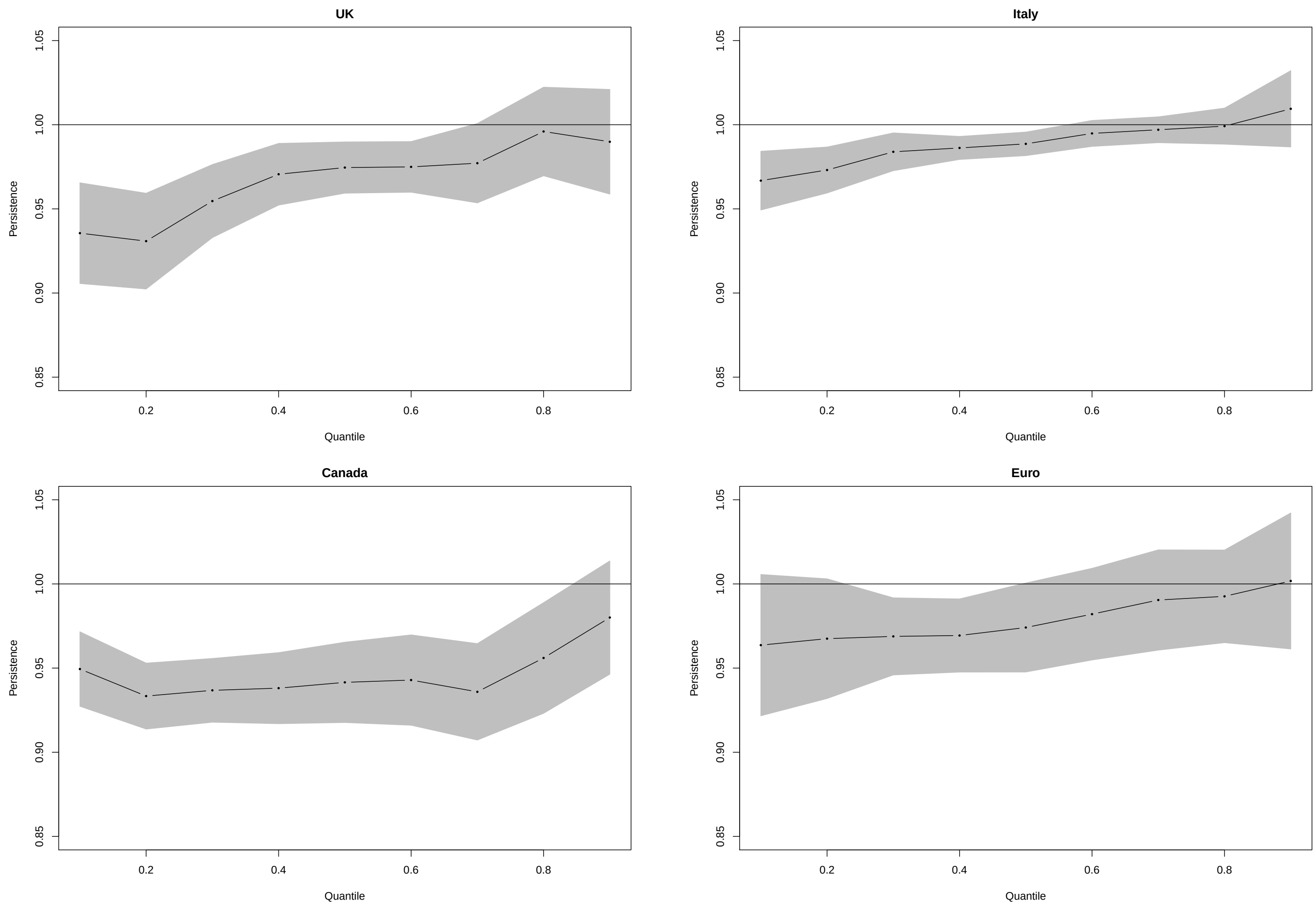

Figure 2: The Degree of Persistence (cont.)

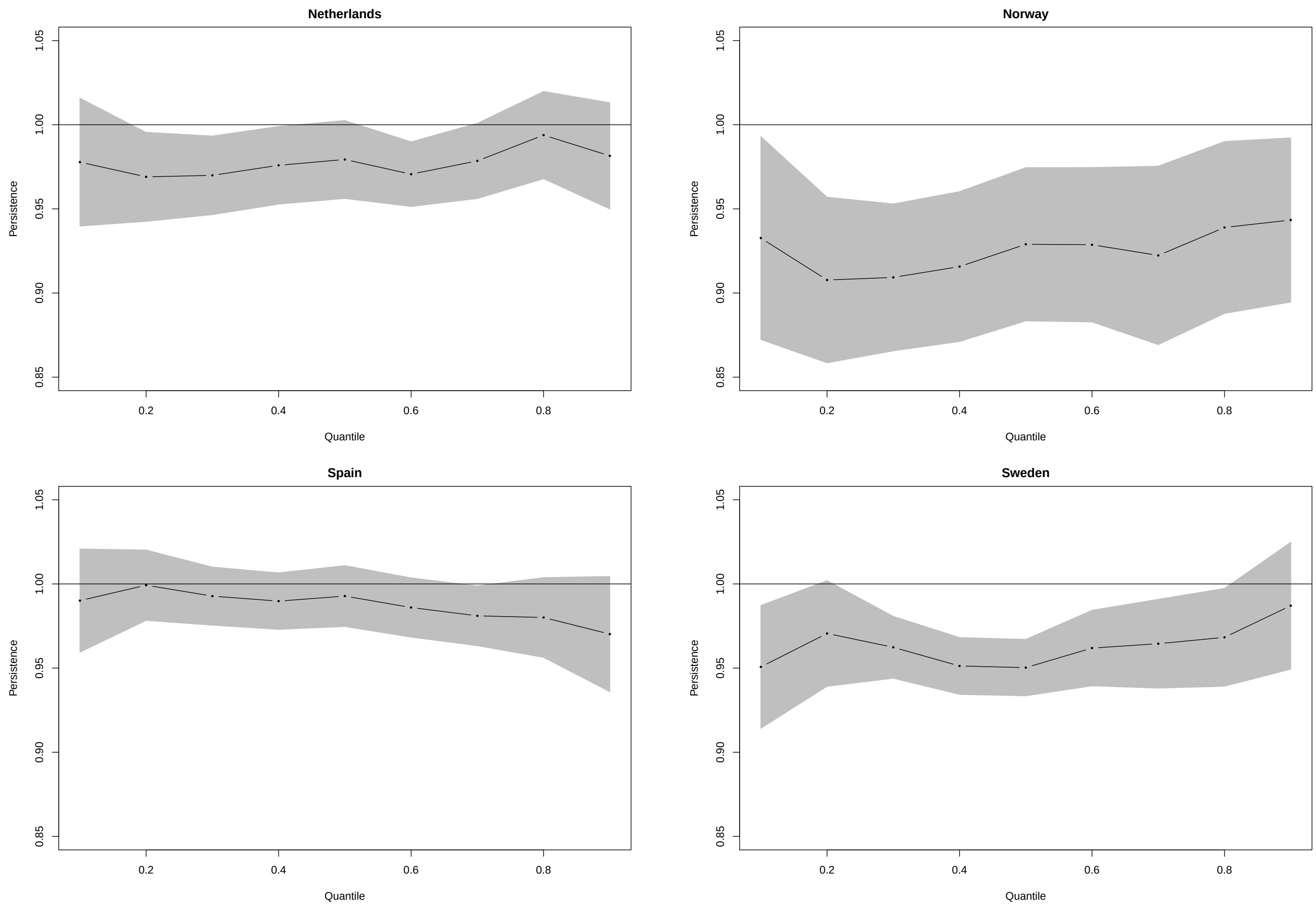

Figure 3: The Degree of Persistence (cont.)

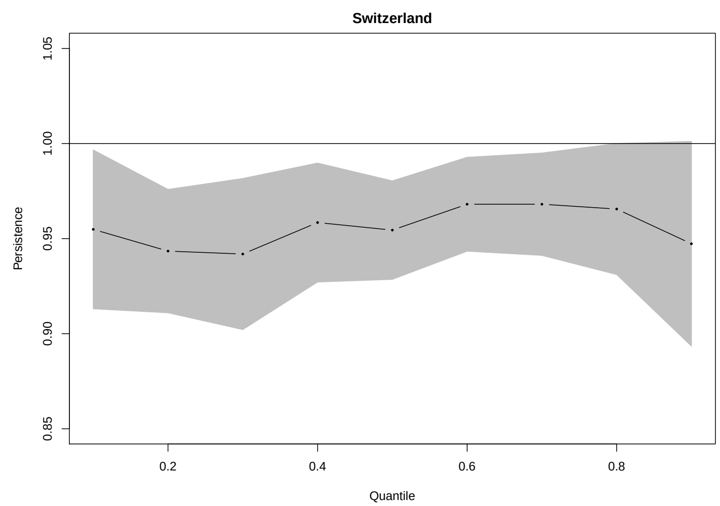

Figure 4: The Degree of Persistence (cont.)

Table 2: Findings of the Quantile Unit Root Test

Country	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
USA	**Yes**	**Yes**	**Yes**	No	No	No	No	No	No
Japan	No	No	**Yes**	No	No	**Yes**	**Yes**	No	**Yes**
Germany	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
France	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
UK	No	No	No	No	No	No	No	**Yes**	**Yes**
Italy	No	No	No	No	No	**Yes**	**Yes**	**Yes**	**Yes**
Canada	No	No	No	No	No	No	No	No	**Yes**
Euro	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Netherlands	**Yes**	**Yes**	No	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**
Norway	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**
Spain	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Sweden	**Yes**	**Yes**	No	No	No	No	No	No	**Yes**
Switzerland	**Yes**	No	No	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**

Notes: The table summarizes the results of the quantile unit root test. It reports a **Yes** if a unit root is detected at the respective quantile and a No if this is not the case.

