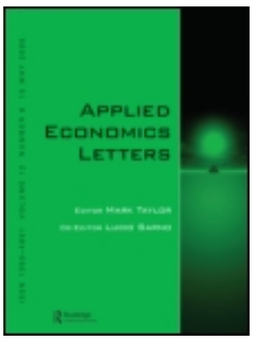

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Revisiting Svensson's test of inflation target credibility

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I revisit Svensson's (1993) test of inflation target credibility by applying it to the European Central Bank (ECB)'s credibility regarding the maintenance of price stability. By selecting seven European bond pairs, each consisting of an inflation-linked and nominal bond, I show that Svensson's test is applicable during relatively calm times but does not work properly during the recent financial and sovereign debt crisis. Risk premia and flight-to-liquidity effects bias yields of both bond types and hamper a meaningful analysis during this time. However, in line with existing literature, the ECB's credibility can be confirmed during calm financial times.

Keywords: inflation indexed; inflation stabilization; monetary policy; central banking; EMU

JEL Classification: E52; E58; E31; E63; F33

I. Introduction

This article revisits Svensson's (1993) test of inflation target credibility and applies it to the European Central Bank (ECB)'s credibility regarding the maintenance of price stability. While inflation targeting was very popular in the 1990s as developed as well as developing countries committed to low and stable inflation rates, it is still an important factor in the overall goal of several central banks worldwide.[1] More specifically, both the Federal Reserve (Fed) in the United States and the ECB propagate for price stability. The Fed's monetary objectives, however, focus on maximum employment, stable prices and moderate long-term interest rates (12 USC § 225a), while the ECB's duty is solely to maintain price stability with an inflation rate close to 2% (ECB, 2004).

The sovereign debt crisis in the euro area necessitated extensive policy initiatives by the European Union as well as by the ECB, leading to a substantial increase of the latter's total assets. The ECB's deep involvement in rescue measures might lead to growing concerns regarding the central bank's goal of maintaining price stability with an inflation rate of 2%. Whether these concerns rise or not is a question of the ECB's credibility, which therefore represents an interesting and relevant research area. This article revisits and applies Svensson's 'simplest test of inflation target credibility' to the ECB before and during sovereign debt crisis by comparing yields of nominal

[1] See Bernanke and Mishkin (1997) for an introduction to inflation targeting and Svensson (2010) for an overview of inflation targeting economies.

government bonds with those of their inflation-linked counterparts. While Taylor (2010) cautions the ECB against losing credibility due to the enormous rescue initiatives in the sovereign debt crisis, related research mainly focuses on the ECB's independency (Weber and Forschner, 2014), on citizens' trust in the ECB (Gros and Roth, 2010; Wälti, 2012) and on changes in investors' inflation expectations due to the crisis (Galati *et al.*, 2011; Van Der Cruijsen and Demertzis, 2011). Similar to this article, Galati *et al.* (2011) use, among other measures, inflation-linked bond yields to analyse inflation expectations in the United States, the United Kingdom and the euro area. Financial markets' inflation measures (i.e. inflation-linked bond yields and inflation swap rates) show structural breaks during the crisis for all regions, but differences between survey-based and market measures suggest 'difficulties in measuring expectations accurately' (Galati *et al.*, 2011, p. 201). Svensson's test also investigates changes in investors' inflation expectations and thereby draws conclusions regarding the central bank's credibility (see Section II). Since Svensson's test, however, only relies on market measures, heterogeneities in expectation formation, as in Galati et *al.* (2011), are negligible.

This article contributes to current research by revisiting Svensson's test as a method to analyse central banks' credibility with regard to inflation targeting and by adding new insights about investors' inflation expectations before and during the sovereign debt crisis. In line with existing literature, Svensson's test suggests a high credibility regarding the maintenance of price stability within the euro area before the bankruptcy of Lehmann Brothers in September 2008. During the crisis, however, and even in the absence of heterogeneities in expectation formation, the test is not able to disentangle market disturbances from changes in inflation expectations.

The remainder of the article is structured as follows: Section II describes Svensson's original test, its modifications and the underlying data. Section III discusses the results and concludes the article.

