A historical analysis of European monetary integration using Taylor curves

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Abstract

Taylor (1979) posits a permanent trade-off between the volatility of output gap and the volatility of inflation. This trade-off can be viewed as an efficiency envelope for optimal monetary policy. Using time-series data beginning in 1960, we examine the efficiency of monetary policy of European Union (E.U.) countries by measuring the orthogonal distance between the observed volatilities of the output gap and inflation from their optimal levels. We find that the monetary policy of the European Central Bank has primarily benefited some economies relative to others. In addition, we identify time periods in which the variability of the E.U. economies changed by observing shifts in this efficiency frontier.

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1. Introduction

In order to prevent Greece from defaulting on its sovereign debt, in May 2010, the European Monetary Union (EMU) and the International Monetary Fund (IMF) approved an unprecedented €720 billion financial aid package to Greece. While unemployment rates in Ireland, Spain, Greece, and Portugal remained persistently high, Germany's unemployment rate has returned to pre-crisis levels. This lack of synchronization is important because European Central Bank (ECB) council members are only to consider the economic environment in Europe as a whole when formulating monetary policy. As such, the ECB's "one size fits all" monetary policy is often controversial because the optimal policy for one country, say Germany, might not be in the best interests of the other EMU nations. Moreover, as evidenced by Heinemann and Huefner (2004) and Howarth and Loedel (2005), there has been widespread suspicion that nationalistic sentiments play a significant role in the policy making process. For example, ECB President Trichet's (2010) call for austerity measures set off a particularly contentious debate regarding the appropriateness of such actions given the poor economic climate in some of the European economies.

Our objectives are threefold: first, to use the Taylor curve as a historical lens through which to evaluate ECB monetary policy; second, to identify time periods in which the underlying variability of the economies changed; and third, to determine whether the slope of the Taylor curve (reflecting the opportunity cost of stabilizing inflation) has changed over time. Specifically, we estimate Taylor curves for six different EMU nations in order to evaluate the effects of the ECB's blanket monetary policy on its individual members. Taylor (1979) argues that there exists a "second order Phillip's curve" in which there is a permanent trade-off between the *variance* of inflation and the *variance* of the output gap. Chatterjee (2002) and Mervyn King

(2007) of the Bank of England argue that the so-called Taylor curve has replaced the Phillip's curve as a policy menu since the former is more compatible with current mainstream macroeconomic theory. Nevertheless, we take the view of Milton Friedman (2006) who argues that the Taylor curve is more likely to be an efficiency frontier yielding the tradeoff for an optimal monetary policy. Instead of being constrained to operate on the Taylor curve, the economy will be on its efficiency locus only if the central bank pursues an optimal monetary policy. To the extent that monetary policy is suboptimal, Friedman (2006) argues that it is possible to simultaneously reduce the variances of both inflation and the output gap.

If Friedman's (2006) perspective is correct, the distance away from the Taylor curve is a measure of the performance of the monetary authorities. As such, by measuring the distance the EMU countries have operated from their respective Taylor curves, it is possible to historically gauge monetary policy for each country. Toward this end, we estimate rolling VARs using data spanning the 1960–2009 time period and use the estimated parameters to construct the Taylor curves for six countries of the EMU. The years prior to 1999 provide a natural benchmark with which to compare ECB monetary policy. We then use the estimated curves to construct the time-series of the minimum distances of each economy from its Taylor curve.

By estimating the Taylor curves over a number of sample periods, it is possible to determine whether the location and the slope of the Taylor curve over time. A key determinant of the location of the curve is the variability of the aggregate supply shocks that the economy experiences. The smaller (larger) the size of the shocks the economy experiences the closer (further) the efficiency frontier will be to the origin. For example, the well-documented decline in the variance of many macroeconomic variables in the mid-1980s implies that the Taylor curve has shifted towards the origin.

To preview our results, we find that: (1) monetary integration in Europe did not move all countries towards their existing Taylor curves, (2) countries (excepting France) in which decreases in distances which did occur took place before the ECB began setting policy in 1999, (3) the French economy is the only country of our sample that has consistently moved towards its Taylor curve. The paper proceeds as follows. In section 2, the intuition and background is given for the Taylor curve. Section 3 presents the macroeconometric model and details the construction of the Taylor curve. Section 4 contains results and section 5 concludes.

2. Background

The standard derivation of the Taylor curve begins with a central bank trying to minimize the expected value of the loss function (L):

$$L = \lambda(\pi_t - \pi_t^*)^2 + (1-\lambda)(y_t - y_t^*)^2 \tag{1}$$

where π_t is the inflation rate, π_t^* is the target inflation rate, λ is the central bank's preference for inflation stability, y_t is output, and y_t^* is the target level of output. Given the structural equations of the economy, and the weight assigned to inflation, it is possible obtain a point on the Taylor curve. This point represents the optimized values of the variance of inflation and the variance of output for a given value of λ. By varying λ, it is possible to plot the efficiency frontier as the locus of points indicating the smallest variance of inflation obtainable for any given variance of the output gap.[1]

Consider the Taylor curve T_1 T_1 depicted in Figure 1a. Monetary policy that is optimal would result in the economy operating on its efficiency frontier at a point such as A. Policy which is sub-optimal would result in the observed volatilities being to the right of the Taylor

[1] The same type of derivation also results in the so-called Taylor Rule yielding the central bank's target interest rate as a function of output and the inflation rate.

curve (point B). Any movement towards the Taylor curve from point B can be viewed as an improvement in monetary policy.

Of course, the Taylor curve itself can shift if the underlying variability of the economy changes. An inward shift, such as the movement from $T_1\,T_1$ to $T_2\,T_2$, would occur if the variance of the economy diminishes. It is important to note that shifts need not be parallel. As illustrated in Panel b of Figure 1, a central bank at point A wishing to reduce inflation volatility will have to tolerate greater output volatility along $T_3\,T_3$ than along $T_4\,T_4$.

[Insert Figure 1a and 1b here]

3. Estimating the Efficiency Frontier

In order to obtain the structural parameters necessary for construction of Taylor curve, we estimate a variant of the aggregate demand and supply model developed in Mishkin and Schmidt-Hebbel (2007). Consider:

$$y_t = \sum_{i=1}^{n} \alpha_{1,i}\, y_{t-i} + \sum_{i=1}^{n} \beta_{1,i}\, \pi_{t-i} + \sum_{i=1}^{n} \phi_{1,i}\, i_{t-i} + \varepsilon_{1,t} \tag{2}$$

$$\pi_t = \sum_{i=1}^{n} \alpha_{2,i}\, y_{t-i} + \sum_{i=1}^{n} \beta_{2,i}\, \pi_{t-i} + \sum_{i=1}^{n} \phi_{1,i}\, i_{t-i} + \varepsilon_{2,t} \tag{3}$$

Equation (2) represents an aggregate demand function such that the output gap (y_t) is a function of its own lags, lags of the nominal interest rate (i_t), and lags of the inflation rate (π_t). Equation (3) represents a Phillips curve, in which inflation is a function of its own lags, lags of the output gap, and lags of the nominal interest rate (i_t).

In order to estimate a VAR in the form of (2) and (3), we obtained quarterly data from the IMF's *International Financial Statistics* for the 1960Q1 – 2008Q4 time period. The output gap was measured as 100 times the log difference of industrial production from a Hodrick-Prescott (HP) filter. Inflation was defined as the year-over-year percentage change in the consumer price index. The VAR was estimated using the deviation of inflation from an HP trend. The interest rate series for each country was spliced with short-term money market or deposit interest rates with the Eurosystem Deposit Facility Rate beginning in 1999Q1.[2] The sample of countries, Austria, Belgium, Netherlands, France, Italy, and Spain, was motivated by two factors. First and foremost, the above countries had reliable data on short-term interest rates dating back to 1960; second, the sample naturally dichotomizes into three large and three small economies. Germany was excluded to the data restrictions resulting from the unification in the early 1990s.

