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Sticky Information Phillips Curves: European Evidence[§]

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Abstract

We estimate the sticky information Phillips curve model of Mankiw and Reis (2002) using survey expectations of professional forecasters from four major European economies. Our estimates imply that inflation expectations in France, Germany and the United Kingdom are updated about once a year, in Italy about once each six months.

Keywords: Inflation expectations, sticky information, Phillips curve, inflation persistence

JEL classification: D84, E31

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1 Introduction

Macroeconomic expectation formation, information transmission and models of persistent inflation expectations have again attracted much interest in the past few years.[1] Several recent papers, including Mankiw and Reis (2002, 2003, 2006), argue that models in which agents update their information occasionally rather than instantaneously resolve some stylized business cycle puzzles. These puzzles include the fact that inflation is considerably persistent and empirically disinflations are found to be costly.[2] Theoretical foundations for the new sticky information paradigm were elaborated in Carroll's (2003) work on the "epidemiological model of expectations". Furthermore, Reis (2004, 2005) and Mankiw and Reis (2006) discuss the microfoundations of the sticky information approach and propose to replace the widely used backward-looking and New Keynesian Phillips curves with the Sticky Information Phillips curve (SIPC).

Interestingly, there has been relatively little research on estimation the key parameters of the SIPC empirically. Carroll (2003) and Döpke et al. (2005) estimate the epidemiological model of transmission of information between households and forecasters using US and European data, respectively. Among the few papers we are aware of that estimate the SIPC directly are Khan and Zhu (2002, 2006). However, due to data limitations Khan and Zhu have to use inflation and output forecasts generated using a VAR model as a proxy for the actual forecasts. Similarly, the estimation of the SIPC of Kiley (2005), Korenok (2005) and related work of Laforte (2005) also proxy for inflation expectations. In contrast to these papers, we use survey-based inflation expectations directly.

Using recent data from four major European economies we find that producers in France, Germany and the United Kingdom update their information sets about once a year, those in Italy about once each six months. These findings are quite robust to the two estimation methods we use (equation-by-equation estimation and seemingly unrelated regressions) and the number of lags of right-hand side variables included. The estimates of λ are consistent with those of Döpke et al. (2005) except for Italy whose λ Döpke et al. pin down to be comparable to the other countries. Khan and Zhu find similar results for Canada, United Kingdom and United States and Korenok (2005) for the United States. Kiley (2005) reports that λ in his models ranges between 0.44 and 0.71 (in the US data).

[1] See Phelps (1969); Lucas (1973) for early work on these issues.

[2] The sticky-information models are related to models of rational inattention (Sims, 2003) and learning (Branch, 2004).

2 Sticky Information Phillips Curve

2.1 The Model

Mankiw and Reis (2002) assume that each period, only a fraction λ of firms gathers the up-to-date information about the current state of the economy and re-computes and adjusts the optimal path of future prices. Remaining $(1-\lambda)$ firms continue using their previous plans and thus set prices based on outdated information. The firm's probability of information updating is exogenously determined and independent of price adjustment history. Under this assumption Mankiw and Reis derive the following closed economy version of the SIPC:

$$\pi_t = \frac{\lambda\alpha}{1-\lambda}\tilde{y}_t + \lambda\sum_{j=0}^{\infty}(1-\lambda)^j\,\mathbf{E}_{t-1-j}\left(\pi_t + \alpha\Delta\tilde{y}_t\right) + \varepsilon_t, \qquad (1)$$

where π_t is the inflation rate and $\tilde{y}_t$ the output gap. $\mathbf{E}_t(\cdot)$ denotes the rational (mathematical) expectation as of time t. Parameter α measures the sensitivity of the optimal relative price to the current output gap and depends on the structure of the economy (e.g. the preferences, technology, and the market structure parameters).[3] To increase the precision of the estimates of λ, on which we primarily focus, we impose that α lies between 0.10 and 0.20, a range considered plausible in the literature (e.g. Mankiw and Reis (2002)).

Note that in contrast to the standard (forward-looking) sticky-price model, in which current expectations of future state of the economy play an important role, what matters in the sticky-information model (1) are the past expectations of present events.

2.2 The Data

We use quarterly data between 1993Q2 and 2004Q4 for Germany, France, Italy and the United Kingdom. The actual GDP and inflation series were obtained from OECD's Main Economic Indicators database.

