Food inflation at risk

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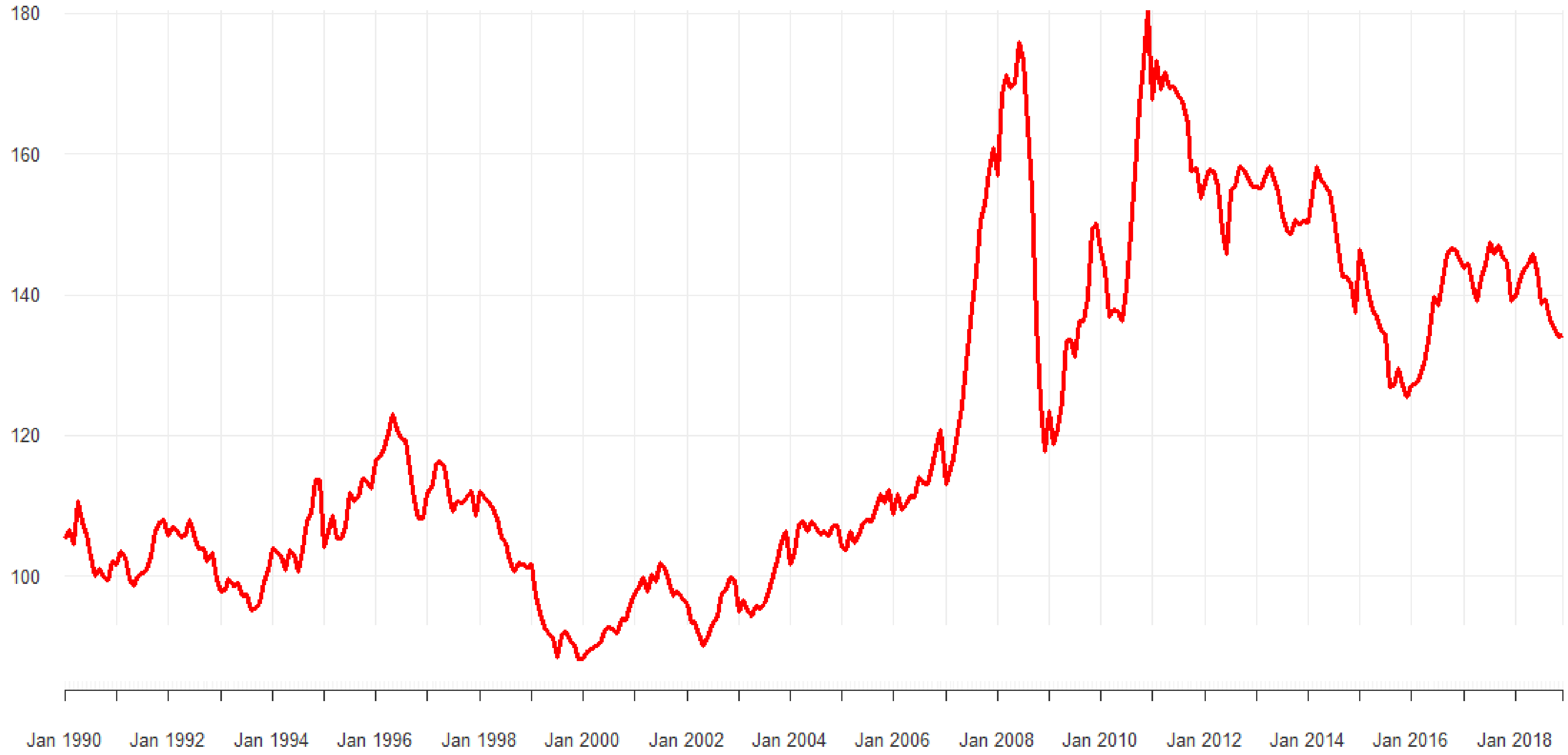
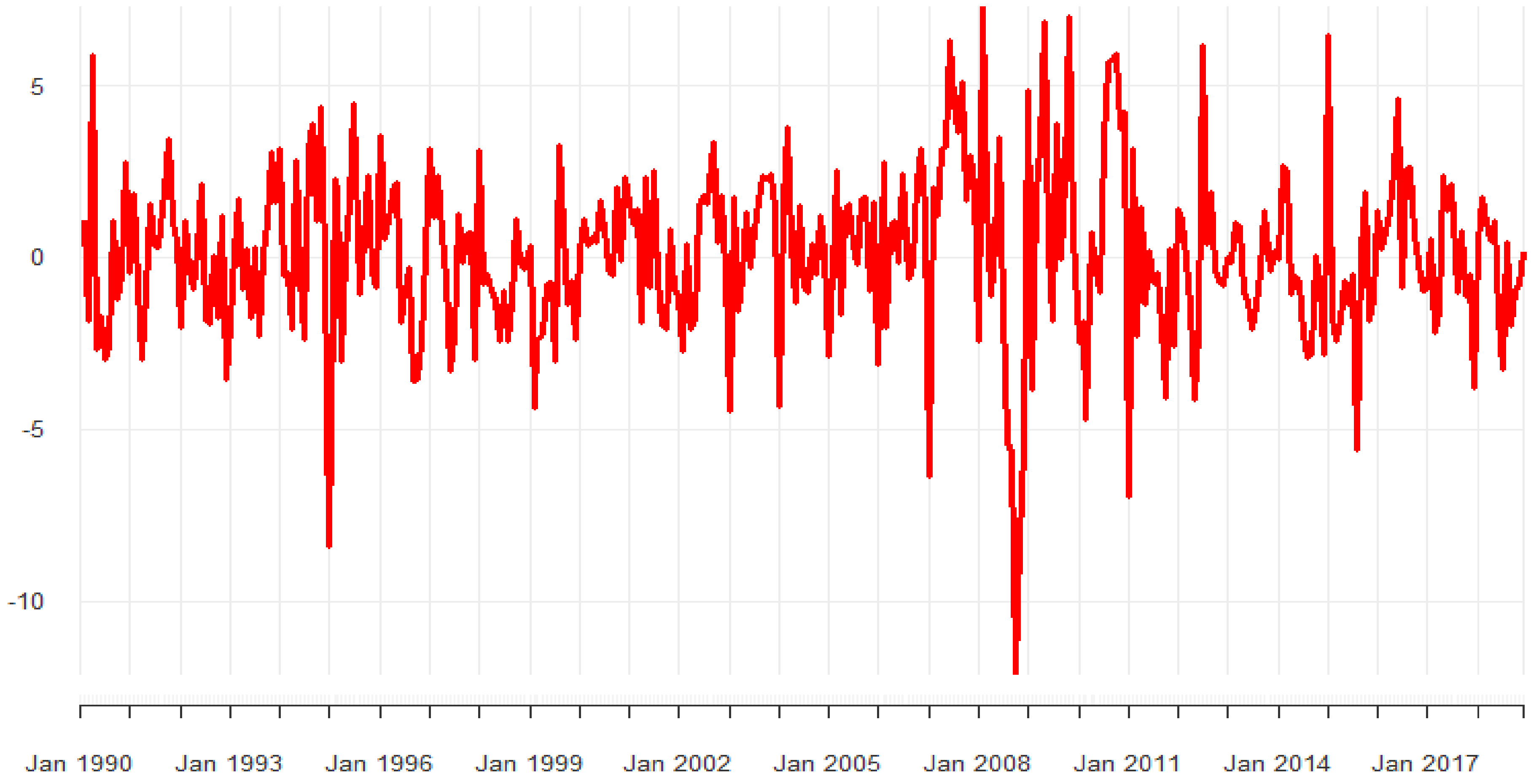
Motivation

FFPI - International food price index



Source: Food and Agriculture Organization of the United Nations (FAO)

Inflation rate of the FAO food price index



Source: Authors' calculations

In this paper, we:

Study the **risk** associated with the **inflation rate** of food price

Atribute the total food inflation risk to the **underlying food items**

Propose some **implications** for Food Stability Policies

Food inflation risk

=

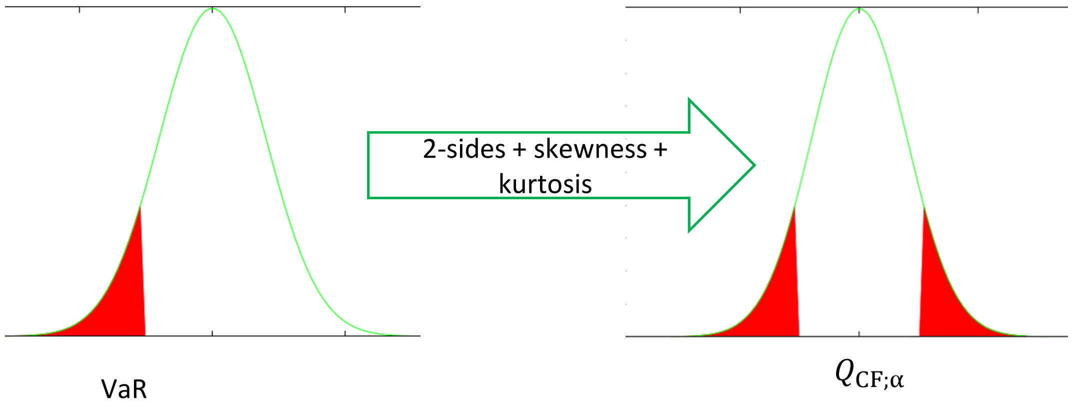
the risk that the actual food inflation rate will be different with the expected inflation rate

Important for:

- Central banks
- Consumers
- Producers

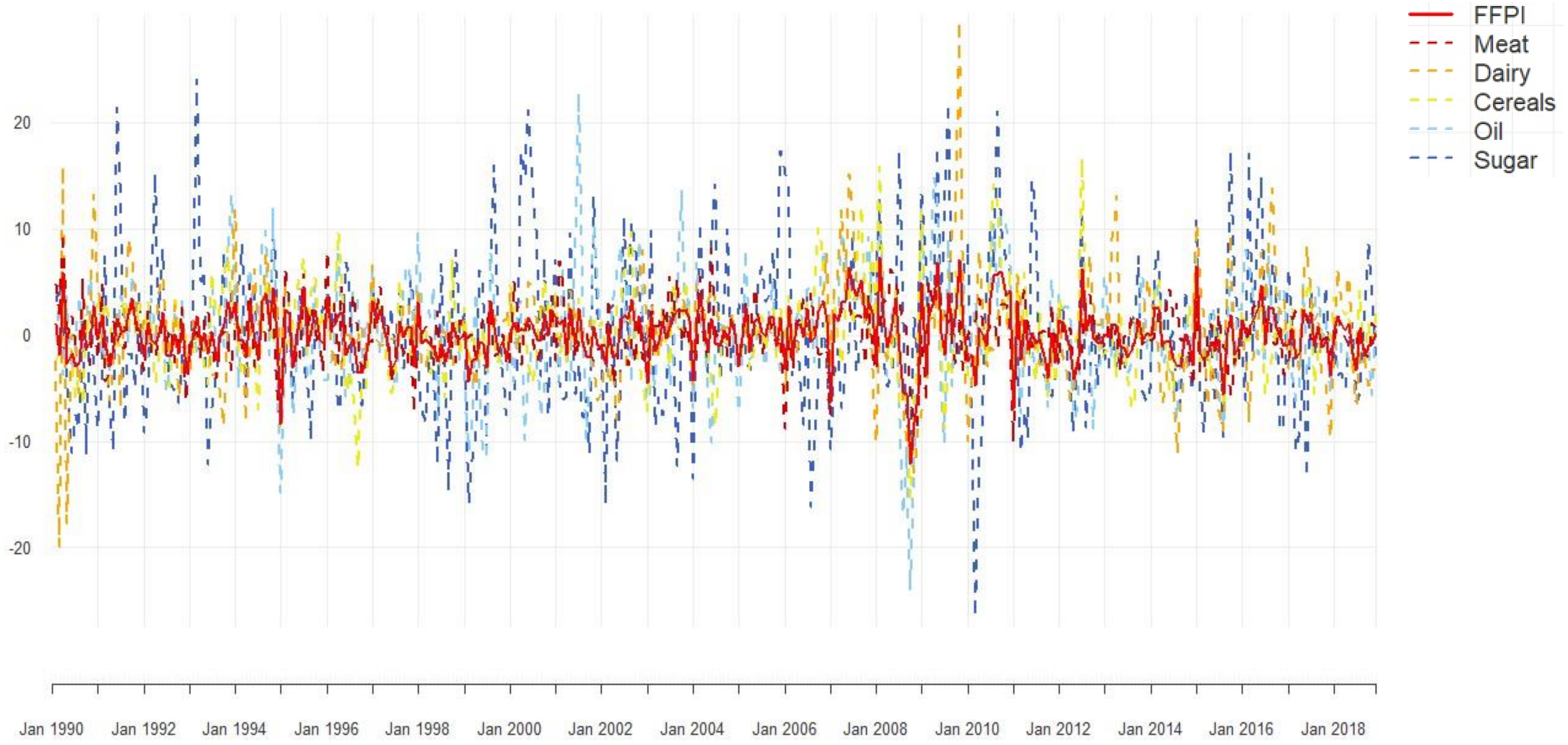
Risk measures?

Volatility or standard deviation: the lower the volatility is, the more stable the inflation rate is	Alpha quantile risk measure: determine 5% and 95% quantiles of the inflation distribution



Data

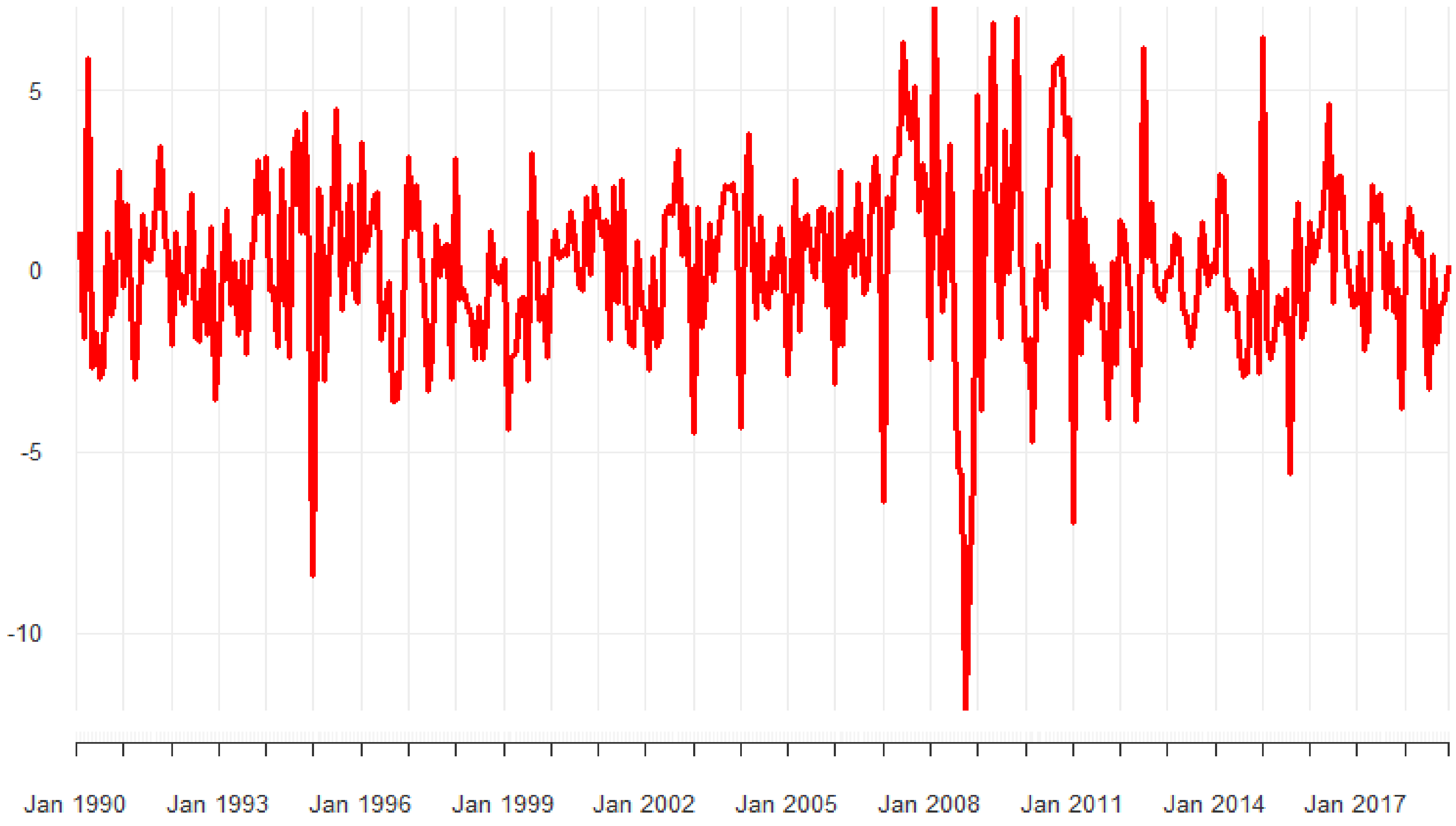
Inflation rates of food and 5 components