Even though the HP filtered series should be stationary, as a precaution, we performed standard augmented Dickey-Fuller tests to determine whether or not the variables are stationary. All transformed variables in the form represented by (2) and (3) were found to be stationary at the 5% significance level. The various lag lengths for the VARs were selected according to two criteria. First, the adequacy of the model was checked by calculating Ljung-Box Q-statistics for the residuals to ensure the absence of serial correlation. All Ljung-Box Q-statistics tests were found to be insignificant up to the twelfth lag. Second, the multivariate generalizations of the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (BIC) were used to measure the overall fit of the alternative models.[3]

3.1 Constructing the Taylor Curve

In constructing the various Taylor curves, we followed the methodology outlined in Taylor (1979) and Cecchetti, Flores-Lagunes, and Krause (2006). The optimization procedure is best described by rewriting the structural model in (2) – (3) in its state-space representation,

[2] All data uses in the paper can be obtained from the authors upon request.
[3] The results of the lag length tests and the *Q*-statistics can be obtained upon request from the authors.

$$\mathbf{Y_t} = \mathbf{B}\,\mathbf{Y_{t-1}} + \mathbf{c}\,\mathbf{i_{t-1}} + \mathbf{v_t} \tag{4}$$

where

$$\mathbf{Y_t} = \begin{bmatrix} y_t \\ \vdots \\ y_{y-n} \\ \pi_t \\ \vdots \\ \pi_{t-n} \\ i_{t-1} \end{bmatrix} \mathbf{B} = \begin{bmatrix} \alpha_{11} & \cdots & \alpha_{1n} & \beta_{11} & \cdots & \beta_{1n} & ø_{12} \\ 1 & 0 & \cdots & \cdots & \cdots & \cdots & 0 \\ 0 & \ddots & \cdots & \cdots & \cdots & \cdots & 0 \\ \alpha_{2n} & \cdots & \alpha_{2n} & \beta_{21} & \cdots & \beta_{2n} & ø_{22} \\ 0 & \cdots & \cdots & \ddots & \cdots & \cdots & 0 \\ 0 & \cdots & \cdots & \cdots & \ddots & \cdots & 0 \\ 0 & \cdots & \cdots & \cdots & \cdots & 1 & 0 \end{bmatrix} \mathbf{C} = \begin{bmatrix} ø_{11} \\ 0 \\ \vdots \\ ø_{22} \\ 0 \\ \vdots \\ 1 \end{bmatrix} \mathbf{V} = \begin{bmatrix} \varepsilon_{1t} \\ 0 \\ \vdots \\ \varepsilon_{2t} \\ 0 \\ \vdots \\ 0 \end{bmatrix} \tag{5}$$

In matrix notation, the loss function (1) can be as:

$$\mathbf{Y_t'\Lambda Y_t} \tag{6}$$

where Λ is a square weighting matrix with the first diagonal element equal to λ, the n^{th} diagonal element equal to (1- λ) and the remaining elements equal to zero. The objective of the central bank is to pick the interest rate path which minimizes (6) subject to the constraints imposed by (4). Given the quadratic nature of the loss function, the solution for the interest rate will be linear in $\mathbf{Y}_{t-1}$:

$$\mathbf{i_t} = \mathbf{g}\,\mathbf{Y}_{t-1}. \tag{7}$$

The control vector **g** in the steady state is found using optimal control techniques and given by:

$$\mathbf{g} = -(\mathbf{c'Hc})^{-1}\mathbf{c'HB} \tag{8}$$

where **H** is the solution of the equations

$$\mathbf{H} = \mathbf{\Lambda} + (\mathbf{B} + \mathbf{cg})'\mathbf{H}(\mathbf{B} + \mathbf{cg})^{4}. \tag{9}$$

[4] See Chow (1975) for further discussion.

Given the estimated values of the parameters in **B** and **c**, it is possible to simultaneously solve **H** and **g** for any particular value of λ. For a given set of feedback coefficients, **g**, the stochastic component of $\mathbf{Y_t}$ is described by (7). Thus, the steady state covariance matrix of $\mathbf{Y_t}$ is given by $\boldsymbol{\Sigma}$ which satisfies

$$\boldsymbol{\Sigma} = \boldsymbol{\Omega} + (\mathbf{B} + \mathbf{cg})'\boldsymbol{\Sigma}(\mathbf{B} + \mathbf{cg}). \tag{10}$$

where $\boldsymbol{\Omega}$ is the covariance matrix of the residuals in **V**. The first and the n^{th} diagonal elements of $\boldsymbol{\Omega}$ contain the steady-state variances. Given a particular weight to inflation stability, λ, this procedure determines a single point on the Taylor curve. By varying the weight assigned to inflation, an entire Taylor curve can be traced out[5].

3.2 Constructing the Taylor Curve Through Time

As a first step, we estimate (2) and (3) for the 1960Q1-1980Q1 time period and subsequently derive the Taylor curve by implementing the procedure outlined above. Given this efficiency frontier, we calculate the minimum orthogonal distance between the observed volatilities for the 1960Q1-1980Q1 time period and their optimal values. These calculations are then repeated by adding one additional quarter of data, i.e. 1960Q1-1980Q2, and continued until the entire sample period is used in estimation.[6] For robustness, we also calculate a relative distance measure to account for shifts in the Taylor curve by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin.

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[5] While optimal control techniques are certainly subject to the Lucas critique, the empirical significance of the Lucas critique is ambiguous. See Favero and Hendry (1992), Hendry (2000), Estrella and Fuhrer (1999), and Ericsson et al. (1998) for further discussion.

[6] We also performed the analysis using a rolling window instead of an expanding window. The VAR and Taylor curve estimates using both techniques can be obtained from the authors upon request.

4. Results

Our results below are organized as follows. The first subsection *4.1* provides a brief summary of major economic and political events in the EMS to provide a context through which to interpret our later results. *4.2* provides a preliminary analysis by examining business cycle synchronization and price convergence. Subsections *4.3 and 4.4* evaluate monetary policy in small and large economies using our distance metrics. *4.5* builds on the previous two sections by evaluating policy through analysis of the location and shape of the Taylor curves. Table 1 lists the major currency realignments during the 1979-1990 time period. Table 2 displays the average distance each economy operated from its Taylor curve for three stages of the EMS: 1979 – 1992, 1993 – 1998, and 1999 – 2008. Figures 2a, 2b, 3a, and 3b display the output gaps and inflation rates for small and large countries respectively. Figures 4a – 4f display the two time series of minimum distances as described in section 3.3 with the absolute distance measured on the left hand axis and the relative distance measured on the right. The vertical lines in each figure denote currency crises from 1979 – 1992 as measured by Eichengreen, Rose, and Wyplosz (1994). And Figures 5a and 5b display the Taylor curves corresponding to the last quarter for each of the above listed time periods.

4.1 Brief EMS History

The Single European Act of 1986 was designed to eliminate the currency realignments detailed in Table 1. Moreover, the Maastricht Treaty, ratified in the early 1990s , specified that monetary unification of Europe was to be carried out in three stages. Stage I (1991-1993) called for the elimination of any remaining capital controls and the induction of all EU members to the ERM. Stage II (1994-1998) began implementation of four convergence criteria meant to unify member states' economic policies. The criteria were the following. First, the candidate country's average inflation rate observed during the year prior to the examination for admission to the euro could not be more than 1.5% higher than the average of the three best performing members. Second, government deficits must not exceed 3% of gross domestic product (GDP) and public debt must not exceed 60 % of GDP. Three, candidate countries must have observed the normal fluctuation bands provided in the EMS for two years without devaluing their currency. Fourth, the average long-term interest rate could not be 2% higher than the three best performing member states. Stage III (1999) introduced the euro and marked the beginning of active ECB monetary policy.

4.2 Business Cycle Synchronization and Price Convergence

Figures 2a, 2b, 3a, and 3b plot the output gaps and inflation rates for our entire sample period. Interestingly, output gaps for small economies appear more synchronized before the beginning of the EMS in 1979. Output gaps in large countries exhibit the opposite pattern. Business cycles appear much more synchronized after the establishment of the EMS in 1979. However, it should be noted that synchronization appears to begin closer to Stage I of the Maastricht Treaty rather than Stage III. Inflation rates exhibit the same pattern in both large and small economies; rates climb throughout the 1970s, peak in the early 1980s, decline throughout the late 1980s and early 1990s, and have largely stay constant since. Nevertheless, inflation rates in large countries were consistently and substantially higher than those in small countries throughout the entire sample period. Particular attention should be paid to the disinflation which occurred in all countries which began in the first 6 years of the EMS. Frieden (2002) credits the disinflation in France and Italy during the early 1980s as being the catalyst to monetary integration in Europe. The convergence of inflation rates in EMS countries authenticated the exchange rate commitments of each country. As such, the results support the claim that the common monetary policy in EMS countries really began in the early 1980s as a result of credible fixed exchange rates with the German policy being the de facto policy.

[Insert Figures 2a, 2b, 3a, 3b here]

4.3 Small Country Analysis

Notice the results in Figure 4a-4c and the average distances reported in Table 2.The most striking feature of the results from the small countries is the volatility of the time series in the early 1980s. The frequency and magnitude of the currency realignments in the 1980s in France, Germany, and Italy were clearly not optimal for small countries. While Austria did not formally participate in the EMU until 1995, it entered into an informal monetary union by pegging its exchange rate to the German mark in 1982. Figure 4a illustrates how Austria moved towards its Taylor curve beginning in late 1984 (corresponding to the last major currency appreciation for Germany). Only in 2008, after the ECB considerably eased monetary policy due to the financial crises, is there any meaningful movement towards the efficiency frontier. As reported in Table 2, the distance declines from 0.38 in 1979 – 1992 to 0.34 thereafter. Using the relative distance measure, the distance declines from 0.18 to 0.16.

The Belgian economy experienced currency crises in 1982 and 1992. Figure 4b and Table 2 indicate that our distance measure for the Belgian economy substantially declined near the introduction of the EMS and subsequently increased throughout the 1980s. As shown in Figure 4b, the decrease in our distance measure in 1994 corresponds to Stage II of the Maastricht Treaty. Both distance measures are clearly less volatile after 1994 suggesting that the convergence criteria stabilized the position of the economy relative to its Taylor curve. As was the case in Austria, the quantitative easing by the ECB in 2008 appears to move the Belgian economy towards its efficiency frontier. Interestingly, there are no large changes in either distance measure following Stage III in 1999.

