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Does the Financial Market Believe in the Phillips Curve? – Evidence from the G7 countries

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Does the Financial Market Believe in the Phillips Curve? - Evidence from the G7 countries

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April 2008
Preliminary Version

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Keywords: Phillips curve, Forecasting, Panel data model
JEL classification: C23, E37, E31

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Abstract

This paper uses monthly survey data for the G7 countries for the time period 1989 - 2007 to explore the link between expectations on nominal wages, prices and unemployment rate as suggested by the traditional and Samuelson-and-Solow-type Phillips curve. Three major findings stand out: First, we find that survey participants trust in the original as well as the Samuelson-and-Solow-type Phillips curve relationship. Second, we find evidence in favor of nonlinearities in the expected Samuelson-and-Solow-type Phillips curve. Third, when we take into account a kink in the expected Phillips curve indicating that the slope of the Phillips curve differs during the business cycle, we find strong evidence of this feature in the data which confirms recent theoretical discussions in the literature that the Phillips curve is flatter in case of an economic downturn.

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1 Introduction

In his seminal paper Arthur W. Phillips (1958) investigates the link between the change in nominal wages and the unemployment rate in the UK for the period 1862 - 1957 by means of the following equation:

$$w_t - w_{t-1} = \alpha + \beta_1(u_t - u_{t-1}) + \epsilon_t, \tag{1}$$

where $w_t - w_{t-1}$ and $u_t - u_{t-1}$ refer to changes in nominal wages and the unemployment rate and ϵ_t is an idiosyncratic error term. Phillips (1958) finds that increasing wages are associated with a lower level of unemployment. Samuelson and Solow (1960) argue that the negative sign of β_1 is due to an increase in bargaining power of workers in periods which reflects lower levels of unemployment. In such a situation it seems easier to increase wages. This so-called traditional Phillips curve has been extended by taking changes in the overall price level into account. Samuelson and Solow (1960) modified the traditional Phillips curve by assuming that companies incorporate a rise in nominal wages in their goods prices leading to an increase in the overall price level. Samuelson and Solow (1960) find evidence of a negative relationship between the inflation rate and unemployment rate by estimating the following relationship:

$$\pi_t = \alpha + \beta_2(u_t - u_{t-1}) + \epsilon_t, \tag{2}$$

where π_t represents the current inflation rate. The Phillips curve discussion has gained significant importance in economic theory and policy. Although the structure of the Phillips curve is simple, it apparently allows policy makers to determine a certain level of inflation and unemployment. Friedman (1968) and Phelps (1967) contribute to the Phillips curve discussion by claiming that this negative relationship will only persist in case of money illusion. They argue that, in fact, there exist no long-term relationship between inflation and unemployment. They claim that the coefficient of β_2 is not statistically different from zero in the long-term. Moreover, Friedman (1977) argues that countries which experience high inflation rates suffer from high menu costs such as frequent labor negotiations and information costs. Therefore, it is not unlikely if possible that higher inflation rates produce higher social costs in terms of higher unemployment. This would ultimately yield an upward sloping Phillips curve.

This paper analyzes whether financial market participants believe in the Phillips curve in the way that professional forecasters adopt this relationship by forecasting nominal wages, inflation rates and unemployment rates. More precisely, we investigate whether the forecasts of those economists are in line with the textbook Phillips curve in its different versions. Since the Phillips curve states that nominal wages, inflation and unemployment rate are linked through a certain relationship, it is possible to check whether forecasts are internally consistent (i.e., display relationships known from previous estimations of the Phillips curve) or whether they are inconsistent in a sense that academia is concerned with the relationship while the financial market does not employ this reasoning in its forecasts.

The rest of the paper is structured as follows: The subsequent section 2 describes the data set employed. While Section 3 presents the empirical model and the estimation results of the expected linear Phillips curve. Section 4 and 5 include asymmetries into the model. Section 6 concludes.

2 The Data

We use monthly survey data provided by Consensus Economics Inc. on professional economists' forecasts for the G7 countries, i.e. Canada, France, Germany, Italy, Japan, the UK and the USA. The survey is available for the sample period from October 1989 to December 2007 on a monthly basis and, therefore, covers 219 periods. It includes individual forecasts of several macroeconomic variables such as the change in nominal wages, the unemployment rate and the inflation rate. Table 1 provides an overview and summarizes the main features of the data set. It also shows that the expectations on the macroeconomic variables were on average a good predictor for the actual value. For instance, for Germany the average forecasts for the inflation and unemployment rate (2.12 and 9.88 percent) are close to the actual average values of 2.16 and 9.62 percent, respectively. Only for France and Italy the unemployment forecasts (10.37 and 10.29 percent) differ noticeably from the actual values (9.98 and 9.44 percent, respectively). However, we leave the discussion of the accuracy of the forecasts to further research. Table 1 also shows that only for France, the UK and the USA the wage growth rate is available for the full time period while for Canada the survey provides wage forecast only as of August 2004 and for the remaining countries as of the early 1990's. However, the forecasts only differ slightly from the actual values for the respective period. This undermines that the forecasts provided by Consensus Economics Inc. are on average very good predictors for the actual variable.

– Insert Table 1 about here –

The survey participants are professional economists working for universities and financial institutions such as international economic research institutes, investment and commercial banks. The number of professional economists participating in the survey varies form country to country. It is highest for the UK (66 forecasters) and lowest for Canada (37 forecasters). Since our data set is an unbalanced panel and in order to investigate the time series characteristics of the expectation formation process, we need to apply a minimum participation frequency of each forecaster. Therefore, we only include those forecasters in our analysis, who participated at least ten times in the poll. We also used other minimum participation rates. The results, however, do not change and are available upon author's request.

