An Evaluation of ECB Policy in The Euro’s Big Four

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Abstract

The Taylor curve can be viewed as an efficiency frontier displaying the trade-off between the volatility of output and volatility of inflation. We build on the existing literature in this area and view Taylor curves as a lens through which to gauge the deviations of actual ECB policy from the optimum. We employ data over the period 1999-2013 period to measure the orthogonal distance of the observed volatilities from the Taylor curve in Germany, France, Italy and Spain using a recursive VARs. We find that the distance has substantially increased for all four countries suggesting that monetary policy has become less efficacious for Germany, France, Italy, and Spain since the financial crisis in 2007-2008. We also find estimate counterfactual Taylor rules and find that a simple Taylor rule would have only substantially improved monetary policy efficacy in Germany.

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JEL classifications: E31, E58, C32

Key words: Monetary Policy, Taylor Curve, Optimal Control, Euro

1. Introduction
On January 22, 2015 the ECB ushered in a new era by launching an aggressive quantitative easing program in attempts to stimulate the Eurozone economy. However, there has been a substantial disagreement between ECB council members regarding monetary policy’s role since the financial crisis of 2007-2008. In particular, Jens Weidmann, the governor of the Bundesbank has been particularly outspoken against the unconventional measures undertaken by the ECB.¹ The Bundesbank’s insistence on low inflation has come under fire by many prominent economists and policy makers. For example, the Head of the International Monetary Fund, Christine Lagarde, recently warned that “low-flation” risked undermining global growth.² Moreover, several notable economists have called for a doubling or tripling of the ECB’s target 2% inflation rate.³

While the ECB council members state that only euro-wide economic conditions are considered in policy settings, the economic differences across euro countries mean that monetary policy (conventional or unconventional) may not be appropriate for each member state. As such, an important question is how efficacious is ECB policy for each member state? Previously, Dorbusch et al (1998), Berger and De Haan (2002), Meade and Sheets (2005) argue that diverging national economic conditions would likely influence the voting patterns of individual members on the ECB council. As divergences in economic conditions become more apparent, it is not surprising that disagreements between members have arisen. For example, Figure 1 displays the year over year inflation rate, output gap, yield on the 10 year government bond, and the real interest rate (10 year government bond – inflation rate) for France, Germany, Italy, Spain.

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¹ [http://www.ft.com/intl/cms/s/0/08f93276-8521-11e4-bb63-00144feabdc0.html#axzz3Qd5RDQse](http://www.ft.com/intl/cms/s/0/08f93276-8521-11e4-bb63-00144feabdc0.html#axzz3Qd5RDQse)

² [http://www.reuters.com/article/2014/04/02/imf-economy-idUSL1N0MU15O20140402](http://www.reuters.com/article/2014/04/02/imf-economy-idUSL1N0MU15O20140402)

³ For example see Ken Rogoff’s [http://www.project-syndicate.org/commentary/the-benefits-of-higher-inflation-by-kenneth-rogoff](http://www.project-syndicate.org/commentary/the-benefits-of-higher-inflation-by-kenneth-rogoff) and
over the 1999 – 2013 time period. While the trends in the output gap and inflation rate appear somewhat synchronized, the borrowing rates and real interest rates are not, especially after the financial crisis of 2008. Table 1 displays the summary statistic of the four variables in Figure 1 over the 2010 – 2013 sample period. As can be seen in Table 1, the real interest rate in Italy and Spain has been five time higher than in Germany and twice as high as the real interest rate in France. Thus, given the divergence in economic performance, it is not surprising that dissention has arisen on the ECB’s governing council. In fact, September 6, 2012 was the first time that the ECB openly acknowledged that a monetary policy decision was not reached by a consensus vote.