On the other hand, throughout the early 1980s, the Netherlands has steadily moved away from its Taylor curve. As illustrated in Table 4c, the Netherlands experienced substantial variation in the location of the economy relative to its Taylor curve in the early 1980s. However, the distances fall dramatically in 1986, rise again in 1989, and peak during the currency crisis in 1992. Again, as with the Austrian and Belgian case, the adoption of ECB policy in 1999 shows no substantial improvement in terms of the distance the economy operated with respect to its Taylor curve. Unlike Austria and Belgium, the ECB's policy in 2008 did not move the Netherlands economy towards its Taylor curve. As reported in Table 2, both distance measures show a clear movement away from the Taylor curve from the first to the second time period, (the distance rises from 0.12 to 0.17), but no major change from the second to the third period.

It is also interesting that recent distance measures for all three countries are very similar. The absolute distance measures for Austria, Belgium and the Netherlands are 0.34, 0.38 and 0.38, respectively. The relative distances are even closer, with Austria, Belgium, and the Netherlands at 0.16, 0.17, and 0.18, respectively. Furthermore, there does not appear to be any substantial change after the adoption of the ECB; all three economies appear to have been operating at those distances prior to adoption of the ECB.

4.4 Large Country Analysis

The large currency depreciations which occurred in France (Figure 4d) in the early 1980s appear to have had mixed results. The depreciations in 1981 and 1987 moved the economy closer to its efficiency frontier. In contrast, the depreciation in early 1982 had the opposite effect and the crisis in 1992 appears to have had no effect at all. The variation in the minimum distances is significantly lower for France than for the three small economies. Again, note that there is relatively little changed after the adoption of ECB policy in 1999. Instead, as reported in Table 2, the distance measure for France steadily declined 0.67 in the first time period to 0.51 in the third. In relative terms these movements were small; over the entire time period, the relative distance fell from 0.26 to 0.23.

As illustrates in Figure 4e, the 1981 Italian currency realignment moved the Italian economy towards its efficiency frontier. Surprisingly, the 1992 crisis had a much less drastic effect in its effects. Table 2 reports that the absolute distance from the first to the third period fell from 0.91 to 0.74. The relative measure fell from 0.27 to 0.25. Notice that both distances measures remained quite stable from the mid-1990s to the 2008 financial crisis. Also notice that the absolute and relative distance measures for Italy were larger than those for France.

As shown in Figure 4f, the distance measures for Spain are quite distinct from those of France and Italy. The distance measures decreased substantially in 1980 and remained low until Spain joined the EMS in 1986. After 1986, the distances meander upward until the crisis in 1992 and subsequently stabilize. Table 2 indicates that the absolute distance increased from 0.28 to 0.36 from the first to the second time period. For the same two time periods, the relative distance measure increased from 0.10 to 0.14.

[Insert Figures 4a – 4f here]

4.5 Analysis of Taylor Curves

Thus far we have only gauged monetary policy by the distance of the economy from the Taylor curve. However, changes in monetary policy itself could influence the estimated position and shape of the Taylor curve. As such, it is possible that monetary policy that is tailored to a specific economy may result in an inward shift in one economy's Taylor curve while at the same time shifting others outward. While there is little difference in the scales of the inflation axis in Figures 5a and 5b, there is substantial variation in the scales on the output gap axis.

Particular attention should be paid to how much larger the scale of the output gap axis is for the Belgian economy. Its Taylor curve has consistently shifted outward. Thus, even though Figure 4b suggests that the Belgian economy has moved towards its Taylor curve, Figure 5b indicates that some of the decreased distance may be due to the outward shift in its Taylor curve rather than better monetary policy. Of the small countries, only the Netherlands' Taylor curve shifted inward each period. The Taylor curve for Austria shifted inward from the first to the second time period but not from the second to the third. Of the large countries, only the Spanish Taylor curve has appreciably shifted since 1999. In contrast, the 2009 Italian and French Taylor curves are largely unchanged from the one in 1998.

Notice the flattening in the Taylor curves between the 1992 and 2009 Taylor curves in Austria, Italy, the Netherlands, and Spain. This result suggests that the cost of stabilizing inflation has decreased over the sample period. The flattening of the Taylor curves correspond to time period to the time period in which λ was greatest due to the ECB sole mandate of price stability. Interestingly, only Belgium's Taylor curve actually steepens.

[Insert Figures 5a and 5b here]

5. Conclusion

When we use the Taylor curve to gauge monetary policy since the beginning of the EMS, the results are mixed. Monetary integration in Europe during the late 1980s and 19990s has resulted in a convergence in the distance most economies operate from their Taylor curves. The distance differs depending on whether the country is a large or small economy. However, monetary integration did not result in every economy moving towards its efficiency frontier. The distance measures for the Netherlands and Spain have increased; however, these economies have seen the largest shifts in their Taylor curves towards the origin. Belgium, on the other hand, has moved closer to its Taylor curve since the 1979 but its efficiency frontier has consistently shifted outward. Only the French economy has consistently decreased the distance it operates from a stable Taylor curve. In a sense, France and Italy are the two nations studied that can be said to experience an unambiguous gain from the EMS.

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Table 1: Year of Currency Realignments to the European Currency Unit (1979-1990)

Note: Dates are from the European Navigator's (ENA) knowledge database (www.ena.lu). The German deutsche mark was included to establish time periods in which the Austrian schilling changed due to the schilling's peg to the mark.

Year	**DEM**	**BEF**	**NLG**	**FRF**	**ITL**
1979	+2.0				
1980					
1981	+5.5		+5.5	-3.0	-6.0
					-3.0
1982	+4.25	-8.5	+4.25	-5.75	-2.75
1983	+5.5	+1.5	+3.5	-2.5	-2.5
1984					
1985	+2.0	+2.0	+2.0	+2.0	-6.0
1986	+3.0	+1.0	+3.0	-3.0	
1987	+3.0	+2.0	+3.0		
1988					
1989					
1990					-3.7

Table 2: Average Distance From Taylor Curve

Note: Absolute is the average minimum orthogonal distance between the observed volatilities for each given time period. Relative is the average distance by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin for each respective time period.

	1979 – 1992		**1993 – 1998**		**1999 – 2009**	
	Absolute	*Relative*	Absolute	*Relative*	Absolute	*Relative*
Austria	0.38	*0.18*	0.34	*0.16*	0.34	*0.16*
Belgium	0.70	*0.34*	0.49	*0.23*	0.38	*0.17*
the Netherlands	0.29	*0.12*	0.38	*0.17*	0.38	*0.18*
France	0.67	*0.26*	0.57	*0.24*	0.51	*0.23*
Italy	0.91	*0.27*	0.77	*0.24*	0.74	*0.25*
Spain	0.28	*0.10*	0.36	*0.14*	0.35	*0.14*