Furthermore, the survey covers two different forecast horizons, namely forecasts for the end of the current and the end of the next year. This allows us to estimate the Phillips curve relationship for two different forecast horizons, i.e. forecasts with an average forecast horizon of six months and forecasts with an average forecast horizon of 18 months. Hence, we refer to the short-term when applying forecasts for the current year and refer to the long-term when applying forecasts for the next year.

One potential drawback of our analysis is the problem of overlapping forecast horizons since the monthly data set provides forecasts for the respective year. This means that a forecaster who experienced a high (low) forecast error in period $t-1$ most likely exhibits a high (low) forecast error in period t. This obviously leads to serial correlation in the error terms by construction. In order to overcome this shortcoming we use a serial correlation model to account for the autocorrelation in the error term. We, therefore, allow the error term of each forecaster i to depend on their past realization in the way that:

$$\epsilon_{t,i} = \phi_i \epsilon_{t-1,i}, \tag{3}$$

where the autoregressive term ϕ_i measures the degree of persistence in the error term and it is assumed that $0 < \phi_i < 1$. Equation (3) underlies our econometric analysis investigating the linear Phillips curve relationship which begins in the subsequent section.

3 The Model and Estimation Results for the Linear Phillips Curve

In order to evaluate the adoption of the Phillips curve relationship among survey participants, we start our empirical model by estimating whether the traditional relationship proposed by Phillips (1958) prevails in the forecasts of the professional economists. Therefore, we estimate the following specification separately for each country:

$$E_{t,i}[w_{t+j} - w_t] = \alpha_i + \beta_{1,i}(E_{t,i}[u_{t+j} - u_t^{nat}]) + \frac{1}{k}\,\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}, \quad (4)$$

where j $E_{t,i}[w_{t+j} - w_t]$ denotes the expected change in nominal wages of forecaster i at time t for the forecast horizon j with $j = 1$ (short-term) or 2 (long-term). $E_{t,i}[u_{t+j} - u_t^{nat}]$ refers to the difference between the expected unemployment rate and the time-varying natural rate of unemployment (TV-NAIRU). For the TV-NAIRU we use the data provided by the OECD for each country respectively which is available on a quarterly basis. In order to obtain the TV-NAIRU on a monthly basis we basically interpolate the series. This seems to be appropriate to us as the TV-NAIRU is a long-term concept the NAIRU and, hence, does not change dramatically on a quarterly basis. Additionally, $\sum_{k=1}^{19} year_k$ reflects the time fixed-effect for each year before 2007. Put differently, for each year a single constant is estimated where the expression $\sum_{k=1}^{19} year_k$ measures the difference to the constant term which reflects time effect of the year 2007. Finally, ϵ_t denotes the idiosyncratic error term where equation (3) applies for the autoregressive process of the error term.

Subsequently, we estimate equation (4) in a time-fixed effects model for all G7-countries. As suggested by the traditional Phillips curve $\beta_{1,i}$ is expected to be negative indicating the trade-off relationship between the change in nominal wages and unemployment rate.

Table 2 shows the results for the short-term and long-term traditional Phillips curve in the time-fixed effects specification. All long-term coefficients show the expected negative sign while only for Italy the short-term as well as the long-term coefficients are not significantly different from zero. The long-term Phillips curve relationship is expected to be the strongest for Japan with a value of -0.63 reflecting that an expected one percent decrease of the unemployment rate in Japan is associated with an excepted increase in nominal wages of about 0.63 per cent. The short-term relationship is also expected to be negative with the exception of Canada and Germany. While for the latter this result might be attributed to the aftermaths of Germany's reunification in 1990 for Canada wages forecasts are only available from 2005 onwards. Hence, the database might be of limited use for analyzing the original Phillips curve in case of Canada. However, the persistence of the error terms is significant and the autoregressive term (AR) ranges between 0.74 and 0.85. Additionally, the time-fixed effects (indicated as "TFE" in Table 2) specification is highly significant which basically reflects a shift of the constant term α_i over time. Put differently, the part of the nominal wage change that can not be attributed to a change in the unemployment rate is varying over time.

– Insert Table 2 about here –

We now turn to the Samuelson-and-Solow-type Phillips curve. Samuelson and Solow (1960) suggest that an increase in nominal wages pushes business companies to increase the prices of their produced goods leading ultimately to a change in the overall price level. Figure 1 shows the relationship between expected inflation and unemployment rates exemplarily using long-term forecasts for Japan. From Figure 1 it can clearly be seen that the negative relationship prevails in case of Japan for the whole sample period of 19 years. We now modify the traditional Phillips curve in the way suggested by Samuelson and Solow (1960) and use the expected inflation rate instead of the expected change in nominal wages as the dependent variable:

$$E_{t,i}[\pi_{t+j}] = \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+j} - u_t^{nat}]) + \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}, \tag{5}$$

where $E_{t,i}[\pi_{t+j}]$ represents the expected inflation rate and all other notations being the same as before. Table 3 represents the results estimating equation (5). Four findings stand out: First, with the exception of Germany the financial market predicts a negative long-term relationship between the long-term relationship between unemployment and inflation rate as suggested by the Samuelson-and-Solow-type Phillips curve. This relationship is strongest in case of forecasts for the Japanese economy with a value of -0.25. Second, the short-term relationship between unemployment and inflation rate is negative for 4 out of 7 economies with values between -0.16 and -0.29 for the UK and Canada, respectively. Only for France, Italy and Germany the short-term coefficient is positive which basically reflects the positive relationship estimated by the expected original Phillips curve from our previous analysis. Third, the time fixed-effects are significant. This can be attributed to changes in the long-term unemployment rate. Fourth, the persistence of the error terms is significant and ranges from 0.69 to 0.95 undermining our choice of model specification.