Previous studies, such as Gerlach (2007), Gorter et al. (2010), Van Poeck (2010), Hayo and Méon (2013), and Bouvet and King (2013) examine the appropriateness of ECB policy by comparing the ECB policy rate to national estimated Taylor rules. Heinemann and Huefner (2004) tackle whether ECB policy makers consider national data rather than euro-wide economic data when setting interest rates. Heinemann and Huefner (2004) report some evidence for national bias. Fendel and Frenkel (2009) find that the ECB is less likely to tighten policy when high inflation differentials rise between euro members to deflationary in the low inflation countries. Hayo and Meon (2013) use national Taylor rules to generate a counterfactual interest rate series to compare how closely they matched the 1-day Euro Overnight Index Average (Eonia) rate. They find that national interest typically dominate the euro wide area interest as a whole.

The objective of this paper is to contribute to the extant literature by estimating recursive Taylor curves to evaluate ECB policy for the four largest economies in the euro area (Germany, France, Italy, and Spain). Taylor (1979) develops a “second order” Phillips curve allowing for a permanent trade-off between the second moments of the Phillips curve variables. As argued by
Bernanke (2004), the so-called Taylor curve is consistent with the modern macroeconomic view that central banks cannot systematically increase the level of output but can stabilize the variance of output. Taylor (1979, 2014) and Friedman (2006) point out that the Taylor curve can be viewed as an efficiency locus in that the actual variances of output and inflation can exceed the values lying on the Taylor curve. We build on Taylor (1979) and Olson and Enders (2012) and use the Taylor curve as a lens through which to gauge the deviations of actual ECB policy from the optimum. In addition, we follow Hayo and Meon (2013) and generate counterfactual interest rate series using national Taylor rules, and gauge the counterfactual performance through the lens of the Taylor curve. However, because the Taylor curve is unobservable, discrepancies could result whenever the central bank incorrectly perceives the location of the curve or is unaware of structural changes in domestic economies, as documented by, Cecchetti, Flores-Lagunes, and Krause (2006).

As a preview of our results, we find that the four countries examined are found to move away from their respective Taylor curves beginning with the financial crisis in mid-2007 and 2008. Prior to 2007, France, Germany, Italy and Spain were all operating relatively close to their respective Taylor curve. However, beginning in 2007 the Spanish economy begins to dramatically move away from its Taylor curve. France, Italy, and Germany follow suit in mid 2008 with the most drastic changes occurring in Italy and Germany. We also investigated whether the ECB economies experienced an abrupt ending to the “Great Moderation” in 2008. We find that the French, German, and Italian Taylor curves appear to be much more stable than the Spanish Taylor curve. We find that the most dramatic outward shifts was clearly the Italian and Spanish economies. We conclude that the Taylor curves of all four large EU economies have shifted outward post 2007-2008.
The remainder of the paper proceeds as follows. In Sections 2 and 3 we explain the nature of the Taylor curve and show how it can be estimated. In Section 4, we report the recursive Taylor curves estimated from 2005 – 2013. We characterize the historical efficacy of monetary policy by calculating the minimum orthogonal distance between the observed volatilities of inflation and the output gap from the optimum. In section 5 we display a time series displaying how the Taylor curve for each country has shifted over time. Our conclusions are contained in section 6.

2. The Derivation of the Taylor curve

The construction of efficiency frontiers (Taylor curves) begins with a central bank minimizing the expected value of the loss function \( L \):

\[
L = \lambda (\pi_t - \pi_t^*)^2 + (1 - \lambda) (y_t - y_t^*)^2
\]  

(1)

where \( \pi_t \) is the inflation rate, \( \pi_t^* \) is the target inflation rate, \( \lambda \) is the central bank’s preference for inflation stability, \( y_t \) is output, and \( y_t^* \) is the target level of output. Given a model of the economy and the weight assigned to price stability, it is possible to obtain a point on the Taylor curve. Each point on the Taylor curve is the optimized values of the variance of inflation and the variance of output for a given value of \( \lambda \). Varying \( \lambda \) generates a locus of points indicating the smallest variance of inflation possible for any given variance of the output gap. Thus, the efficiency frontier then serves as a tool by which one may gauge monetary policy.