Source: Authors' calculations

Analysis

Inflation rate of the FAO food price index

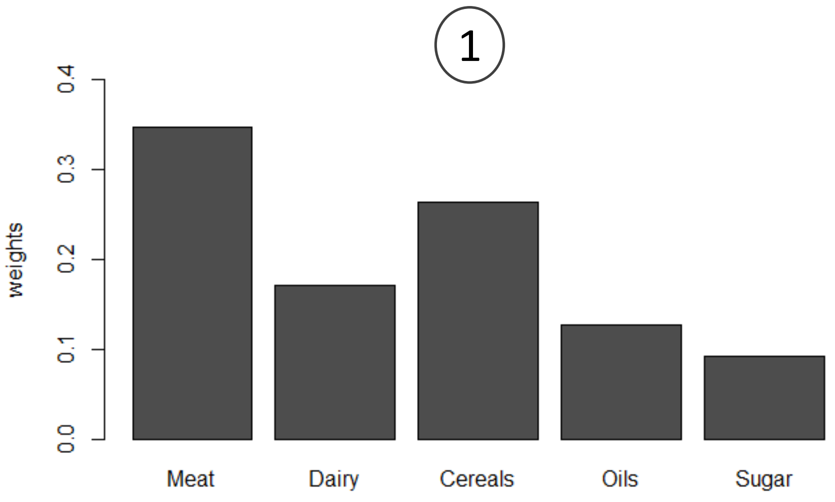


Source: Authors' calculations

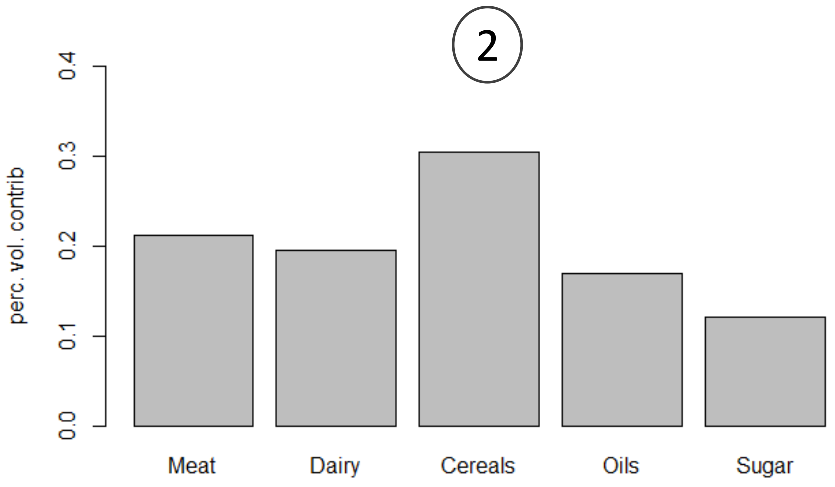
Volatility = 2.45%

5% quantile = -4.1%

95% quantile = 3.8%

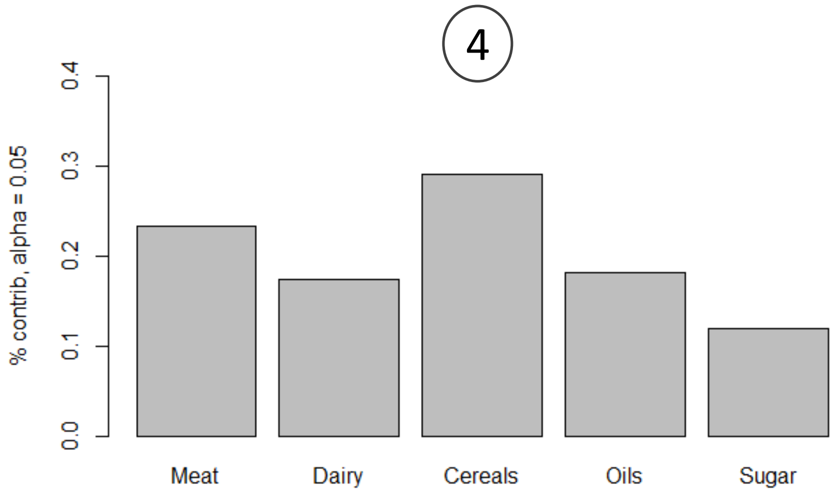


Weight allocation

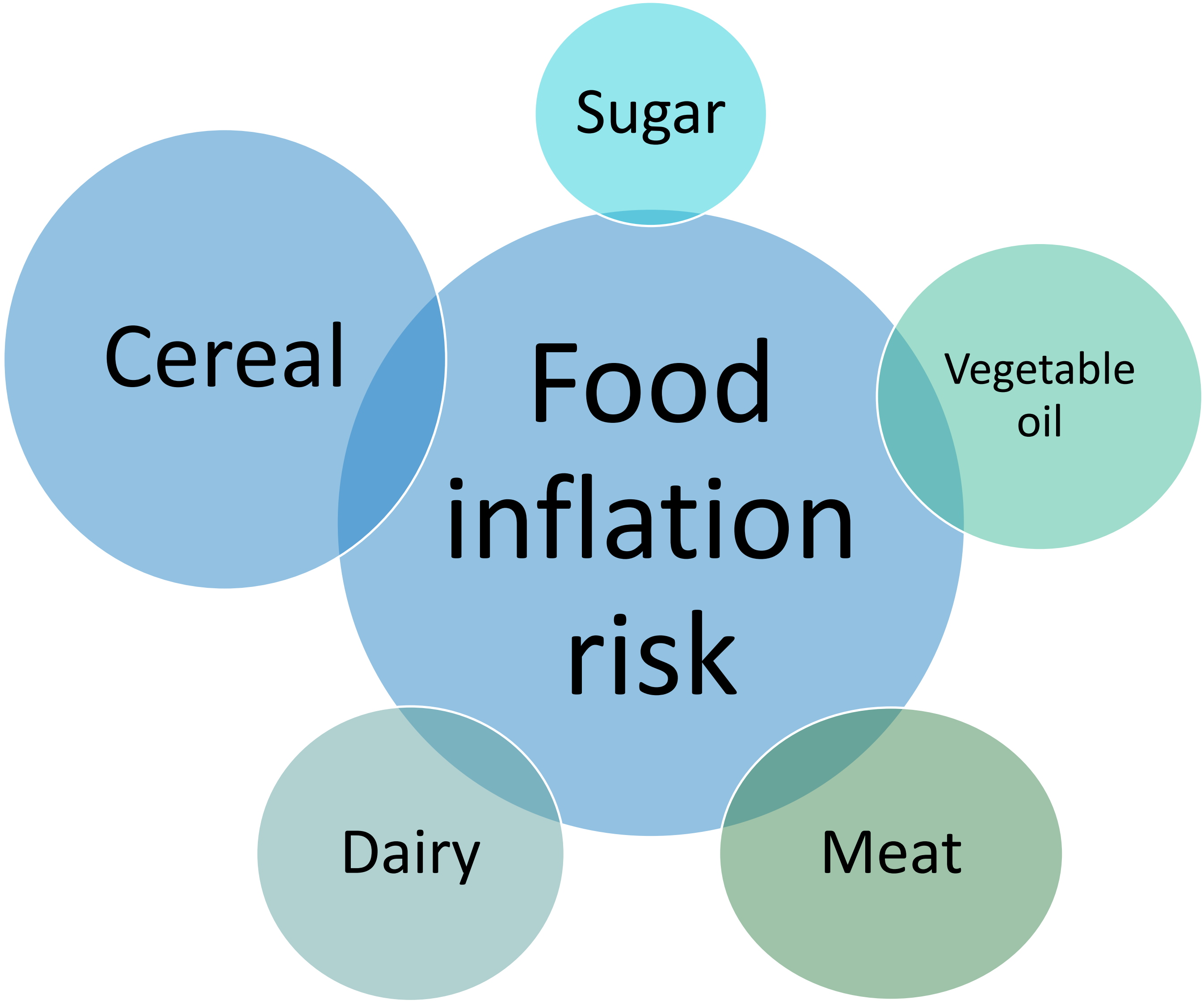


Contributions of components in unconditional food volatility