Additionally, Table 3 offers the opportunity to compare the actual and the expected inflation rate inherent in the Phillips curve. The expected inflation rate is calculated as the average time-fixed effect for the respective period assuming that $E_{t,i}[u_{t+1}] = u_t^{nat}$ for a five-year period. Using the estimates of the short-term specification this yields the average expected inflation rate ($E_{t,i}[\pi_{t+1}]$ which can be compared to the actual inflation rate. Table 3 shows that the five-year average inflation forecasts are very close to the actual inflation rate for the respective five-year period. For instance, the expected inflation rate for the time period 1994 to 1998 for Japan (Germany) is .65 (1.82) while the actual inflation rate is 0.66 (1.61). Of course this undermines our previous argument that the forecasts are on average good predictor for the actual outcome, but moreover the forecast accuracy is even good if we assume that the survey participants apply the Philips curve relationship. Put differently, applying the expectation formation process yields good predictors in the framework of the Samuelson-and-Solow-type Phillips curve.

As it stands, the Samuelson-and-Solow-type Phillips curve is fairly accepted by professional forecasters except for Germany which, however, experienced the reunification during our sample period. We now depart from estimating the linear Phillips curve and turn to the specification that has been dominant in the recent literature, i.e. the non-linear Phillips curve.

– Insert Table 3 and Figure 1 about here –

4 Expectations on the Nonlinear Phillips Curve

The recent discussion (Laxton et al., 1999) on the Phillips curve has focused on whether the curve shows a nonlinear feature in the sense that it exhibits a certain degree of skewness. The reason is that in a recession a further increase in unemployment does not produce much disinflation. Or, to put it differently, in a situation of an economic downturn when production slows down and the unemployment rate increases, an expansionary monetary policy can stimulate production and decrease the unemployment rate by slightly increasing inflation. This ultimately yields a relatively flat Phillips curve reflecting a pronounced trade-off between inflation and unemployment rate in times of an economic downturn (Laxton et al., 1999). Contrary to that, the ability of the monetary policy to affect the economy in times of an economic boost is limited to nominal variables only (i.e. the inflation rate). When the economy is overheated an increase in unemployment produces faster disinflation leading to a less pronounced relationship and a steeper Phillips curve. In functional terms this means that the Phillips curve is convex rather than being a linear relationship. This feature might be already drawn from the inspection of Figure 1 where the expected Phillips curve relationship is displayed for Japan.

This asymmetry has important implications for the conduct of monetary policy. If the Phillips curve is of linear type, positive and negative demand shocks will have equal effects on inflation and the overall effect will average to zero, regardless of the response of the monetary policy. Contrary to that, in case of an asymmetric Phillips curve, positive shocks to demand raise inflation to a greater extent than negative shocks of the same magnitude lower it. This implies that early actions to counteract inflation pressures can reduce the need to take stronger disinflation action later. Moreover, to the extent that a prompt monetary policy response can succeed in stabilizing employment, it will also lower the average rate of unemployment (Laxton et al., 1999).

The asymmetry of the Phillips curve is recently analyzed using the actual development for different countries. The results are, however, ambiguous and depend on the country as well as the methodology that is applied to implement the skewness into the Phillips curve. Laxton et al. (1999) show that the convex form fits the US data better than a linear alternative. Contrary to that, Stiglitz (1997) and Eisner (1997) show that asymmetric price setting in monopolistically competitive markets is consistent with a concave Phillips curve. Stiglitz (1997) advocates a Phillips curve for the USA with a kink at the NAIRU and finds that the best fit is with a concave function.

For our subsequent analysis we first follow Laxton et al. (1999) and directly implement the skewness of the expected Phillips curve in our model before we, secondly, take the approach of Stiglitz (1997) into consideration and indirectly measure asymmetries by allowing for a kinked Phillips curve. As a first step of investigation the non-linear relationship displayed in forecasts of inflation and unemployment rate we include an additional coefficient β_3 in equation (6):

$$\begin{aligned} E_{t,i}[\pi_{t+j}] &= \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+j} - u_t^{nat}]) + \beta_{3,i}(E_{t,i}[u_{t+j} - u_t^{nat}])^2 \\ &+ \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}, \end{aligned} \tag{6}$$

where β_3 captures the nonlinear relationship between the expected deviation of the unemployment rate from its natural level and the expected inflation rate and all other notations being the same as before. If there exists a convex relationship between unemployment and inflation rate forecasts the parameter β_3 is estimated with a positive sign, whereas a concave function is reflected by a negative sing of β_3.

Table 4 represents the results estimating equation (6). The introduction of the nonlinear feature into the expectation formation process of the Phillips curve does not change the results substantially. However, two main findings stand out: First, the long-term negative relationship between unemployment and inflation rates in the expectation formation process still prevails in the G7 countries except for France, Germany and the USA. The negative relationship is again expected to be strongest in Japan with values about -0.29. Contrary to that, there exists no short-term relationship in forecasts for Germany and Italy.