Table 3: Quantile Unit Root Test

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
USA	$\hat{\alpha}_0(\tau)$	-0.126	-0.081	-0.049	-0.026	-0.002	0.014	0.034	0.063	0.112
	$\hat{\alpha}_1(\tau)$	0.986	0.977	0.972	0.972	0.966	0.963	0.964	0.960	0.951
	Unit Root	Yes	Yes	Yes	No	No	No	No	No	No
	t-Stat	-0.571	-1.835	-2.432	-2.706	-3.883	-4.243	-3.811	-2.884	-3.632
	crit. Value	-2.475	-2.514	-2.546	-2.425	-2.415	-2.262	-2.224	-2.125	-2.120
	Half Life	∞	∞	∞	24.204	19.898	18.431	18.977	16.883	13.708
Japan	$\hat{\alpha}_0(\tau)$	-0.114	-0.059	-0.032	-0.014	-0.003	0.015	0.039	0.058	0.100
	$\hat{\alpha}_1(\tau)$	0.954	0.973	0.984	0.982	0.985	0.987	0.986	0.985	0.990
	Unit Root	No	No	Yes	No	No	Yes	Yes	No	Yes
	t-Stat	-3.402	-2.974	-2.251	-3.866	-3.325	-2.189	-2.294	-2.406	-0.795
	crit. Value	-2.721	-2.491	-2.562	-2.616	-2.431	-2.453	-2.488	-2.329	-2.162
	Half Life	14.770	25.702	∞	38.104	44.938	∞	∞	45.538	∞
Germany	$\hat{\alpha}_0(\tau)$	-0.095	-0.056	-0.030	-0.012	0.002	0.015	0.031	0.052	0.079
	$\hat{\alpha}_1(\tau)$	0.992	0.986	0.985	0.987	0.987	0.991	0.989	0.993	0.995
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.338	-1.493	-2.157	-2.156	-2.494	-1.646	-1.853	-1.048	-0.460
	crit. Value	-2.505	-2.494	-2.661	-2.728	-2.597	-2.553	-2.594	-2.524	-2.294
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
France	$\hat{\alpha}_0(\tau)$	-0.089	-0.055	-0.038	-0.019	-0.003	0.013	0.026	0.045	0.065
	$\hat{\alpha}_1(\tau)$	0.993	0.998	0.993	0.988	0.984	0.983	0.985	0.990	0.99
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.469	-0.235	-0.872	-1.333	-1.866	-2.189	-1.954	-1.053	-1.112

Continued on next page

Table 3 – continued from previous page

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
	crit. Value	-2.551	-2.335	-2.483	-2.542	-2.542	-2.388	-2.419	-2.336	-2.417
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
UK	$\hat{\alpha}_0(\tau)$	-0.132	-0.085	-0.049	-0.020	-0.006	0.012	0.031	0.063	0.133
	$\hat{\alpha}_1(\tau)$	0.936	0.931	0.955	0.971	0.975	0.975	0.977	0.996	0.990
	Unit Root	No	No	No	No	No	No	No	Yes	Yes
	t-Stat	-4.355	-7.643	-5.829	-5.130	-4.469	-4.509	-3.380	-0.411	-0.681
	crit. Value	-2.254	-2.463	-2.531	-2.532	-2.542	-2.483	-2.471	-2.388	-2.524
	Half Life	10.480	9.65	15.045	23.553	27.378	27.378	29.789	∞	∞
Italy	$\hat{\alpha}_0(\tau)$	-0.129	-0.072	-0.040	-0.025	-0.011	0.006	0.022	0.046	0.094
	$\hat{\alpha}_1(\tau)$	0.967	0.973	0.984	0.986	0.989	0.995	0.997	0.999	1.009
	Unit Root	No	No	No	No	No	Yes	Yes	Yes	Yes
	t-Stat	-2.925	-3.879	-3.561	-3.704	-3.792	-1.552	-0.861	-0.169	1.062
	crit. Value	-2.494	-2.591	-2.580	-2.549	-2.580	-2.525	-2.523	-2.440	-2.356
	Half Life	20.514	25.400	42.718	49.890	60.589	∞	∞	∞	∞
Canada	$\hat{\alpha}_0(\tau)$	-0.121	-0.074	-0.055	-0.036	-0.018	0.001	0.032	0.054	0.102
	$\hat{\alpha}_1(\tau)$	0.949	0.933	0.937	0.938	0.942	0.943	0.936	0.956	0.980
	Unit Root	No	No	No	No	No	No	No	No	Yes
	t-Stat	-4.101	-6.283	-9.146	-8.788	-6.491	-5.799	-6.202	-3.426	-1.483
	crit. Value	-2.256	-2.485	-2.486	-2.647	-2.557	-2.612	-2.535	-2.425	-2.302
	Half Life	13.363	10.054	10.617	10.845	11.506	11.789	10.465	15.414	∞
Eurozone	$\hat{\alpha}_0(\tau)$	-0.076	-0.046	-0.028	-0.014	-0.002	0.012	0.026	0.043	0.066
	$\hat{\alpha}_1(\tau)$	0.964	0.967	0.969	0.969	0.974	0.982	0.990	0.993	1.002
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Table 3 – continued from previous page

Country	τ	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	t-Stat	-1.406	-1.658	-1.964	-2.323	-2.083	-1.413	-0.746	-0.512	0.071
	crit. Value	-2.639	-2.694	-2.616	-2.682	-2.628	-2.521	-2.444	-2.358	-2.120
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Netherlands	$\hat{\alpha}_0(\tau)$	-0.109	-0.059	-0.037	-0.017	-0.002	0.014	0.035	0.057	0.091
	$\hat{\alpha}_1(\tau)$	0.978	0.969	0.970	0.976	0.979	0.971	0.979	0.994	0.982
	Unit Root	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
	t-Stat	-0.897	-2.073	-2.625	-2.397	-2.272	-3.026	-2.124	-0.529	-0.791
	crit. Value	-2.295	-2.462	-2.534	-2.528	-2.542	-2.676	-2.614	-2.536	-2.520
	Half Life	∞	∞	22.694	∞	∞	23.240	∞	∞	∞
Norway	$\hat{\alpha}_0(\tau)$	-0.155	-0.103	-0.049	-0.028	0.001	0.023	0.054	0.097	0.147
	$\hat{\alpha}_1(\tau)$	0.933	0.908	0.909	0.916	0.929	0.929	0.922	0.939	0.943
	Unit Root	Yes	No	No	No	No	No	No	Yes	Yes
	t-Stat	-1.895	-2.798	-2.885	-3.447	-3.652	-3.303	-3.475	-2.084	-1.279
	crit. Value	-2.416	-2.629	-2.662	-2.735	-2.691	-2.601	-2.538	-2.462	-2.431
	Half Life	∞	7.160	7.288	7.871	9.407	9.368	8.574	∞	∞
Spain	$\hat{\alpha}_0(\tau)$	-0.127	-0.084	-0.054	-0.033	-0.011	0.009	0.027	0.058	0.130
	$\hat{\alpha}_1(\tau)$	0.990	0.999	0.993	0.990	0.993	0.986	0.981	0.980	0.970
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.481	-0.056	-0.703	-1.202	-0.877	-1.766	-1.905	-1.347	-1.567
	crit. Value	-2.574	-2.321	-2.376	-2.526	-2.542	-2.522	-2.528	-2.258	-2.205
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Sweden	$\hat{\alpha}_0(\tau)$	-0.148	-0.079	-0.050	-0.025	0.001	0.021	0.044	0.073	0.115
	$\hat{\alpha}_1(\tau)$	0.951	0.971	0.962	0.951	0.950	0.962	0.964	0.968	0.987

Continued on next page

Table 3 – continued from previous page

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
	Unit Root	Yes	Yes	No	No	No	No	No	No	Yes
	t-Stat	-1.825	-1.700	-2.690	-4.252	-4.651	-3.787	-3.341	-2.563	-0.509
	crit. Value	-2.516	-2.591	-2.619	-2.625	-2.548	-2.560	-2.528	-2.473	-2.430
	Half Life	∞	∞	18.067	13.873	13.597	17.852	19.174	21.508	∞
Switzerland	$\hat{\alpha}_0(\tau)$	-0.108	-0.074	-0.042	-0.014	0.003	0.019	0.035	0.052	0.095
	$\hat{\alpha}_1(\tau)$	0.955	0.943	0.942	0.958	0.954	0.968	0.968	0.966	0.947
	Unit Root	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
	t-Stat	-1.765	-2.653	-2.897	-2.468	-2.952	-2.489	-2.305	-1.778	-1.410
	crit. Value	-2.581	-2.636	-2.742	-2.658	-2.616	-2.546	-2.483	-2.362	-2.120
	Half Life	∞	11.902	11.577	∞	14.872	∞	∞	∞	∞

Notes: The table shows the estimated coefficients $\alpha_0(\tau)$ and $\alpha_1(\tau)$ in $Q(y_t \mid y_{t-1},\ldots,y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau)y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau)\Delta y_{t-j}$. Further the test statistic and critical value of the quantile unit root test by Koenker and Xiao (2004) as well as the half live, measured as $\ln(0.5)/\ln(\alpha_1(\tau))$. If a unit root is detected the half live is set to ∞.

4 Structural Changes

The results found by the literature regarding the stability of the degree of persistence of inflation are ambiguous. Significant breaks as the introduction of the Euro might induce changes in the adaption of shocks in expectation formation. Accordingly, different expectation regimes have different parameter and persistence levels. In this section we contribute to this literature by analyzing the changing dynamics of the persistence of inflation expectations.

We apply the methodology developed by Qu (2008) and Oka and Qu (2011) to estimate structural breaks at different quantiles for unknown dates. We apply their DQ-test to identify breaks occurring over a range of quantiles τ. Testing over a specific range instead of merely at a given quantile τ yields a more complete picture about the changing dynamics and therefore ensures robustness. We focus on the upper and lower part of the distribution as these are the most interesting events regarding both the interpretation as well as the previous results on estimated persistence The DQ-test is applied to a range of quantiles centered around $\tau = 0.1$ and $\tau = 0.9$. First we apply the test to detect structural changes among deflationary shocks for the quantiles $\tau = \{0.050, 0.055, 0.060, \ldots, 0.1, \ldots, 0.140, 0.145, 0.150\}$, then for inflationary shocks at $\tau = \{0.850, 0.855, 0.860, \ldots, 0.9, \ldots, 0.940, 0.945, 0.950\}$. The test is applied to both sets of quantiles independently. Table 4 on the following page presents the estimated break dates.

The findings suggest that the degree of persistence is stable over time. Only for two countries breaks are found for deflationary shocks and three countries when considering inflationary shocks. The stability of the persistence of inflation expectations is therefore for the majority of the countries under consideration in line with the findings of O'Reilly and Karl (2004) and Cecchetti and Debelle (2006) for the actual inflation process. For the USA we find five breaks at the lower quantiles and two for Italy, respectively. At the upper quantiles we detect one break each for Canada, the UK and the USA. The USA therefore stand out as the country most prone to structural changes.

Complementing the results in previous section we analyze the unit root property in the following again at quantiles $\tau = 0.1$ and $\tau = 0.9$. Table 5 on page 25 presents the results for the quantile unit root test applied to the subsamples.