Figure 1a: The Shifting Taylor Curve

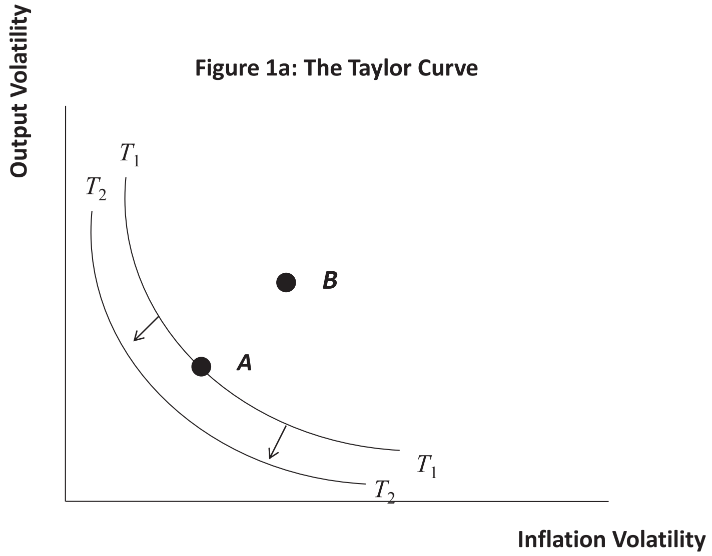
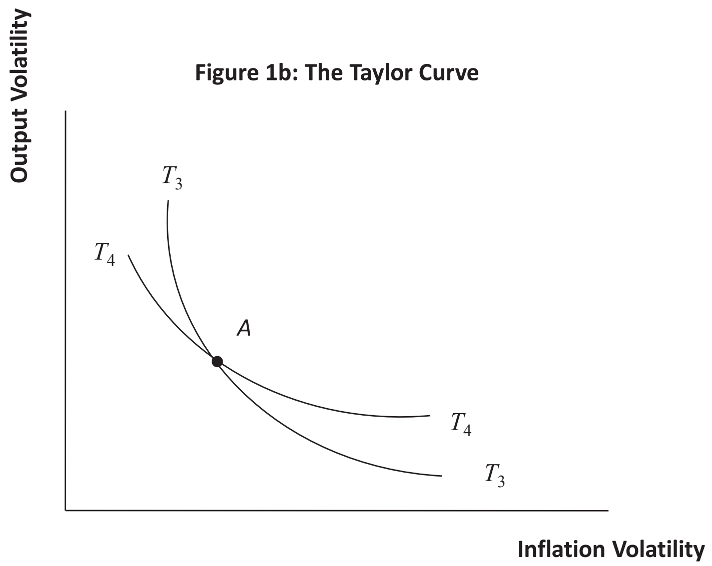
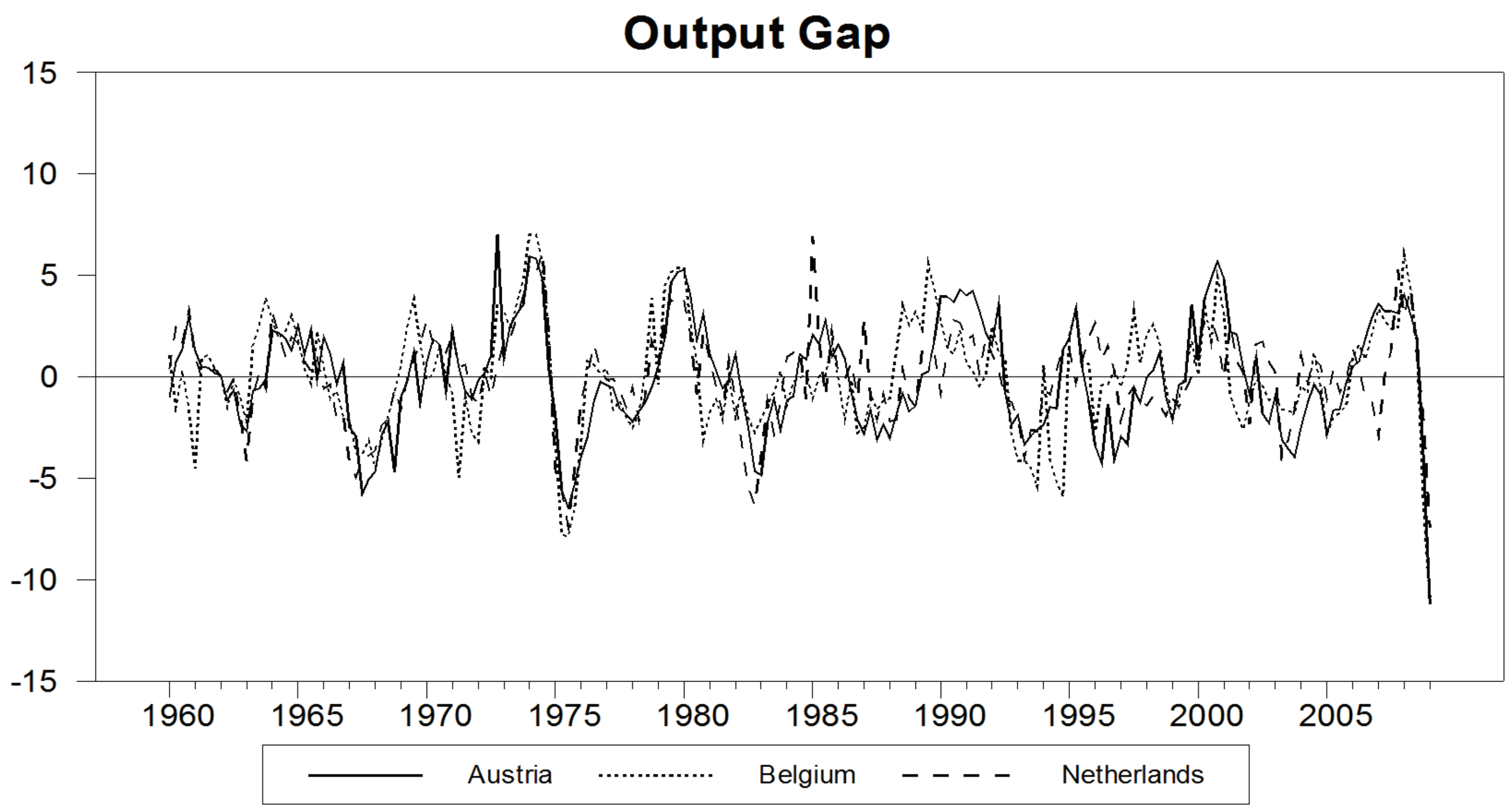


Figure 1b: The Shifting Taylor Curve



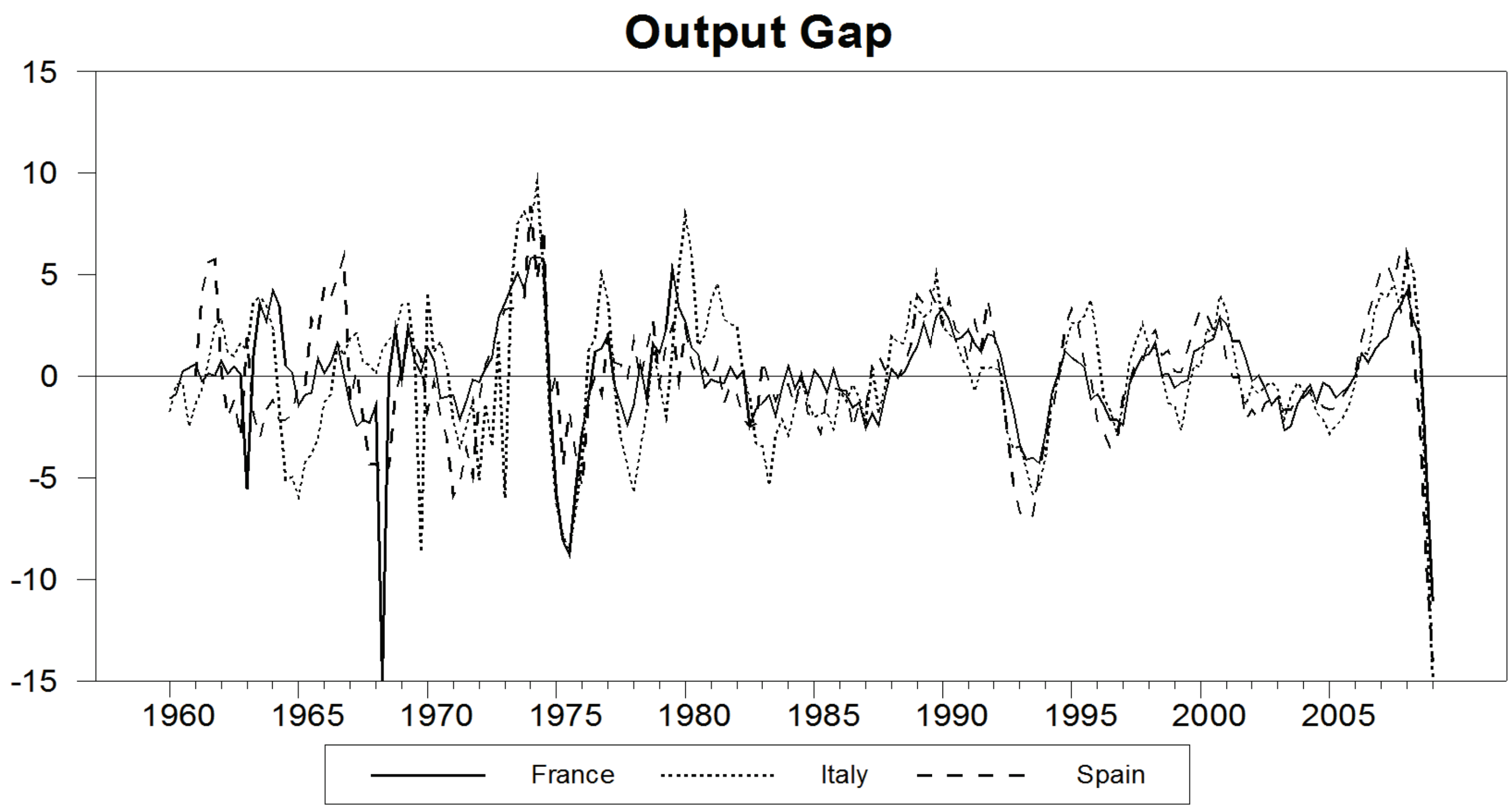
Note: Figure A displays the Taylor curve displays a parallel shift towards the origin. Under such a scenario the tradeoff between output and inflation variability is constant. Figure B displays a shifting Taylor curve in which the variability tradeoff changes.