Second, the coefficient β_3 capturing the nonlinear effect is significantly different from zero for Canada, France, Japan, the UK and the USA. For Japan (long-term) and the UK we find that that β_3 is positive and, hence, displays the expected convex relationship. For Canada, France and the USA, we find a concave relationship which supports the argument of Stiglitz (1997) and Eisner (1997) stating that the actual Phillips curve of the USA is indeed concave. This can be attributed to the asymmetric price setting argument raised by Stiglitz (1997). In monopolistic competitive markets producers adjust prices downwards to avoid being undercut by a rival but will be more reluctant to raise prices even in the face of generally rising prices. This ultimately leads to a concave Phillips curve.

Additionally, Table 4 allows us to compare the expected to the actual average inflation rate. Since the constant terms and the time-fixed effect coefficient reflect the inflation rate at which the expected unemployment rate equals the NAIRU both add up to the expected average inflation rate. For instance, for Germany (short-term) the constant term is 1.54 and the time-fixed effects coefficient is 0.60. Both add up to an expected inflation rate of 2.14 per cent. This exactly mirrors the realized average inflation rate of 2.1 per cent also reported in Table 4. For the other countries, the expected and the realized average inflation rate are also close to each other. Put differently, the forecasts of inflation rates are on average a good predictor for the actual inflation development even in the context of the non-linear Phillips curve.

In sum, we find evidence for the adoption of nonlinear relationships by financial market participants as suggested by the recent literature on the Phillips curve relation. Moreover, we find country specific nonlinearities in the relationship between unemployment and inflation rate forecasts, for instance a concave Phillips curve for the USA and a convex function for Japan which are well established by empirical analysis on the actual development of unemployment and inflation rates. Figure 2 plots the unemployment and inflation rate forecasts for the long-term relationship for Japan. The solid line represents the expected nonlinear relationship as suggested by estimating equation (5) and results obtained in Table 4. Figure 2 emphasizes on the nonlinear relationship of unemployment and inflation rate forecasts and shows that indeed, the slope is not constant along the expected Phillips curve.

– Insert Table 4 and Figure 2 about here –

As a potential drawback Laxton et al. (1999) argue that the analysis of a nonlinear Phillips curve is only appropriate when the data exhibit a certain amount of extreme values. Put differently, to measure convexity additionally to the linear relationship requires that the data set contains sufficient observations at the extreme points of the Phillips curve. If the number of these observations are insufficient the analysis would fail to detect nonlinearities. In order to circumvent the reproach that our data set might not have sufficient extreme values and, hence, our model might not be capable in detecting nonlinearities we now investigate the nonlinear relationship between inflation and unemployment rate forecasts by the means of a kinked Phillips curve as advocated by Stiglitz (1997).

5 Expectations on the Kinked Phillips Curve

We now analyze the kinked Phillips curve which allows us to investigate asymmetries in the Phillips curve even if we have not sufficient extreme values in the data set. We follow the argument before that the Phillips curve trade-off is expected to be more pronounced in an economic downturn compared to an economic boost. Again, the reason is that in a recession a further increase in unemployment does not produce much disinflation reflected by a relatively flat Phillips curve. Contrary to that, the ability of the monetary policy to affect the economy in times of an economic boost is limited to monetary variables only (i.e. the inflation rate) as reflected by a steep Phillips curve. In order to separate expectations over the business cycle we include a recession dummy $D(.)$ in equation (7):

$$
\begin{aligned}
E_{t,i}[\pi_{t+j}] &= \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+j} - u_t^{nat}]) \\
&+ \gamma D(E_{t,i}[u_{t+j} - u_t^{nat}])E_{t,i}[u_{t+j} - u_t^{nat}] \\
&+ \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}, \qquad (7)
\end{aligned}
$$

where $D(.)$ assumes the value of unity whenever the unemployment rate is expected to be higher than its natural rate provided by the OECD database, and zero otherwise. Put differently, $D(.)$ captures periods in which the professional forecaster expects the unemployment rate to be higher than its natural level, i.e. the forecaster expects an economic downturn. This leads to a kinked Phillips curve with different slope parameters for boost and bust periods. The coefficient γ basically measures the difference of the slope parameter between these periods. If the Phillips curve trade-off is expected to be more pronounced in the economic downturn, γ is positive reflecting a flatter Phillips curve in a recession compared to an economic boost. The coefficient β_2 basically reflects the slope parameter in case of an economic boost as γ is zero in that case. In order to estimate the total slope of the kinked Phillips curve in an economic downturn we only have to add up β_2 and γ which are in sum expected to be negative.

Table 5 presents the estimation results of equation (7) where the second row reflects the β_2 coefficient when $\gamma = 0$ (i.e. slope in an expected economic boost) and the last row represents the slope coefficient when an economic downturn is expected (i.e. $\beta_2 + \gamma$). Three findings stand out: First, we find a negative Phillips curve relationship in the forecasts for Canada, France, Germany (long-term), Japan and the UK in case of an economic boost as indicated by the significantly negative coefficient β_2 in Table 5 while for the other countries the β_2 coefficient is not significant.

Second, for all countries the slope of the expected Phillips curve crucially depends on the expected economic situation at least in one specification. This is indicated by the significant γ coefficients. Apparently, the slope coefficients differ between an expected recession and an expected boom yielding the kinked Phillips curve.

Third, the long-term slope coefficient (i.e. $\beta_2 + \gamma$) in times of an expected recession is negative for all G7-countries except for Germany. Apparently, the financial market expects the sacrifice ratio to be higher in case of an economic downturn compared to an economic boost. This result supports the argument mentioned in the literature (Laxton et al., 1999), that the impact of the Phillips curve in times of an economic boost is limited.