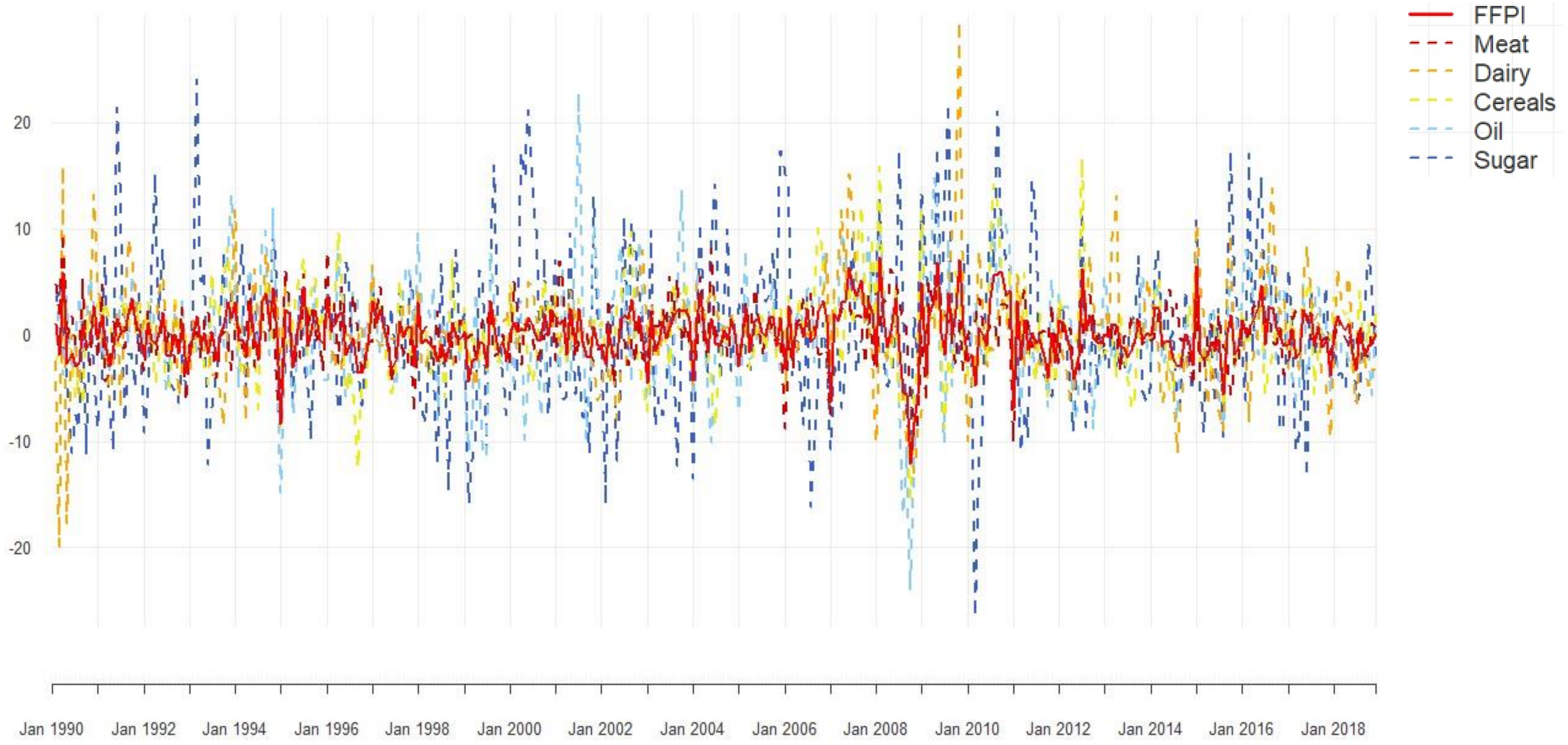
Contributions of components in unconditional 5% quantile



Contributions of components in unconditional 95% quantile


Sugar
Cereal
Food inflation risk
Vegetable oil
Dairy
Meat

Inflation rates of food and 5 components



Source: Authors' calculations

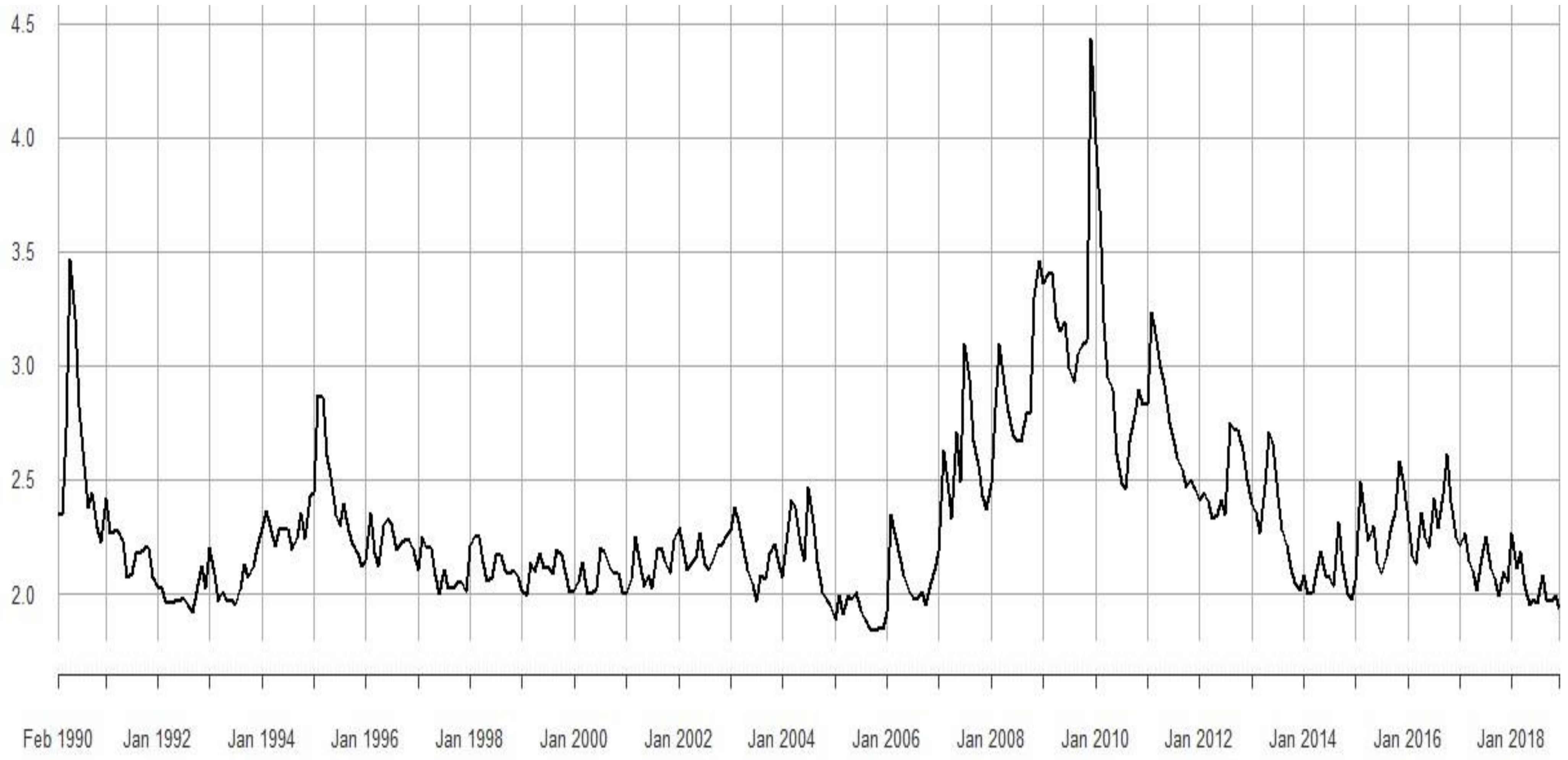
Table 1: Unconditional correlation between food inflation and component inflations

