Deflation in the Euro Zone: Theoretical and Empirical Analysis

(Draft version, August 2016)

22nd Annual Conference on Alternative Economic Police in Europe

"The European Union: the Threat of Disintegration"

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I. Introduction

- **The aim of this paper**
  - Is to **discuss** both **theoretical** and **empirical aspects** of **deflation** in the **Euro Zone** with **two objectives** in mind
- **Objectives**
  - The **first objective** is to clarify the **problems caused by deflation** and the **circumstances** in which it could pose important dangers to the economy
    - In doing so we will also have to **discuss** the **causes** and **consequences** – and the **definition** itself – of deflation
  - The **second objective** is to assess the magnitude of the **risk of deflation** in the Euro Zone
    - This part of the paper will begin by **reviewing** the **evolution of inflation** in the Euro Zone

I. Introduction

❑ Methodology

- ❑ To **measure** the **risk of deflation** in the Euro Zone we employ the **methodology** of **Kilian and Manganelli (2007)**
  - ❑ **Kilian and Manganelli (2007)** use **data for 1960-2002**
    - ❑ **We have collected data** for **1960-2014**
  - ❑ **Kilian and Manganelli (2007)** use the **money supply** and the **oil price** to forecast inflation
  - ❑ **We use additionally** the **output gap**, **GDP**, **unit labour costs** and the **effective exchange rate**, which are variables commonly found in studies of inflation

I. Introduction

❑ Empirical Results

- ❑ Our **preliminary results** **suggest** that
  - ❑ The **risk of deflation** in the **Euro Zone** is **related**
    - ❑ To the **international financial crisis** and
    - ❑ To the **sovereign debt crisis** in Europe
  - ❑ However, the **uncertainty** concerning the **appropriate model** for **forecasting inflation/deflation** is **large**

Deflation in the Euro Zone: Theoretical Analysis

II. Deflation in the Euro Zone: Theoretical Analysis

- **The possibility of deflation in the Euro Zone**
  - Has been presented as an **impending menace** to the **well-being of Europeans**
- **However, the basic macroeconomic models**
  - Do **not describe deflation** as something **different from inflation**
    - In fact, a model in monetary economics, due to Milton Friedman, predicts that the **optimal rate of inflation** is **actually negative**
    - Maintaining a **certain rate of deflation** is the **optimal course** of **monetary policy** according to that model
  - **However**, in ordinary **media reports**, **avoiding deflation** appears to be a **more pressing concern than avoiding inflation**
    - Typically, **reference is made** to the ongoing (since the early 1990s) **crisis in Japan**, **deflation** being a **characteristic of that crisis**

II. Deflation in the Euro Zone: Theoretical Analysis

- **In fact, many developed regions, including the Euro Zone**
  - Have been **undershooting** their **inflation target** very **close to 2%** for more than ten years
- **However, inflation in the Euro Zone**
  - Has been **declining since early 2012** and **today stands at 0.2%**
- **This low rates of inflation or disinflation**
  - **Exerts debt-deflation dynamics** (Irving Fisher) which can be dire for **all economies**
  - But are **even worse** in the **countries of the Euro Zone** with the **highest debt levels**, like **Spain**, **Ireland**, **Portugal** and **Greece**
    - In Greece in particular, the rate of inflation is now negative (-1.1%), which increases the adverse effects of the deflationary process

II. Deflation in the Euro Zone: Theoretical Analysis

- **But when prices declines become toxic**
  - Many **other Euro Zone countries** started also to **be worried** about the **prospects of experiencing deflation** in the near future

- **Thus, the Euro Zone as a whole**
  - Is facing the **prospect** of a **serious 'attack'** of **deflation** that **could lead** to an even **higher unemployed rate** and **economic stagnation**

- **Under these circumstances, we can say that**
  - The **risks of deflation** **in the** **Euro Zone** seem to be **today a reality**

Deflation: Definition

II.1. Deflation: Definition

- **The phenomenon of deflation happens**
  - When **general price levels fall** for a **prolonged period of time**, essentially because **goods and services become cheaper** due to the **lack of inflation**