– Insert Table 5 about here –

Figure 3 plots the unemployment and inflation rate forecasts for the long-term relationship for Japan. The solid line represents the expected kinked relationship as suggested by estimating equation (7) and results obtained in Table 5. Figure 3 clearly emphasizes that the trade-off between both variables is not expected to be constant over the business cycle. Periods of an economic downturn which are located on the right hand side of Figure 3 show a lower slope of the expected Phillips curve compared to points of an expected boost located on the left hand side of Figure 3.

– Insert Figure 3 about here –

In sum this section provides evidence in favor of a nonlinear relationship between expected inflation and unemployment rates. The reason being is that during our sample period from 1989 - 2007 the long-term relationship between these variables has changed. As a matter of fact, if convexity in the short-term Phillips curve becomes higher at low inflation rates, then the long-term Phillips curve would not be vertical but rather horizontal (Akerlof et al., 1996). We take this result as evidence that the financial market applies not only the simple Phillips curve relationship but is also aware of feature of the Phillips curve that have been evolved in the recent time. To undermine this argument the next section examines the most recent development in the Phillips curve discussion namely the expectations augmented Phillips curve.

6 Conclusion

This paper uses the disaggregated Consensus Forecast poll to analyze whether professional economic forecasters believe in and, thus, apply the traditional and Samuelson-and-Solow-type Phillips curve relationship for their own forecasts. Three findings stand out: First, we find that survey participants trust in the original as well as the Samuelson-and-Solow-type Phillips curve relationship. Second, we find evidence in favor of nonlinearities in the expected Samuelson-and-Solow-type Phillips curve. Although the skewness of the expected Phillips curve differs among countries, empirical studies on the actual Phillips curve indicate that this feature is also present in the actual data. For instance, for the USA we find a concave expected Phillips curve which is also found by Stiglitz (1997) analyzing the actual Phillips curve. Third, we take into account a kink in the expected Phillips curve indicating that the slope of the Phillips curve differs during the business cycle. We find strong evidence of this feature in the data which confirms recent theoretical discussions in the literature that the Phillips curve is flatter in case of an economic downturn.

However, we do not claim that each and every financial market participant is aware of the Phillips curve relationship but we find overwhelming evidence that the financial market adopts this macroeconomic model - may be unknowingly- to forecast real sector variables.

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Table 1: Overview of the monthly data for the G7 countries

Country	Canada	France	Germany	Italy	Japan	UK	USA
Wage Growth Rate since	08/04	10/89	12/91	03/93	12/91	10/89	10/89
Short-term	3.03	3.08	2.74	2.93	0.77	4.98	3.66
Long-term	3.07	3.09	2.69	2.94	1.21	5.01	3.74
Actual Wage Growth Rate (mean)	3.15	3.23	2.59	2.83	0.98	4.79	3.95
Source IMF (since)	(2005)	(1990)	(1992)	(1994)	(1992)	(1990)	(1990)
CPI Forecasts since	10/89	10/89	10/89	10/89	10/89	10/89	10/89
Short-term	2.33	1.92	2.12	3.32	0.55	3.12	2.88
Long-term	2.34	1.95	2.13	3.03	0.63	3.08	2.85
Actual CPI Growth (mean)	2.22	1.85	2.16	3.35	0.55	3.38	2.91
Source IMF (1989 -2007)							
Unemployment Rate Forecast since	10/89	10/89	10/89	10/89	10/89	10/89	10/89
Short-term	8.39	10.37	9.88	10.29	3.80	5.60	5.47
Long-term	8.19	10.15	9.71	10.08	3.85	5.64	5.47
Actual Unemployment Rate	8.48	9.98	9.62	9.44	3.77	5.33	5.47
Source IMF (1989 -2007)							

Notes: Table 1 shows the expected and the actual mean of the variables under investigation over the sample period Oct 1989 - December 2007.

Table 2: Expectations on the Original Phillips Curve for the G7 Countries

Countries	Canada		France		Germany		Italy		Japan		UK		USA	
Horizon	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Constant	3.21*	2.96*	2.10*	2.06*	2.02*	2.19*	2.01*	1.89	.38*	.72*	2.62*	3.13*	2.46*	2.45*
	(.19)	(.18)	(.01)	(.01)	(.01)	(.01)	(.02)	(.02)	(.02)	(.02)	(.01)	(.01)	(.02)	(.01)
Δ UN	-.34	-.47*	-.19*	-.18*	.06*	-.08*	-.02	-.01	-.49*	-.63*	-.43*	-.21*	-.09+	-.11*
	(.22)	(.13)	(.03)	(.02)	(.02)	(.01)	(.04)	(.03)	(.09)	(.06)	(.02)	(.01)	(.04)	(.03)
TFE	-.09*	-.00	1.37*	1.55*	.88*	.97*	1.18*	1.38*	.63*	.77*	2.45*	2.10*	1.54*	1.65*
	(.02)	(.02)	(.08)	(.08)	(.05)	(.06)	(.10)	(.10)	(.12)	(.14)	(.05)	(.08)	(.06)	(.07)
AR	.85*	.74*	.82*	.84*	.78*	.82*	.80*	.82*	.84*	.85*	.78*	.85*	.75*	.83*
R^2 within	.09	.09	.25	.20	.57	.19	.38	.21	.23	.19	.63	.25	.26	.17
R^2 between	.31	.00	.68	.48	.87	.60	.74	.69	.87	.71	.96	.75	.68	.32
R^2 overall	.14	.07	.61	.50	.87	.60	.63	.55	.71	.54	.93	.69	.46	.22
Hausman	.21	.57	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Obs.	262	259	3,019	2,705	4,546	4,361	1,609	1,566	1,681	1,458	5,990	5,956	3,269	3,207
Groups	10	10	38	36	43	43	32	32	37	37	66	66	59	59

Notes: Estimated equation (4) $E_{t,i}[w_t - w_{t-1}] = \alpha_i + \beta_{1,i}(E_{t,i}[u_{t+1} - u_t^{nat}]) + \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}$; robust standard errors in parentheses; * (+) indicates significance at the one (ten) per cent level; we applied the fixed effect estimator when the Hausman test rejects the hypothesis of a single constant on the ten per cent level, otherwise the random effects estimator is applied.