The experts' inflation and output forecasts we use were collected by Consensus Economics, a major London-based macroeconomic survey firm. Each quarter since 1989 Consensus Economics publishes the consensus forecasts constructed as the median of 20–30 individual predictions of major banks and research institutes (in each country). The consensus forecasts are available up to six quarters ahead, i.e. for quarters t through $t+6$.

[3] The parameter α can be interpreted as a measure of the degree of real rigidity, see e.g. Ball and Romer (1990).

We use the GDP growth forecasts to extract estimates of future output gap $\tilde{y}_t$ as follows. First, we take into account that the expectations reported in the survey refer to year-on-year changes rather than annualized quarterly changes as implied by the SIPC model. Second, we proxy the expected output gap based on expected GDP growth as follows. Denote y_t and y_t^* the log of output and the log of potential output, respectively. We first recursively construct a prolonged GDP series, $y_S^*(t)$ ($S = t_0, \ldots, t, \ldots, t+6$), for each sample point t by setting $y_S^*(t) = y_t$ for $S \leq t$ and $y_{t+1}^*(t) = y_{t-3}^*(t) + \mathbf{E}_t \Delta y_{t-3,t+1}$, $y_{t+2}^*(t) = y_{t-2}^*(t) + \mathbf{E}_t \Delta y_{t-2,t+2}$, $\ldots$, $y_{t+6}^*(t) = y_{t+2}^*(t) + \mathbf{E}_t \Delta y_{t+2,t+6}$, where $\mathbf{E}_t \Delta y_{i,j}$ denotes the expectation for GDP growth between time i and j formed at time t. We then apply the Christiano and Fitzgerald (2003) full sample asymmetric band-pass filter to filter out the cyclical component of $y_S^*(t)$, say $\tilde{y}_S^*(t)$, as a proxy for the output gap. We interpret the last six observations of this series as the expectation of the output gap for periods $t+1$ through $t+6$ as of time t.

For the expert expectations of the inflation rate we also face the first problem mentioned above that the expectations reported in the survey refer to year-on-year changes rather than annualized quarterly changes. Analogously to the previous paragraph, we compute annualized expected quarterly inflation rates by prolonging the actual consumer price index time series based on the expected year-to-year inflation rates and transforming this prolonged series into expected quarterly inflation rates.

2.3 The Results

We assume that the updating firms each period simply adopt professional forecasts to form rational expectations of inflation and output gap up to six quarters ahead. Consequently, the infinite sum in equation (1) is truncated alternatively at four and six lags.[4] We estimate equation (1) first individually for each country using non-linear least squares (in Table 1) and then jointly using seemingly unrelated regressions (SUR) (in Table 2).

2.3.1 Equation-by-Equation Estimation

Table 1 summarizes the results of estimating (1) with truncation lags $n = 4$ and 6 for values of α between 0.1 and 0.2 for Germany, France, Italy, and the United Kingdom. As the theoretical model (1) does not have a constant we exclude it in the empirical estimation and report the uncentered R^2.[5]

[4] The results with 5 lags do not differ considerably and are available from the authors upon request.

[5] If the constant is included it is insignificant.

We find the following five key results. First, all estimates of λ are highly significant for all parameterizations of the model. Second, for France, Germany, and the UK their values lie around 0.20 to 0.30. This is about the size one would expect and in line with findings in Khan and Zhu (2002), Döpke et al. (2005) and Korenok (2005). Third, there is a lot of homogeneity across the latter three countries. Given the same parametrization, $\hat{\lambda}$s do not differ by more than 0.02. Fourth, the results for Italy deviate quite substantially from the outcomes for the other countries. λ is estimated around 0.5 to 0.6 which implies about twice as high frequency of information updating compared to the findings for other countries. Furthermore, the estimates for Italy are more sensitive with respect to the values chosen for α. This is not the case for the other countries. Finally, the models including up to 6 lags of the sequence of expectation terms generally show a better fit to the data and smaller $\hat{\lambda}$ (this latter result is also evident from the results in Khan and Zhu, 2006).

Our estimates of λ are typically a bit smaller than Carroll's (2003) estimates for the US. This indicates that the information transmission process is somewhat slower in the three European countries considered here in this study. This is in line with the evidence of Döpke et al. (2005), who estimate the Carroll (2003) model for European countries, and find the information updating process of households to be also somewhat slower than for the US economy.

2.3.2 Seemingly Unrelated Regression (SUR) Estimation

As the residuals of the individual equations are substantially cross-correlated, we investigate in table 2 how using the SUR affects our baseline results approach to improve the efficiency of the estimation.