The first break at the lower quantiles for the USA occurs in July 1993. As we see in figure 5, which shows the evolution of US inflation expectations as calculated by equation (1), this period includes a sharp drop in inflation expectations from 5% down tom 3%. As table 5 on page 25 reveals this decline is however not characterized by a unit root at the 10% quantile. The second break determines the subsample to last from August 1993 until September 1997. The persistence is 0.876 and we find statistical evidence for the unit root property.

The following period whose end is determined by a break in April 2001 contains the burst of the Dotcom bubble in March 2000. The persistence of inflation expectations is increasing up to 0.942 and retains the unit root property. This indicates that the economic distortions exerted by the burst of the bubble and FED reactions intensified the de-anchoring of inflation expectations and induced a more permanent decline in inflation expectations. FED credible to head off deflationary pressure ceased.

The next two subsamples range from May 2001 until April 2005 and thereafter until November 2008. In both periods the 0.1 quantile is not depicting the unit root behavior. The persistence falls down to 0.862 and further to 0.615 despite the occurrence of various recessions. Expectation inflations reanchored in this time period.

The last break occurs in November 2008 and coincides with the bankruptcy of Lehman Brothers. The subsequent subsample therefore covers the Global

Table 4: Estimated Break Dates for the Different Countries

$\tau = \{0.050, 0.055, 0.060, \ldots, 0.1, \ldots, 0.140, 0.145, 0.150\}$					
Country	1. Break	2. Break	3. Break	4. Break	5. Break
USA	Jul 1993	Sep 1997	Apr 2001	Apr 2005	Nov 2008
Italy	Mar 1996	Feb 2011	-	-	-
$\tau = \{0.850, 0.855, 0.860, \ldots, 0.9, \ldots, 0.940, 0.945, 0.950\}$					
Country	1. Break	2. Break	3. Break	4. Break	5. Break
Canada	Mar 2002	-	-	-	-
UK	Nov 2008	-	-	-	-
USA	May 2007	-	-	-	-

Notes: The table shows the estimated break dates based on the DQ-test at the quantiles $\tau = \{0.050, 0.055, 0.060, \ldots, 0.1, \ldots, 0.140, 0.145, 0.150\}$ for deflationary shocks and at quantiles $\tau = \{0.850, 0.855, 0.860, \ldots, 0.9, \ldots, 0.940, 0.945, 0.950\}$ for inflationary shocks. For both sets of quantiles the methodology to estimate structural changes for quantile regression models with unknown break dates developed by Qu (2008) and Oka and Qu (2011) is applied independently.

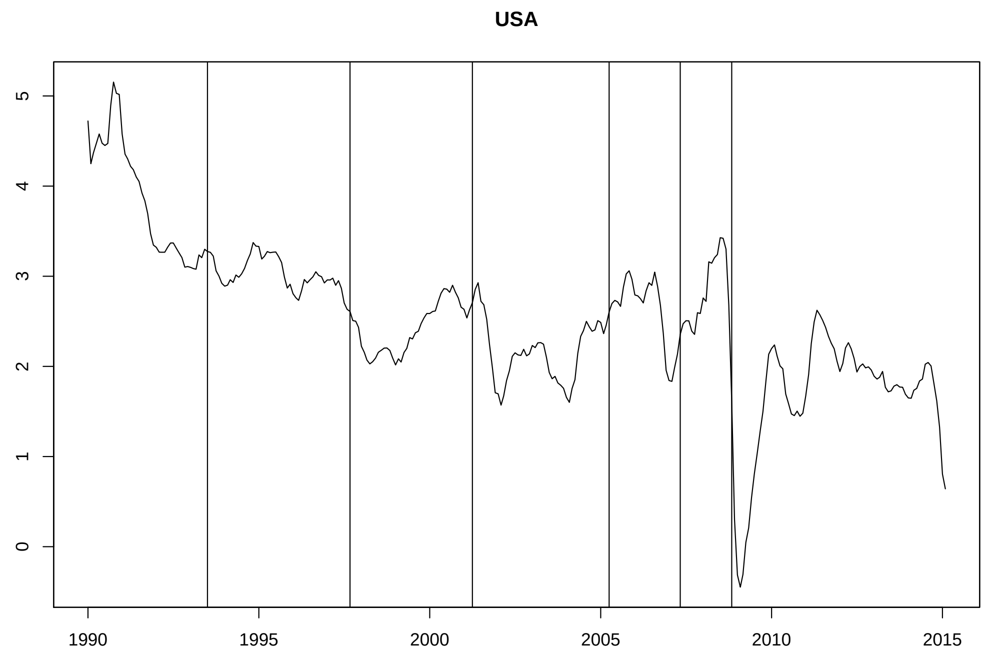

Figure 5: The Inflation Expectations for the USA

Notes: The figures depicts the time series of inflation expectations of participants in the Consensus Economics Panel for the USA. Fixed-event forecasts are converted to fixed 12-month horizon forecasts according to $\hat{\pi}_{t+12|t} = \frac{(k-1)}{12}\hat{\pi}_{t+k|t} + \frac{(13-k)}{12}\hat{\pi}_{t+12+k|t}$ in which $\hat{\pi}_{t+k|t}$ is the k month ahead forecast of inflation based on information available at time t, i.e. the forecast for the current calendar year, whereas $\hat{\pi}_{t+12+k|t}$ is the k month ahead forecast of inflation for the next calendar year based at time t. k denotes the remaining months of the year. The vertical bars correspond to the break dates listed in table 4 on the preceding page.

Financial Crisis and its aftermath. During this subsample the expectations depict a similar behavior as in the period covering the Dotcom bubble. Persistence is increasing up to 0.970 and a unit root is detected.

Our findings for the USA show that during normal recessions market participants seem to be able to look through the crisis and expectations remain anchored. However in periods with severe financial crises the persistence of inflation expectations is increasing, the unit root hypothesis cannot be rejected and expectations loose their long run anchor. This pattern is especially prevalent during the Global Financial Crisis. The results indicate that market participants in the USA do not deem the Fed credible to counter deflationary pressure resulting from a shock emanating from the financial sector.

Italian inflation expectations show two structural breaks in March 1996 and February 2011. The last subsample spanning from March 2011 until the end of the sample in February 2015 therefore covers the ongoing Eurocrisis. As figure 6 reveals Italian inflation expectations approach 0% during 2015. This subsample shows unit root behavior as the persistence of deflationary shocks is 0.981. This current unanchoring of expectations can be lead back to real or nominal causes. On the one hand, production is currently low and economic subjects expect it to remain low inducing low future prices. Economic recovery is hence not expected. On the other hand, the decline in inflation expectations can represent an expected fall in relative prices. This internal devaluation could restore competitiveness as demanded by European partners and the IMF. However, Italy achieved an internal devaluation of only 0.6 % in 2012 (compare de Grauwe (2012)). The possibility that market participants expect a significant internal devaluation to occur is therefore low. Thus our results indicate, that markets have a very pessimistic view on the Italian economy. It is expected to experience a prolonged period with low growth and low inflation.

The second panel of table 5 on the next page presents the results for quantile $\tau = 0.9$. Inflation expectations in Canada experience a structural change in March 2002 when persistence decreases from 1.004 to 0.949. Both periods retain the unit root property. For the UK we find a break in November 2008 when the size of a inflationary shock, i.e. the estimated coefficient $\hat{\alpha}_0(\tau)$ increases from 0.086 to 0.113. This increase is rationalized by the fact that inflation expectations exceeded 4% after the Global Financial Crisis. The persistence decreases, however, down to 0.969 from a value of 0.991.

The USA experience an additional break at the upper quantiles in June 2007 when inflation expectations begin to depict non-stationary behavior. This time period approximately coincides with the aggressive policy response by the Fed to act against the Global Financial Crisis and the Great Recession. The coincidence of breaks at both tails of the distribution with the outbreak of the financial crisis suggests that the aggressive unconventional monetary policy conducted by the Fed unanchored inflation expectations. As a result both deflationary and inflationary shocks hitting the expectations will lead to deflation and inflation (expectations) respectively in the future. Inflation expectations thus do not allow for the flexibility needed to pursue the unprecedented monetary policy to counter the financial disruptions brought by the Subprime crisis.

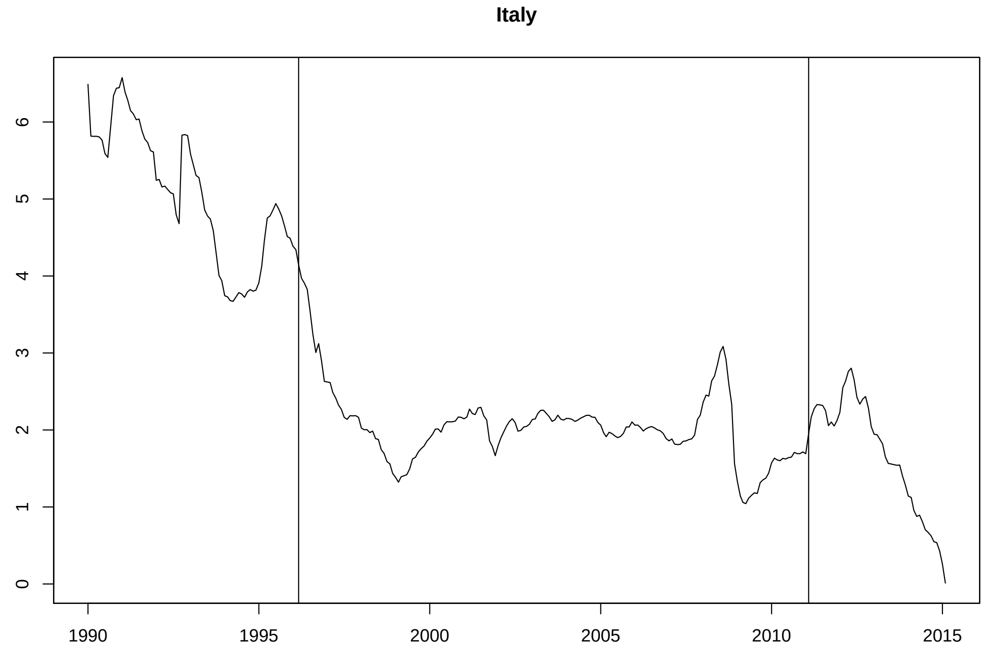

Figure 6: The Inflation Expectations for Italy

Notes: The figure depicts the time series of inflation expectations of participants in the Consensus Economics Panel for Italy. Fixed-event forecasts are converted to fixed 12-month horizon forecasts according to $\hat{\pi}_{t+12|t} = \frac{(k-1)}{12}\hat{\pi}_{t+k|t} + \frac{(13-k)}{12}\hat{\pi}_{t+12+k|t}$ in which $\hat{\pi}_{t+k|t}$ is the k month ahead forecast of inflation based on information available at time t, i.e. the forecast for the current calendar year, whereas $\hat{\pi}_{t+12+k|t}$ is the k month ahead forecast of inflation for the next calendar year based at time t. k denotes the remaining months of the year. The vertical bars correspond to the break dates listed in table 4 on page 22.