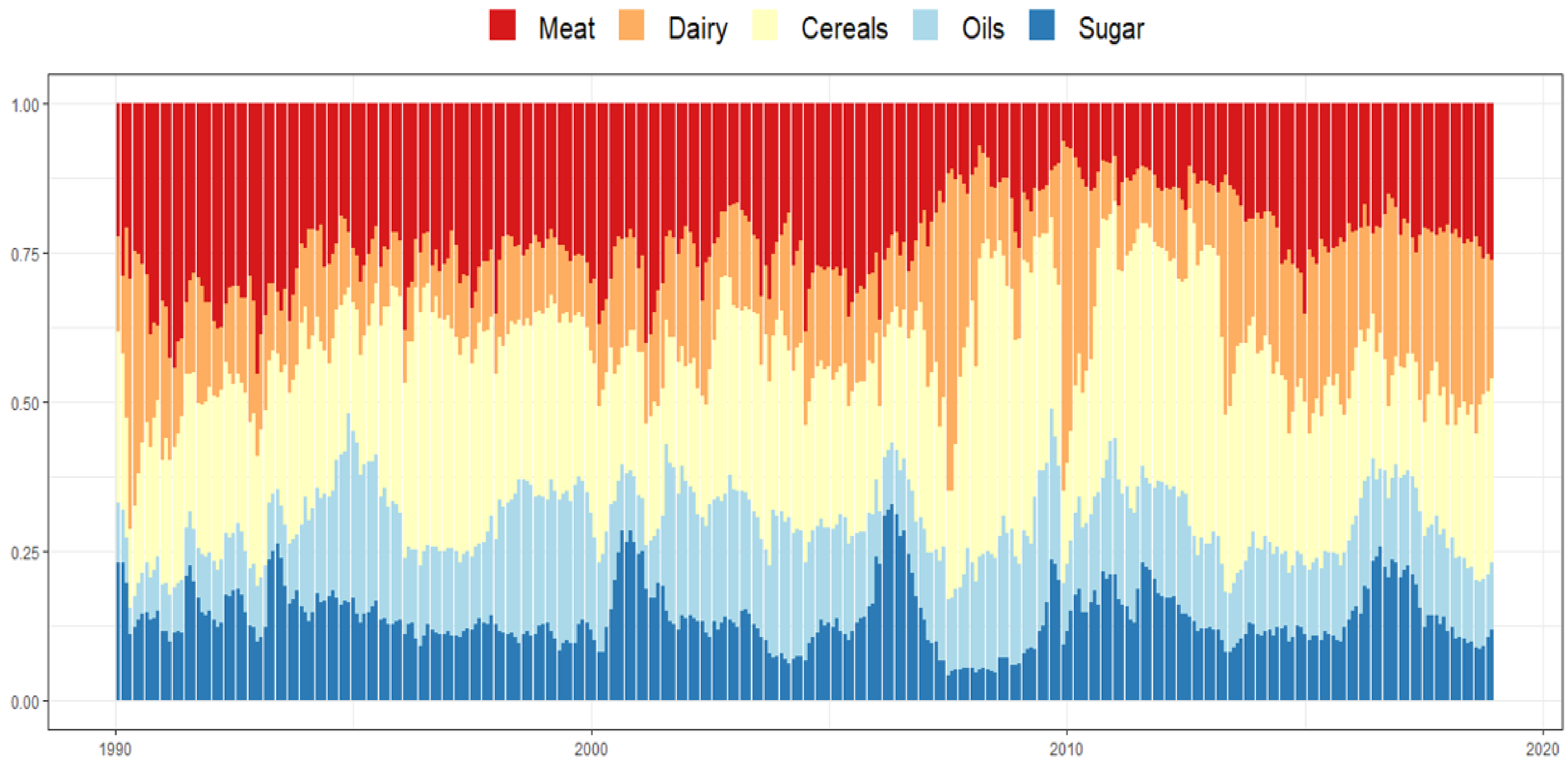
Correlation	Meat	Dairy	Cereals	Oils	Sugar
Food	0.53	0.57	0.71	0.63	0.43

Table 2: Unconditional weight shares of component inflations

	Meat	Dairy	Cereals	Oils	Sugar
	0.35	0.17	0.26	0.13	0.09

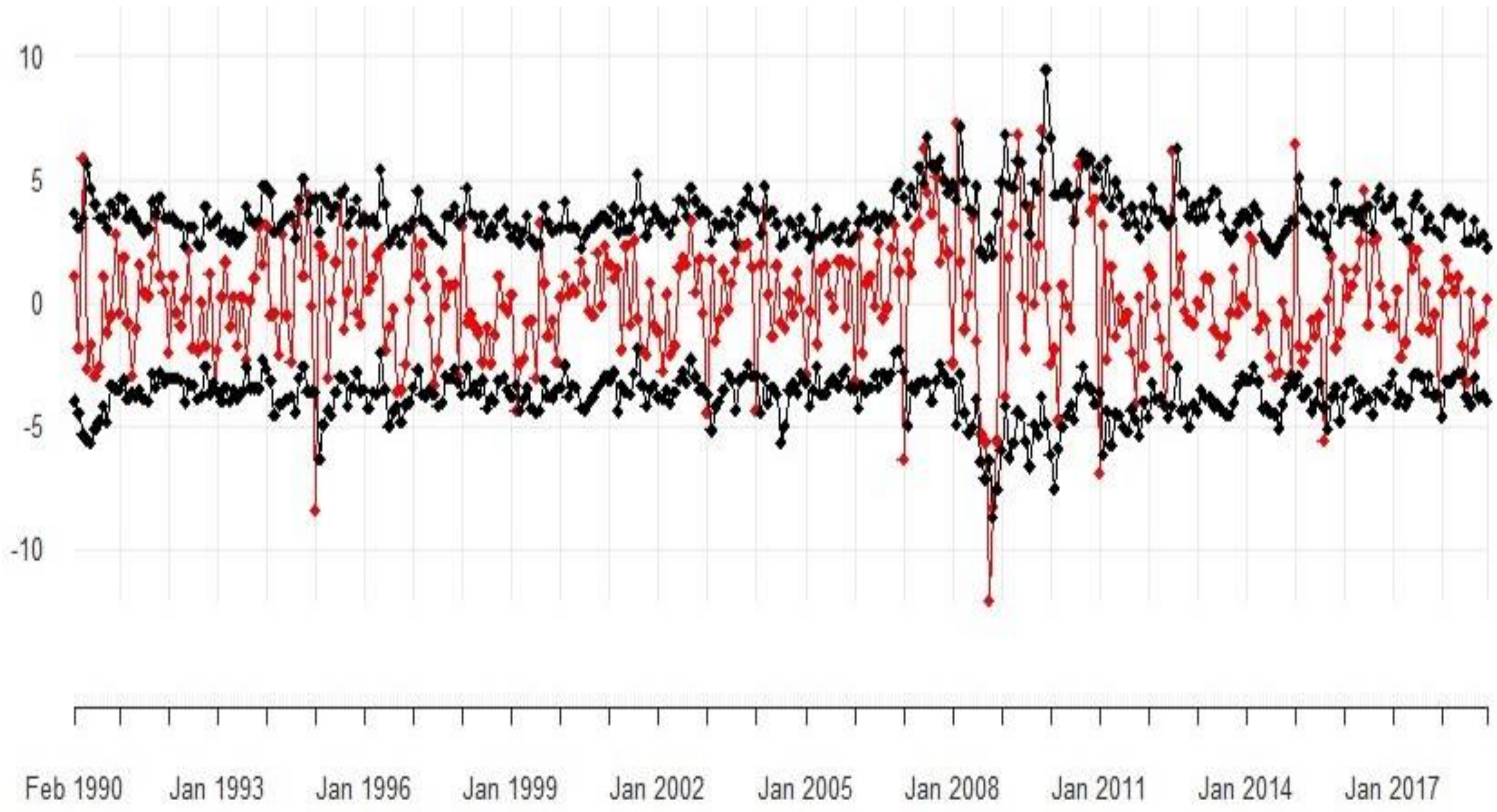
Conditional volatility of food inflation