Interestingly, the derivation of the Taylor curve is very similar as that used to derive the interest rate rules, such as the Taylor rule. For example, one simple case would be one in which the central bank chooses a rule of the form \( i_t = my_t + (1 - m)\pi_t \) where the selection of the weight \( m \) minimizes the expected value of the loss function given by (1). Thus, the selected weight \( m \) depends on the central bank’s preference for price stability (\( \lambda \)). The resulting optimized values of
the variances of inflation and the output from their respective targets depend on preference parameter $\lambda$. By changing $\lambda$, it is possible to plot an efficiency frontier or Taylor curve ($T_1T_1$) as depicted in Figure 2. Thus, the Taylor Curve ($T_1T_1$) displays the locus of points indicating the smallest variance of inflation obtainable for any given variance of the output gap.

Monetary policy that is optimal would result in the economy operating on its efficiency frontier at a point such as point A in Figure 3. Policies which are sub-optimal results in the observed volatilities of inflation and output being located to the right of the Taylor curve (point B). Movement towards the Taylor curve from point B can be viewed as an improvement in monetary policy.

[Insert Figure 2]

As mentioned above, the Taylor curve can shift if the underlying variability or the structure of the economy changes. For example, the unconventional measures undertaken since the sovereign and financial crises erupted in 2008 could result in substantially less than optimum policy for certain countries. Figures 3a and 3b displays estimated Taylor curves in Germany, France, Italy, and Spain in 2005 (Figure 3a) and 2013 (Figure 3b).4

[Insert Figures 3a and 3b]

As can be seen in the Figures, with the exception of Germany, the Taylor curves in France, Italy, and Spain have all shifted outward from the origin since 2005.

As documented by Cecchetti, Flores-Lagunes, and Krause (2006) and Mishkin and Schmidt-Hebbel (2007) the efficiency frontier can shift if the underlying variability or the structure of the economy changes. A decline in macroeconomic variability would result in an

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4 The Taylor curves were derived using the data and methodology outlined below for the respective time period.
efficiency frontier shifting from $T_1 T_1$ to $T_2 T_2$. Changes in monetary regimes, fiscal policies, inflation expectations, and labor policies can affect the location of the efficiency frontier.

3. Estimating the Taylor Curve

3.1. The VAR

In order to obtain the structural parameters necessary for construction of a Taylor curve, we rely on a vector autoregression (VAR) that is a variant of the aggregate demand and supply model developed in Mishkin and Schmidt-Hebbel (2007) and similar to that in Olson and Enders (2012). Consider:

\begin{equation}
y_t = \alpha_{1,0} + \sum_{i=1}^{n} \alpha_{1,i} y_{t-i} + \sum_{i=1}^{n} \beta_{1,i} \pi_{t-i} + \sum_{i=1}^{n} \phi_{1,i} i_{t-i} + \varepsilon_{1,t}
\end{equation}

\begin{equation}
\pi_t = \alpha_{2,0} + \sum_{i=1}^{n} \alpha_{2,i} y_{t-i} + \sum_{i=1}^{n} \beta_{2,i} \pi_{t-i} + \sum_{i=1}^{n} \phi_{2,i} i_{t-i} + \varepsilon_{2,t}
\end{equation}

Equation (2) represents a reduced form model of the output gap ($y_t$) as a function of its own lags, lags of the nominal interest rate ($i_t$), and lags of the difference between the inflation rate and its target ($\pi_t$). Equation (3) represents a reduced form model of the Phillips curve, in which our measure of inflation (minus a 2% target) is a function of its own lags, lags of the output gap, and lags of the nominal interest rate ($i_t$). Monthly data from the IMF’s *International Financial Statistics* were obtained for the 1999M1 – 2013M12 sample period for France, Italy, Spain, and Germany. Following Cecchetti, Flores-Lagunes, and Krause (2006) and Olson and Enders (2012), the output gap was measured as the log difference of industrial production from a Hodrick-Prescott (HP) filter. Inflation was defined as the log yearly change (year over year) in the consumer price index less a 2 percent inflation target. The interest rate series for each country
was the Eurosystem Deposit Facility Rate. The lag length of the VAR was obtained using the bic.