Figure 2a: EU Small Country Output Gaps



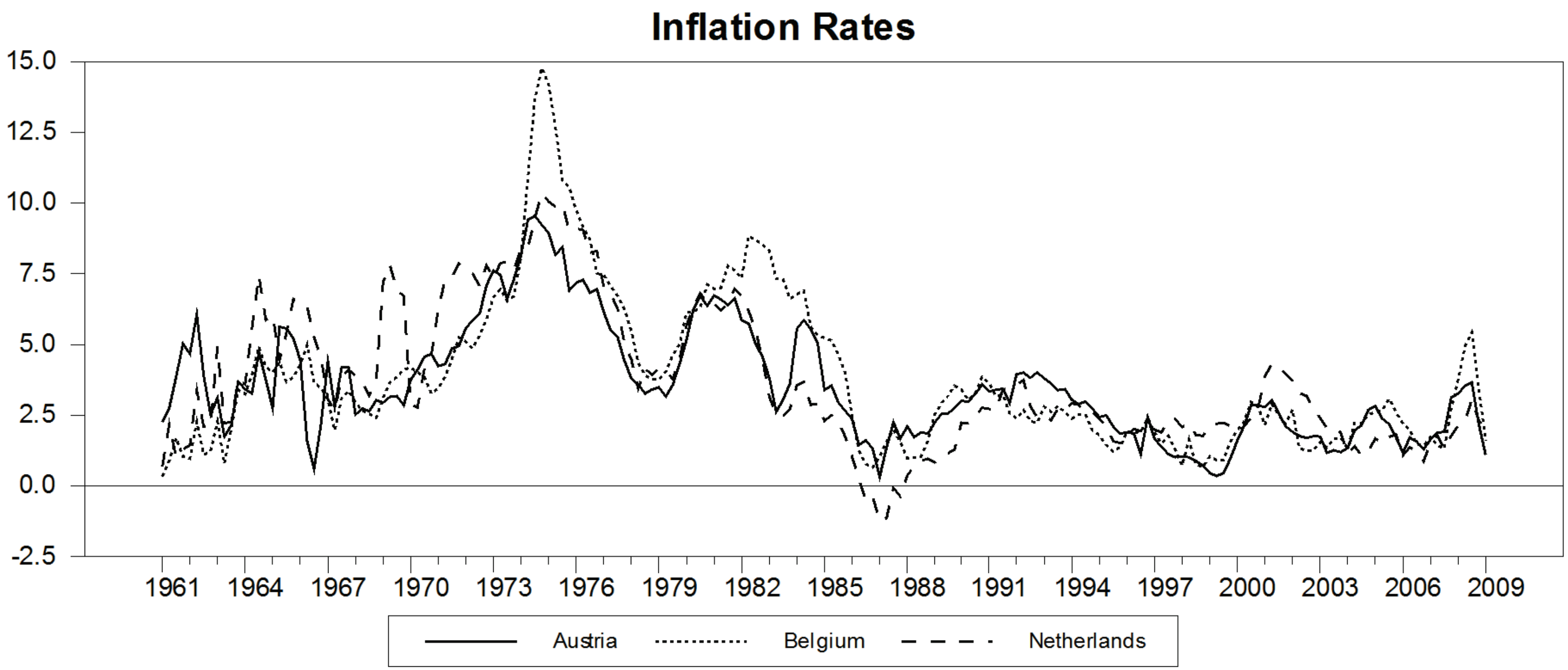
Note: The figure above displays the output gaps for Austria, Belgium, and the Netherlands as measured by the deviation of industrial production from an HP trend.

Figure 2b: EU Large Country Output Gaps



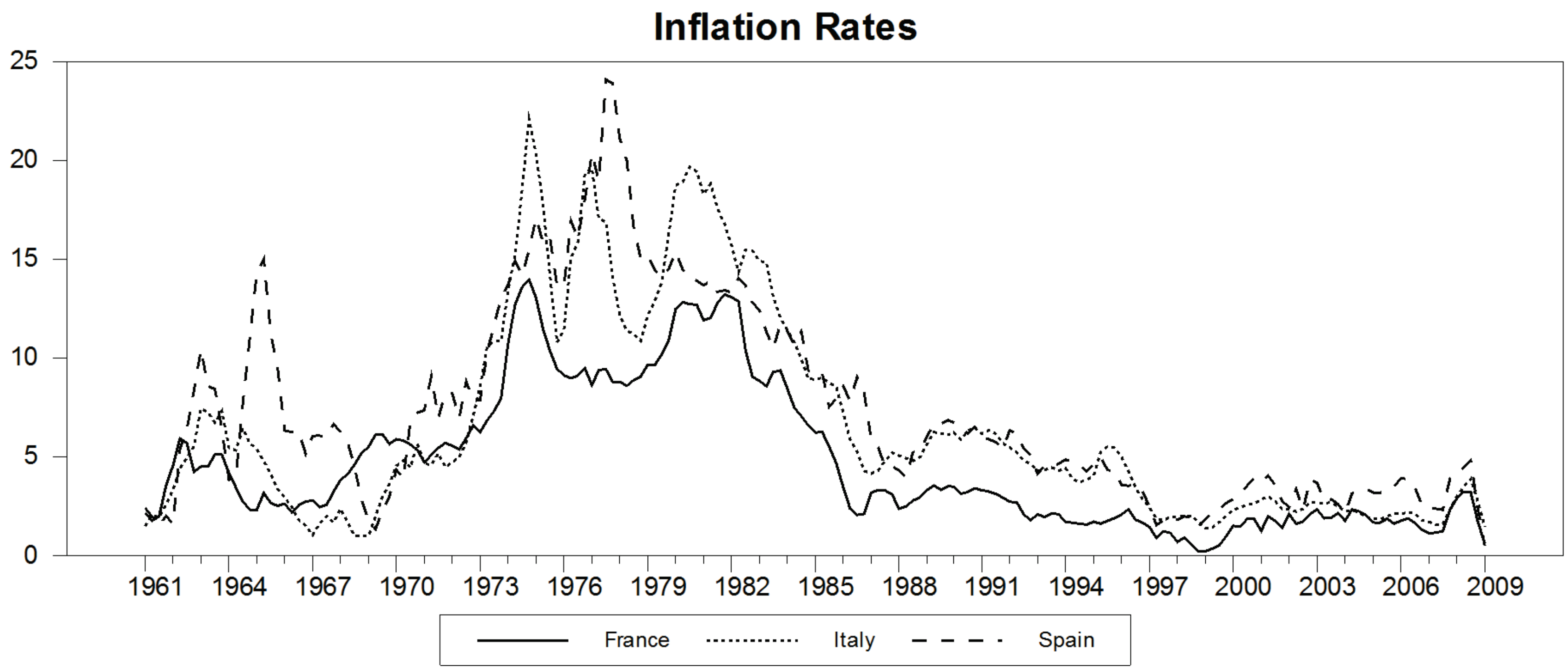
Note: The figure above displays the output gaps for France, Italy, and Spain as measured by the deviation of industrial production from an HP trend.

Figure 3a: EU Small Country Inflation Rates



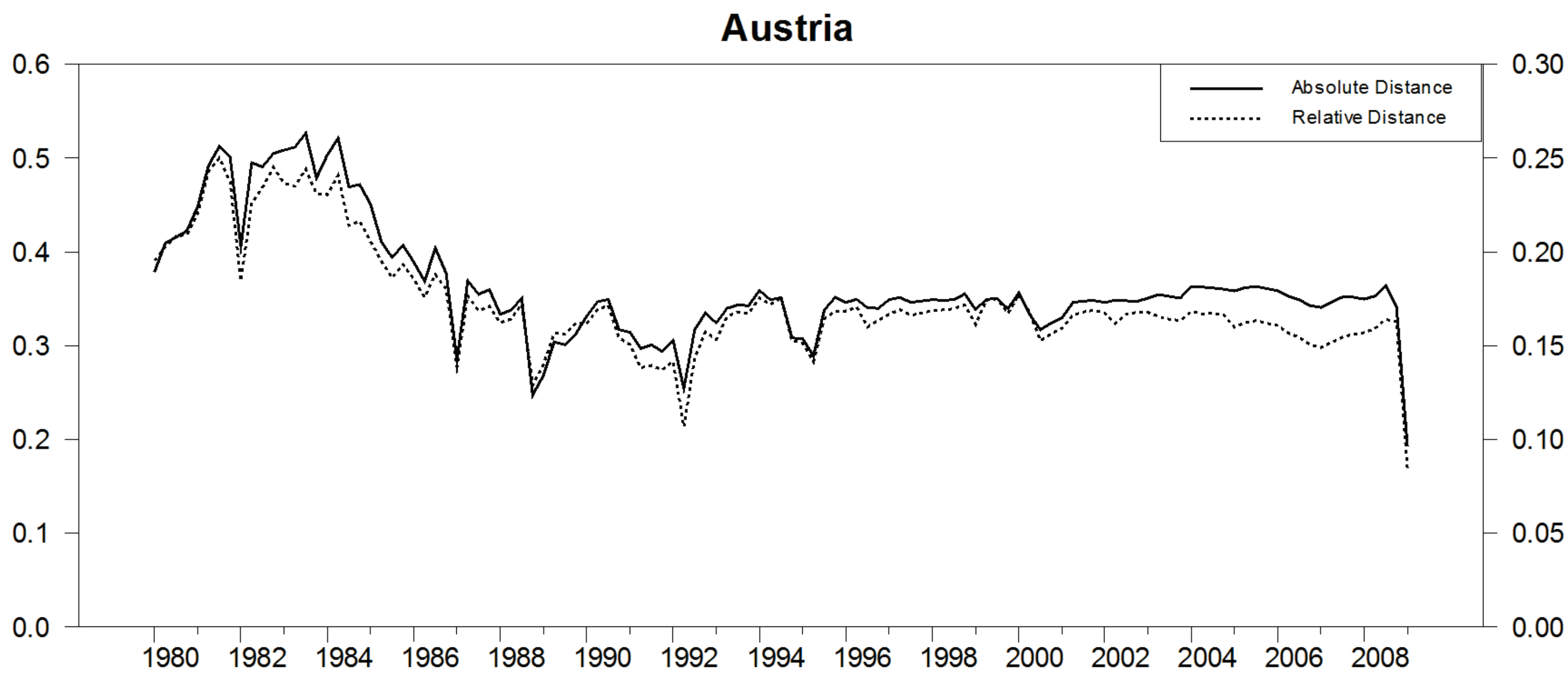
Note: The Figure above displays the inflation rates as defined by the year-over-year percentage change in the consumer price index.