Table 5: Quantile Unit Root Test for Subsamples

Country		**Quantile**					
				$\tau = 0.1$			
USA	Sample	Jan 1990 Jul 1993	Aug 1993 Sep 1997	Oct 1997 Apr 2001	May 2001 Apr 2005	May 2005 Nov 2008	Dec 2008 Feb 2015
	$\hat{\alpha_0}(\tau)$	-0.006	-0.029	-0.064	-0.165	-0.208	-0.159
	$\hat{\alpha_1}(\tau)$	0.925	0.876	0.942	0.862	0.615	0.970
	Unit Root	No	Yes	Yes	No	No	Yes
	t-Stat	-10.058	-1.056	-1.485	-5.155	-3.519	-0.428
	crit. Value	-2.120	-2.339	-2.171	-2.120	-2.194	-2.436
Italy	Sample	Jan 1990 Mar 1996	Apr 1996 Feb 2011	Mar 2011 Feb 2015			

Continued on next page

Table 5 – continued from previous page

Country		Quantile		
	$\hat{\alpha_0}(\tau)$	-0.175	-0.148	-0.171
	$\hat{\alpha_1}(\tau)$	0.990	0.899	0.981
	Unit Root	Yes	Yes	Yes
	t-Stat	-0.219	-2.348	-1.344
	crit. Value	-2.158	-2.513	-2.270
				$\tau = 0.9$
Canada	Sample	Jan 1990 Mar 2002	Apr 2002 Feb 2015	
	$\hat{\alpha_0}(\tau)$	0.114	0.101	
	$\hat{\alpha_1}(\tau)$	1.004	0.949	
	Unit Root	Yes	Yes	
	t-Stat	0.556	-1.031	
	crit. Value	-2.344	-2.316	
UK	Sample	Jan 1990 Nov 2008	Dec 2008 Feb 2015	
	$\hat{\alpha_0}(\tau)$	0.086	0.113	
	$\hat{\alpha_1}(\tau)$	0.991	0.969	
	Unit Root	Yes	Yes	
	t-Stat	-0.415	-0.605	
	crit. Value	-2.366	-2.363	
USA	Sample	Jan 1990 May 2007	Jun 2007 Feb 2015	
	$\hat{\alpha_0}(\tau)$	0.106	0.125	
	$\hat{\alpha_1}(\tau)$	0.959	1.003	
	Unit Root	No	Yes	
	t-Stat	-4.446	0.082	
	crit. Value	-2.234	-2.120	

Notes: The table depicts results for different regimes for the quantiles $\tau = \{0.1, 0.9\}$. The results contain the estimated coefficients $\alpha_0(\tau)$ and $\alpha_1(\tau)$ in $Q_\tau(y_t \mid y_{t-1}, \ldots, y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau)y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau)\Delta y_{t-j}$. Further the test statistic and critical value of the quantile unit root test by Koenker and Xiao (2004).

5 Robustness I: Changes in the Persistence Due to the Euro Changeover

In this section we analyze the effects of introducing Euro coins and banknotes in January 2002 on inflation expectations. This policy shock can have significant impacts on prices and inflation expectations. Impacts can be due to changes in consumer's perception of the price level and due to arising frictions from the Euro changeover. An example of such frictions is given by Dziuda and Mastrobuoni (2009). They find that retailers exploit consumer's difficulties with the conversion of prices by increasing profit margins. This effect is especially pronounced for cheaper goods. Ehrmann (2011) confirms that conversion complexity is a driving force of prices of cheap products. Changes in consumer's perception of inflation, on the other hand, can feed into expectations of future prices directly. Additionally these changes can affect the willingness to spend which in turn has real economic consequences. Jonas et al. (2002) show that the Euro changeover had an effect on price perception. They show that the conversion from German Mark (DM) to Euro has an inherent feature. When people are confronted with converting DM to Euro they overestimate prices and change their perception regarding wages. The same effect is, however, absent when the conversion is from DM to British Pound or Austrian Schilling. Traut-Mattausch et al. (2004) find that the expectation of increasing prices due to the Euro changeover alone suffices to increase inflation perceptions.

In sum this evidence for a change in the perception of inflation might lead to a break in inflation expectations. Neglecting such a break will lead to spuriously high autoregressive coefficients (see Wolters and Tillmann (2015)). Therefore we demean inflation expectations separately for both subsamples, i.e. before January 2002 and thereafter and restrict the analysis to the countries that introduced the Euro. Table 6 on the following page summarizes the findings of the unit root test. Germany, France, the Netherlands and Spain retain the pattern of the unit root property across quantiles as found in section 3. An exception is Italy, which did not depict the unit root property at the lower quantiles in the previous analysis. For Italy the unit root property is present at every quantile in both subsamples (see table 6). Table 4.7 shows the remaining results from the unit root test. When comparing these results for Italy with the results displayed in table 4.3 for which no mean shift is taken into account we see that the size of the shock occurring at the 0.1 quantile drops down to -0.155 when compared with a value of -0.129 from the specification above. The sizes of shocks at the other quantiles remain largely unchanged.

Summarizing the results for Italy, we have shown that deflationary shocks in Italy can gain momentum and disconnect inflation expectations from their long run values. This property was hidden when neglecting the break through the Euro introduction. For the Italian full sample, we had the puzzling result that the unit root could not be found at the lower tail of the distribution indicating that market participants deemed it unlikely that deflationary shocks could be long-lasting. This result was puzzling because potential explanations - like a central bank never seriously conducting disinflationary policies or the absence of sources for deflationary shocks e.g. energy price or wage declines - can't be found for Italy since energy prices usually soared during the time period under consideration and a high trade union density in Italy prevents holding down labor costs.

After controlling for the different means, the Italian results adapted to the other Euro countries' results. Controlling for the introduction of Euro

Table 6: Findings of the Quantile Unit Root Test for Inflation Expectations Demeaned Due to the Euro Changeover

Country	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Germany	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
France	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Italy	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Netherlands	**Yes**	No	**Yes**	**Yes**	No	No	No	**Yes**	**Yes**
Spain	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Notes: The table summarizes the results of the quantile unit root test. It reports a **Yes** if a unit root is detected at the respective quantile and a No if this is not the case.

coins and banknotes thus leads to consistent results and confirms our previous findings. Italian inflation expectations are not systematically different from other countries that introduced the Euro such as Germany, France or Spanish which all show unit root properties across all quantiles. Market participants' expectations clearly show possible long term effects of deflationary and inflationary shocks.

Table 7: Quantile Unit Root Test For Inflation Expectations Demeaned Due to the Euro Changeover

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Germany	$\hat{\alpha}_0(\tau)$	-0.086	-0.055	-0.034	-0.012	0.001	0.015	0.032	0.053	0.078
	$\hat{\alpha}_1(\tau)$	0.998	0.982	0.981	0.990	0.984	0.988	0.989	0.990	0.996
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.068	-1.890	-2.359	-1.436	-2.331	-1.813	-1.537	-1.348	-0.278
	crit. Value	-2.464	-2.544	-2.615	-2.701	-2.680	-2.608	-2.633	-2.597	-2.453
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
France	$\hat{\alpha}_0(\tau)$	-0.090	-0.053	-0.038	-0.017	-0.002	0.014	0.023	0.046	0.066
	$\hat{\alpha}_1(\tau)$	1.005	0.999	0.989	0.986	0.986	0.986	0.990	0.997	0.989
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	0.312	-0.134	-1.222	-1.443	-1.683	-1.781	-1.376	-0.387	-0.947
	crit. Value	-2.561	-2.368	-2.438	-2.541	-2.445	-2.385	-2.447	-2.517	-2.378
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Italy	$\hat{\alpha}_0(\tau)$	-0.155	-0.073	-0.041	-0.022	-0.007	0.006	0.020	0.044	0.093
	$\hat{\alpha}_1(\tau)$	0.971	0.981	0.986	0.994	0.993	0.994	0.994	0.997	1.010
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-2.236	-1.730	-1.751	-1.387	-1.984	-1.739	-1.334	-0.430	0.696
	crit. Value	-2.598	-2.729	-2.738	-2.624	-2.601	-2.602	-2.544	-2.563	-2.418
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Netherlands	$\hat{\alpha}_0(\tau)$	-0.104	-0.061	-0.035	-0.020	0.003	0.014	0.032	0.053	0.091
	$\hat{\alpha}_1(\tau)$	0.966	0.950	0.965	0.969	0.960	0.957	0.957	0.965	0.973
	Unit Root	Yes	No	Yes	Yes	No	No	No	Yes	Yes
	t-Stat	-1.078	-2.786	-2.390	-2.495	-3.753	-4.500	-3.848	-2.384	-1.098
	crit. Value	-2.286	-2.404	-2.567	-2.650	-2.666	-2.598	-2.595	-2.470	-2.524
	Half Life	∞	13.531	∞	∞	16.858	15.777	15.907	∞	∞

Continued on next page

Table 7 – continued from previous page

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Spain	$\hat{\alpha}_0(\tau)$	-0.142	-0.084	-0.053	-0.029	-0.010	0.006	0.028	0.053	0.131
	$\hat{\alpha}_1(\tau)$	0.984	0.994	0.994	0.996	0.995	0.987	0.979	0.973	0.967
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.626	-0.456	-0.527	-0.410	-0.510	-1.527	-2.034	-1.445	-1.456
	crit. Value	-2.595	-2.440	-2.393	-2.367	-2.590	-2.539	-2.508	-2.380	-2.218
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞

Notes: The table shows the estimated coefficients $\alpha_0(\tau)$ and $\alpha_1(\tau)$ in $Q(y_t \mid y_{t-1},\ldots,y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau)y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau)\Delta y_{t-j}$. Further the test statistic and critical value of the quantile unit root test by Koenker and Xiao (2004) as well as the half live, measured as $\ln(0.5)/\ln(\alpha_1(\tau))$. If a unit root is detected the half live is set to ∞.