3.2 Constructing the Taylor Curve

In construction of the Taylor curve we follow the methodology detailed in Taylor (1979), Cecchetti, Flores-Lagunes, and Krause (2006) and Olson and Enders (2012). The optimization procedure is best described by rewriting the structural model of (2) – (3) in its state-space representation. Thus,

\[ Y_t = B Y_{t-1} + c i_{t-1} + v_t \]  \hspace{1cm} (4)

where

\[ Y_t = \begin{bmatrix} y_t \\ \vdots \\ y_{y-n} \\ \pi_t \\ \pi_{t-n} \\ i_{t-1} \end{bmatrix}, \quad B = \begin{bmatrix} \alpha_{11} & \cdots & \alpha_{1n} & \beta_{11} & \cdots & \beta_{1n} & \varphi_{12} \\ 1 & 0 & \cdots & \cdots & \cdots & \cdots & 0 \\ 0 & \ddots & \cdots & \cdots & \cdots & \cdots & 0 \\ \vdots \\ 0 & \cdots & \ddots & \cdots & \cdots & \cdots & 0 \\ \pi_{t-n} \\ 0 & \cdots & \cdots & \ddots & \cdots & \cdots & 1 \end{bmatrix}, \quad C = \begin{bmatrix} \varphi_{11} \\ 0 \\ \vdots \\ \vdots \\ \varphi_{22} \\ 0 \end{bmatrix}, \quad V = \begin{bmatrix} \varepsilon_{1t} \\ 0 \\ \vdots \\ \vdots \\ \varepsilon_{2t} \end{bmatrix} \]  \hspace{1cm} (5)

The loss function (1) is rewritten as:

\[ Y_t' \Lambda Y_t \]  \hspace{1cm} (6)

where \( \Lambda \) is a square weighting matrix with the first diagonal element equal to \( \lambda \), the \( n^{th} \) diagonal element equal to \( (1-\lambda) \) and the remaining elements equal to zero. Thus, the central bank’s objective is to pick the interest rate path which minimizes (6) subject to the constraints imposed by (4). Given the loss function in (6), the solution for the interest rate will be:

\[ i_t = g Y_{t-1} \]  \hspace{1cm} (7)

The control vector \( g \) is found using optimal control techniques and given by:
\[ g = - (c' H c)^{-1} c' H B \]  \hspace{1cm} (8)

where \( H \) is the solution of the equations

\[ H = \Lambda + (B + cg)' H (B + cg)^5. \]  \hspace{1cm} (9)

For a given set of feedback coefficients, \( g \), the stochastic component of \( Y_t \) is described by (7). Thus, the steady state covariance matrix of \( Y_t \) is given by \( \Sigma \) which satisfies

\[ \Sigma = \Omega + (B + cg)' \Sigma (B + cg). \]  \hspace{1cm} (10)

where \( \Omega \) is the covariance matrix of the residuals in \( V \). Thus, the first and the \( n^{th} \) diagonal elements of \( \Sigma \) contain the steady-state variances. Given a particular \( \lambda \) this procedure determines a single point on the Taylor curve. Varying \( \lambda \) over the \([1, 0]\) interval in conjunction with the steady state variances in \( \Sigma \) results in an entire Taylor curve.\(^6\)

3.3 Constructing Recursive Taylor Curves Through Time

In order to estimate the Taylor Curves, we report results using an expanding window beginning with the 1999M1 – 2004M1 time period. We estimate the VAR as in Section 3.1 for the first 5 years of monthly observations, select the lag length \( n \) using the BIC, and subsequently derive the Taylor curve by implementing the procedure outlined in Section 3.2. Given this efficiency frontier, we calculate the minimum orthogonal distance between the observed volatilities for the respective time period and their optimal values. The above calculations are then repeated by adding one additional month of data until we reach the end of the sample in December 2013. As such, the resulting time series allows one to gauge the efficacy of ECB

\(^5\) See Chow (1975) or Taylor (1979) or Cecchetti, Flores-Lagunes, and Krause (2006) for further discussion.

