

Castelnuovo, Efrem; Surico, Paolo

Working Paper

What does monetary policy reveal about central bank's preferences?

Nota di Lavoro, No. 2.2002

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Castelnuovo, Efrem; Surico, Paolo (2002) : What does monetary policy reveal about central bank's preferences?, Nota di Lavoro, No. 2.2002, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/119611>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



Fondazione Eni Enrico Mattei

What Does Monetary Policy Reveal about Central Bank's Preferences?

Efrem Castelnuovo* and Paolo Surico**

NOTA DI LAVORO 2.2002

JANUARY 2002

ETA - Economic Theory and Applications

*Bocconi University and Fondazione Eni Enrico Mattei

**Bocconi University

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:

http://www.feem.it/web/attiv/_attiv.html

Social Science Research Network Electronic Paper Collection:

<http://papers.ssrn.com/abstract=XXXXXX>

Fondazione Eni Enrico Mattei
Corso Magenta, 63, 20123 Milano, tel. +39/02/52036934 – fax +39/02/52036946
E-mail: letter@feem.it
C.F. 97080600154

SUMMARY

The design of monetary policy depends upon the targeting strategy adopted by the central bank. This strategy describes a set of policy preferences, which are actually the structural parameters to analyse monetary policy making. Accordingly, we develop a novel calibration method to identify central bank's preferences from the estimates of an optimal Taylor-type rule. The empirical analysis on US data shows that output stabilization has not been an independent argument in the Fed's objective function during the Greenspan era. This suggests that the output gap has entered the policy rule only as leading indicator for future inflation, therefore being only instrumental (to stabilize inflation) rather than important per se.

Keywords: Central bank's preferences, calibration, inflation targeting, optimal monetary policy

JEL: C61, E52, E58

CONTENTS

1.	Introduction	2
2.	The model	3
	2.1 The structure of the economy	4
	2.2 The loss function and the optimal monetary policy	5
3.	Identifying central bank's preferences	7
4.	The conduct of monetary policy in the US	8
	4.1 A small empirical model of the US economy	8
	4.2 The Fed policy preferences	10
	4.3 Sensitivity analysis	12
5.	Conclusions	13
	Appendix: the optimal control problem	14
	References	16

1 Introduction

A burgeoning empirical literature has established interest rate rules as a convenient representation of central bank's behaviour. Since the influential paper of John Taylor (1993) numerous specifications of the policy rule have been proposed to describe the response of monetary authorities to the developments in the economy. The main focus has been the evaluation of monetary policy as well as the identification of policy regime shifts from the estimates of alternative Taylor-type reaction functions¹.

From a theoretical point of view, interest rate rules have been modeled as the solution of a constrained optimization problem in which policy makers pursue in a quadratic fashion the stabilization of several goal variables around the relative targets. According to this modeling, the estimated policy rule coefficients can only be interpreted as convolutions of the parameters describing central bank's preferences (i.e. the coefficients in the objective function) and the parameters framing the structure of the economy (i.e. the coefficients in the constraints). It follows that those are reduced form estimates and therefore they cannot be used to analyze the structural features of policy making that characterize a monetary regime.

In contrast, the preference parameters in the central bank's objective function capture those structural features and they are worthy to identify for three main reasons. First, to improve our understanding of policy actions because any decision can be more easily interpreted once the scope is identified. Second, to assess the performance of monetary policy by establishing if the policy outcome is the pursued result of targeted policies rather than the random payoff of favorable macroeconomic conditions. Third, to carry out policy evaluations from the comparison between optimal and observed interest rates, since a sample-specific optimal rule can only be derived once the preference parameters are estimated over that sample.

Accordingly, we develop a novel calibration method to extract central bank's preferences from the estimates of the reaction function that solves the policy makers' optimization problem. In particular, we select among a fairly wide class of alternative targeting policies the set of preference parameters that makes the associated optimal simulated path of policy rate closest to the estimated one. We apply our identification method to US data

¹These include Bernanke and Mihov (1998), and Bagliano and Favero (1998) who specify the policy rule as a part of monetary policy vector autoregressions; Judd and Rudebusch (1998), and Clarida, Gali and Gertler (2000) that formulate a simple ad-hoc reaction function; and Rudebusch (2001a), and Muscatelli, Tirelli and Trecroci (2000) who model an optimal state-contingent feedback rule, among many others.

in order to identify the policy preferences of the Federal Reserve during the Greenspan's chairmanship. The empirical analysis shows that the stabilization of output over the cycle has not been a final concern of monetary authorities, although the Fed has set policy rates in response to both inflation and output gap. This implies that any deviation of output from its potential value has been regarded as a *leading indicator* for future inflation, thus being only instrumental to stabilize inflation rather than important *per se*.

Our work is closely related to several recent studies. Favero and Rovelli (2001) identify central bank's preferences by estimating via GMM the Euler equations for the solution of alternative specifications of the optimization problem. Cecchetti and Ehrmann (2001) capture the dynamics of the economy in a VAR framework and then recover policy makers' preferences from the estimates of the output-inflation variability and those obtained via VAR. Dennis (2001) uses FIML to jointly estimate the policy preferences in the central bank's objective function and the behavioral parameters in the constraints of the economy. While our purpose stands by those of previous studies, we take from them two important departures. First, we use a different sample, which is restricted to a single administration on the reasoning that policy preferences are Chairman-specific. Second, we employ a different identification method as we calibrate rather than estimate those idiosyncratic preferences.

The paper is organized as follows. Section 2 sets up the model and solves the optimization problem relevant to the central bank. Section 3 discusses in details the calibration method, which is applied in section 4 to identify the Fed policy preferences during the Greenspan's tenure. Section 5 concludes, while the appendix provides a guideline to solve numerically the optimal control problem.

2 The model

The central bank faces a dynamic optimal control problem whose solution describes its policy actions. These are the optimal response of monetary authorities to the evolution of the economy as captured by the relationships among the state variables. We describe such a dynamics by means of a simple closed economy-two equation framework made up of an aggregate supply and an aggregate demand, which actually represent the constraints of the policy makers' optimization problem.

2.1 The structure of the economy

The empirical evidence from VAR studies shows that monetary policy affects the economy at different lags (see Christiano, Eichenbaum and Evans, 1996, and Bernanke and Mihov, 1998). Furthermore, if the central bank faces an intertemporal optimization problem, then forecasting the behaviour of the state variables (i.e. inflation and output gap) becomes crucial to set policy rates as the optimal response to the developments in the economy. It follows that for the purpose of monetary policy making, which relies on forecasting method, a backward-looking model is likely to be preferred to a forward-looking one since the former overperforms the latter in fitting the data (see Fuhrer, 1997).

Accordingly, we let the structure of the economy evolve as follows:

$$\pi_{t+1} = \alpha_1\pi_t + \alpha_2\pi_{t-1} + \alpha_3\pi_{t-2} + \alpha_4\pi_{t-3} + \alpha_5y_t + \varepsilon_{t+1} \quad (1)$$

$$y_{t+1} = \beta_1y_t + \beta_2y_{t-1} + \beta_3(\bar{i}_t - \bar{\pi}_t - \bar{r}) + u_{t+1} \quad (2)$$

where π_t is the quarterly inflation in the GDP chain-weighted price index, p_t , calculated at annual rate, that is $4(p_t - p_{t-1})$, and $\bar{\pi}_t$ is four-quarter inflation constructed as $\frac{1}{4} \sum_{j=0}^3 \pi_{t-j}$. The quarterly average federal funds rate, i_t , is expressed in percent per year whereas the four quarter average federal funds rate, \bar{i}_t , is computed as $\frac{1}{4} \sum_{j=0}^3 i_{t-j}$. The constant \bar{r} stands for the average real interest rates, and ε_t and u_t are supply and demand iid shocks respectively. All variables but the funds rate are in logs and rescaled upward on a 100 point basis such that the output gap, say, is $y_t = 100 * (\log(Q_t) - \log(Q_t^*))$ where Q_t and Q_t^* are respectively actual and potential GDP, both in levels. All variables are demeaned, therefore no constants appear in the equations and \bar{r} is set equal to zero.