Table 3: Expectations on the Samuelson-and-Solow-Type Phillips Curve for the G7 Countries

Countries	Canada		France		Germany		Italy		Japan		UK		USA	
Horizon	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Constant	1.57*	1.72*	1.21*	1.39*	1.55*	1.45*	1.14*	1.54*	.07*	.32*	1.56*	1.74*	1.49*	2.00*
	(.01)	(.01)	(.01)	(.01)	(.00)	(.01)	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Δ UN	-.29*	-.17*	.05+	-.07*	.03*	.01	.02	-.08*	-.23*	-.25*	-.16*	-.15*	-.19*	-.08*
	(.02)	(.02)	(.02)	(.01)	(.01)	(.01)	(.02)	(.02)	(.03)	(.02)	(.02)	(.02)	(.02)	(.02)
TFE	1.16*	1.02*	.80*	.83*	.60*	.90*	2.62*	2.01*	.71*	.54*	1.87*	1.52*	1.74*	1.14*
	(.06)	(.06)	(.03)	(.04)	(.05)	(.05)	(.09)	(.07)	(.04)	(.05)	(.05)	(.08)	(.05)	(.05)
AR	.78*	.80*	.71*	.78*	.92*	.87*	.95*	.83*	.69*	.83*	.82*	.83*	.85*	.83*
R^2 within	.73	.50	.56	.37	.50	.30	.50	.49	.72	.35	.69	.25	.43	.20
R^2 between	.93	.83	.93	.86	.89	.89	.92	.97	.98	.90	.97	.76	.87	.75
R^2 overall	.91	.83	.88	.78	.69	.70	.78	.90	.93	.82	.93	.62	.63	.56
Hausman	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Obs.	3,272	3,241	3,822	3,477	5,782	5,536	2,839	2,741	3,950	3,272	6,046	6,002	5,640	5,398
Groups	37	37	40	39	46	46	38	38	44	43	66	66	65	65
Actual / Exp. Inflation	Act.	Exp.	Act.	Exp.	Act.	Exp.	Act.	Exp.	Act.	Exp.	Act.	Exp.	Act.	Exp.
89 – 93	2.56	4.10	2.53	3.01	4.20	3.24	5.56	5.98	2.13	2.30	4.32	5.84	3.79	4.20
94 – 98	1.13	2.25	1.31	1.65	1.61	1.82	3.17	4.16	.66	.65	2.93	3.12	2.38	2.92
99 – 03	2.17	2.39	1.36	1.55	1.14	1.92	2.37	2.61	-.59	-.19	2.02	2.19	2.33	2.88
04 – 07	1.89	1.83	1.71	1.69	1.74	1.30	2.03	1.33	.30	.08	3.11	1.98	2.92	2.75

Notes: Estimated equation (5) $E_{t,i}[\pi_{t+1}] = \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+1} - u_t^{nat}]) + \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}$; robust standard errors in parentheses; * (+) indicates significance at the one (ten) per cent level; we applied the fixed effect estimator when the Hausman test rejects the hypothesis of a single constant on the ten per cent level, otherwise the random effects estimator is applied; the expected inflation in the last row rate are calculated as the average time-fixed effects coefficient for the respective period based on the estimation of the short-term specification.