II. Method and Data

Svensson's test and potential modifications

One variant of Svensson's test for inflation target credibility uses the yields of inflation-linked bonds and therefore requires a well-working market for them. Given the availability and functioning of a sovereign inflation-linked bond market in a specific country (or monetary union), the test's main idea is based on the Fisher equation (Fisher, 1930)[2]: Nominal bond yields consist of the real interest rate plus the expected inflation, target-consistent real yields can thus be computed by subtracting the target inflation from nominal bond yields. More specifically, if a central bank announces a certain range of target inflation (i.e., a target minimum and maximum inflation rate), target-consistent minimum and maximum real yields are obtained by subtracting the given range from nominal bond yields as follows:

$$r_{tc\ min} = i_{nom} - \pi_{target\ min} \tag{1}$$

$$r_{tc\ max} = i_{nom} - \pi_{target\ max} \tag{2}$$

The original version of Svensson's test then checks whether yields from inflation-linked bonds fall between the specific target-consistent minimum and maximum real yields or not. If the yields from inflation-linked bonds lie inside the range, central bank's credibility can be accepted.[3]

Since the ECB does not announce a certain range of target inflation but rather the maintenance of price stability with an inflation rate close to 2%, target-consistent minimum and maximum real yields cannot be calculated, and a modification is essential: I calculate target-consistent real yields by subtracting 2% (i.e. the ECB's desired inflation rate) from nominal bond yields and compare them with yields from inflation-linked bonds as follows:

$$r_{tc} = i_{nom} - \pi_{target} \tag{3}$$

If target-consistent real yields considerably differ from inflation-linked bond yields, central bank's credibility should be rejected. A visual analysis

[2] The exact formula for the Fisher equation is $i = r + \pi^e + (r \times \pi^e)$, where i is the nominal interest rate, r the real interest rate and π^e the expected inflation. For very low values, however, the last term becomes extremely small and can be ignored. The Fisher equation is thus generally reduced to $i = r + \pi^e$ (see, e.g., Mishkin, 2001).

[3] Note that Svensson differentiates between credibility in expectations and absolute credibility. See Svensson (1993) for further information.

serves to give an initial insight as to whether both yield series move closely or not. By comparing both time series, the development of central bank's credibility can be examined over time. Note, however, that a rejection of the hypothesis of central bank credibility due to different trends in yields series does not necessarily imply a change in credibility since other factors, such as potential risk premia (e.g., liquidity premium), might distort one yield series but not the other. This concern will be addressed explicitly in Section III.

Following the visual analysis, I use an econometric analysis to check whether yields from inflation-linked bonds and target-consistent real yields differ over time. The test for multiple breakpoints proposed by Bai and Perron (2003), which is an extension of the Quandt–Andrew's framework, is applied. Based on a simple ordinary least squares regression model, this procedure derives all significant breakpoints within a specific time series.[4] Given no other factors biasing the yield series, one (or more) detected breakpoint(s) lead to a rejection of central bank's credibility. On the other hand, credibility can only be accepted if no breakpoint is detected, and the visual analysis additionally confirms a close movement of the yield series. Before discussing the results of the visual and econometric analysis, the underlying data are described.

Data

For testing the hypothesis of ECB's credibility to maintain price stability with an inflation rate of 2%, sovereign bond yields are extracted for countries that (i) are member of the EMU, (ii) have issued nominal and inflation-linked bonds and (iii) are not directly affected by the sovereign debt crisis. Given these constraints, only German and French government bonds can be used for the analysis below. The procedure to find appropriate bonds for applying Svensson's test reads as follows: First, a basket of inflation-linked bonds issued by Germany and France is selected. Second, nominal counterparts with a similar maturity date and maturity are looked for. Each couple of bonds represents an object of investigation for Svensson's test. Table 1 summarizes all selected bond pairs. Note that in Germany, inflation-linked bonds are always linked to the European inflation index (i.e. EU HCPI ex tobacco) but in France, inflation-linked bonds can be linked to either the national (i.e. France CPI ex tobacco) or to the European inflation index.