On the one hand, the aggregate supply equation in (1), AS henceforth, captures the inflation dynamics by relating inflation to its lagged values and to current and lagged output gaps. On the other hand, the aggregate demand equation in (2), AD henceforth, explicitly models the monetary transmission mechanism by relating output gap to its lagged values and most importantly to past real interest rate (see Rudebusch and Svensson, 1999 and 2001).

This empirical model of inflation and output, although parsimonious, embodies the minimal set of variables one may want to include for the analysis of monetary policy (see, for instance, Christiano, Eichenbaum and Evans, 1998), and, as argued in Rudebusch and Svensson (1999), it appears to be broadly in line with the view that policy makers

hold about the dynamics of the economy (see the report of the Bank for International Settlements for 11 central bank models, 1995). Moreover, monetary policy affects (through the instrument i_t) aggregate demand with one lag and aggregate supply with two lags, in the spirit of the specifications in Ball (1999) and Svensson (1997). Finally, such a dynamics can be interpreted either as structural relations, as we do, or as a reduced-form restricted VAR with impulse responses that are consistent with those of the FRB-US model.

2.2 The loss function and the optimal monetary policy

We assume that monetary authorities operate by following a *targeting rule* as defined in Svensson (1999a), and Rudebusch and Svensson (1999)². Thus, they use all available information to bring at each point in time the target variables in line with their targets by penalizing any future deviation of the former from the latter. This type of rule seems to be closer than an *instrument rule*, which is a prescribed rule coming from an 'once and for all' decision making (see McCallum, 1999), to the actual practice of policy makers since it embodies some degree of commitment (to a loss function) and some degree of discretion (through a state-contingent rule). Following Rudebusch and Svensson (1999 and 2001), we let the central bank pursue the stabilization of the four-quarter inflation around the inflation target, the stabilization of the output around its potential value and the smoothing of interest rate. The inflation target is assumed to be constant over time and it is normalized to zero because all variables are demeaned³. Then, policy rates are set to minimize the following objective function:

$$\lambda_\pi Var [\bar{\pi}_t] + \lambda_y Var [y_t] + \lambda_{\Delta i} Var [\Delta i_t] \quad (3)$$

The quarterly average short-term interest rate, i_t , is regarded as the instrument under policy makers' control whereas Δi_t represents its first difference. The parameters λ_π and λ_y are the focus of our analysis and unlike in Rudebusch and Svensson (2001), who set them exogenously, they are determined within the model by means of our identification method. They represent the (potentially time-variant) central bank's policy preferences towards inflation and output stabilization respectively. We constrain both parameters to be non negative meaning that the central bank values any deviation of either inflation

² Accordingly, we label 'target variables' the variables in the objective function (and not those in the reaction function). Our terminology lines up with the one in Walsh (1998, Ch. 8), Clarida, Gali and Getler (1999), Rudebusch and Svensson (1999), and Svensson (1999c).

³ Our analysis is meant to identify the central bank's preferences over the target variables rather than to estimate the targets per se. A number of papers cover the issue, including Judd and Rudebusch (1998), Sack (2000), Favero and Rovelli (2001) and Dennis (2001).

or output from the target as a *bad*. Finally, we normalize the weights in the objective function to sum to one and in accordance to Rudebusch and Svensson (1999 and 2001) we assume $\lambda_{\Delta i} = 0.2$.

The specification in (3) is empirically attractive since, unlike alternative monetary models as the FRB-US, it is able to predict an interest rate path that exhibits the kind of smoothness observed in the data. (see Clarida, Galí and Gertler, 2000, and Muscatelli, Tirelli and Trecroci, 2000)⁴. A rationale for why interest rate behaviour displays policy inertia is beyond the scope of this paper, although several explanations are provided in the literature⁵.

The optimal control problem described in (1)-(3) falls in the class of dynamic programming problems characterized by a quadratic objective function and a linear law of motion. This specification leads to the *stochastic optimal linear regulator problem* according to which the decision rule for interest rates is a linear function of the state variable vector

$$X_t' = [\pi_t \quad \pi_{t-1} \quad \pi_{t-2} \quad \pi_{t-3} \quad y_t \quad y_{t-1} \quad i_{t-1} \quad i_{t-2} \quad i_{t-3}] \quad (4)$$

In particular, the central bank minimizes the loss (3) subject to the dynamic constraints (1) and (2). In so doing, it determines an optimal reaction function that can be expressed in the compact form⁶:

$$i_t = fX_t \quad (5)$$

The coefficients in the vector f represent some convolution of the central bank's preferences, λ s, and the behavioral parameters of the economy, α s and β s, such that for any given distribution of weights in (3) there exists a different optimal f in (5).

⁴Goodfriend (1987), Walsh (1998, Ch. 10), Mishkin (1999), Svensson (1999b) and Woodford (2001) interestingly discuss why interest rate smoothing may be an explicit objective into policy makers' preferences. Alternatively, the observed policy inertia can be rationalized either by imposing some form of partial adjustment of actual interest rates towards the equilibrium value or by introducing strong serial correlation and long lags in monetary policy effects through the economic dynamics. However, to remain consistent with other empirical studies, we take the first view and we let interest rate smoothing enter the central bank's objective function.

⁵These include, *inter alia*, persistence in the structure of the economy (Sack, 2000 and Rudebusch, 2001a), serially correlated shocks rule (Rudebusch, 2001b), commitment of the authorities which want to have a quick and strong impact on the economy by simply reverting the direction of policy rate changes (Woodford, 1999), fear of disruption of financial markets (Goodfriend, 1991), and concern of policy makers about potential misspecifications of the macroeconomic dynamics (Castelnuovo and Surico, 2001).

⁶The appendix provides a full derivation of the feedback rule that solves the stochastic optimal linear regulator problem.

3 Identifying central bank's preferences

Once defined the object of our analysis, we have to search for a strategy to move from the reduced form parameters in the policy rule to the structural ones in the objective function. In this section we propose a calibration method to extract the policy preferences, λ_s , from the vector of feedback coefficients, f .

We estimate the reaction function in (5) and we solve numerically the stochastic optimal linear regulator problem for alternative targeting policies (i.e. for alternative distribution of weights λ_s in the loss function). Among those, we select the pair $[\lambda_\pi, \lambda_y]$ that makes the associated optimal interest rate path closest to the fitted path, which comes from the estimation of the optimal state-contingent rule derived in (5). In so doing, *de facto* we are calibrating the central bank's preferences relevant for the period under analysis. Notice that by defining our measure of distance upon the *fitted* rather than the *actual* rate we are restricting our attention to the systematic component of policy rate behaviour, that is, to the component that we can explain within an optimal control framework.