Table 4: Expectations on the Nonlinear Samuelson-and-Solow-Type Phillips Curve

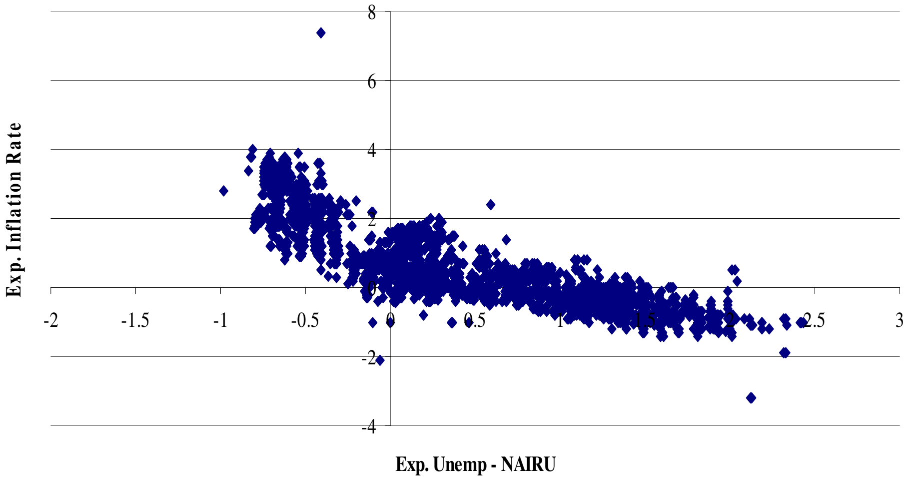
Countries	Canada		France		Germany		Italy		Japan		UK		USA	
Horizon	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Constant	1.60*	1.74*	1.20*	1.39*	1.54*	1.47*	1.14*	1.54*	.07*	.31*	1.39*	1.63*	1.50*	1.98*
	(.01)	(.01)	(.01)	(.01)	(.00)	(.01)	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Δ UN	-.22*	-.11*	.10*	-.01	.04	-.01	.05	-.07+	-.28*	-.29*	-.15*	-.17*	-.14*	-.03
	(.03)	(.02)	(.03)	(.02)	(.02)	(.02)	(.03)	(.03)	(.04)	(.03)	(.02)	(.02)	(.03)	(.02)
$(\Delta UN)^2$	-.04*	-.04*	-.02+	-.04*	-.00	.00	-.01	-.01	.03	.02+	.04*	.02*	-.05*	-.07*
	(.01)	(.01)	(.01)	(.01)	(.00)	(.00)	(.01)	(.00)	(.02)	(.01)	(.00)	(.00)	(.02)	(.02)
TFE	1.14*	1.01*	.80*	.85*	.60*	.90*	2.60*	2.01*	.71*	.54*	1.87*	1.54*	1.75*	1.17*
	(.06)	(.06)	(.03)	(.04)	(.05)	(.04)	(.09)	(.07)	(.06)	(.05)	(.05)	(.08)	(.05)	(.05)
AR	.78*	.80*	.71*	.79*	.92*	.87*	.95*	.82*	.69*	.83*	.81*	.83*	.85*	.83*
R^2 within	.73	.50	.56	.37	.50	.30	.50	.49	.72	.35	.70	.25	.44	.21
R^2 between	.93	.83	.94	.86	.89	.88	.92	.97	.98	.90	.98	.77	.87	.75
R^2 overall	.91	.84	.88	.78	.69	.70	.78	.90	.93	.82	.94	.62	.65	.56
Hausman	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Obs.	3,272	3,241	3,822	3,477	5,782	5,536	2,839	2,741	3,950	3,272	6,046	6,002	5,640	5,398
Groups	37	37	40	39	46	46	38	38	44	43	66	66	65	65
Exp./Actual Inflation	2.7 / 2.4 (p.a.)		2.0 / 1.9 (p.a.)		2.1/ 2.1 (p.a.)		3.7 / 3.4 (p.a.)		0.8 / 0.6 (p.a.)		3.3 / 3.2 (p.a.)		3.3 / 3.0 (p.a.)	

Notes: Estimated equation (6) $E_{t,i}[\pi_{t+1}] = \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+1} - u_t^{nat}]) + \beta_{3,i}(E_{t,i}[u_{t+1} - u_t^{nat}])^2 + \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}$; robust standard errors in parentheses; * (+) indicates significance at the one (ten) per cent level; we applied the fixed effect estimator when the hausman test rejects the hypothesis of a single constant on the ten per cent level, otherwise the random effects estimator is applied.

Table 5: Expectations on the Kinked Phillips Curve with Recession Dummy

Countries	Canada		France		Germany		Italy		Japan		UK		USA	
Horizon	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Constant	1.59*	1.74*	1.22*	1.40*	1.55*	1.45*	1.12*	1.50*	.05*	.29*	1.35*	1.69*	1.57*	2.00*
	(.01)	(.01)	(.01)	(.01)	(.00)	(.01)	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Δ UN	-.23*	-.10*	.20*	-.01	-.11	-.56+	-.07	-.26*	-.54*	-.44*	-.28*	-.18*	-.00	-.04
	(.05)	(.03)	(.05)	(.03)	(.75)	(.23)	(.08)	(.07)	(.08)	(.05)	(.02)	(.02)	(.05)	(.03)
recession	-.09	-.10+	-.17*	-.08+	.14	.56+	.09	.20*	.38*	.22*	.31*	.04	-.25*	-.04
dummy	(.06)	(.04)	(.06)	(.03)	(.75)	(.23)	(.09)	(.08)	(.08)	(.06)	(.03)	(.03)	(.06)	(.03)
TFE	1.17*	1.03*	.82*	.84*	.60*	.90*	2.63*	2.03*	.61*	.52*	1.81*	1.52*	1.73*	1.15*
	(.06)	(.06)	(.03)	(.04)	(.05)	(.05)	(.09)	(.07)	(.04)	(.05)	(.05)	(.08)	(.05)	(.05)
AR	.78*	.79*	.71*	.78*	.92*	.87*	.95*	.83*	.69*	.83*	.81*	.83*	.84*	.83*
R^2 within	.72	.51	.56	.37	.50	.30	.50	.49	.73	.36	.69	.25	.45	.21
R^2 between	.93	.83	.93	.86	.89	.88	.92	.97	.98	.91	.98	.77	.89	.76
R^2 overall	.91	.84	.88	.78	.69	.69	.78	.90	.93	.83	.93	.62	.68	.56
Hausman	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Obs.	3,272	3,241	3,822	3,477	5,782	5,536	2,839	2,741	3,950	3,272	6,046	6,002	5,640	5,398
Groups	37	37	40	39	46	46	38	38	44	43	66	66	65	65
Slope recession	-.31*	-.20*	-.03	-.08*	.03	.01	.02	-.06*	-.17*	-.22*	.03	-.13*	-.26*	-.10*
	(.03)	(.02)	(.02)	(.01)	(.02)	(.01)	(.02)	(.02)	(.03)	(.03)	(.03)	(.02)	(.03)	(.02)

Notes: Estimated equation (7) $E_{t,i}[\pi_{t+1}] = \alpha_i + \beta_{2,i}(E_{t,i}[u_{t+1} - u_t^{nat}]) + \gamma D(E_{t,i}[u_{t+1} - u_t^{nat}])E_{t,i}[u_{t+1} - u_t^{nat}] + \frac{1}{k}\theta_k \sum_{k=1}^{19} year_k + \epsilon_{t,i}$; robust standard errors in parentheses; * (+) indicates significance at the one (ten) percent level; we applied the fixed effect estimator when the Hausman test rejects the hypothesis of a single constant on the ten percent level, otherwise the random effects estimator is applied.