- **Lower prices may sound good…**
  - However, when they come as a result of deflation rather than efficiency in production or improvements in supply,
  - They can also negatively affect the economy with the slowdown in economic growth

Deflation: Causes and Consequences

II.2. Deflation: Causes and Consequences

- **The fundamental cause of deflation**
  - Is the **weak demand** within the Euro Zone
- **Two mechanisms help to explain this situation**
  - **On one hand**, Euro Zone countries are following **fiscal austerity** measures to try and **reduce budget deficits**
    - These **spending cuts** and **tax increases** are causing a significant **drop in demand**
  - **On the other hand**, by **creating expectations** that **prices will be lower** in the future it gives **consumers incentives** to **defer purchases**

II.2. Deflation: Causes and Consequences

- **As a result,**
  - Aggregate **demand declines** putting further **pressure on prices to decrease**
- **With inflation falling,**
  - The **real interest rate is rising**
  - This consequently **depress investment**
- **This in turn**
  - **Increases** the intensity of the **deflationary process**, creating a **negative downward spiral**
  - This is one of the **most important negative effects of deflation**

II.2. Deflation: Causes and Consequences

- **In the economic literature we can still find**
  - Many **other causes** and **consequences** of **deflation**

- **Among them, we can also mention**
  - The **high rates of unemployment** in the Euro Zone that put **downward pressure on wages** **creating** an **internal devaluation**
  - The **fear of inflation in Germany** translated into a constant **reluctance** of this country to **cut interest rates** given the possibility of inflation pressures
  - The relatively **strong euro single currency**, which makes **exports** from the Euro Zone **more expensive** with **negative consequences** in terms of **competitiveness** and **current account**
  - The recent **global signs of overcapacity** in many **large manufacturing sectors**. Oil prices, e.g., continue to fall

II.2. Deflation: Causes and Consequences

- **Under these circumstances**
  - The **European Central Bank** (ECB) started **buying sovereign bonds** on an industrial scale, **pushing cash into the markets**, pursuing the **strategy known** as **Quantitative Easing (QE)**
- **In theory, Quantitative Easing**
  - **Increases** the **supply of money** in the economy, **increasing spending** and potentially **inflating prices**
- **However,**
  - The **US** went through **three big programmes of QE without inflation** rising above 3%

II.2. Deflation: Causes and Consequences

- **Thus, if the QE programmes are unable to restore confidence**
  - The **phenomenon of deflation** in the Euro Zone could have **negative consequences** not only for the **19 Member-countries**,
  - **But also** for the already-strained **global economy**
- **For all these reasons**
  - It is **important to analyse** not only the **causes and consequences** of this phenomenon, but also
  - To **understand how** it **can be predicted and/or avoided**

Deflation in the Euro Zone: Empirical Analysis

III. Deflation in the Euro Zone: Empirical Analysis

- **Our empirical approach to the measurement of deflation risk in the Euro Zone**
  - **Follows Kilian and Manganelli (2007) model**
  - **Kilian and Manganelli (2007) use a GARCH (1,1) model for the conditional variance of inflation shocks**

- **The general model can thus be written as:**

$$\pi_t = \mu_t + u_t \qquad (1)$$

$$u_t = \varepsilon_t \sqrt{h_t}, \quad \varepsilon_t | I_t \sim N(0,1) \qquad (2)$$

$$h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1} \qquad (3)$$

Where $\boldsymbol{I_t}$ is the **information set** (containing the series μ up to time *t* and the lags of u and ε), $\boldsymbol{\pi_t}$ is **inflation**, $\boldsymbol{\mu_t}$ is the **conditional mean of inflation** and $\boldsymbol{u_t}$ is the **inflation shock**, which is written as the product of its **conditional variance**, given by $\boldsymbol{h_t}$, and a **Gaussian innovation**, $\boldsymbol{\varepsilon_t}$