Our calibration strategy can be seized in five steps:

- i) *constraint estimates*: we estimate the AD-AS system as specified in (1) and (2). The estimates roughly summarize the structure of the economy over a given sample and they will enter the recursive formulation of our simulated economy.
- ii) *reaction function estimates*: we estimate the reduced form reaction function derived in (5) and we call $\hat{i}_t = \hat{f}X_t$ the fitted value of policy rate at time t , where \hat{f} is the vector of feedback coefficient estimates.
- iii) *optimal control problem solution*: since a variation of the set of policy makers' preferences $[\lambda_\pi, \lambda_y]$ implies a modification of the feedback coefficients in the optimal rule, we solve the stochastic optimal linear regulator problem for many different targeting policies. In other words, we compute numerically as many vectors of optimal feedback coefficients f in (5) as the number of possible permutations of the λ_s over the range $[0, 1 - \lambda_{\Delta i}]$, where steps are one percent point basis.
- iv) *implied optimal interest rate path*: we first substitute, period by period, the actual values of the state variables into the derived rules, and then we compute for each optimal f the interest rate path implied by the relative control problem. We define it as $i_t = f(\lambda_\pi, \lambda_y) X_t$ to stress that any optimal path depends upon the specification

of a set of central bank’s preferences.

- v) *policy preference calibration*: finally, we select the set of policy preferences capable to deliver the minimum distance between fitted and optimal interest rate according to a canonical measure of the type proposed in Sack(2000), and Cecchetti, McConnell and Perez-Quiros (1999):

$$\sum_t [i_t(\lambda_\pi, \lambda_y) - \hat{i}_t]^2 \tag{6}$$

With this identification strategy at hand, we can evaluate the monetary policy making over a specific sample. This is the focus of the next section.

4 The conduct of monetary policy in the US

In this section we apply our identification method to US data. Our goal is to identify the Federal Reserve policy preferences over a given period and to establish the sensitivity of these results to robustness and stability analyses. A natural time-break candidate for sample selection is the appointment of Paul Volker in the October 1979 since it has represented the watershed for the US economy from an high to a low inflation era. However, with a backward looking model, the selection of a long time-horizon may undermine the stability of the behavioral parameters, which is an important condition for drawing inference and surviving the Lucas critique (1976). This consideration motivates our focus on a single tenure, namely the one of Alan Greenspan. Indeed, one may argue that this period has been characterized not only by an increasing macroeconomic stability and a lower inflation but also by the expectations of some form of inflation targeting, thereby being particularly suited for our kind of analysis.

4.1 A small empirical model of the US economy

We capture the dynamics of the US economy from 1987:3 to 2001:1 by applying OLS method to the AD-AS system described in (1) and (2). The potential output is obtained from the Congressional Budget Office whereas all other data are taken from the web-site of the Federal Reserve Bank of St. Louis. In particular, we collect monthly time-series for the Fed funds rate, quarterly data for the GDP chain-weighted 1996 commodity price index and quarterly data for the potential output. All series are seasonally adjusted. We then convert monthly data in quarterly data by taking end-of-quarter observations. Lastly, we de-mean all variables.

The estimates are as follows, standard errors in parenthesis:

$$\pi_{t+1} = \underset{(0.133)}{0.282}\pi_t - \underset{(0.134)}{0.025}\pi_{t-1} + \underset{(0.134)}{0.292}\pi_{t-2} + \underset{(0.136)}{0.385}\pi_{t-3} + \underset{(0.054)}{0.141}y_t + \hat{\varepsilon}_{t+1} \quad (7)$$

$$y_{t+1} = \underset{(0.136)}{1.229}y_t - \underset{(0.149)}{0.244}y_{t-1} - \underset{(0.078)}{0.073}(\bar{y}_t - \bar{\pi}_t) + \hat{u}_{t+1} \quad (8)$$

The system displays a reasonably good empirical fit with an Adjusted R² equal to 0.58 for the AS and 0.93 for the AD⁷. All estimates have the expected sign but the second lag of inflation in the AS, although it has not explanatory power. Furthermore, the coefficient for the real interest rate is not statistically significant. While undesirable, this result confirms the evidence from several studies for the US and the UK over recent samples (see for instance Neiss and Nelson, 2001). Finally, although these estimates suggest a minor initial role for monetary policy, the impact of the lagged values of the output gap in the AD is large implying that the response of aggregate demand to policy rates is much greater in the long-run.

Given the backward-looking nature of the problem, the derivation of the optimal policy rule in (5) relies on the assumption that the structure of the economy is invariant to monetary policy, and therefore it is subject to the Lucas critique (1976). However, we show below not only that the policy preference parameters are stable over the sample but also that the associated optimal path of interest rates displays substantial policy inertia and limited deviations from the estimated one. It follows that one may reasonably expect the behavioral parameters to be stable as well, thereby reducing the significance of the Lucas critique⁸.

Notice the timing assumption in our model. At the beginning of each period t the Central Bank observes all the state variables up to time t included (i.e. the policy maker knows the value of the variables in the vector (4)). On the basis of these values the Central Bank sets the optimal policy rate; then, nominal and real shocks hit the economy, so that at the beginning of period $t+1$ a new vector of state variables influences the Central Bank's decisions.

That is why, consistently with our set-up, we may exploit all the information available at time t to estimate by OLS the stochastic version of the optimal rule derived in (5). The

⁷The cross-correlation of the errors is 0.137, implying that the parameter estimates are barely the same when a SUR estimation is performed.

⁸Moreover, the Andrews' test (1993) cannot reject the null of stability for both equations.

estimates yield the following results:

$$\begin{aligned}
 i_t = & \frac{0.212\pi_t}{(0.07)} + \frac{0.043\pi_{t-1}}{(0.08)} + \frac{0.151\pi_{t-2}}{(0.08)} - \frac{0.177\pi_{t-3}}{(0.09)} + \frac{0.346y_t}{(0.10)} + \\
 & -\frac{0.265y_{t-1}}{(0.11)} + \frac{1.259i_{t-1}}{(0.14)} - \frac{0.398i_{t-2}}{(0.20)} - \frac{0.008i_{t-3}}{(0.12)} + \hat{v}_t
 \end{aligned} \tag{9}$$

with an Adjusted R^2 of 0.96⁹. The coefficients show that monetary authorities adjust gradually funds rates in response to both inflation and output gaps since the relevant parameters are significantly different from zero. In particular, the first lag of the funds rate implies that the Fed tends to move its instrument in a particular direction over several periods, while the second lag confirms the potential for few reversals in the policy rate path (see Rudebusch, 1995 and Goodhart, 1997).

The reduced form estimates of the feedback coefficients are convolutions of the very structural parameters described above, then they are not well-suited to address structural issues as the characterization of a monetary regime. Conversely, our method serves to extract from those feedback estimates the component that refer to central bank's preferences.

4.2 The Fed policy preferences

The behaviour of policy rates in our framework can be determined by three factors: the (variability of) supply and demand shocks, the dynamics of the economy and the policy preferences of the central bank. In a linear model with a quadratic loss function the certainty equivalence principle holds, and hence the solution to the control problem is unaffected by the additive uncertainty in the constraints. Furthermore, we assume that the Fed knows with certainty the dynamics of the economy as described by the point estimates in the AS and AD. It follows that our identification strategy, which selects the optimal interest rate path closest to the observed path, turns out to be particularly well-suited to recover policy makers' preferences as these remain the main determinant of interest rate movements.