6 Robustness II: The Persistence of the Inflation Expectation Gap

In this section we check the robustness of the results by evaluating the unit property at the different quantiles of the inflation expectation gap series. We decompose the inflation expectation data into the trend component and the inflation expectation gap component. Distinguishing between these two components allows the analysis to abstract from movements of the expectations towards the central bank's inflation target which are usually the driving forces of the trend component (see Cogley et al. (2010)). We suspect these movements to be especially prevalent for the Eurozone countries due to the convergence effects during the forerun of the Euro introduction which are likely to carry over to inflation expectations.

Figures7 to 10 contrast the estimated degree of persistence, i.e. $\alpha_1(\tau)$ in equation (2), of the original (depicted in black) with the detrended series (presented in red). As mentioned above, the persistence of the detrended series measures the speed of mean-reversion of shocks that are not due to convergence towards the inflation target. This persistence is therefore crucial for the central banker. On the other hand it also allows to evaluate the central bank's effectiveness to respond to transitory shocks as perceived by market participants.

The figures indicate roughly the same pattern of persistence across the quantiles for both series. The persistence for both series is typically increasing in tandem from the lower to the upper quantiles, see e.g. Italy. Another stylized fact is that the persistence of the detrended series is lower than for the raw inflation expectation series for most countries. This indicates that inflation expectations appear to be much better anchored once the trend component is removed.

Table 8 on the next page and 6 on page 37 present the summarized and augmented results of the quantile unit root, respectively. For virtually all countries the findings from section 3 remain unchanged. In the case of Italy and Canada contrary to the results for the raw inflation expectation series we find the unit property now also at the 0.1 quantile.

To conclude although the persistence is lower for most countries when considering the inflation expectation gap series, the unit root property is still prevailing at both tails of the distribution. We can confirm our original results, that both inflationary and deflationary shocks can gain momentum. Due to this unanchoring of the expectation the monetary authorities need to closely monitor and act most aggressively upon movements occurring at both ends of the distribution of inflation expectations.

Table 8: Findings of the Quantile Unit Root Test for the Detrended Series

Country	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
USA	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**
Japan	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Germany	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
France	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
UK	No	No	No	No	No	No	**Yes**	**Yes**	**Yes**
Italy	**Yes**	No	**Yes**	No	No	**Yes**	**Yes**	**Yes**	**Yes**
Canada	**Yes**	No	No	No	No	No	**Yes**	**Yes**	**Yes**
Euro	**Yes**	**Yes**	No	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**
Netherlands	**Yes**	No	**Yes**	**Yes**	No	No	**Yes**	**Yes**	**Yes**
Norway	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**
Spain	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Sweden	**Yes**	**Yes**	**Yes**	No	No	No	No	**Yes**	**Yes**
Switzerland	**Yes**	No	No	No	No	No	**Yes**	**Yes**	**Yes**

Notes: The table summarizes the results of the quantile unit root test. It reports a **Yes** if a unit root is detected at the respective quantile and a No if this is not the case.

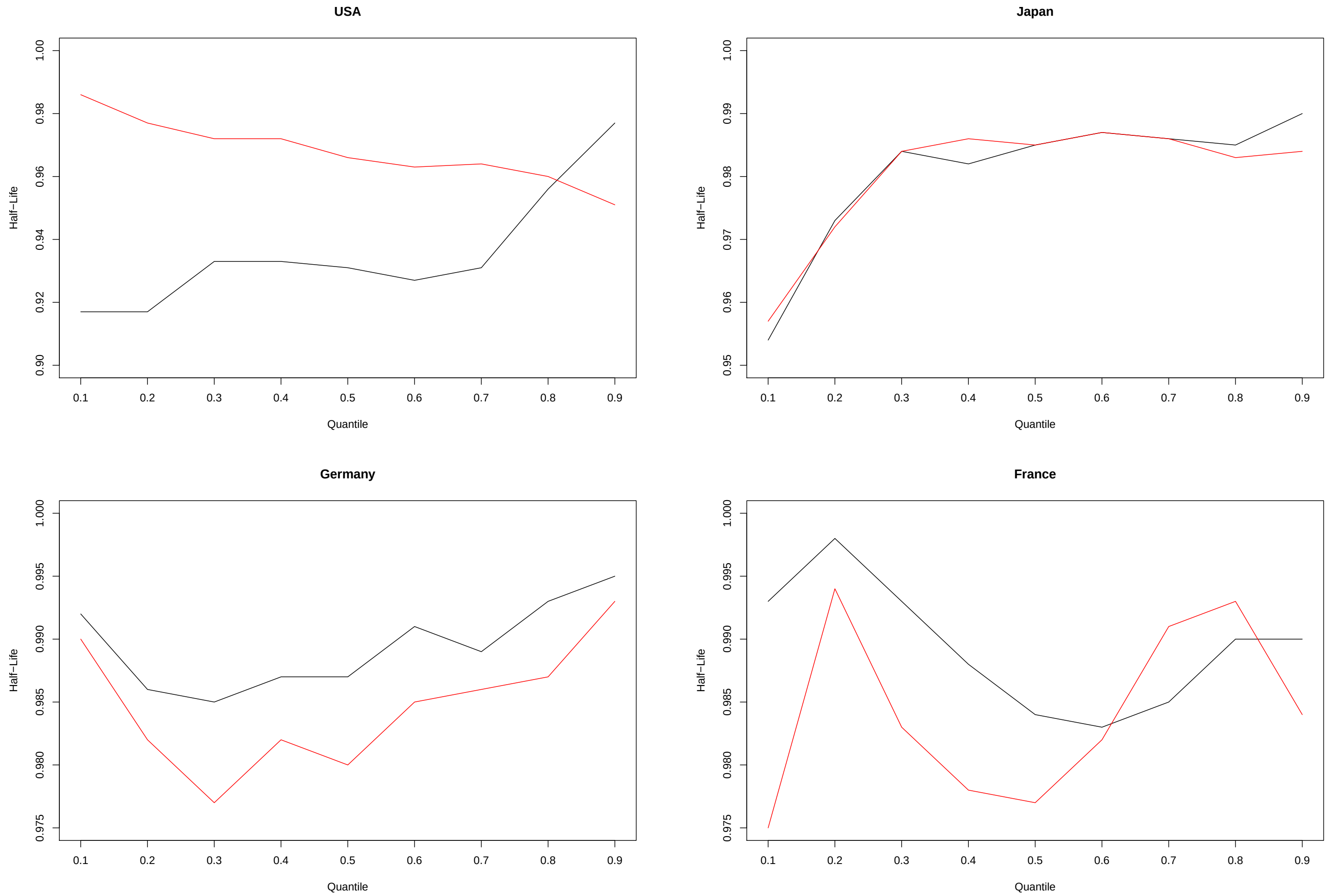

Figure 7: Comparison of the Degree of Persistence

Notes: The figures contrasts the estimated degree of persistence, i.e. $\alpha_1(\tau)$ in $Q(y_t \mid y_{t-1}, \ldots, y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau) y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau) \Delta y_{t-j}$ between the original and detrended inflation expectation series. The black line depicts the original inflation expectation series, whereas the detrended series is presented in red.

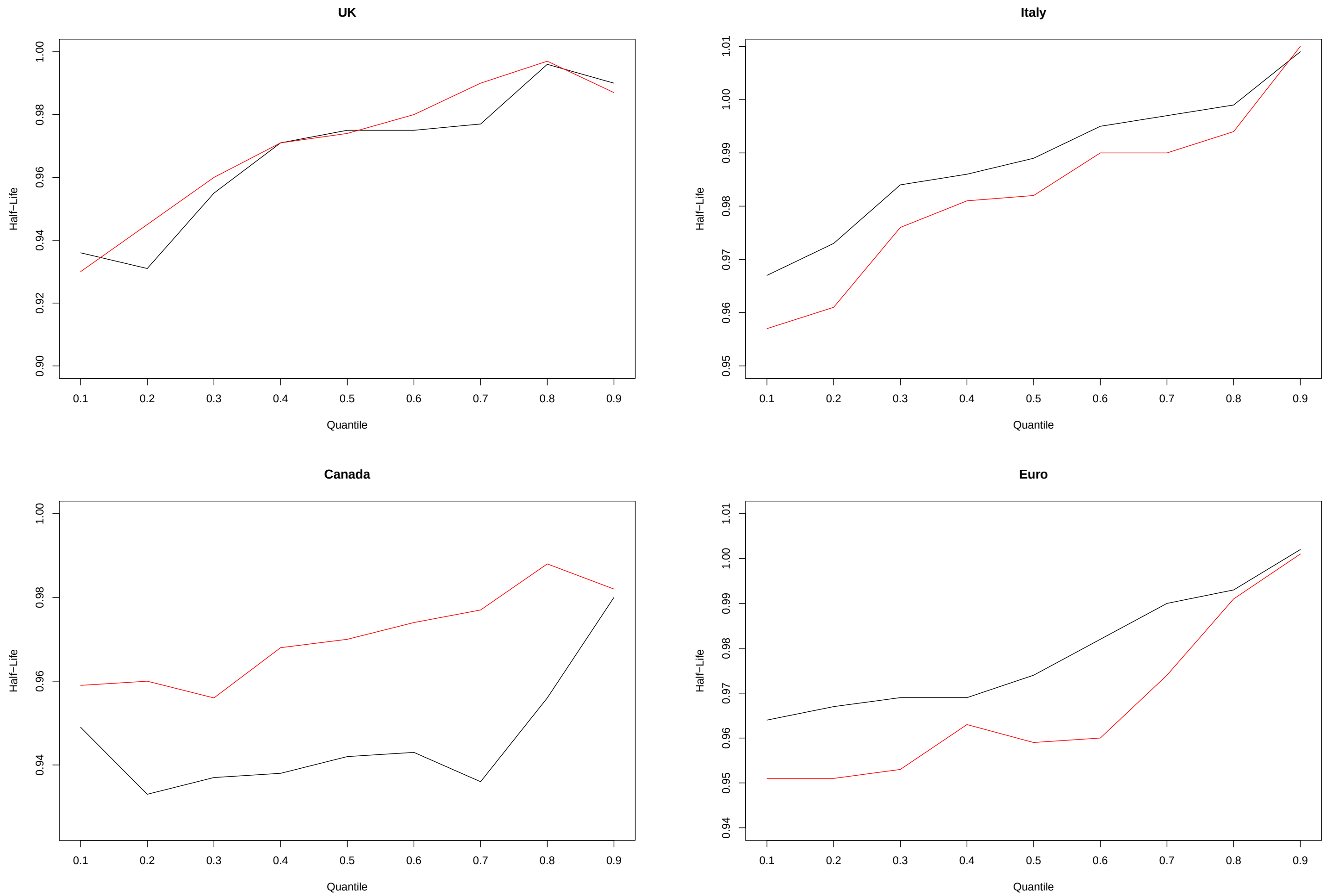

Figure 8: Comparison of the Degree of Persistence (cont.)