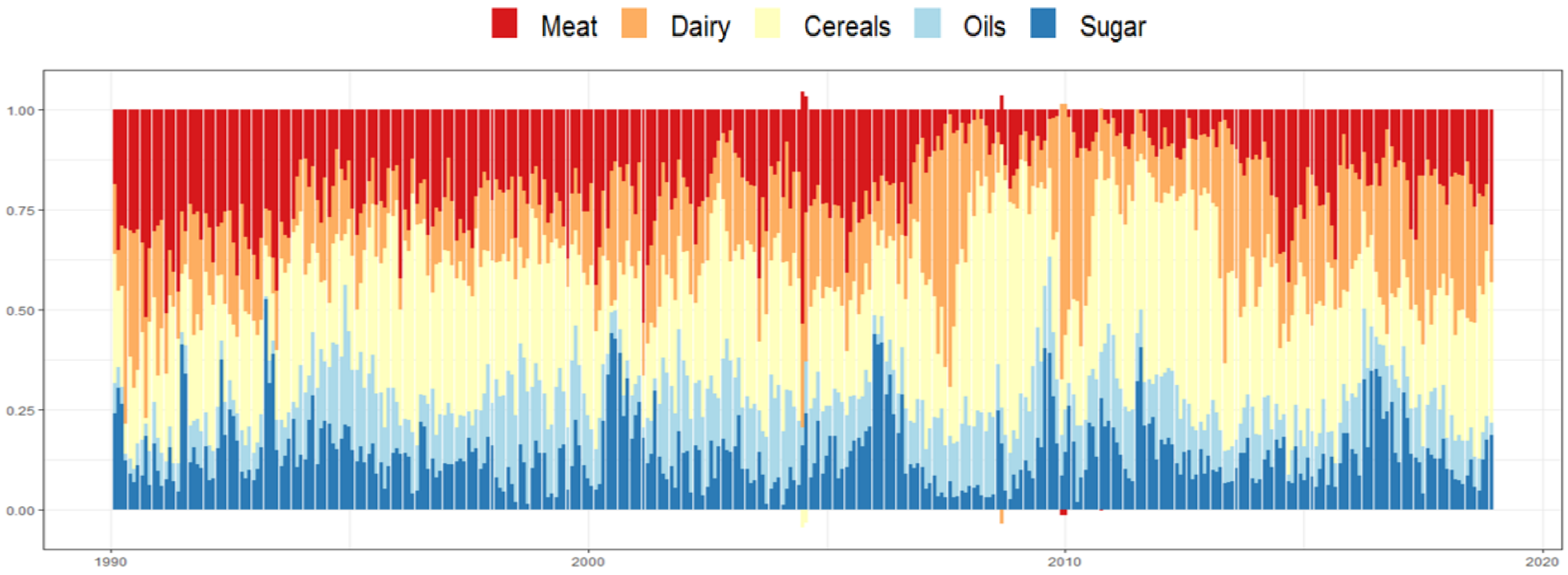




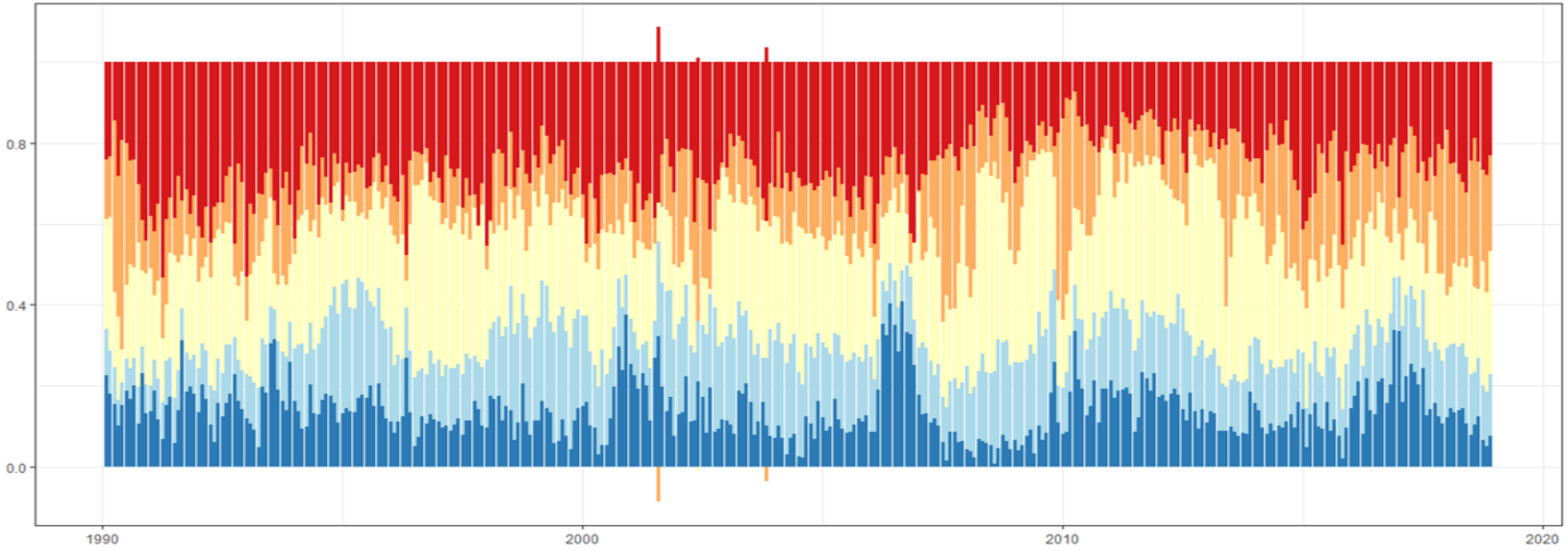
Conditional contribution of 5 components in food volatility