The optimal path of policy rates is derived given the actual history of the economy at each point in time, that is, it is obtained by substituting the vector of actual state variables, period by period, into the optimal policy rule. Since the optimal path depends upon the specification of a set of policy preferences, we use our calibration method to identify the preferences of the US Federal Reserve over the sample. Then, we compute for

⁹Neither the point estimates nor the standard errors change significantly when GMM method is applied.

any quarter the optimal level of funds rate, given that the Fed has behaved in accordance to the calibrated policy preferences and that it has previously implemented the actual level of interest rates. Figure 1 plots the optimal values of policy rates associated to the preference parameters coming from the calibration whereas Figure 2 plots the actual series of inflation. In particular, the first graph displays the optimal policy rule associated to the values $\lambda_\pi = 0.80$ and $\lambda_y = 0.00$, after having imposed $\lambda_{\Delta i} = 0.20$.

Insert Figure 1 and 2 about here

The optimal policy effectively captures the main features of funds rate movements under the Greenspan's chairmanship, although it predicts an higher level of interest rates both at the beginning and at the end of the sample. Since inflation is found to be the only final concern of the Fed and since it is affected by interest rates with two lags, we look at the relationship between forwarded inflation and current interest rates. Interestingly, a comparison between Figures 1 and 2 shows that whenever observed policy rates are lower (higher) than those predicted by the optimal rule, inflation is high (low) and above (below) its target, which is zero by construction¹⁰. This seems to call for a time-varying inflation target over the sample. However, to be consistent with other empirical analyses, we keep a constant inflation target. Our findings line up with those in Sack (2000), although we use a different specification of the economic structure and most importantly a different set of policy preferences.

The values of the preference parameters are not affected by imposing other values for the interest rate-smoothing weight, $\lambda_{\Delta i}$, since the value of λ_π turns out to be always the complement to one of any $\lambda_{\Delta i}$ value. Furthermore, the higher the preference parameter on inflation stabilization, the better is the match between optimal and fitted rates for any given value of the interest rate-smoothing coefficient. This suggests that the conduct of monetary policy in the US is successfully described by a *strict inflation targeting* as defined in Rudebusch and Svensson (2001) and Ball (1999), and according to which the stabilization of output around its potential value has not been a final concern of monetary authorities (i.e. $\lambda_y = 0.00$). However, we do not mean that the output gap has not been important in policy actions. Indeed, the feedback rule estimates show that it has been regarded as a leading indicator for future inflation rather than as a goal variable (i.e. it is

¹⁰It can be shown in our set up that demeaning all variables corresponds to targeting inflation to its sample mean. In particular, such a mean is 2.49, which seems to be a reasonable value for the inflation target over the sample.

an argument in the reaction function rather than in the loss); this finding is in line with those in Favero and Rovelli (2001), and Dennis (2001).

4.3 Sensitivity analysis

The calibration of the central bank's policy preferences relies on the assumption that the AD-AS system specified in (1) and (2) is actually the macroeconometric model that policy makers have in mind. Indeed, researchers are uncertain about what it is, along both the parameter and the model dimension. In particular, monetary authorities may use sub-sample windows to capture the changing of the economic structure or may employ a different dynamics specification of their empirical model. For this reason, we relax in turn the assumptions that both the behavioral parameters and the model specification are time-invariant in order to assess the robustness of our results. First, given the model (1)-(2), we perform rolling sub-sample estimates to identify the associated values of the US policy makers' preferences for five-year moving windows. The values that the inflation stabilization coefficient, λ_π , takes over time are plotted in Figure 3 for the benchmark case (i.e. $\lambda_{\Delta i} = 0.2$).

Insert Figure 3 about here

The results are overwhelming and more general than those shown in the graph. For any value of $\lambda_{\Delta i}$, the parameter on inflation stabilization turns out to be fairly stable. Moreover, once we eliminate for the outlayer in the first quarter of 1999, its full sample mean is virtually equal to 0.8, implying that the monetary policy of the Fed can be evaluated within a single policy regime.

We turn now the attention on alternative specifications of the economic structure that might as well be relevant to monetary authorities. The goal is to identify of a set of policy preferences robust to model mis-specifications¹¹. To this end, we apply our calibration method to a number of empirical models that display a reasonably good fit in a given class of specifications. This class is made up of all combinations of a base set of eight regressors for the AS and nine for the AD whose richest specification takes the following form:

$$\begin{aligned} \pi_{t+1} = & \alpha_1\pi_t + \alpha_2\pi_{t-1} + \alpha_3\pi_{t-2} + \alpha_4\pi_{t-3} + \\ & \alpha_5y_t + \alpha_6y_{t-1} + \alpha_7y_{t-2} + \alpha_8y_{t-3} + \xi_{t+1} \end{aligned} \quad (10)$$

¹¹We stress that the source of uncertainty here is the unknown view that Greenspan has about the economy rather than the unknown 'true' dynamics of the world.

$$\begin{aligned}
y_{t+1} = & \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 y_{t-2} + \beta_4 y_{t-3} + \beta_5 \pi_t + \\
& \beta_6 \pi_{t-1} + \beta_7 \pi_{t-2} + \beta_8 \pi_{t-3} + \beta_9 (\bar{i}_t - \bar{\pi}_t) + \eta_{t+1}
\end{aligned} \tag{11}$$

Among these, we first select and then combine the top ten AS with the top ten AD where the ranking is based on the Akaike model selection criterion. In ninety out of one hundred cases, a *strict inflation targeting* overperforms any other targeting strategy and not surprisingly the outlayers are the specifications combining the alternative AS equations with the only 'theoretically not plausible' AD, namely the one in which the Aggregate Demand positively depends on interest rate.

This evidence shows that our findings seem to be stable and robust to both model and parameter uncertainty, and therefore they may fairly describe the Fed policy preferences under the Greenspan's chairmanship.

5 Conclusions

Monetary policy reflects central bank's preferences, thus to evaluate the former it is crucial to identify the latter. A simple way to do this is to go backward and, as a kind of revelation principle, to extract the relevant information from observed policy decisions. Since the estimated coefficients in a feedback rule are convolutions of the 'deep' parameters of the economy and those describing the policy makers' preferences, they are natural candidates for the purpose at hand. This paper develops a novel calibration method to recover the central bank's policy preferences from the reduced form estimates of a Taylor-type reaction function. To this end, we solve the intertemporal optimization of monetary authorities under the constraints provided by a small empirical model of the US economy. Then, we select among a fairly wide class of alternative targeting policies, the one that minimizes the sum of squared deviations between the associated optimal rule and the estimated one.

Our findings show that the Greenspan's tenure as Fed chairman is effectively described by a *strict inflation targeting* policy according to which the stabilization of inflation around its target has been the only concern of monetary authorities. Indeed, the feedback estimates show that the output gap has been important in policy making. However, since it is found to enter the policy rule but not the objective function, it can only be interpreted as a leading indicator for future inflation. Furthermore, our results are pretty stable over the Greenspan's era and particularly robust to alternative specifications of the relevant structure of the economy.

Appendix: the optimal control problem

For a discount factor δ , $0 < \delta < 1$, the central bank faces an intertemporal optimization problem of the form:

$$E_t \sum_{\tau=0}^{\infty} \delta^\tau LOSS_{t+\tau} \quad (12)$$

according to which it minimizes the expected discounted sum of future loss values. In particular, the objective function reads in each period:

$$LOSS_t = \lambda_\pi \bar{\pi}_t^2 + \lambda_y y_t^2 + \lambda_{\Delta i} (i_t - i_{t-1})^2 \quad (13)$$

The loss function is quadratic in the deviations of output and inflation from their target values and embodies an additional term that is meant to penalize for an excessive volatility of the policy instrument, i_t . The parameters λ_π and λ_y represent the (potentially time-variant) central bank's policy preferences towards inflation and output stabilization respectively. The weights in the objective function are normalized to sum to one.