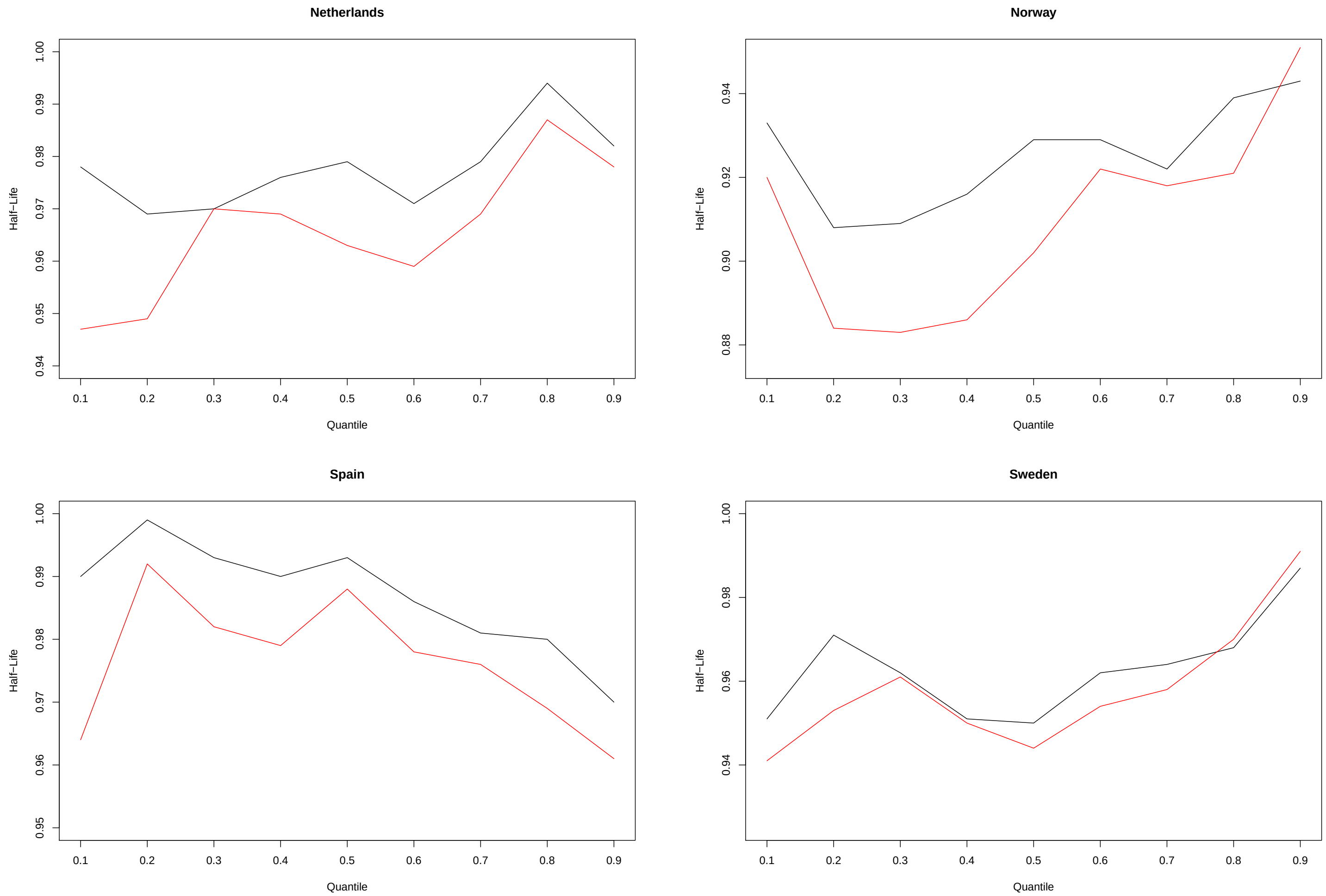

Figure 9: Comparison of the Degree of Persistence (cont.)

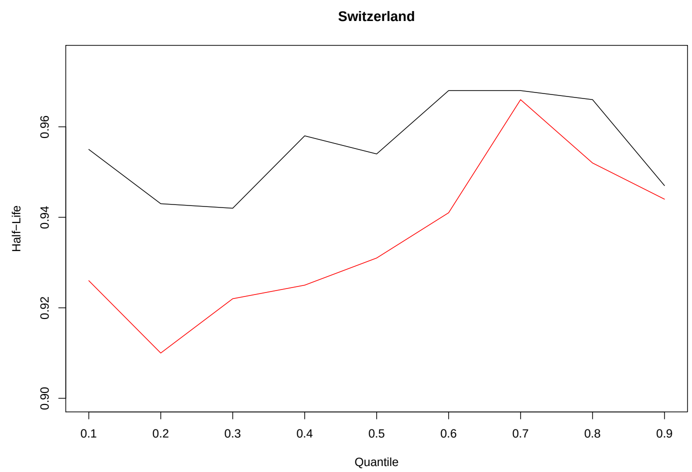

Figure 10: Comparison of the Degree of Persistence (cont.)

Table 9: Quantile Unit Root Test of the Detrended Inflation Expectations.

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
USA	$\hat{\alpha}_0(\tau)$	-0.123	-0.078	-0.044	-0.028	-0.005	0.017	0.041	0.074	0.116
	$\hat{\alpha}_1(\tau)$	0.917	0.917	0.933	0.933	0.931	0.927	0.931	0.956	0.977
	Unit Root	Yes	No	No	No	No	No	No	Yes	Yes
	t-Stat	-1.676	-3.886	-3.960	-5.038	-4.971	-5.276	-4.259	-2.021	-0.927
	crit. Value	-3.090	-2.753	-2.876	-2.870	-2.894	-2.873	-2.607	-2.506	-2.521
	Half Life	∞	7.981	9.997	9.927	9.624	9.183	9.701	∞	∞
Japan	$\hat{\alpha}_0(\tau)$	-0.122	-0.059	-0.029	-0.011	0.002	0.020	0.040	0.062	0.101
	$\hat{\alpha}_1(\tau)$	0.957	0.972	0.984	0.986	0.985	0.987	0.986	0.983	0.984
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-2.292	-2.619	-2.257	-2.386	-2.707	-2.020	-2.020	-1.854	-1.193
	crit. Value	-2.992	-2.818	-3.121	-2.953	-2.934	-2.870	-2.811	-2.686	-2.310
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Germany	$\hat{\alpha}_0(\tau)$	-0.094	-0.049	-0.028	-0.011	0.007	0.018	0.034	0.055	0.080
	$\hat{\alpha}_1(\tau)$	0.990	0.982	0.977	0.982	0.980	0.985	0.986	0.987	0.993
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-0.389	-1.508	-2.566	-2.357	-2.713	-2.155	-1.937	-1.600	-0.481
	crit. Value	-2.848	-2.931	-3.114	-3.193	-3.045	-2.991	-3.035	-2.946	-2.642
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
France	$\hat{\alpha}_0(\tau)$	-0.086	-0.050	-0.031	-0.015	-0.001	0.015	0.031	0.049	0.069
	$\hat{\alpha}_1(\tau)$	0.975	0.994	0.983	0.978	0.977	0.982	0.991	0.993	0.984
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-1.323	-0.507	-1.606	-2.170	-2.268	-1.691	-0.863	-0.675	-1.371
	crit. Value	-2.854	-2.945	-2.822	-2.832	-2.839	-2.683	-2.791	-2.931	-2.708
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞

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Table 9 – continued from previous page

Country	τ	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
UK	$\hat{\alpha}_0(\tau)$	-0.133	-0.084	-0.049	-0.023	-0.001	0.019	0.039	0.067	0.134
	$\hat{\alpha}_1(\tau)$	0.930	0.945	0.960	0.971	0.974	0.980	0.990	0.997	0.987
	Unit Root	No	No	No	No	No	No	Yes	Yes	Yes
	t-Stat	-3.967	-5.443	-4.943	-4.515	-3.996	-3.152	-1.346	-0.233	-0.739
	crit. Value	-2.756	-2.803	-3.109	-3.021	-3.014	-2.945	-2.935	-2.793	-2.938
	Half Life	9.520	12.259	17.006	23.208	26.529	34.898	∞	∞	∞
Italy	$\hat{\alpha}_0(\tau)$	-0.121	-0.068	-0.036	-0.019	-0.002	0.014	0.029	0.051	0.096
	$\hat{\alpha}_1(\tau)$	0.957	0.961	0.976	0.981	0.982	0.990	0.990	0.994	1.010
	Unit Root	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes
	t-Stat	-2.367	-3.583	-2.730	-3.139	-3.468	-1.873	-1.746	-0.675	0.485
	crit. Value	-3.034	-3.042	-3.149	-2.997	-2.950	-2.886	-2.842	-2.854	-2.921
	Half Life	∞	17.307	∞	35.901	38.815	∞	∞	∞	∞
Canada	$\hat{\alpha}_0(\tau)$	-0.119	-0.080	-0.048	-0.023	0.002	0.024	0.045	0.080	0.112
	$\hat{\alpha}_1(\tau)$	0.959	0.960	0.956	0.968	0.970	0.974	0.977	0.988	0.982
	Unit Root	Yes	No	No	No	No	No	Yes	Yes	Yes
	t-Stat	-2.541	-4.077	-5.087	-3.464	-3.442	-3.084	-2.582	-1.191	-1.346
	crit. Value	-2.825	-2.995	-2.989	-3.134	-3.095	-3.020	-2.995	-2.790	-2.684
	Half Life	∞	17.080	15.493	21.447	22.949	26.591	∞	∞	∞
Eurozone	$\hat{\alpha}_0(\tau)$	-0.079	-0.037	-0.025	-0.013	-0.001	0.014	0.027	0.044	0.068
	$\hat{\alpha}_1(\tau)$	0.951	0.951	0.953	0.963	0.959	0.960	0.974	0.991	1.001
	Unit Root	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
	t-Stat	-1.737	-2.512	-2.956	-3.020	-3.183	-2.901	-1.851	-0.498	0.037
	crit. Value	-2.734	-3.080	-2.944	-3.026	-2.966	-2.962	-2.817	-2.714	-2.345
	Half Life	∞	∞	14.323	∞	16.753	∞	∞	∞	∞
Netherlands	$\hat{\alpha}_0(\tau)$	-0.107	-0.066	-0.036	-0.014	0.003	0.019	0.037	0.058	0.094
	$\hat{\alpha}_1(\tau)$	0.947	0.949	0.970	0.969	0.963	0.959	0.969	0.987	0.978