Figure 3b: EU Large Country Inflation Rates



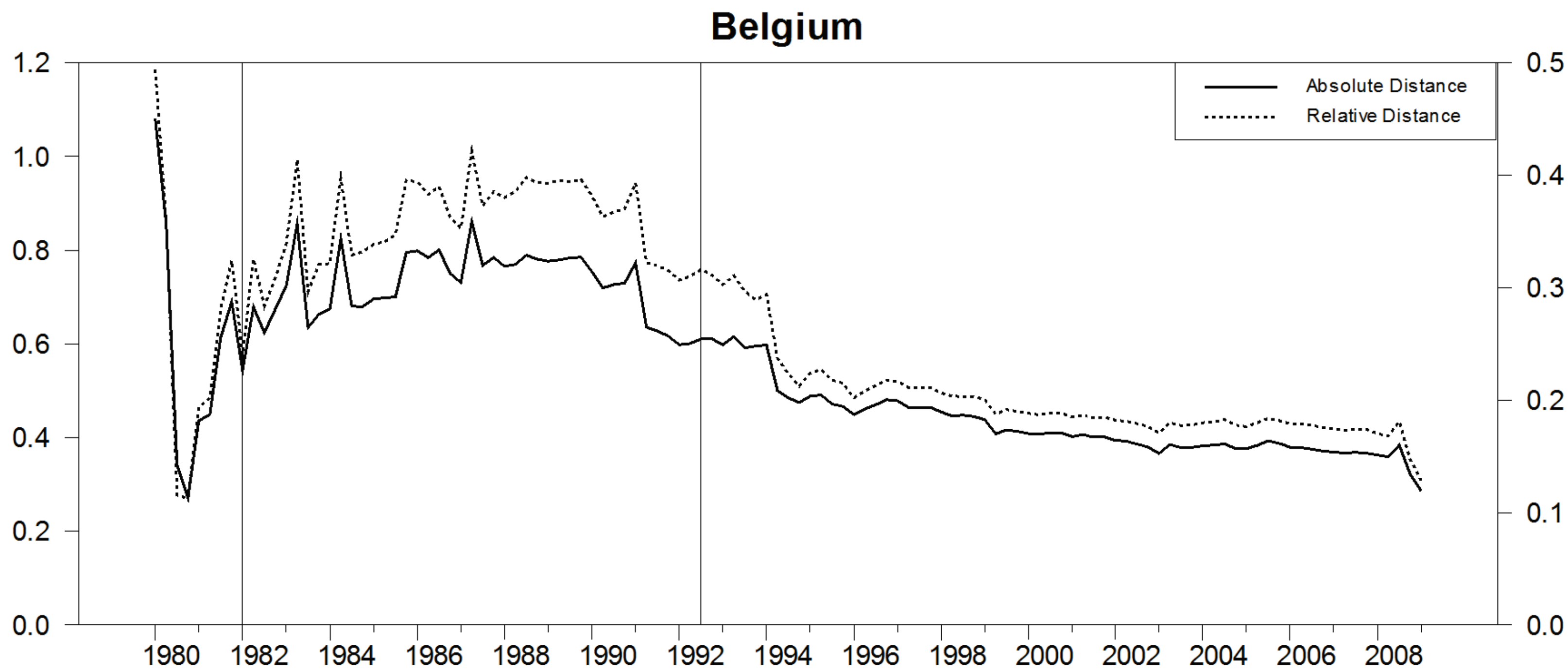
Note: The Figure above displays the inflation rates as defined by the year-over-year percentage change in the consumer price index.

Figure 4a: The Austrian Economy's Distance from Taylor Curve



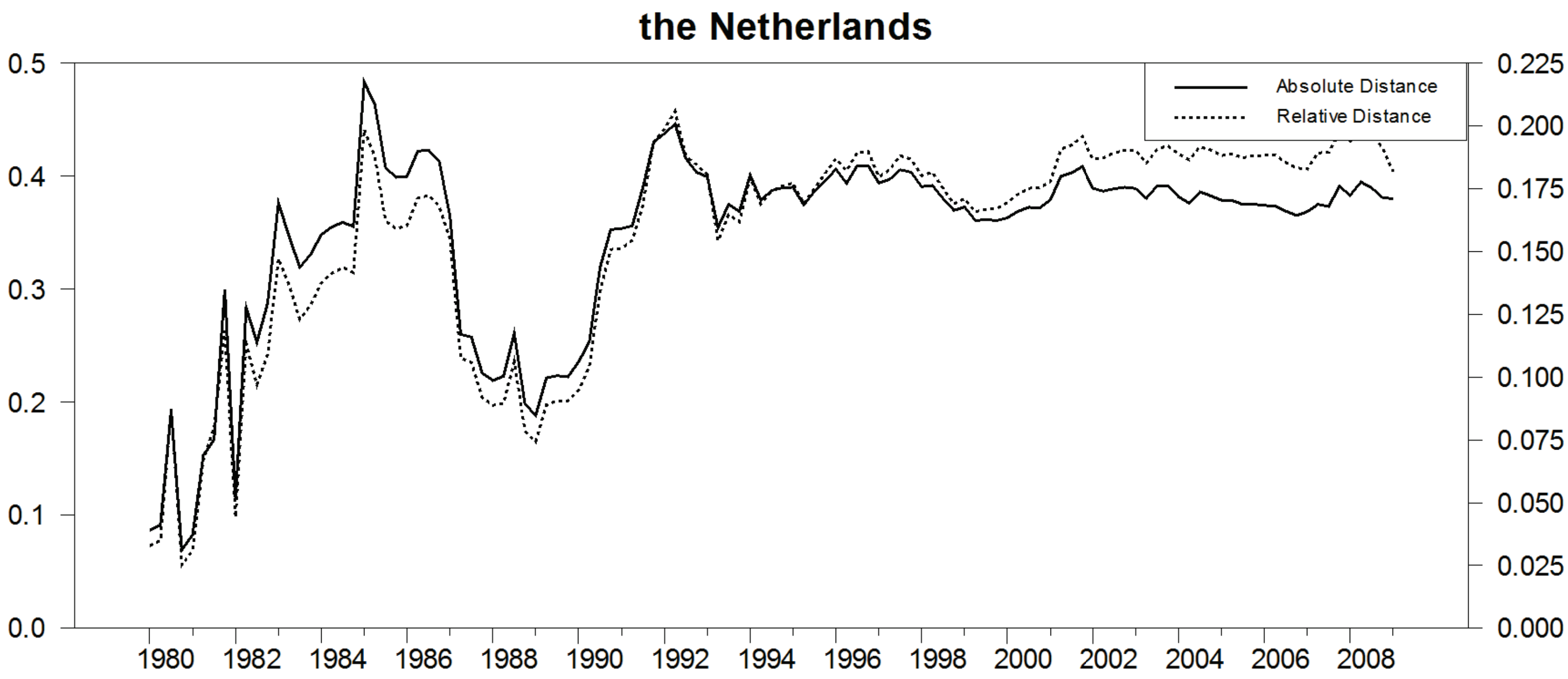
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 4b: The Belgian Economy's Distance from Taylor Curve