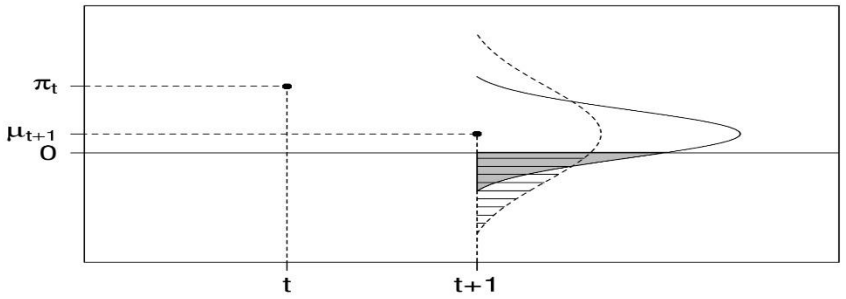
III. Deflation in the Euro Zone: Empirical Analysis

- **The conditional mean of inflation**
  - Is **determined** by a **forecast model**

- **Kilian and Manganelli (2007) consider three alternative specifications of this forecast model for inflation**
  - The **first forecast model** **uses** only **inflation lags**
  - The **second forecast model** **includes lagged percent changes** of the **oil price** besides inflation lags
  - The **third forecast model** **replaces** the **oil price changes** **with** **money supply growth rates**
    - As we mentioned before, **besides** the **oil price** and the **money supply**, **we will also consider** **nominal unit labour costs**, **real GDP**, the **output gap** and the **nominal effective exchange rate**
    - The **combination** of **lagged inflation** and **six other variables** gives a **total** **of** **22 alternative formulations** of the forecast model

III. Deflation in the Euro Zone: Empirical Analysis

- **The basic idea underlying this framework is illustrated in the following Figure**



- **In this Figure it is assume that**
  - At **time *t+1***, the **conditional mean of inflation** is still **positive** ($\mu_{t+1} > 0$)
  - However, **inflation at time *t+1*** will **equal its conditional mean plus a shock** (u_{t+1})
  - The **shock may be such** that **inflation at time *t+1* is actually negative** (i.e., there is **deflation**)

III. Deflation in the Euro Zone: Empirical Analysis

- **Under these circumstances, for deflation to occur**
  - The **shock** will have **to be sufficiently negative**
  - The **threshold** being the **symmetric** of the **conditional mean of inflation** $(-\mu_{t+1})$

- **The focus of our empirical analysis is therefore on**
  - The **computation** of the **probability** that the **shock to inflation** is

$$u_{t+1} < -\mu_{t+1} \qquad (4)$$

Which is equivalent to

$$\varepsilon_{t+1} < -\frac{\mu_{t+1}}{\sqrt{h_{t+1}}} \qquad (5)$$

  - Thus, the previous **Figure shows** an **example** where the **increase of the conditional variance of the inflation shock implies** a **larger deflation probability**