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Table 9 – continued from previous page

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
	Unit Root	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes
	t-Stat	-1.839	-2.921	-2.273	-2.750	-3.428	-4.216	-2.742	-0.903	-0.886
	crit. Value	-2.585	-2.797	-2.878	-3.031	-3.018	-3.064	-3.064	-2.867	-2.866
	Half Life	∞	13.198	∞	∞	18.427	16.692	∞	∞	∞
Norway	$\hat{\alpha}_0(\tau)$	-0.152	-0.099	-0.053	-0.020	-0.004	0.024	0.050	0.096	0.153
	$\hat{\alpha}_1(\tau)$	0.920	0.884	0.883	0.886	0.902	0.922	0.918	0.921	0.951
	Unit Root	Yes	No	No	No	No	No	No	Yes	Yes
	t-Stat	-1.860	-3.631	-3.942	-5.027	-4.387	-3.248	-3.306	-2.418	-1.085
	crit. Value	-2.849	-3.122	-3.000	-3.082	-3.123	-2.966	-2.837	-3.025	-2.640
	Half Life	∞	5.612	5.569	5.734	6.692	8.531	8.095	∞	∞
Spain	$\hat{\alpha}_0(\tau)$	-0.129	-0.080	-0.045	-0.025	-0.005	0.012	0.031	0.064	0.132
	$\hat{\alpha}_1(\tau)$	0.964	0.992	0.982	0.979	0.988	0.978	0.976	0.969	0.961
	Unit Root	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	t-Stat	-1.363	-0.387	-1.306	-2.037	-1.098	-1.993	-1.813	-1.466	-1.660
	crit. Value	-3.170	-2.772	-2.883	-2.876	-3.001	-2.900	-2.904	-2.587	-2.470
	Half Life	∞	∞	∞	∞	∞	∞	∞	∞	∞
Sweden	$\hat{\alpha}_0(\tau)$	-0.147	-0.081	-0.050	-0.027	0.005	0.023	0.050	0.070	0.120
	$\hat{\alpha}_1(\tau)$	0.941	0.953	0.961	0.950	0.944	0.954	0.958	0.970	0.991
	Unit Root	Yes	Yes	Yes	No	No	No	No	Yes	Yes
	t-Stat	-2.085	-2.677	-2.624	-3.979	-5.178	-4.237	-4.134	-2.142	-0.315
	crit. Value	-3.004	-3.135	-3.052	-3.058	-3.119	-2.824	-2.827	-2.800	-2.742
	Half Life	∞	∞	∞	13.476	12.004	14.863	16.282	∞	∞
Switzerland	$\hat{\alpha}_0(\tau)$	-0.108	-0.068	-0.036	-0.017	0.000	0.015	0.039	0.052	0.095
	$\hat{\alpha}_1(\tau)$	0.926	0.910	0.922	0.925	0.931	0.941	0.966	0.952	0.944
	Unit Root	Yes	No	No	No	No	No	Yes	Yes	Yes

Continued on next page

Table 9 – continued from previous page

Country	τ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
	t-Stat	-2.698	-3.323	-3.657	-4.010	-3.689	-3.561	-2.216	-2.333	-1.210
	crit. Value	-3.012	-2.867	-3.024	-3.143	-3.091	-2.884	-2.922	-2.700	-2.400
	Half Life	∞	7.346	8.529	8.837	9.647	11.399	∞	∞	∞

Notes: The table shows the estimated coefficients $\alpha_0(\tau)$ and $\alpha_1(\tau)$ in $Q(y_t \mid y_{t-1}, \ldots, y_{t-q}) = \alpha_0(\tau) + \alpha_1(\tau) y_{t-1} + \sum_{j=1}^{q} \alpha_{j+1}(\tau) \Delta y_{t-j}$. Further the test statistic and critical value of the quantile unit root test by Koenker and Xiao (2004) as well as the half live, measured as $\ln(0.5)/\ln(\alpha_1(\tau))$. If a unit root is detected the half live is set to ∞.

7 Conclusion

In our paper we study the stability of inflation expectations. We estimate the persistence of inflationary and deflationary shocks using the Consensus Economics survey.

Using the quantile unit root test by Koenker and Xiao (2004) we find unit-root behavior for the Netherlands, Norway, Sweden and Switzerland for large deflationary shocks as wells as large inflationary. Hence both kinds of shocks gain momentum as so far QE measures have not been effective in anchoring expectations. Although the missing counterfactual precludes to measure the effects of an absence of stabilization attempts exerted by the monetary authorities, at least we can say that expectations did not return to normal.

We analyze the changing dynamics of the degree of inflation persistence by detecting structural breaks with the methodology by Qu (2008) and Oka and Qu (2011). Effects of the Euro changeover show that the degree of persistence is stable over time.

An exception are inflation expectations for the USA. For this series we find that expectations become de-anchored for the period coinciding with the unconventional monetary policy actions conducted by the Fed.

While normal recessions seem not to be able to deanchor expectations, in periods with severe financial crises the persistence is increasing and the expectations process becomes non-stationary. Market participants in the US do not deem the Fed credible to counter deflationary pressure resulting from a shock emanating from the financial sector. The coincidence of breaks at both tails of the distribution with the outbreak of the financial crisis suggests that the aggressive unconventional monetary policy conducted by the Fed unanchored inflation expectations. As a result both deflationary and inflationary shocks hitting the expectations will lead to deflation and inflation (expectations) respectively in the future. Hence, the effectiveness of monetary policy is questioned in times of Global Financial Crisis and Great Recession.

These findings have direct consequences for policy makers. In the current post Subprime-crisis era with interest rates close to the Zero lower bound (ZLB) monetary authorities turn to the management of inflation expectations to achieve price stability. Measures range from forward guidance to even considerations about raising the inflation target level.

Our results show that in times of low inflation and even deflation, as is currently the case, expectations can become a problem in their own regard. When inflation expectations are hit by a large deflationary or inflationary shock they are not anchored any longer. This is making monetary policy difficult.

At the time when standard instruments are not at hand any more, monetary policy needs to act even more intensely to provoke reactions. Keeping this in mind, the use of unconventional monetary policy measures must be reviewed differentiated. "Deperate times call for desperate measures." However, the effectivity of these measures is decreasing in time and even becoming negative, so the problem amplifies. At the same time the expectations are more sensitive to economic activity and in turn inflation itself will be more sensitive to economic activity. Hence, the central bank needs to wield the monetary instruments more aggressively to stabilize the expectations.

The sacrifice ratio (the price of lowering inflation in terms of production lost) is not constant across the distribution of inflation expectations since inflation expectations are more prone to react to large shocks to economic activity. In contrast to the tails, the persistence is low around the median. This low persistence implies that expectations vary less to economic activity and imply through their effect on ongoing inflation a flat Phillips curve but high sacrifice ratios. This varying degree of the sacrifice ratio implies that the monetary instruments are more effective to head off large inflationary or deflationary shocks. The question for central banker is, however, if they can generate a stimulus large enough to offset the initial shock that caused the deflation or inflation in the first place. Evidence from measures of unconventional monetary conducted by central banks around the globe remains inconclusive.

What can central bankers do to render the tails of the distribution anchored? A straightforward solution seems to be the implementation of an inflation target as is currently implemented in the UK, Sweden and Canada. But the results show that these countries also suffer from unanchored inflation expectations at the tails. Another possible solution is the improvement of central bank communication. Especially when confronted with unprecedented shocks market participants can be in doubt about the central bank's action and the efficacy about these actions. For example the burst of the Subprime bubble reduced production and exerted deflationary pressure. On the other hand, the response by central banks were so unprecedented that some observers warned about coming inflation. A cogent communication can help market participants to look through shocks and remain forward-looking.

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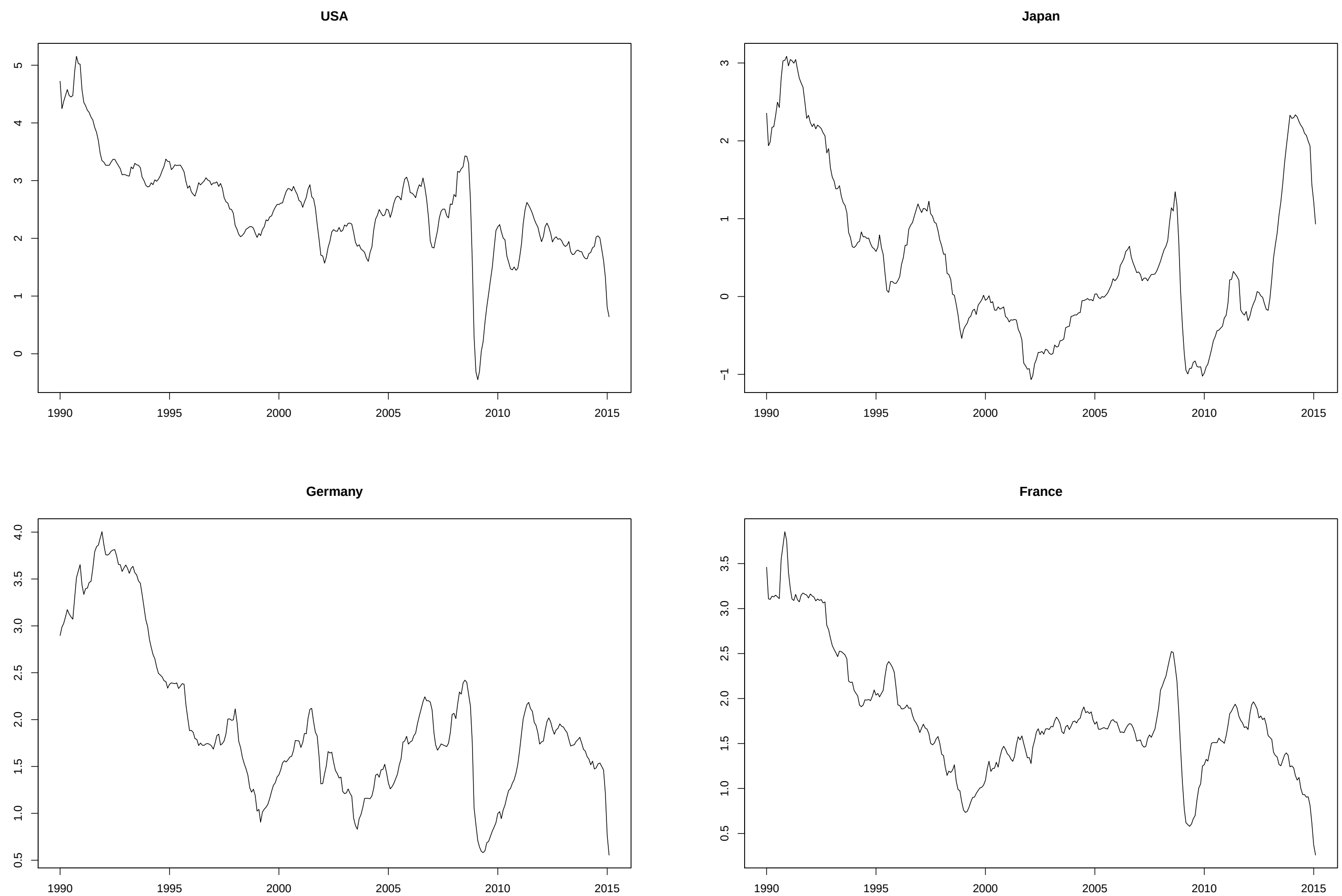