Table 1. Overview of selected bond pairs

Name	ISIN	Type	Index	Coupon (in %)	Issue volume (in bn €)	Maturity date	Issue date
DE_2016	DE0001135291	Nominal	–	3.50	23.0	4 January 2016	19 May 2006
	DE0001030500	Inflation-linked	EU	1.50	15.0	15 April 2016	15 March 2006
DE_2020	DE0001135390	Nominal	–	3.25	15.0	4 July 2020	13 November 2009
	DE0001030526	Inflation-linked	EU	1.75	22.0	15 April 2020	12 June 2009
FR_2015	FR0010163543	Nominal	–	3.50	24.9	25 April 2015	8 February 2005
	FR0010135525	Inflation-linked	EU	1.60	13.5	25 July 2015	23 November 2004
FR_2017	FR0010415331	Nominal	–	3.75	35.0	25 April 2017	9 January 2007
	FR0010235176	Inflation-linked	FR	1.00	20.2	25 July 2017	20 September 2005
FR_2023	FR0010466938	Nominal	–	4.25	33.2	25 October 2023	9 May 2007
	FR0010585901	Inflation-linked	FR	2.10	11.2	25 July 2023	20 February 2008
FR_2029	FR0000571218	Nominal	–	5.50	27.2	25 April 2029	12 March 1998
	FR0000186413	Inflation-linked	FR	3.40	7.7	25 July 2029	1 October 1999
FR_2040	FR0010371401	Nominal	–	4.00	23.9	25 October 2038	12 September 2006
	FR0010447367	Inflation-linked	EU	1.80	9.1	25 July 2040	14 March 2007

Note: Table 1 presents the selected bond pairs consisting of a nominal and inflation-linked bond each.
Source: French debt agency (Agence France Trésor) and German debt agency (Finanzagentur GmbH).

[4] The test is conducted by regressing the difference between yields from inflation-linked bonds and target-consistent real yields on the intercept: $\left(r_{tc} - i_{inflation-linked}\right) = \alpha + \varepsilon$. See Bai and Perron (1998, 2003) for further information about multiple breakpoint tests.

III. Results and Discussion

The visual analysis allows for a comparison of yields from inflation-linked bonds and target-consistent real yields (see Fig. 1). While all pairs exhibit a rather close co-movement over time, there are certain deviations which will be discussed in the following. A common observation for all bond pairs is that deviations start to increase in the years 2007 and 2008 and target-consistent real yields decrease to a larger extent than their inflation-linked counterparts since 2012. Additionally, the null hypothesis of stability in the difference between both yield series is rejected for all bond pairs since the Bai–Perron test detects at least two significant breakpoints for all bond pairs (see Table 2). Strikingly, breakpoints are detected in autumn 2008 as well as in summer 2011 for nearly all bond pairs. To conclude, both the visual and statistical analysis suggest breaks in the relation between both yield series indicated by time-varying deviations. Whether this indicates a loss