When the discount factor, δ , approaches unity, the intertemporal loss function in (12) approaches the unconditional mean of the period loss function:

$$E[LOSS_t] = \lambda_\pi Var[\bar{\pi}_t] + \lambda_y Var[y_t] + \lambda_{\Delta i} Var[\Delta i_t] \quad (14)$$

The constraints of the optimization problem describe the structure of the economy, and they are specified by the AD-AS system in (1) and (2). This has a convenient state-space representation of the form:

$$X_{t+1} = AX_t + Bi_t + \eta_{t+1} \quad (15)$$

where the elements of (15) are given by:

$$X_t' = [\pi_t \quad \pi_{t-1} \quad \pi_{t-2} \quad \pi_{t-3} \quad y_t \quad y_{t-1} \quad i_{t-1} \quad i_{t-2} \quad i_{t-3}] \quad (16)$$

$$A = \begin{bmatrix} \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 & \alpha_5 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{-\beta_3}{4} & \frac{-\beta_3}{4} & \frac{-\beta_3}{4} & \frac{-\beta_3}{4} & \beta_1 & \beta_2 & \frac{\beta_3}{4} & \frac{\beta_3}{4} & \frac{\beta_3}{4} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ \frac{\beta_3}{4} \\ 0 \\ 1 \\ 0 \\ 0 \end{bmatrix} \quad (17)$$

$$\eta_t' = [\varepsilon_t \quad 0 \quad 0 \quad 0 \quad u_t \quad 0 \quad 0 \quad 0 \quad 0] \quad (18)$$

X_{t+1} is the 9 x 1 vector of state variables, i_t is the policy control (i.e. the federal funds rate) and η_{t+1} is a 9 x 1 vector of supply and demand iid normally distributed shocks with

mean vector zero and covariance matrix $E\eta_t\eta_t' = \Sigma$. Lastly, A and B are the matrices of behavioral parameters.

The loss function in (13) can be represented in a more compact form by defining the 3 x 1 vector Y_t of goal variables. This vector reads:

$$Y_t = CX_t + Di_t \quad (19)$$

where the elements of (19) are given by:

$$Y_t = \begin{bmatrix} \bar{\pi}_t \\ y_t \\ i_t - i_{t-1} \end{bmatrix}, C = \begin{bmatrix} \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \end{bmatrix}, D = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad (20)$$

Accordingly, the loss function can be rewritten as:

$$LOSS_t = Y_t'RY_t \quad (21)$$

where R is a negative semidefinite symmetric 3 x 3 matrix characterized by the weight λ_π , λ_y and $\lambda_{\Delta i}$ on the diagonal and zeros elsewhere.

The central bank's optimal control problem is to minimize over choice of $\{i_t\}_{t=0}^\infty$ the criterion:

$$\sum_{\tau=0}^{\infty} \delta^\tau \{Y_{t+\tau}'RY_{t+\tau}\} \quad (22)$$

subject to the dynamic evolution of the economy described in (15) and given the current state of the economy X_t .

The quadratic objective function, the linear transition equation and the property $E(\eta_{t+1} | X_t) = 0$ are convenient forms for the stochastic optimal linear regulator problem (see Ljungqvist and Sargent, Ch. 4, 2000). It follows that the feedback rule that solves the optimization is linear and independent from the problem's noise statistics, Σ , as the certainty equivalence holds. Then, the first-order necessary condition turns out to be:

$$(S + \delta B'PB) i = -(V' + \delta B'PA)X \quad (23)$$

which implies the following feedback rule for the policy instrument $i = fX$ where f is given by:

$$f = -(S + \delta B'PB)^{-1} (V' + \delta B'PA)$$

The 9 x 9 matrix P is the solution of the algebraic Riccati equation:

$$P = Q + \delta (A + Bf)' P (A + Bf) + f' S f + V f + f' V' \quad (24)$$

where Q , V and S are defined as $C'RC$, $C'RD$ and $D'RD$ respectively.

Such a reaction function resembles an augmented Taylor's rule according to which monetary authorities set the federal funds rate in every period as the optimal response to movements in the current and lagged values of the state variables as well as lagged values of the fed funds rate itself.

Finally, given this optimal feedback rule the transition law of the economy can be rewritten as $X_{t+1} = MX_t + \eta_{t+1}$, where the 9 x 9 matrix M is equal to $A + Bf$.

References

- Andrews, D.W., 1993. Tests for parameter instability and structural change with unknown change point, *Econometrica*, 61, 821-856.
- Bagliano, F., Favero, C., 1998. Measuring monetary policies with VAR models: an evaluation. *European Economic Review*, 42, 1069-1112.
- Ball, L, 1999. Efficient rules for monetary policy. *International Finance*, 63-83
- Bank of International Settlements, 1995. Financial structure and the monetary policy transmission mechanism. Basle, Switzerland.
- Bernanke, B.S., Mihov, I., 1998. Measuring monetary policy. *Quarterly Journal of Economics*, 113, 869-902.
- Castelnuovo, E., Surico, P., 2001. Model Uncertainty, Optimal Monetary Policy and the Preferences of the Fed. *Fondazione Eni Enrico Mattei working paper* 89.01.
- Cecchetti, S.G., Ehrmann, M., 2001. Does inflation targeting increase output volatility? An international comparison of policymakers' preferences and outcomes. In: Schmidt-Hebbel, K. (Ed). *Monetary policy: rules and transmission mechanism*.
- Cecchetti, S.G., McConnell, M., Perez-Quiros, G., 1999. Policymakers revealed preferences and the output-inflation variability trade-off. Unpublished, Federal Reserve Bank of New York.
- Christiano L.J., Eichenbaum, M., Evans, C., 1998. Monetary policy shocks: what have we learned and to what end? In: Woodford, M., Taylor, J.B (Eds). *Handbook of monetary economics*, North-Holland.
- Christiano L.J., Eichenbaum, M., Evans, C., 1996. The effects of monetary policy shocks: evidence from the flows of funds. *Review of Economic and Statistics*, 78, 16-34.
- Clarida, R., Gali, J., Gertler, M., 2000. Monetary policy rules and macroeconomic stability: evidence and some theory. *Quarterly Journal of Economics*, 115, 147-180.
- Clarida, R., Gali, J., Gertler, M., 1999. The science of monetary policy: a new Keynesian perspective. *Journal of Economic Literature*, 37, 1661-1707.
- Dennis, R., 2001. The policy preferences of the US federal reserve. Mimeo, Federal Reserve of San Francisco.
- Favero, C., Rovelli, R., 2001. Macroeconomic stability and the preferences of the Fed. A formal analysis, 1961-98. *Journal of Money, Credit and Banking*, Forthcoming.
- Fuhrer, J.C., 1997. The (un)importance of forward-looking behavior in price specifications. *Journal of Money, Credit and Banking*, 29, 338-350.
- Goodfriend, M., 1991. Interest rate and the conduct of monetary policy. *Carnegie-Rochester conference series on public policy*, 34, 7-30.
- Goodfriend, M., 1987. Interest rate smoothing and price level trend-stationarity. *Journal of Monetary Economics*, 19, 335-348.
- Goodhart, C.A.E., 1997. Why do the monetary authorities smooth interest rates? In: Collignon, S. (Ed). *European monetary policies*. Chapter 8, Pinter: London.