Figure 11: The Inflation Expectations

Notes: The figures depict the time series of inflation expectations of participants in the Consensus Economics Panel. Fixed-event forecasts are converted to fixed 12-month horizon forecasts according to $\hat{\pi}_{t+12|t} = \frac{(k-1)}{12}\hat{\pi}_{t+k|t} + \frac{(13-k)}{12}\hat{\pi}_{t+12+k|t}$ in which $\hat{\pi}_{t+k|t}$ is the k month ahead forecast of inflation based on information available at time t, i.e. the forecast for the current calendar year, whereas $\hat{\pi}_{t+12+k|t}$ is the k month ahead forecast of inflation for the next calendar year based at time t. k denotes the remaining months of the year.

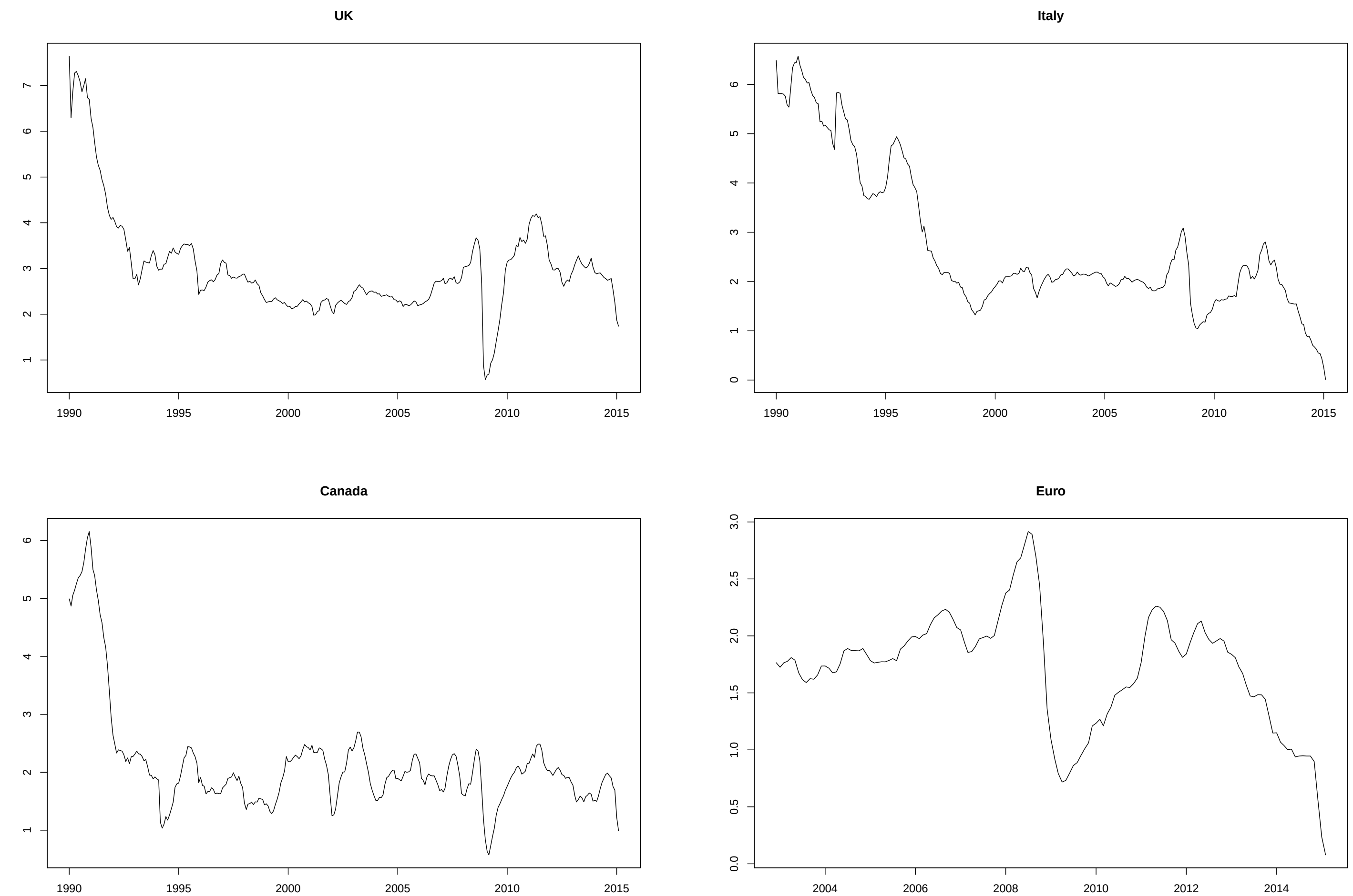

Figure 12: The Inflation Expectations (cont.)

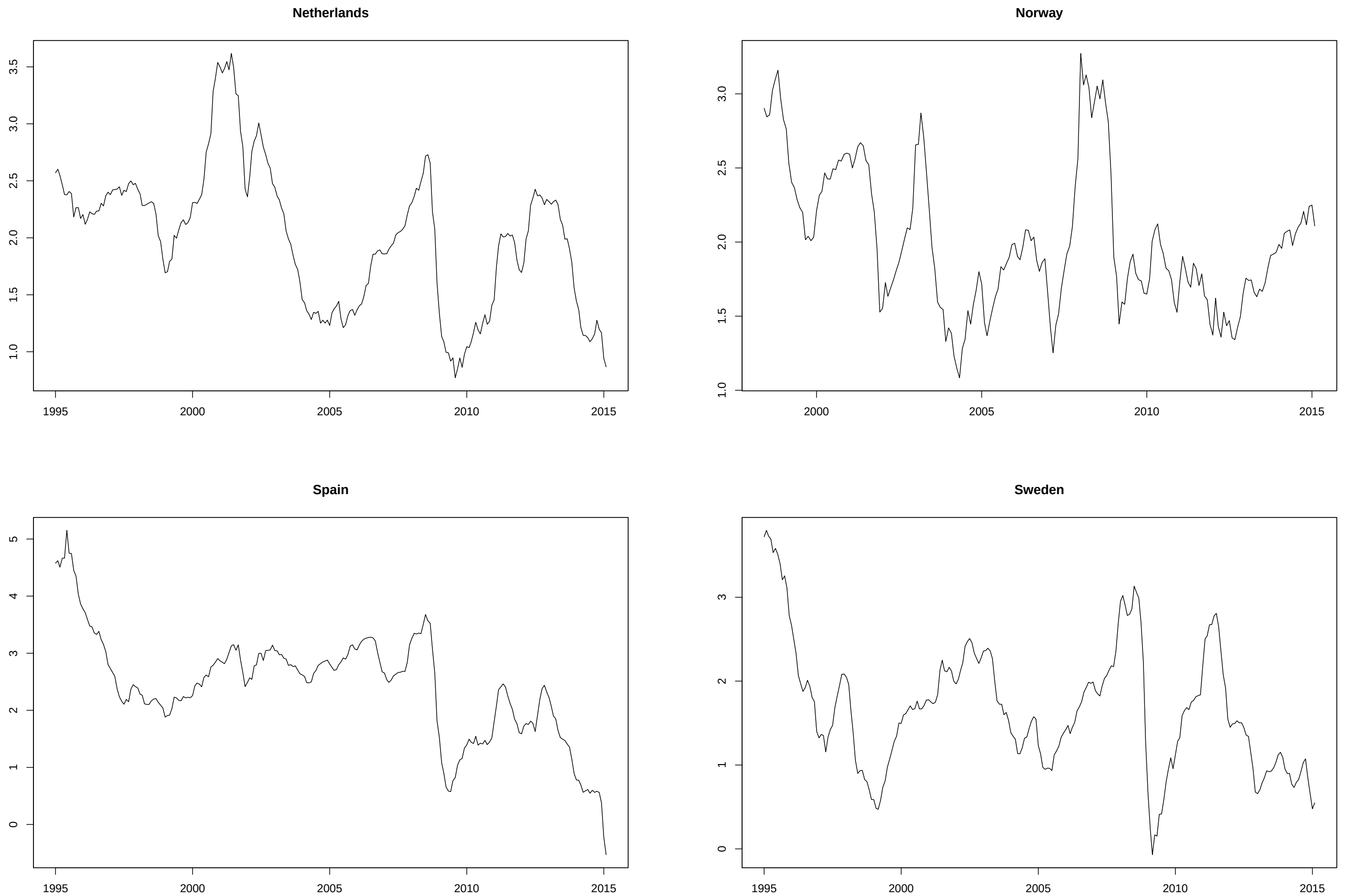

Figure 13: The Inflation Expectations (cont.)

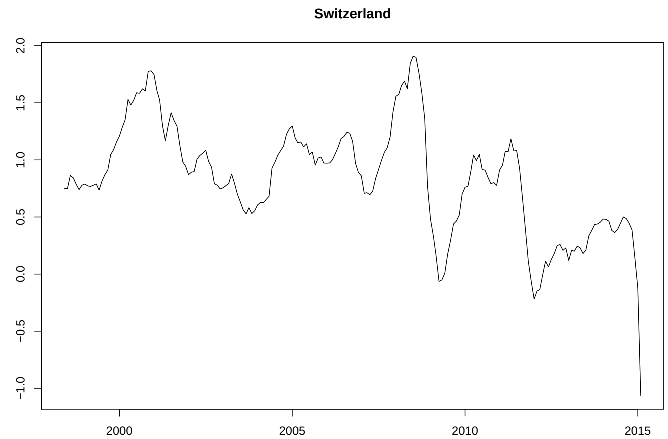

Figure 14: The Inflation Expectations (cont.)