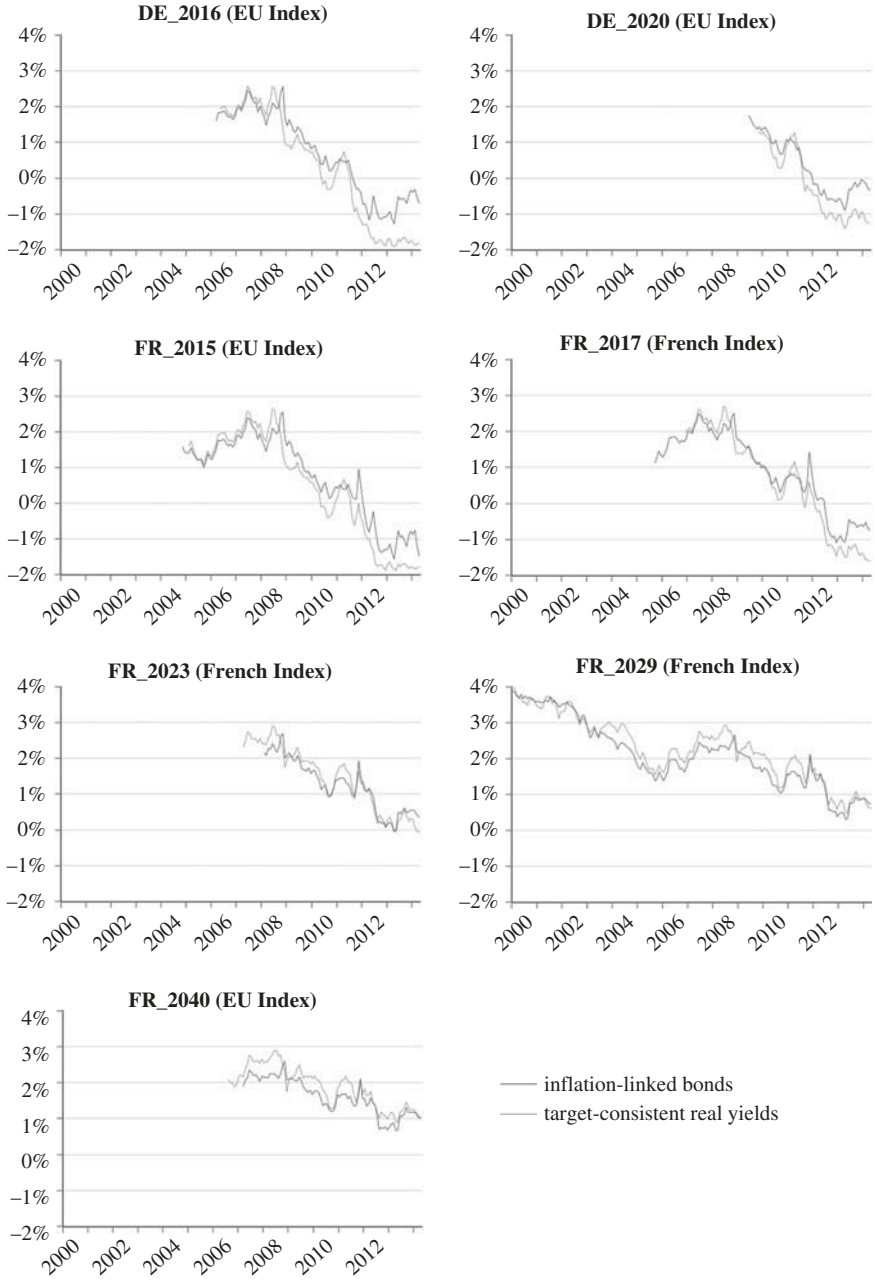

Fig. 1. Yields of inflation-linked bond series and target-consistent yields for each selected bond pair

Table 2. Results of the Bai–Perron test for multiple breakpoints in the selected bond pairs

Name	1. Breakpoint	2. Breakpoint	3. Breakpoint
DE_2016	5 August 2011	1 October 2008	–
DE_2020	29 April 2013	18 August 2011	1 October 2010
FR_2015	6 October 2008	8 August 2011	6 December 2006
FR_2017	18 August 2011	2 October 2008	–
FR_2023	5 September 2011	10 January 2013	7 May 2009
FR_2029	14 July 2003	2 June 2011	31 July 2008
FR_2040	2 October 2008	5 September 2011	3 March 2010

Notes: For all selected bond pairs, Table 2 presents the detected breakpoint dates. All breakpoints are statistically significant at the 1% level. Selected test specification is the Bai–Perron test of multiple breakpoints with a maximum of three breaks and a 15% trimming.

of the ECB's credibility regarding the maintenance of price stability is, however, a nontrivial issue due to the severe market disturbances in the financial and sovereign debt crisis, and is thus not answerable by Svensson's test. The test focuses on the long-term relation of both yield series and does not capture the sources of these deviations: For instance, the first common date detected by the Bai–Perron test (marked by light grey-shaded cells in Table 2) is around the bankruptcy of the investment bank Lehman Brothers in September 2008. This period generally exhibits high liquidity premia for illiquid assets (see, e.g., Campbell *et al.*, 2009), the results thus do not necessarily mean a loss in ECB's credibility since by this time, the sovereign debt crisis was still nonexistent. The second date (dark grey-shaded cells) is around the ECB announcement on 7 August 2011 to again buy government bonds within the Securities Market Programme (ECB, 2011) and can therefore be referred to the rescue activities in the sovereign debt crisis. The detected breaks around this date, though, might be deduced from a change in the ECB's credibility or from flight-to-liquidity effects, which are present in German and French nominal government bonds but not automatically also in the respective inflation-linked bonds (see Beber *et al.*, 2009). A proper differentiation between these effects is not possible with Svensson's test.

The test can show, however, that before the financial crisis yields from inflation-linked bonds and target-consistent real yields move quite closely without any large deviations (see Fig. 1, especially DE_2016, FR_2015 and FR_2019) and breaks are only occasionally detected suggesting a high credibility of the ECB (see Table 2). This finding is in line with existing literature and indicates that during calm financial times Svensson's test is a practical measure to detect central bank's credibility. One possible avenue for future research is an analysis that is able to differentiate between liquidity effects and changes in a central bank's credibility. Furthermore, the construction of an index continuously outlining central bank's credibility based on deviations of target-consistent from inflation-linked bond yields would be a worthwhile research project for academics as well as practitioners.

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