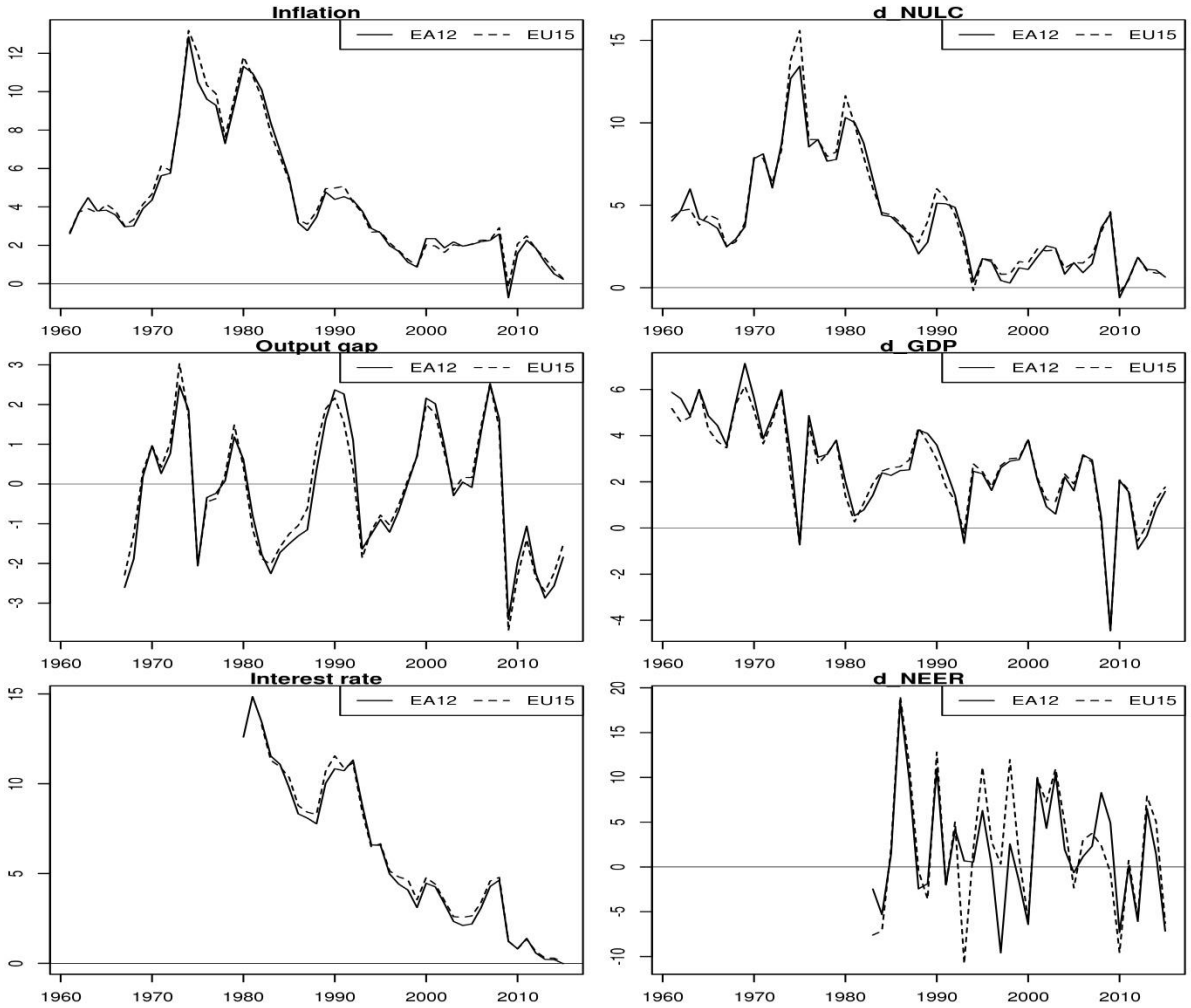
III. Deflation in the Euro Zone: Empirical Analysis

❑ Concerning Data

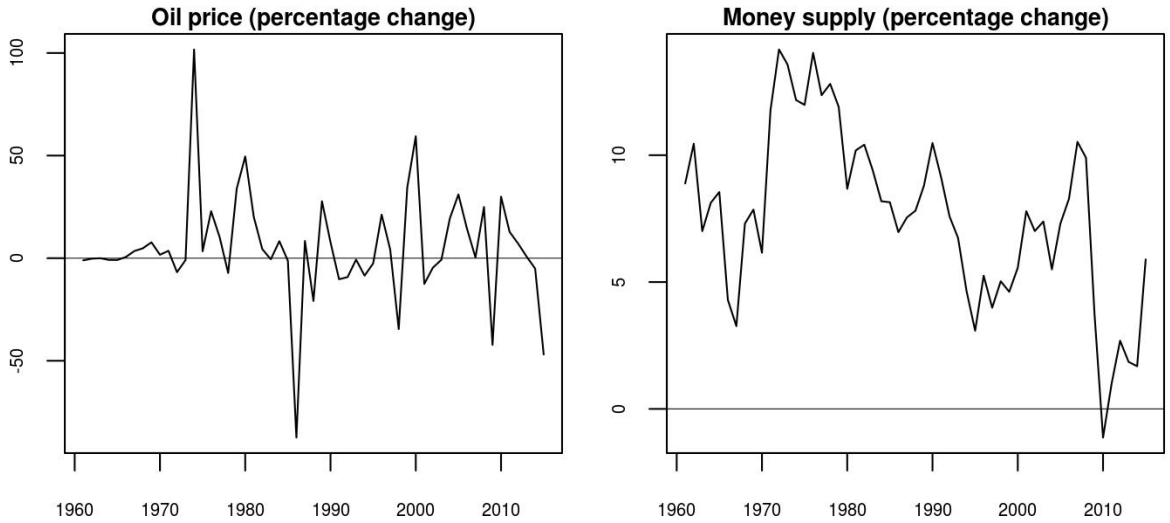
- ❑ We use data from **AMECO** for the **Euro Area** (**12 countries** - **EA12**) and for the **European Union** (**15 countries** - EU15)
- ❑ **We constructed** an **oil price series** with series provided by Federal Reserve Bank of St. Louis for the West Texas Intermediate oil price
- ❑ For the **money supply**, **we used** **Germany's M1 aggregate** (from the IMF's International Financial Statistics) and the **OECD's broad money** (M3) indicator for the Euro Area (19 countries)
- ❑ Most of the series span the **period 1960-2015**
  - ❑ The exceptions are the output gap (which begins in 1967), the nominal effective exchange rate (which begins in 1982) and the interest rate (which begins in 1980 for EA12 and in 1982 for EU15)
- ❑ The **growth rates** (including inflation) were **computed** as the **first difference of the logarithm of the levels**
- ❑ All **computations** were performed using **GRETL**