\(^6\) While such optimal control techniques are certainly subject to the Lucas critique (especially in a reduced form model), the empirical significance of the Lucas critique is an unsettled issue. A number of authors argue that the critique is logically correct, but find that changes in monetary rules have little effect on the coefficients of estimated VARs. See Favero and Hendry (1992), Estrella and Fuhrer (1999), and Ericsson and Irons (1995), and Hendry (2000), for further discussion.
monetary policy for Germany, Italy, Spain and France with respect to each country’s specific Taylor curve. Smaller values are indicative of economics operating closer to their efficiency frontiers and suggest better policy whereas larger values suggest the opposite

4. Distance of economies from the Optimum

Figure 4 displays the distance of each economy from its efficiency frontier using the procedure outlined above. Figure 5 displays the distance of each economy from its efficiency frontier using counterfactual national Taylor rules for the interest rate series. We overlay the results from using the national Taylor rules with the results from above for comparison purposes. Table 2 displays the averages from the statistics of our results from Figures 4 and 5. The column labeled “Policy” in Table 2 is the average distance an economy operated from its Taylor curve (i.e. simply the average of the time series in Figure 4); the column “Policy: Taylor Rule” is the average distance and the column using national Taylor rules as the policy rules and is discussed further below.

First, note that overall in Figure 4, ECB policy appears to be most in sync with the French economy. As displayed in the first column of Table 2, the French economy operated the closest (0.39) followed by Spain (0.77), Germany (0.97) and finally Italy (0.97). However, the most striking feature of Figure 4 is the degree to which the distances of all four countries move away from their Taylor curves beginning with the financial crisis in mid-2007 and 2008. Note that prior to 2007, France, Germany, Italy and Spain were all operating relatively close (i.e. less than 0.5 standard deviations) to their respective Taylor curve. However, beginning in 2007 the Spanish economy begins to dramatically move away from its Taylor curve. France, Italy, and Germany follow suit in mid 2008 with the most drastic changes occurring in Italy and Germany. The distances in Germany and Italy follow a relatively similar pattern; both economies move
away from their Taylor curve by approximately a factor of five in 2009 and then begin a gradual movement back towards their efficiency frontier. France is somewhat similar in that the economy moves approximately three times as far away from its efficiency frontier during 2009, it is different in that it has halved the distance its economy operated from its efficiency frontier over the 2009 – 2013 time period. The Spanish economy follows a completely unique path. Its distance begins to increase beginning in late 2006 early 2007, earlier than France, Germany, and Italy. While the increase in the distance is relatively the same as in Germany and Italy, it moves sharply back towards its efficiency frontier beginning in 2008 when the ECB begin a sharp dive towards the zero lower bound.

While we believe the results in Figure 4 are interesting, a comparison of the results to a counter factual interest rate series would be informative. As such, we generate a counter factual interest rate series using a simple Taylor rule as outlined in Taylor (1993) for each economy. We subsequently re-estimated the recursive Taylor curves as well as re-calculate the minimum distance to the Taylor curves using the Taylor rules as the policy rate for each respective economy. Figure 5 displays the original distances as in Figure 4 as well as the counter factual distances as calculated above. In addition, the last column in Table 2 displays the average distance each economy operated from its efficiency frontier using the counter factual Taylor rule series. The results in Figure 5 and Table 2 display a consistent story. The ECB policy rate is closer to the optimum for the French economy than the national French Taylor rule, but worse for the German, Italian, and Spanish economies. In Table 2, use of the national Taylor rule increases the distance from 0.39 to 0.48 in France. However, use of a simple Taylor rule would have reduced the distance in Germany, Italy, and Spain by 0.21, 0.03, and 0.15 respectively. Note that prior to the financial crisis, ECB policy was better for the German economy than a
simple Taylor rule but worse for the French, Italian, and Spanish economy. However, after the financial crisis in 2008, ECB policy actually generates a distance much closer to what the national Taylor rules would suggest for France, Italy, and Spain. This result is especially interesting given that the Bundesbank has been outspoken against ECB policy much more after the financial crisis than any of the other central banks were before the crisis erupted.