- Judd, J.P., Rudebusch, G.D., 1998. Taylor's rule and the fed: 1970-1997. Federal Reserve Bank of San Francisco, *Economic Review*, 3, 3-16.
- Ljungqvist, L., Sargent, T., 2000. Recursive macroeconomic theory. MIT press.
- Lucas Jr., R., 1976. Econometric policy evaluation: a critique. Carnegie-Rochester conference series on public policy, 1, 19-46.
- McCallum, B.T., 1999. Issues in the design of monetary policy rules. In: Woodford, M., Taylor, J.B (Eds). *Handbook of monetary economics*, North-Holland.
- Mishkin, F.S., 1999. Comment on 'Policy rules for inflation targeting' by Rudebusch, G.D., Svensson, L.E.O. In: Taylor, J.B. (Ed), *Monetary policy rules*. Chicago University press.
- Muscattelli, A., Tirelli, P., Trecroci, C., 2000. Does institutional change really matter? Inflation targets, central bank reform and interest rate policy in the OECD countries. CES-ifo, working paper No 278.
- Neiss, K., Nelson, E., 2001. The real interest rate gap as an inflation indicator. Bank of England, working paper No 130.
- Rudebusch, G.D., 2001a. Is the fed too timid?. *Monetary policy in an uncertain world*. *Review of Economics and Statistics*, 83, 203-217.
- Rudebusch, G.D., 2001b. Term structure evidence on interest rate smoothing and monetary policy inertia. Mimeo, Federal Reserve of San Francisco.
- Rudebusch, G.D., 1995. Federal reserve interest rate targeting, rational expectations and the term structure. *Journal of Monetary Economics*, 35, 245-274.
- Rudebusch, G.D., Svensson, L.E.O., 2001. Eurosystem monetary targeting: lessons from US data. *European Economic Review*. Forthcoming.
- Rudebusch, G.D., Svensson, L.E.O., 1999. Policy rules for inflation targeting. In: Taylor, J.B (Ed.), *Monetary policy rules*. Chicago University press.
- Sack, B., 2000. Does the fed act gradually? A VAR analysis. *Journal of Monetary Economics*, 46, 229-256.
- Svensson, L.E.O., 1999a. Inflation targeting as a monetary policy rule. *Journal of Monetary Economics*, 43, 607-654.
- Svensson, L.E.O., 1999b. Monetary policy issues for the Eurosystem. Carnegie-Rochester conference series on public policy, 51, 79-136.
- Svensson, L.E.O., 1999c. Inflation targeting: some extensions. *Scandinavian Journal of Economics*, 101, 337-361.
- Svensson, L.E.O., 1997. Inflation forecast targeting: implementing and monitoring inflation targets. *European Economic Review*, 41, 1111-1146.
- Taylor, J.B., 1993. Discretion versus policy rules in practice. Carnegie-Rochester conference series on public policy, 39, 195-214.
- Walsh, C.E., 1998. *Monetary theory and policy*. MIT press.
- Woodford, M., 1999, Optimal monetary policy inertia, NBER wp No 7261.
- Woodford, M., 2001, Inflation stabilization and welfare. NBER wp No 8071.

Figure 1: estimated and optimal policy rates



Figure 2: actual path of inflation

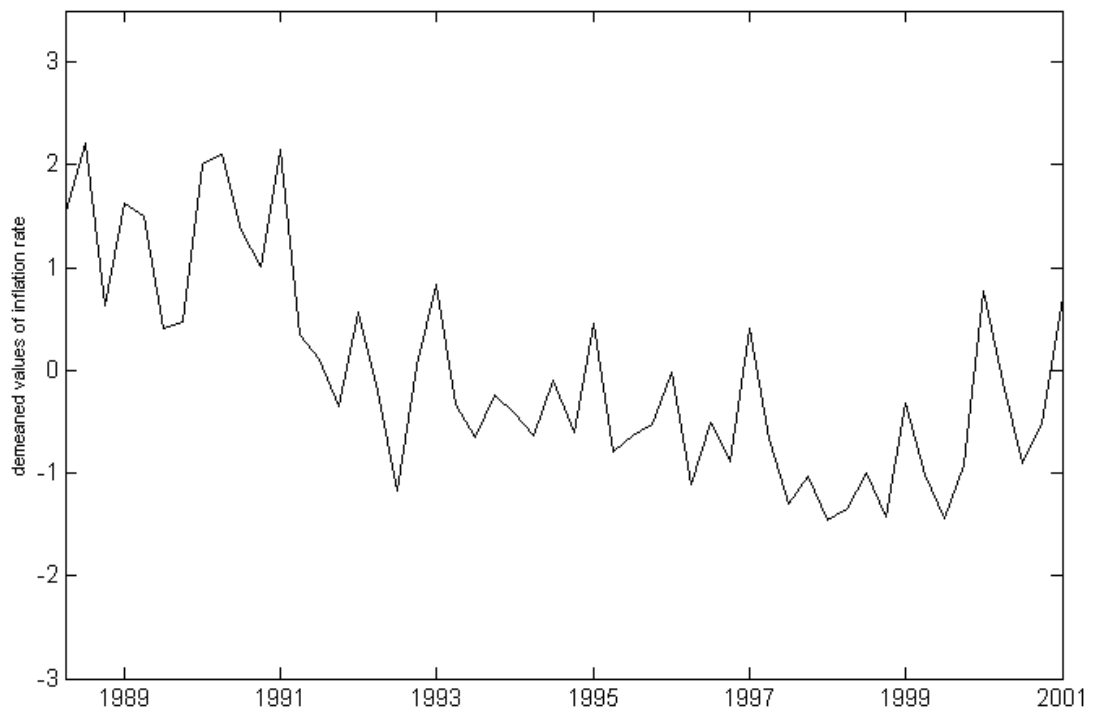
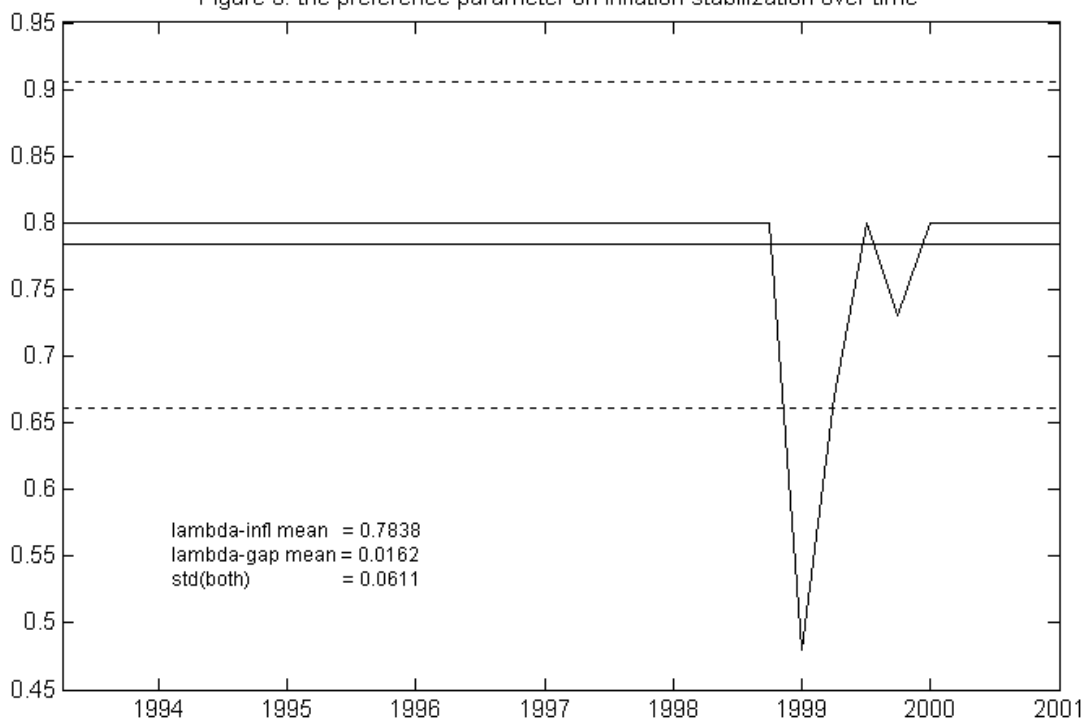


Figure 3: the preference parameter on inflation stabilization over time



Note: each parameter estimate is obtained from a five-year rolling sub-sample regression that ends in the quarter in which the parameter estimate is plotted.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Papers Series

Our working papers are available on the Internet at the following addresses:

Server WWW: WWW.FEEM.IT

Anonymous FTP: FTP.FEEM.IT

To order any of these papers, please fill out the form at the end of the list.