III. Deflation in the Euro Zone: Empirical Analysis

- **The following Figures shows the behaviour of the series**



III. Deflation in the Euro Zone: Empirical Analysis



- **The time series plots reveal**
  - **That deflation has only been recorded in our sample in 2009, the year in which the international financial crisis was at its height,** as the behaviour of GDP in that year confirms

Results

IV. Results

- **The following Table present an example of the results obtained from estimating those models**

Statistics from the estimated models using the sample 1969-2015 for EA12

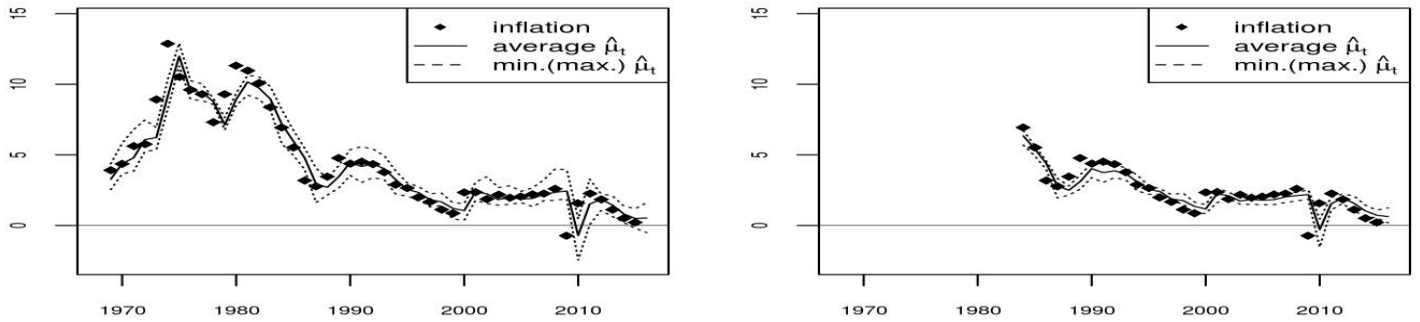
Model	BIC	Lags	RMSE	BG	QLR	ARCH	DH	$\hat{\mu}_{2016}$	$P_N(\pi_{2016} < 0)$	$P_E(\pi_{2016} < 0)$
1	167.7	1	1.328	1.63	25.3***	6.55**	16.7***	0.33	37	32
2	167.4	1	1.270	1.27	19.5***	2.34	20.2***	0.50	31	20
3	170.4	1	1.311	5.66**	26.7***	4.65**	6.2**	0.80	25	30
4	168.9	2	1.189	1.20	23.5***	5.97**	12.4***	0.78	24	24
5	164.3	1	1.228	0.01	16.3**	8.12***	15.6***	0.19	41	40
6	169.5	1	1.298	0.45	25.9***	7.79***	25.1***	-0.03	51	47
9	166.4	1	1.206	0.11	21.8***	8.63***	16.2***	0.22	40	33
10	165.8	1	1.199	1.29	20.3***	6.68***	12.2***	0.48	29	25
11	161.7	1	1.148	0.20	14.0	8.54***	7.2**	0.42	31	27
12	168.1	1	1.228	0.00	19.9**	8.26***	14.4***	0.23	39	37
15	170.8	1	1.263	3.70*	21.4***	1.67	9.5***	0.95	12	9
16	170.1	1	1.255	1.36	19.0**	1.25	23.2***	0.75	25	13
17	171.1	1	1.268	1.65	30.3***	3.32*	3.8	0.55	26	31
20	171.1	2	1.121	1.09	21.3*	3.89**	3.8	1.61	7	9
21	170.7	1	1.263	2.45	38.3***	5.16**	18.8***	0.40	35	36
24	169.0	2	1.097	0.77	21.3*	6.21**	7.9**	0.95	17	12