Food inflation and its conditional 5% and 95% quantiles



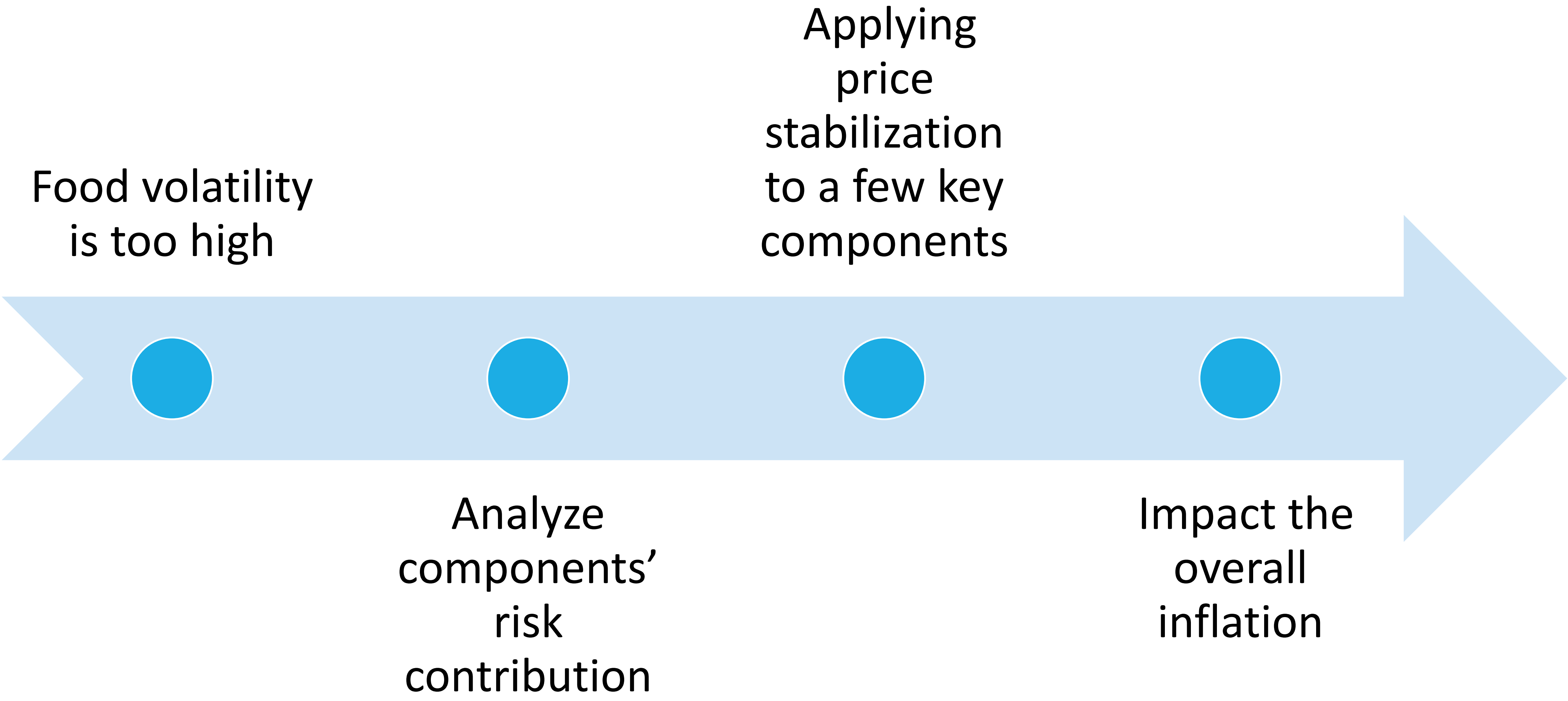


Conditional contributions of 5 components in the upside limit



Conditional contributions of 5 components in the downside limit

Implications

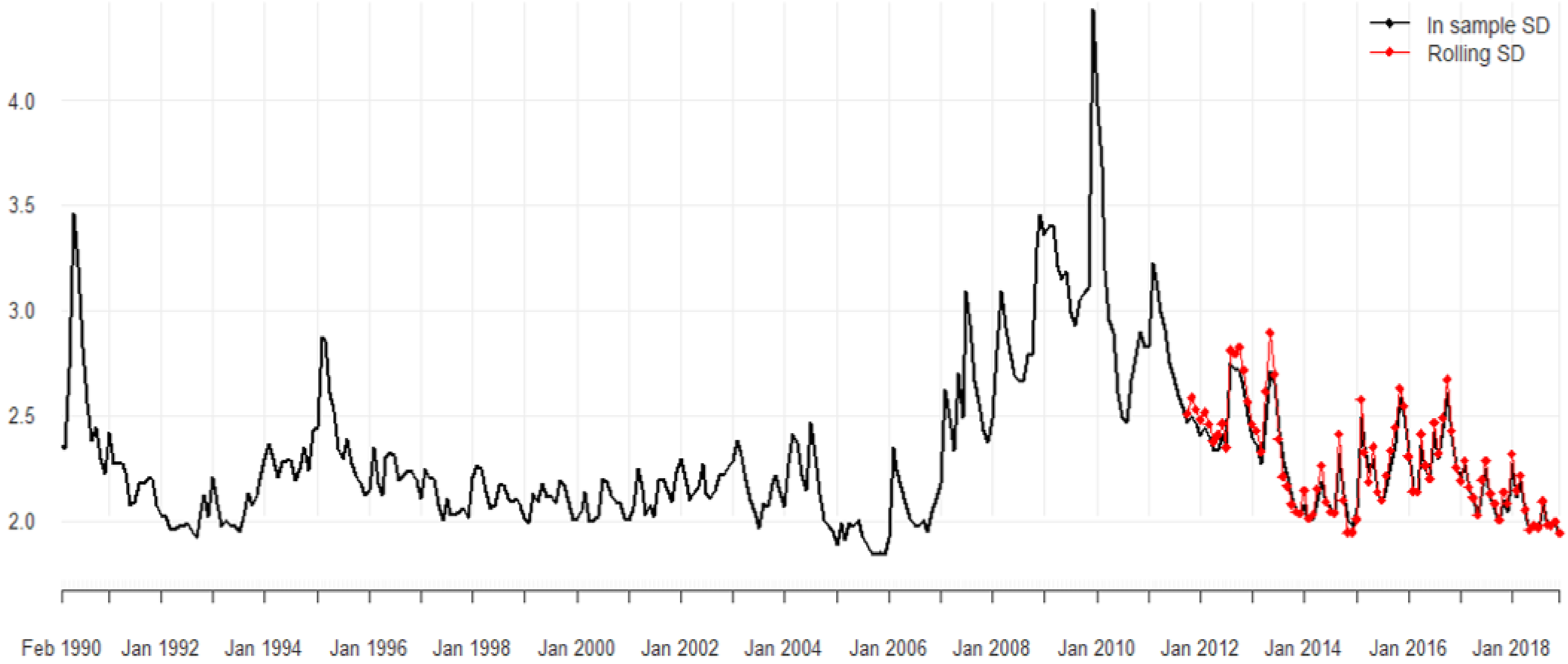


Quantile risk measures and risk decomposition

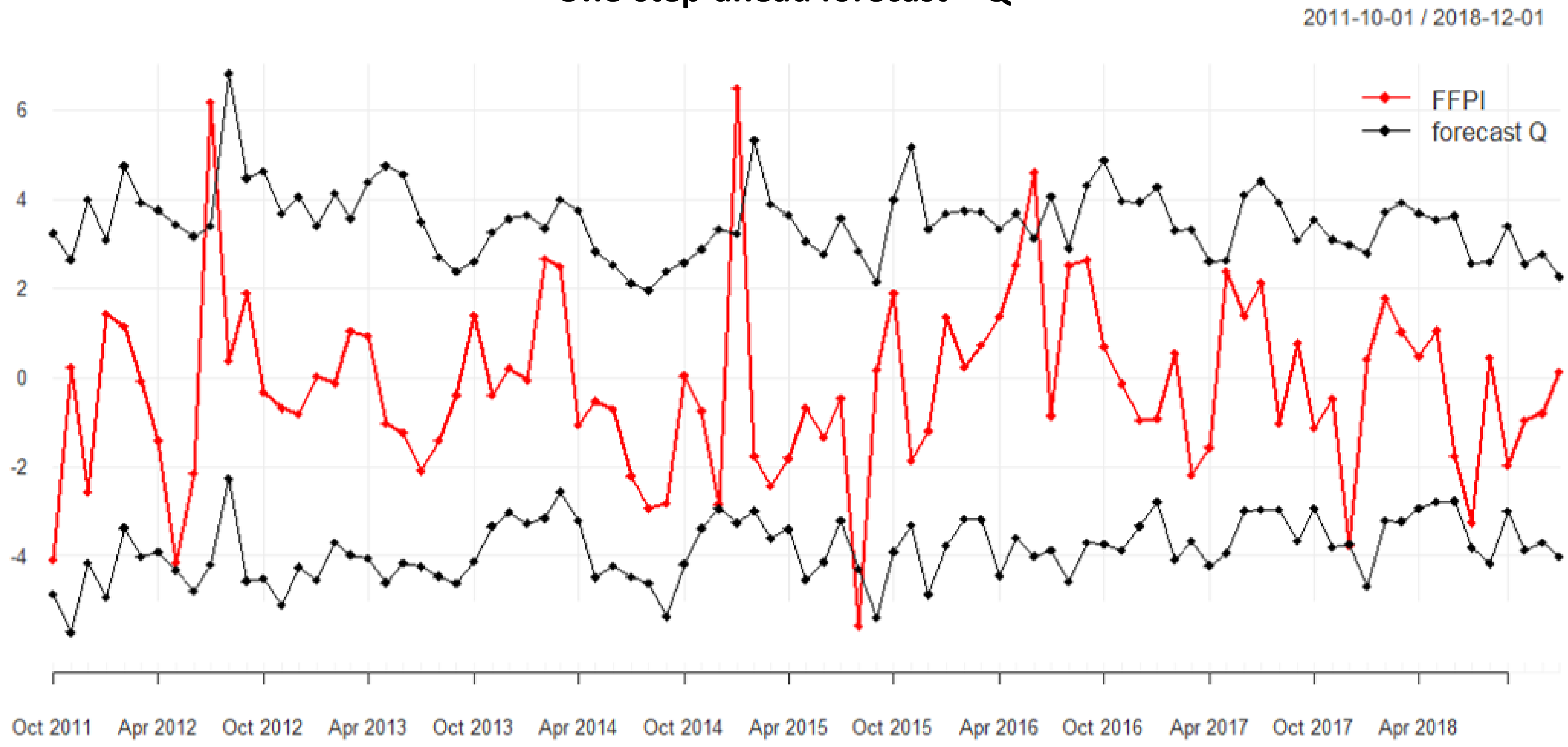
Provide information about how extreme food inflation can become, together with the main responsible factors for it