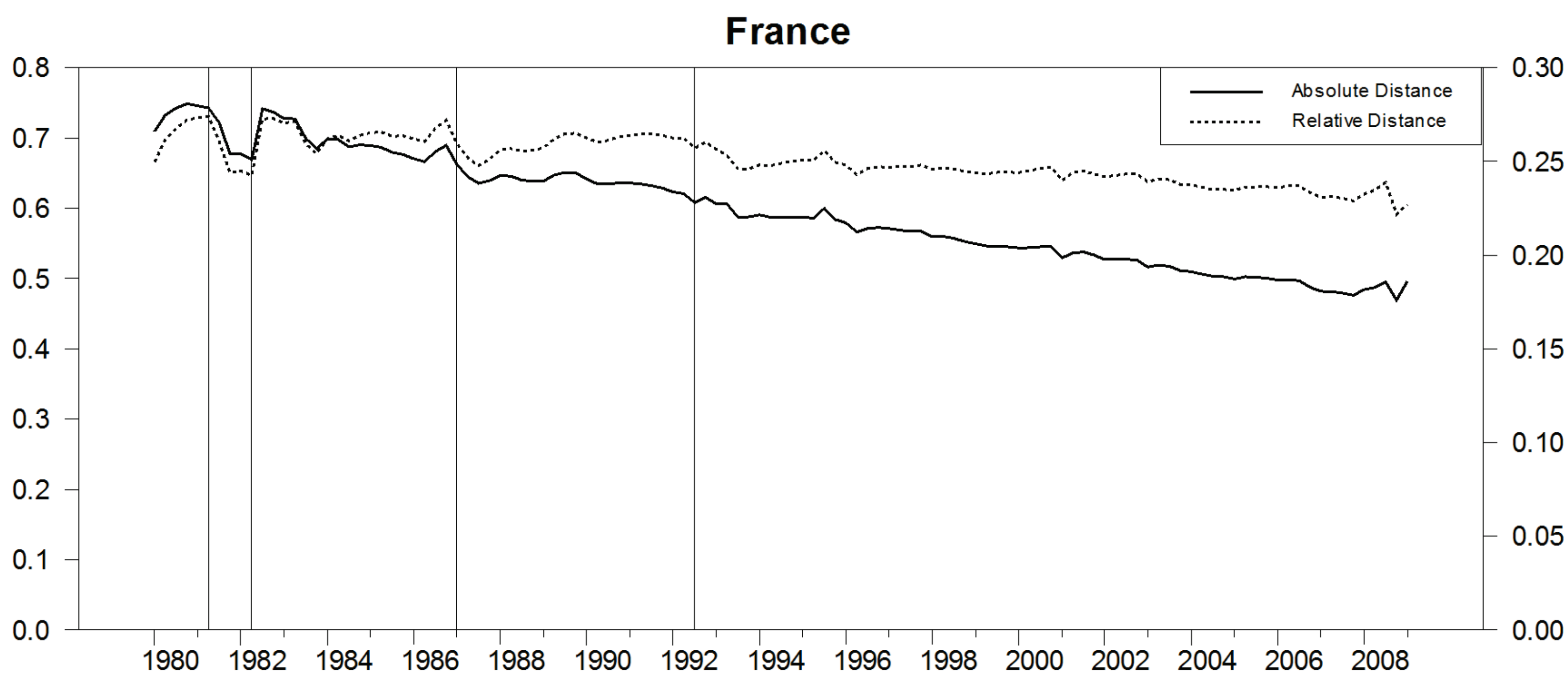
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 4c: The Netherlands Economy's Distance from Taylor Curve



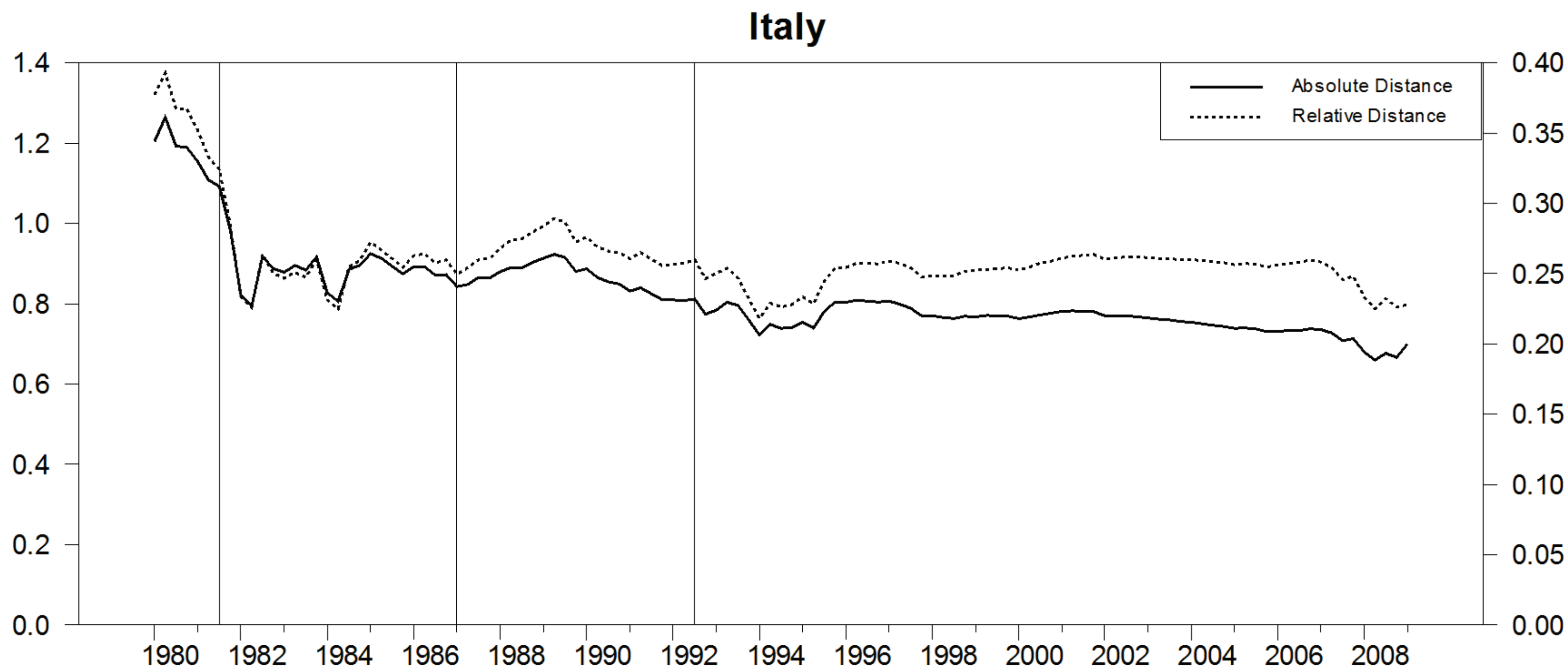
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 4d: The French Economy's Distance from Taylor Curve



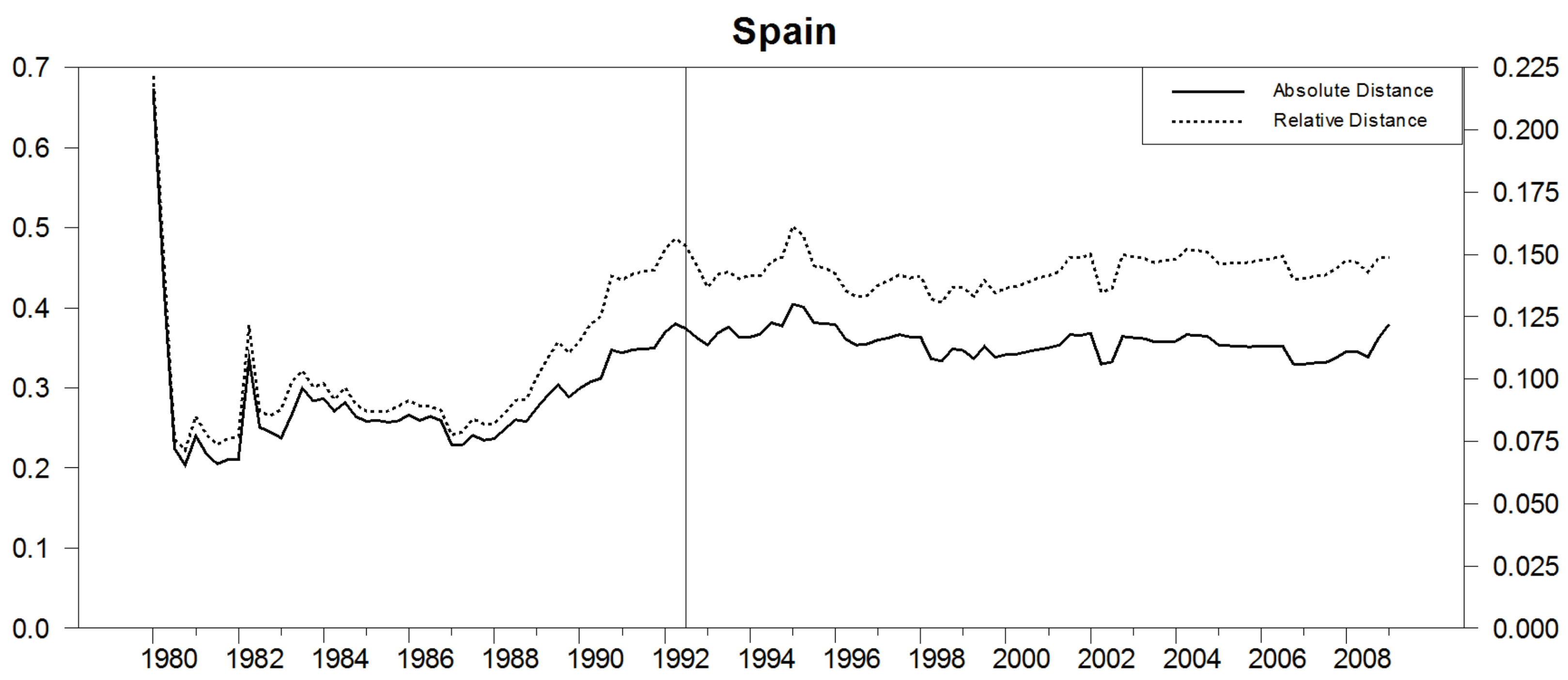
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 4e: The Italian Economy's Distance from Taylor Curve