4.1 What about the Exchange Rate?

Devereux and Engle (2003) demonstrate that exchange rate adjustments are an integral part of optimal monetary policy and welfare maximization under conditions in which country-specific productivity shocks exists. Given that the conversion rates of the German, French, Italian, and Spanish currencies were fixed to the euro in 2002, a pertinent question is the appropriateness of the value of the euro for each domestic economy. As such, we inserted the exchange rate as our policy variable and re-estimated the methodology outlined in section 3. Figure 6 displays the distance of each economy from its Taylor curve using the exchange rate as the control variable. As can be seen, the value of the euro appears to have been substantially better for France than Germany, Italy or Spain. While the distances each of the economies operates from the origin fluctuate over the sample period in Figure 6, it is remarkably consistent that the ordering of the distances for each country is always (1) France (2) Germany (3) Italy (4) Spain.

4.3 What is the Optimal Exchange Rate for Each Country

Given the above results, another interesting question is whether the ECB economies experienced an abrupt ending to the “Great Moderation” in 2008. As such, we followed Olson and Enders (2012) and calculated the minimum distance each economy’s Taylor curve operated

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7 Another possible modeling strategy would be to include the exchange rate in the loss function in (1) and have an additional weight on the exchange rate. However, we opted for simplicity since an additional variable in the loss function would require a third dimension.
from its origin. Figure 6 displays the distances and Table 3 displays the averages from the pre and post financial crisis time periods. The column labeled “Stability: Pre 2008” in Table 3 is the minimum distance a Taylor Curve was from the origin before the financial crisis and “Stability: Post 2008” is the minimum distance the Taylor curve was from the origin after the financial crisis. However, the results in Figure 6 and Table 3 were calculated using the actual ECB policy rate rather than the national Taylor rules. As can be seen in Figure 6, the French, German, and Italian Taylor curves appear to be much more stable than the Spanish Taylor curve. While it is clear from Table 3 that all of the Taylor curve have shifted outward, the most dramatic outward shifts was clearly the Italian and Spanish economies, 1.21 to 1.64 and 1.97 to 2.36 respectively.

Given the results in Figure 6, the Taylor curve of all four large EU economies have shifted outward post 2007-2008

5. Conclusion

We follow Taylor (1979), Friedman (2006), and Olson and Enders (2012) and view the Taylor curve as an efficiency frontier displaying the trade-off between the volatility of output and volatility of inflation. Because monetary policy need not be optimal, it is possible to observe persistent departures from the Taylor curve suggesting sub-optimal monetary policy. We use data over 1999 – 2013 time period to empirically measure the orthogonal distance of the observed volatilities from the Taylor curve in Germany, France, Italy and Spain using a recursive VARs. We find that the distance has substantially increased for all four countries suggesting that monetary policy has become less efficacious for Germany, France, Italy, and Spain since the financial crisis in 2007-2008. In addition, we find that the exchange rate has been closest to the optimum for France then Germany, Italy, and lastly Spain. For robustness, we find estimate counterfactual Taylor rules and find that a simple Taylor rule would have only substantially
improved monetary policy efficacy in Germany. Before concluding, the reader should be aware of the limitations of our methodology. As in Olson and Enders (2012) and Mishkin and Schmidt-Hebbel (2007) we estimate the dynamics of output and inflation using simple VARs. In contrast to DSGE models, we impose no structural restrictions on the VAR. We defend these limitations similar to Olson and Enders (2012) as an attempt to estimate the efficacy of monetary policy by imposing as few *ad hoc* restrictions on the data as we deemed possible. In spite of these limitations, our results do seem reasonable.
References