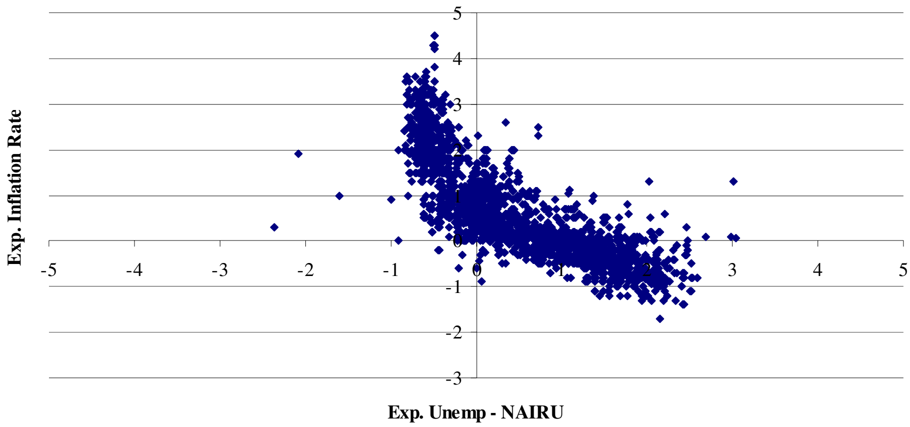


Figure 1: Expected Short-term and Long-term Phillips Curve for Japan

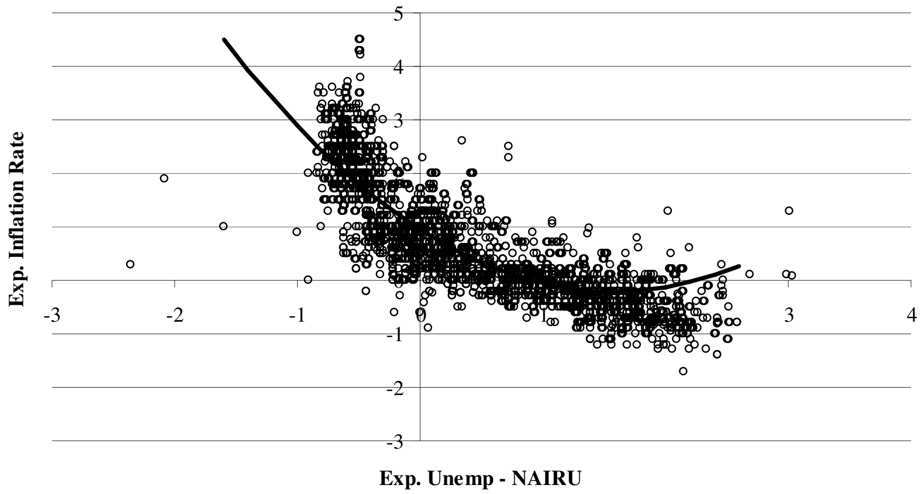


Figure 2: Expected Nonlinear Long-term Phillips Curve for Japan

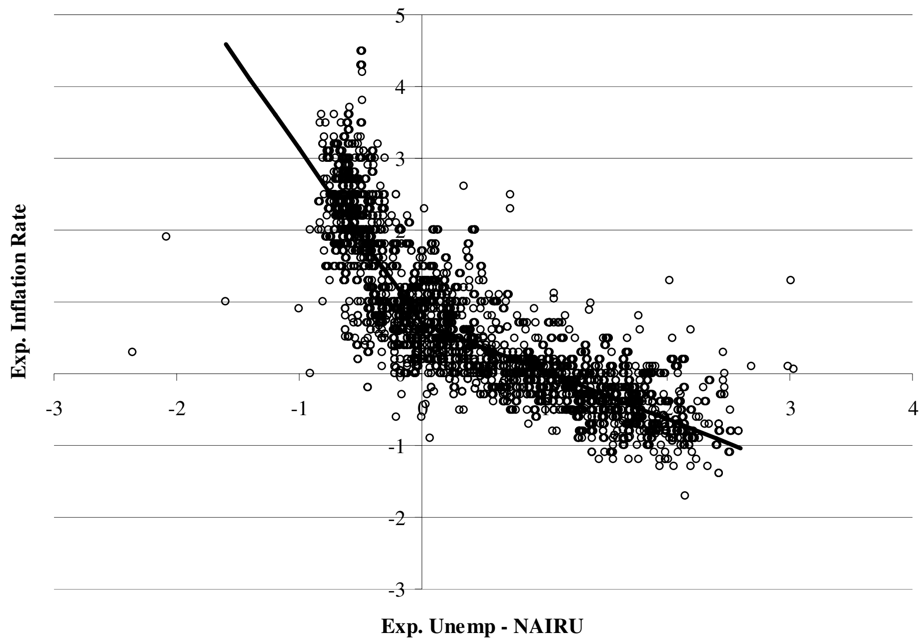


Figure 3: Expected Kinked Long-term Phillips Curve for Japan

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