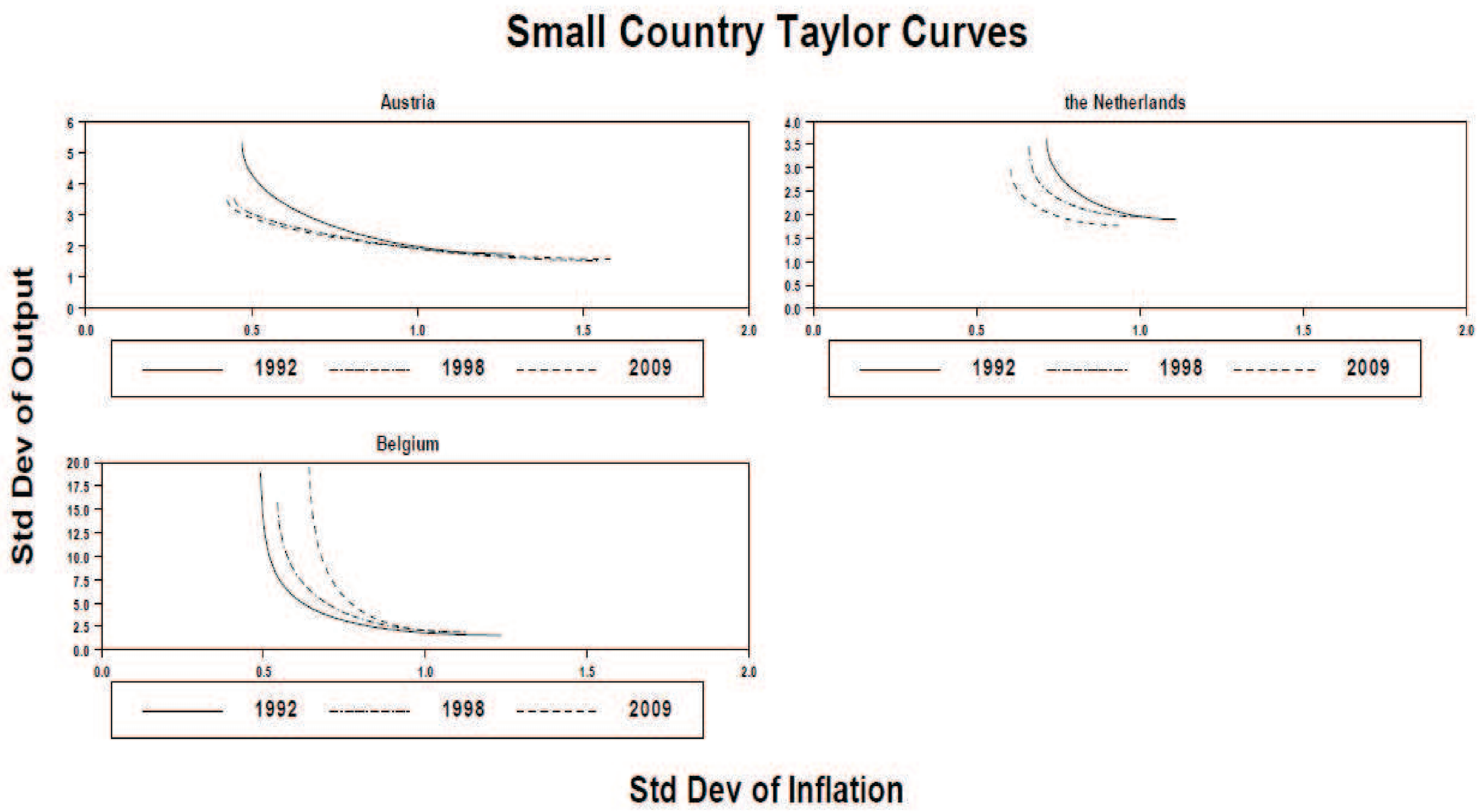
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 4f: The Spanish Economy’s Distance from Taylor Curve



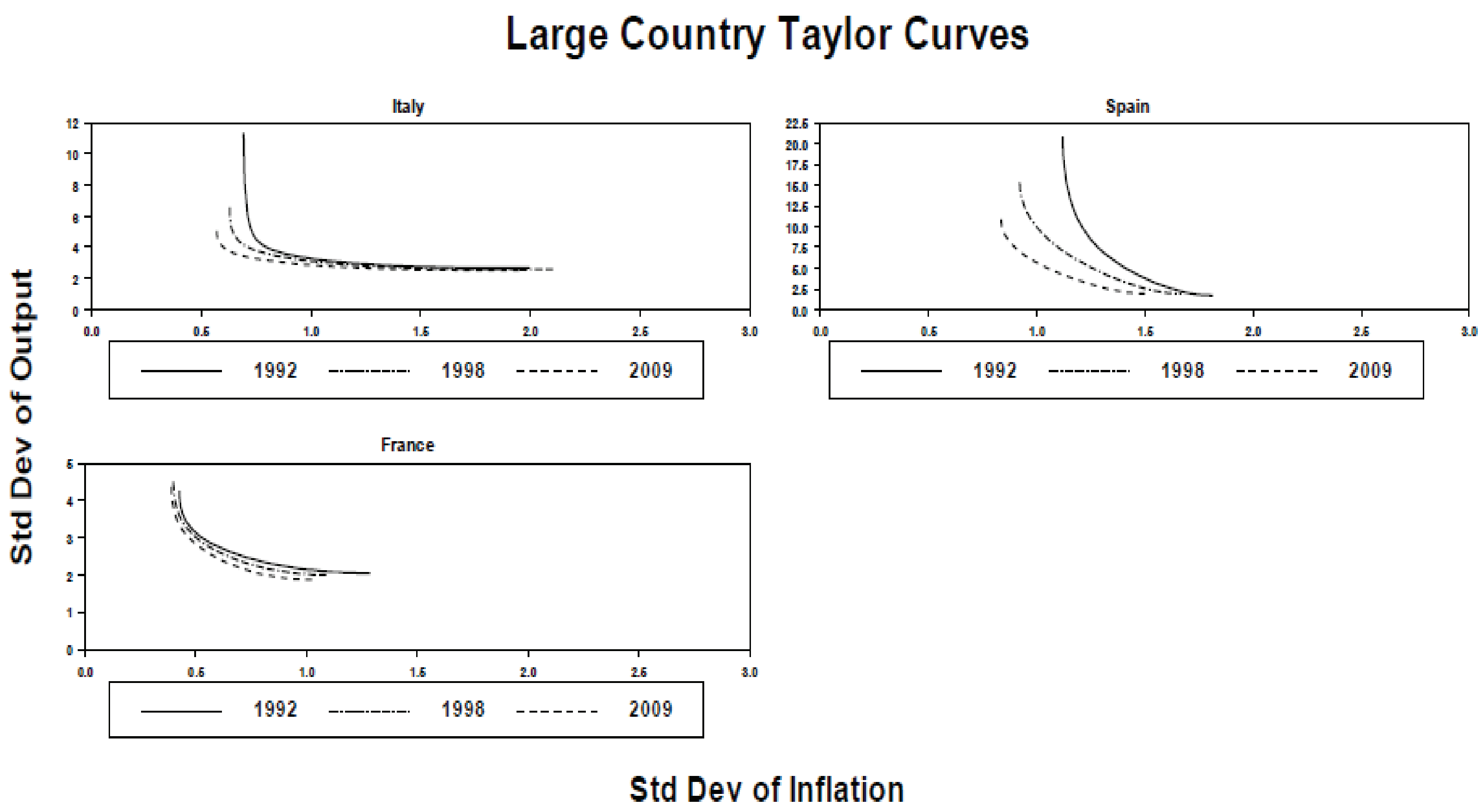
Note: The solid line is a measure of the orthogonal distance between the observed volatilities and the Taylor curve at each point in time. The dotted line is a relative distance measure to account for shifts in the Taylor curve and is calculated by dividing the minimum orthogonal distance between the observed volatilities and the Taylor curve by the minimum distance of the Taylor curve to the origin at each point in time.

Figure 5a: Small Country Taylor



Note: The above figure displays 3 Taylor curves for each country corresponding to major dates of European integration.

Figure 5b: Large Country Taylor Curves



Note: The above figure displays 3 Taylor curves for each country corresponding to major dates of European integration.