Notes: BIC: Bayesian Information Criterion. Lags: the number of lags chosen for each model by BIC. RMSE: square root of the mean of the squared residuals. BG: Breusch-Godfrey test statistic (null hypothesis: no autocorrelation of order one). QLR: Quand likelihood ratio test statistic (null hypothesis: no structural break). ARCH: LM-ARCH test statistic (null hypothesis: no ARCH effect of order one). DH: Doornik-Hansen normality test statistic (null hypothesis: normal distribution). $\hat{\mu}_{2016}$: the **estimated conditional mean of inflation in 2016**. $P_N(\pi_{2016} < 0)$: the **estimated probability of deflation in 2016 using the normal distribution in the computation**. $P_E(\pi_{2016} < 0)$: the **estimated probability of deflation in 2016 using an estimated density in the computation**. ***: significant at the 1% significance level. **: significant at the 5% significance level. *: significant at the 10% significance level.

IV. Results

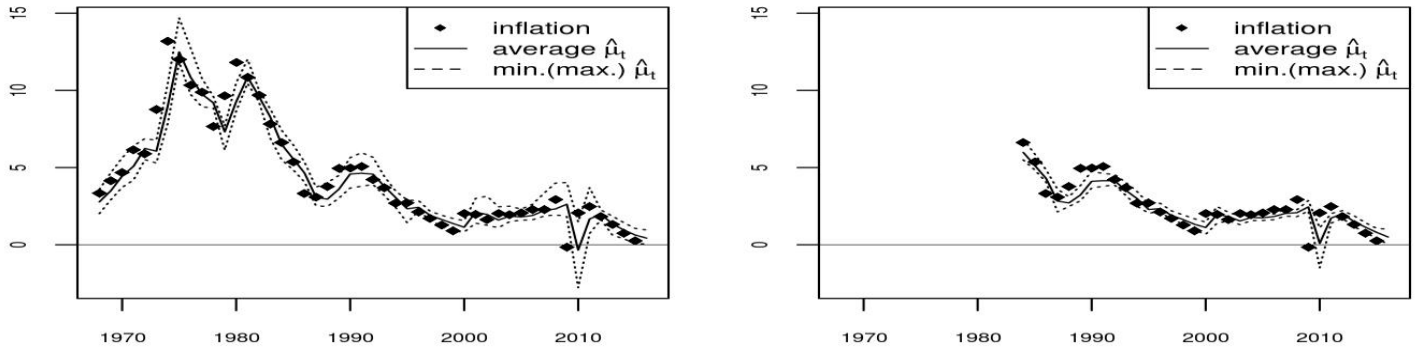
❑ The following Figure shows

Maximum, **minimum** and **average estimated conditional mean of inflation** in **EA12** using (when available) the sample 1969-2015 (left) or just 1984-2015 (right)