SUST	1.2001	<i>Inge MAYERES and Stef PROOST: <u>Should Diesel Cars in Europe be Discouraged?</u></i>
SUST	2.2001	<i>Paola DORIA and Davide PETTENELLA: <u>The Decision Making Process in Defining and Protecting Critical Natural Capital</u></i>
CLIM	3.2001	<i>Alberto PENCH: <u>Green Tax Reforms in a Computable General Equilibrium Model for Italy</u></i>
CLIM	4.2001	<i>Maurizio BUSSOLO and Dino PINELLI: <u>Green Taxes: Environment, Employment and Growth</u></i>
CLIM	5.2001	<i>Marco STAMPINI: <u>Tax Reforms and Environmental Policies for Italy</u></i>
ETA	6.2001	<i>Walid OUESLATI: <u>Environmental Fiscal Policy in an Endogenous Growth Model with Human Capital</u></i>
CLIM	7.2001	<i>Umberto CIORBA, Alessandro LANZA and Francesco PAULI: <u>Kyoto Commitment and Emission Trading: a European Union Perspective</u></i>
MGMT	8.2001	<i>Brian SLACK (xlv): <u>Globalisation in Maritime Transportation: Competition, uncertainty and implications for port development strategy</u></i>
VOL	9.2001	<i>Giulia PESARO: <u>Environmental Voluntary Agreements: A New Model of Co-operation Between Public and Economic Actors</u></i>
VOL	10.2001	<i>Cathrine HAGEM: <u>Climate Policy, Asymmetric Information and Firm Survival</u></i>
ETA	11.2001	<i>Sergio CURRARINI and Marco MARINI: <u>A Sequential Approach to the Characteristic Function and the Core in Games with Externalities</u></i>
ETA	12.2001	<i>Gaetano BLOISE, Sergio CURRARINI and Nicholas KIKIDIS: <u>Inflation and Welfare in an OLG Economy with a Privately Provided Public Good</u></i>
KNOW	13.2001	<i>Paolo SURICO: <u>Globalisation and Trade: A "New Economic Geography" Perspective</u></i>
ETA	14.2001	<i>Valentina BOSETTI and Vincenzina MESSINA: <u>Quasi Option Value and Irreversible Choices</u></i>
CLIM	15.2001	<i>Guy ENGELN (xlii): <u>Desertification and Land Degradation in Mediterranean Areas: from Science to Integrated Policy Making</u></i>
SUST	16.2001	<i>Julie Catherine SORS: <u>Measuring Progress Towards Sustainable Development in Venice: A Comparative Assessment of Methods and Approaches</u></i>
SUST	17.2001	<i>Julie Catherine SORS: <u>Public Participation in Local Agenda 21: A Review of Traditional and Innovative Tools</u></i>
CLIM	18.2001	<i>Johan ALBRECHT and Niko GOBBIN: <u>Schumpeter and the Rise of Modern Environmentalism</u></i>
VOL	19.2001	<i>Rinaldo BRAU, Carlo CARRARO and Giulio GOLFETTO (xliii): <u>Participation Incentives and the Design of Voluntary Agreements</u></i>
ETA	20.2001	<i>Paola ROTA: <u>Dynamic Labour Demand with Lumpy and Kinked Adjustment Costs</u></i>
ETA	21.2001	<i>Paola ROTA: <u>Empirical Representation of Firms' Employment Decisions by an (S,s) Rule</u></i>
ETA	22.2001	<i>Paola ROTA: <u>What Do We Gain by Being Discrete? An Introduction to the Econometrics of Discrete Decision Processes</u></i>
PRIV	23.2001	<i>Stefano BOSI, Guillaume GIRMANS and Michel GUILLARD: <u>Optimal Privatisation Design and Financial Markets</u></i>
KNOW	24.2001	<i>Giorgio BRUNELLO, Claudio LUPI, Patrizia ORDINE, and Maria Luisa PARISI: <u>Beyond National Institutions: Labour Taxes and Regional Unemployment in Italy</u></i>
ETA	25.2001	<i>Klaus CONRAD: <u>Locational Competition under Environmental Regulation when Input Prices and Productivity Differ</u></i>
PRIV	26.2001	<i>Bernardo BORTOLOTTI, Juliet D'SOUZA, Marcella FANTINI and William L. MEGGINSON: <u>Sources of Performance Improvement in Privatised Firms: A Clinical Study of the Global Telecommunications Industry</u></i>
CLIM	27.2001	<i>Frédéric BROCHIER and Emiliano RAMIERI: <u>Climate Change Impacts on the Mediterranean Coastal Zones</u></i>
ETA	28.2001	<i>Nunzio CAPPUCCIO and Michele MORETTO: <u>Comments on the Investment-Uncertainty Relationship in a Real Option Model</u></i>
KNOW	29.2001	<i>Giorgio BRUNELLO: <u>Absolute Risk Aversion and the Returns to Education</u></i>
CLIM	30.2001	<i>ZhongXiang ZHANG: <u>Meeting the Kyoto Targets: The Importance of Developing Country Participation</u></i>
ETA	31.2001	<i>Jonathan D. KAPLAN, Richard E. HOWITT and Y. Hossein FARZIN: <u>An Information-Theoretical Analysis of Budget-Constrained Nonpoint Source Pollution Control</u></i>
MGMT	32.2001	<i>Roberta SALOMONE and Giulia GALLUCCIO: <u>Environmental Issues and Financial Reporting Trends</u></i>