Again, all coefficients were found to be highly significant and to be (with the exception of Italy) in the range of 0.14 to 0.18 for truncation at lag 6 and in the range of 0.20 to 0.29 for truncation at lag 4. In addition, likelihood-ratio tests confirm that we cannot reject the null hypothesis that the λ are equal for France, Germany, and the UK. We only present the test statistic for one particular value of α as for other specifications the outcomes are very similar. For $\alpha = 0.15$ and truncation at lag 4, the LR-statistic is 1.19 (p-val: 0.55). For $\alpha = 0.15$ and truncation at lag 6, the LR-statistic is 0.84 (p-val: 0.66). Obviously, the hypothesis that λ for Italy is also equal to the parameters in the other three countries is rejected at any sensible significance levels. A possible explanation for this finding of a somewhat higher λ in Italy is a higher level of and uncertainty about inflation in the estimation sample in Italy compared to the other three countries.

Estimating λ jointly for France, Germany, and the UK with λ being constrained to be equal across countries (assuming that the price setting mechanism is the same in all three countries) yields no big surprises. For all parameterizations $\hat{\lambda}$ is highly significant and lies in between the individual country estimates. For truncation at lag 4 we find $\hat{\lambda} = 0.3$ and for truncation at lag 6 we find $\hat{\lambda} = 0.16$. The estimates again seem to be very robust to the particular value chosen for α.

3 Conclusion

In this paper, we make the first attempt to estimate the main parameter of the SIPC developed in Mankiw and Reis (2002) for four large European countries using survey-based expectations. We find that λ ranges between 0.15 and 0.3 for Germany, France and the United Kingdom and between 0.5 and 0.6 for Italy. Possible extensions of this work include investigating how the frequency of updating varies across other countries and time periods or more generally what other factors determine the size of λ.

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Table 1: SIPC regression: Equation-by-equation, Non-linear least squares, 1993 II to 2004 IV

Single Equation Estimation					
Truncation at lag:		4		6	
		λ	uncent. R^2	λ	uncent. R^2
France	$\alpha = .10$	0.271	0.56	0.188	0.58
		5.4		5.4	
	$\alpha = .15$	0.268	0.56	0.189	0.59
		5.5		5.3	
	$\alpha = .20$	0.271	0.56	0.191	0.59
		5.4		5.3	
Germany	$\alpha = .10$	0.257	0.64	0.181	0.63
		5.7		5.4	
	$\alpha = .15$	0.258	0.64	0.181	0.63
		5.7		5.4	
	$\alpha = .20$	0.257	0.64	0.181	0.63
		5.7		5.4	
Italy	$\alpha = .10$	0.608	0.90	0.456	0.89
		6.1		3.4	
	$\alpha = .15$	0.577	0.89	0.492	0.90
		4.6		3.7	
	$\alpha = .20$	0.608	0.90	0.540	0.90
		6.1		5.0	
UK	$\alpha = .10$	0.271	0.64	0.201	0.72
		6.2		6.2	
	$\alpha = .15$	0.270	0.64	0.202	0.72
		6.2		6.1	
	$\alpha = .20$	0.271	0.64	0.202	0.72
		6.2		6.1	

The figures below the estimates are t-statistics.

Table 2: SIPC regression: SUR, Non-linear least squares, 1993 II to 2004 IV

SUR Estimation					
Truncation at lag:		4		6	
		λ	uncent. R^2	λ	uncent. R^2
France	$\alpha = .10$	0.213	0.58	0.146	0.57
		5.4		5.1	
	$\alpha = .15$	0.216	0.58	0.146	0.57
		5.5		5.1	
	$\alpha = .20$	0.219	0.58	0.144	0.57
		5.5		5.1	
Germany	$\alpha = .10$	0.296	0.67	0.158	0.63
		5.8		5.6	
	$\alpha = .15$	0.294	0.66	0.160	0.63
		5.8		5.6	
	$\alpha = .20$	0.292	0.66	0.160	0.63
		5.9		5.6	
Italy	$\alpha = .10$	0.451	0.77	0.525	0.69
		8.2		5.6	
	$\alpha = .15$	0.471	0.77	0.568	0.70
		8.0		6.5	
	$\alpha = .20$	0.494	0.78	0.571	0.71
		7.9		7.2	
UK	$\alpha = .10$	0.190	0.57	0.177	0.72
		5.1		5.6	
	$\alpha = .15$	0.193	0.57	0.177	0.72
		5.1		5.6	
	$\alpha = .20$	0.195	0.58	0.176	0.72
		5.2		5.6	

The figures below the estimates are t-statistics.