Apply hedging policies on the food components which carry high hidden risks.

One-step-ahead forecast - SD



One-step-ahead forecast – Q



How?

```
### Load packages
library(PerformanceAnalytics)
library(rugarch)
library(rmgarch)

##### Load data
inflation <- read.csv("inflation.csv")
w1 <- read.csv("w1.csv")
```

	Meat	Dairy	Cereals	Oils	Sugar
Feb 1990	4.78816285	-2.49616816	-2.31723870	-0.69228596	3.16501075
Mar 1990	1.61375197	-19.96406917	-1.79652605	2.85958173	4.85007943
Apr 1990	9.57189712	15.83894501	2.98160501	-3.73443983	-0.78121301
May 1990	-0.38597873	-17.82729805	0.17666111	3.64942529	-4.19927467
Jun 1990	1.70804998	0.00000000	-2.15538356	-3.71499861	-11.16756326
Jul 1990	-1.11180221	0.00000000	-6.07790127	-0.11517420	-7.55298867
Aug 1990	-0.95919491	-5.64480472	-3.39019190	3.63217065	-8.84333111
Sep 1990	5.30284988	3.45204624	-6.70933569	-1.36300417	1.28418391

	wMeat	wDairy	wCereals	wOils	wSugar
Feb 1990	0.3594778	0.1500138	0.2663300	0.09071275	0.13346574
Mar 1990	0.3726313	0.1446931	0.2573552	0.08911408	0.13620631
Apr 1990	0.3857196	0.1179703	0.2574541	0.09337509	0.14548089
May 1990	0.3992225	0.1290837	0.2504399	0.08490749	0.13634647
Jun 1990	0.4086067	0.1089856	0.2577746	0.09042384	0.13420934
Jul 1990	0.4227403	0.1108618	0.2565606	0.08856344	0.12127386
Aug 1990	0.4307719	0.1142381	0.2483058	0.09115557	0.11552854
Sep 1990	0.4379856	0.1106561	0.2462671	0.09697865	0.10811254

Conduct a multivariate model on component inflations

Mean = VAR(1).

Variance = DCC-sGARCH.

Skew-student distribution.

Calculate attributes

Food inflation's moments and their partial derivatives.

Estimate total risks and contributions of components

Standard deviation/ Volatility.

Alpha quantile risk measures.

+ Weight allocation of components

```r
###### Define a DCC-GARCH model to describe component inflations:

### univariate GARCH(1,1) for each series
uspec <- ugarchspec(mean.model = list(armaOrder = c(0,0)), variance.model = list(garchOrder = c(1,1),
          model = "sGARCH", variance.targeting = TRUE), distribution.model = "sstd")
### replicate the specification for 5 components:
muspec <- multispec(replicate(5,uspec))
### DCC specification
spec1 <- dccspec(uspec= muspec, VAR=TRUE,lag=1, dccOrder = c(1,1), distribution = "mvt")
### DCC-GARCH model
fit1 <- dccfit(spec1, data = inflation, fit.control = list(eval.se=T))
```

```r
####### Unconditional risk measures
### Model attributes:
w <- matrix(colMeans(w1),ncol=1)
mu <- matrix(colMeans(inflation),ncol=1)
sigma <- cov(inflation)
z <- fit1@mfit$stdresid
stdm3 <- M3.MM(z)
stdm4 <- M4.MM(z)
```

```r
###### Calculate volatility
 vol_budget <- PerformanceAnalytics:::Portsd(w=w, sigma = sigma)
 Sdfood<- vol_budget$StdDev
 Sdcomponent <- vol_budget$pct_contrib_StdDev

####### Alpha quantile risk measures:
### Lower limit and components’ contributions
out05 <- CFVaR(p=0.05, w= w, mu = mu, sigma= sigma, M3 = stdm3, M4= m4)
05food<- out05$MVaR
05component<- out05$contribution

### Upper limit and components’ contributions
out95 <- CFVaR(p=0.95, w= w, mu = mu, sigma= sigma, M3 = stdm3, M4= stdm4)
95food<- out95$MVaR
95component<- out95$contribution
```

```
### modified version of VaR in PerformanceAnalytics package
CFVaR <- function (p, w, mu, sigma, M3, M4)
{
 alpha = p
  z = qnorm(alpha)
  location = sum(w * mu)
  pm2 =  PerformanceAnalytics:::portm2(w, sigma)
  dpm2 = as.vector( PerformanceAnalytics:::derportm2(w, sigma))
  pm3 =  PerformanceAnalytics:::portm3(w, M3)
  dpm3 = as.vector( PerformanceAnalytics:::derportm3(w, M3))
  pm4 =  PerformanceAnalytics:::portm4(w, M4)
  dpm4 = as.vector( PerformanceAnalytics:::derportm4(w, M4))
  ww = sum(w^2)
  skew = pm3/(ww^(3/2))
  exkurt = (pm4/(ww^2))-3
  derskew = ((ww^(3/2))*dpm3 -3*pm3*(ww^(1/2))*w)/(ww^3)
  derexkurt = (ww*dpm4 -4*pm4*w)/(ww^3)
  h = z + (1/6) * (z^2 - 1) * skew
  h = h + (1/24) * (z^3 - 3 * z) * exkurt - (1/36) * (2 * z^3 - 5 * z) * skew^2
  MVaR = -location - h * sqrt(pm2)
  derh = (z^2 - 1) * derskew/6 + (z^3 - 3 * z) * derexkurt/24 -  (2 * z^3 - 5 *
z) * skew * derskew/18
  derMVaR = -as.vector(mu) - h * as.vector(dpm2)/(2 * sqrt(pm2)) -
sqrt(pm2) * derh
  contrib = as.vector(w) * as.vector(derMVaR)
  pct_contrib = contrib/MVaR
  names(contrib) <- names(w)
  names(pct_contrib) <- names(w)
 ret = (list(-MVaR, -contrib, pct_contrib)) #-1
 names(ret) = c("MVaR", "contribution", "pct_contrib_MVaR")
 return(ret)
}
```

Conditional risk measures

Run a *for* loop

Change to time-varying attributes

sigma <- as.matrix(as.data.frame(fit1@mfit$H[,,i]))

mu <- as.numeric(fit1@model$mu[i,])

w <- as.numeric(w1[i,])

One-step-ahead forecasts

Rolling estimation using expanding window

Reestimate the model

Make forecast of sigma, mu, and w

Function: dccforecast

References

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Thank you