❑ In turn, this Figure shows

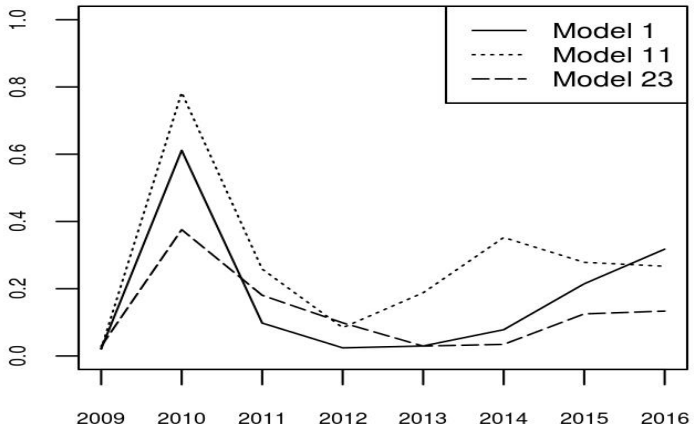
Maximum, **minimum** and **average estimated conditional mean of inflation** in **EU15** using (when available) the sample 1968-2015 (left) or just 1984-2015 (right)

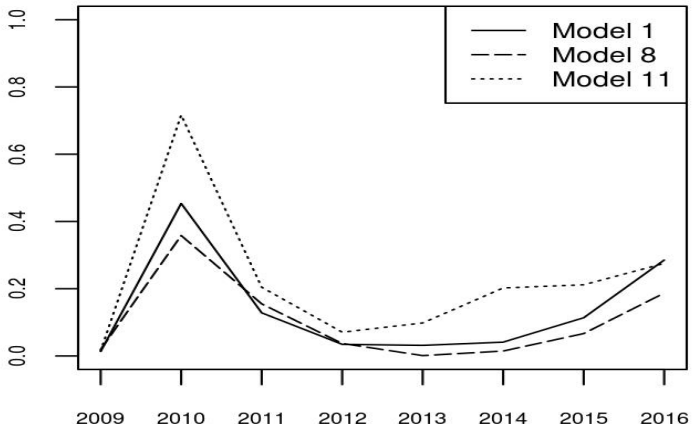


IV. Results

- **Finally, the following Figure shows**

  Probability of deflation in **EA12** (left) and **EU15** (right)





- **As can be seen, our results reveal that**
  - **Models** (specially models 1, 8, 11 and 23) **produce forecasts for inflation** in **2016 between 0.33% and 0.62% for EA12** and **between 0.25% and 0.7%** in **for EU15**
    - The **mean forecast** is **0.51%** for **EA12** and **0.44%** for **EU15**

IV. Results

- **Our results also suggest that**
  - The **dispersion of the forecasts** is **larger** **concerning** the **probability** that **inflation** **will be** **negative in 2016**
    - For **EA12**, the **probability** varies **between 10% and 32%** (using the estimated density)
    - For **EU15**, the range is very similar, going **from 10% to 29%** (again using the estimated density)
  - Thus, our models put the **probability of deflation** **occurring in Europe in 2016** at **about 20%**
    - However, the **estimates obtained** on the **larger sample** lead to **bigger probabilities** – **around 30%**

IV. Results

- **But how do the deflation probabilities produced by our models look like?**
  - **Until 2009**, they were **always very low**, **rarely exceeding 10%**
  - **After 2009**, they became **much larger** (recall the last Figure)
  - However, in our sample, **2009** is the **only year in which there was deflation**
  - The **models failed** to **anticipate deflation** in **2009**, but then **produced high** (above 60%) **deflation probabilities** for **2010**, a year in which the inflation returned to the normal 1.5%-2% range
  - Nevertheless, **inflation probabilities** have been **increasing** in **recent years** (a period of declining inflation), **approaching or surpassing 20%**

Conclusion

V. Conclusion

- **In conclusion, we can say that**
  - The **time series plots reveal** that **deflation** has **only once been recorded in 2009**, the year in which the international financial crisis was at its height
  - In turn, our **models produce forecasts** for **inflation in 2016**
    - **Between 0.33% and 0.62% for EA12** and
    - **Between 0.25% and 0.7% for EU15**
  - The models also put the **probability of deflation occurring in Europe** in 2016 **between 20% and 30%**
  - Nevertheless, **inflation probabilities** have been **increasing in recent years**, **approaching 20%**

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