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### Table 1: Levels (Std. Dev)

<table>
<thead>
<tr>
<th></th>
<th>France 2010 - 2013</th>
<th>Germany 2010 - 2013</th>
<th>Italy 2010 - 2013</th>
<th>Spain 2010 - 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>1.62 (0.52)</td>
<td>1.66 (0.44)</td>
<td>2.14 (0.83)</td>
<td>2.22 (0.89)</td>
</tr>
<tr>
<td>Output Growth</td>
<td>0.97 (3.28)</td>
<td>4.97 (5.81)</td>
<td>-0.39 (5.55)</td>
<td>-2.32 (3.50)</td>
</tr>
<tr>
<td>10 Year Bond Yield</td>
<td>2.80 (0.55)</td>
<td>2.11 (0.69)</td>
<td>4.83 (0.83)</td>
<td>5.04 (0.77)</td>
</tr>
<tr>
<td>Real Interest Rate</td>
<td>1.18 (0.51)</td>
<td>0.44 (0.93)</td>
<td>2.68 (0.47)</td>
<td>2.81 (0.77)</td>
</tr>
</tbody>
</table>

### Table 2: Averages of Distances of Economies from Taylor Curve

<table>
<thead>
<tr>
<th>Policy: ECB Rate</th>
<th>Policy: Taylor Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>0.39</td>
</tr>
<tr>
<td>Germany</td>
<td>0.90</td>
</tr>
<tr>
<td>Italy</td>
<td>0.97</td>
</tr>
<tr>
<td>Spain</td>
<td>0.77</td>
</tr>
</tbody>
</table>

*Policy* is the average of minimum distance of the observed volatilities to the efficiency frontier.

### Table 3: Averages of Distances of Economies from Taylor Curve

<table>
<thead>
<tr>
<th>Stability: Pre-2008</th>
<th>Stability: Post-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>1.13</td>
</tr>
<tr>
<td>Germany</td>
<td>1.34</td>
</tr>
<tr>
<td>Italy</td>
<td>1.21</td>
</tr>
<tr>
<td>Spain</td>
<td>1.97</td>
</tr>
</tbody>
</table>

*Stability* is the average of minimum distance of the efficiency frontier to the origin.
Figure 1

Inflation
Panel A

10 Year Govt Bond Yield
Panel C

Output Growth
Panel B

Real Interest Rates
Panel D
Figure 2

The Taylor Curve

Inflation Volatility
Output Volatility

A
B

T1
T2
T1
T2

Inflation Volatility
Figure 3a

Euro Taylor Curves: 2005

Germany

France

Italy

Spain
Figure 3b

Euro Taylor Curves: 2013

Germany

Output Volatility

Inflation Volatility

Italy

Output Volatility

Inflation Volatility

France

Output Volatility

Inflation Volatility

Spain

Output Volatility

Inflation Volatility
Figure 4: Distance to Taylor Curve using ECB Rate as Policy Variable

Distance to Country's Taylor Curve

*Policy Tool: ECB Rate*

![Graphs showing distance to Taylor Curve for France, Italy, Germany, and Spain](image-url)
Figure 5: Distance to Taylor Curve with *Counterfactual Taylor Rule* as the Policy Rate

**Distance to Taylor Curve**

![Graphs showing the distance to the Taylor Curve for France, Italy, Germany, and Spain with ECB Rate and Taylor Rule plotted over time.](image)
Figure 6: What about the Exchange Rate

Exchange Rate Evaluation

Policy Tool: Euro Exchange Rate

GERMANY  FRANCE  ITALY  SPAIN
Figure 7: Distance of Taylor Curve to the Origin