Coalition Theory Network	33.2001	<i>Shlomo WEBER and Hans WIESMETH</i> : <u>From Autarky to Free Trade: The Impact on Environment</u>
ETA	34.2001	<i>Margarita GENIUS and Elisabetta STRAZZERA</i> : <u>Model Selection and Tests for Non Nested Contingent Valuation Models: An Assessment of Methods</u>
NRM	35.2001	<i>Carlo GIUPPONI</i> : <u>The Substitution of Hazardous Molecules in Production Processes: The Atrazine Case Study in Italian Agriculture</u>
KNOW	36.2001	<i>Raffaele PACI and Francesco PIGLIARU</i> : <u>Technological Diffusion, Spatial Spillovers and Regional Convergence in Europe</u>
PRIV	37.2001	<i>Bernardo BORTOLOTTI</i> : <u>Privatisation, Large Shareholders, and Sequential Auctions of Shares</u>
CLIM	38.2001	<i>Barbara BUCHNER</i> : <u>What Really Happened in The Hague? Report on the COP6, Part I, 13-25 November 2000, The Hague, The Netherlands</u>
PRIV	39.2001	<i>Giacomo CALZOLARI and Carlo SCARPA</i> : <u>Regulation at Home, Competition Abroad: A Theoretical Framework</u>
KNOW	40.2001	<i>Giorgio BRUNELLO</i> : <u>On the Complementarity between Education and Training in Europe</u>
Coalition Theory Network	41.2001	<i>Alain DESDOIGTS and Fabien MOIZEAU</i> (xlv): <u>Multiple Politico-Economic Regimes, Inequality and Growth</u>
Coalition Theory Network	42.2001	<i>Parkash CHANDER and Henry TULKENS</i> (xlv): <u>Limits to Climate Change</u>
Coalition Theory Network	43.2001	<i>Michael FINUS and Bianca RUNDSHAGEN</i> (xlv): <u>Endogenous Coalition Formation in Global Pollution Control</u>
Coalition Theory Network	44.2001	<i>Wietze LISE, Richard S.J. TOL and Bob van der ZWAAN</i> (xlv): <u>Negotiating Climate Change as a Social Situation</u>
NRM	45.2001	<i>Mohamad R. KHAWLIE</i> (xlvii): <u>The Impacts of Climate Change on Water Resources of Lebanon-Eastern Mediterranean</u>
NRM	46.2001	<i>Mutasem EL-FADEL and E. BOU-ZEID</i> (xlvii): <u>Climate Change and Water Resources in the Middle East: Vulnerability, Socio-Economic Impacts and Adaptation</u>
NRM	47.2001	<i>Eva IGLESIAS, Alberto GARRIDO and Almudena GOMEZ</i> (xlvii): <u>An Economic Drought Management Index to Evaluate Water Institutions' Performance Under Uncertainty and Climate Change</u>
CLIM	48.2001	<i>Wietze LISE and Richard S.J. TOL</i> (xlvii): <u>Impact of Climate on Tourist Demand</u>
CLIM	49.2001	<i>Francesco BOSELLO, Barbara BUCHNER, Carlo CARRARO and Davide RAGGI</i> : <u>Can Equity Enhance Efficiency? Lessons from the Kyoto Protocol</u>
SUST	50.2001	<i>Roberto ROSON</i> (xlviii): <u>Carbon Leakage in a Small Open Economy with Capital Mobility</u>
SUST	51.2001	<i>Edwin WOERDMAN</i> (xlviii): <u>Developing a European Carbon Trading Market: Will Permit Allocation Distort Competition and Lead to State Aid?</u>
SUST	52.2001	<i>Richard N. COOPER</i> (xlviii): <u>The Kyoto Protocol: A Flawed Concept</u>
SUST	53.2001	<i>Kari KANGAS</i> (xlviii): <u>Trade Liberalisation, Changing Forest Management and Roundwood Trade in Europe</u>
SUST	54.2001	<i>Xueqin ZHU and Ekko VAN IERLAND</i> (xlviii): <u>Effects of the Enlargement of EU on Trade and the Environment</u>
SUST	55.2001	<i>M. Ozgur KAYALICA and Sajal LAHIRI</i> (xlviii): <u>Strategic Environmental Policies in the Presence of Foreign Direct Investment</u>
SUST	56.2001	<i>Savas ALPAY</i> (xlviii): <u>Can Environmental Regulations be Compatible with Higher International Competitiveness? Some New Theoretical Insights</u>
SUST	57.2001	<i>Roldan MURADIAN, Martin O'CONNOR, Joan MARTINEZ-ALER</i> (xlviii): <u>Embodied Pollution in Trade: Estimating the "Environmental Load Displacement" of Industrialised Countries</u>
SUST	58.2001	<i>Matthew R. AUER and Rafael REUVENY</i> (xlviii): <u>Foreign Aid and Direct Investment: Key Players in the Environmental Restoration of Central and Eastern Europe</u>
SUST	59.2001	<i>Onno J. KUIK and Frans H. OOSTERHUIS</i> (xlviii): <u>Lessons from the Southern Enlargement of the EU for the Environmental Dimensions of Eastern Enlargement, in particular for Poland</u>
ETA	60.2001	<i>Carlo CARRARO, Alessandra POME and Domenico SINISCALCO</i> (xlix): <u>Science vs. Profit in Research: Lessons from the Human Genome Project</u>
CLIM	61.2001	<i>Efrem CASTELNUOVO, Michele MORETTO and Sergio VERGALLI</i> : <u>Global Warming, Uncertainty and Endogenous Technical Change: Implications for Kyoto</u>
PRIV	62.2001	<i>Gian Luigi ALBANO, Fabrizio GERMANO and Stefano LOVO</i> : <u>On Some Collusive and Signaling Equilibria in Ascending Auctions for Multiple Objects</u>
CLIM	63.2001	<i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH</i> : <u>A Note on Testing for Environmental Kuznets Curves with Panel Data</u>

CLIM	64.2001	<i>Paolo BUONANNO, Carlo CARRARO and Marzio GALEOTTI: <u>Endogenous Induced Technical Change and the Costs of Kyoto</u></i>
CLIM	65.2001	<i>Guido CAZZAVILLAN and Ignazio MUSU (I): <u>Transitional Dynamics and Uniqueness of the Balanced-Growth Path in a Simple Model of Endogenous Growth with an Environmental Asset</u></i>
CLIM	66.2001	<i>Giovanni BAIOCCHI and Salvatore DI FALCO (I): <u>Investigating the Shape of the EKC: A Nonparametric Approach</u></i>
CLIM	67.2001	<i>Marzio GALEOTTI, Alessandro LANZA and Francesco PAULI (I): <u>Desperately Seeking (Environmental) Kuznets: A New Look at the Evidence</u></i>
CLIM	68.2001	<i>Alexey VIKHLYAEV (xlviii): <u>The Use of Trade Measures for Environmental Purposes – Globally and in the EU Context</u></i>
NRM	69.2001	<i>Gary D. LIBECAP and Zeynep K. HANSEN (li): <u>U.S. Land Policy, Property Rights, and the Dust Bowl of the 1930s</u></i>
NRM	70.2001	<i>Lee J. ALSTON, Gary D. LIBECAP and Bernardo MUELLER (li): <u>Land Reform Policies, The Sources of Violent Conflict and Implications for Deforestation in the Brazilian Amazon</u></i>
CLIM	71.2001	<i>Claudia KEMFERT: <u>Economy-Energy-Climate Interaction – The Model WIAGEM -</u></i>
SUST	72.2001	<i>Paulo A.L.D. NUNES and Yohanes E. RIYANTO: <u>Policy Instruments for Creating Markets for Biodiversity: Certification and Ecolabeling</u></i>
SUST	73.2001	<i>Paulo A.L.D. NUNES and Erik SCHOKKAERT (lii): <u>Warm Glow and Embedding in Contingent Valuation</u></i>
SUST	74.2001	<i>Paulo A.L.D. NUNES, Jeroen C.J.M. van den BERGH and Peter NIJKAMP (lii): <u>Ecological-Economic Analysis and Valuation of Biodiversity</u></i>
VOL	75.2001	<i>Johan EYCKMANS and Henry TULKENS (li): <u>Simulating Coalitionally Stable Burden Sharing Agreements for the Climate Change Problem</u></i>
PRIV	76.2001	<i>Axel GAUTIER and Florian HEIDER: <u>What Do Internal Capital Markets Do? Redistribution vs. Incentives</u></i>
PRIV	77.2001	<i>Bernardo BORTOLOTTI, Marcella FANTINI and Domenico SINISCALCO: <u>Privatisation around the World: New Evidence from Panel Data</u></i>
ETA	78.2001	<i>Toke S. AIDT and Jayasri DUTTA (li): <u>Transitional Politics. Emerging Incentive-based Instruments in Environmental Regulation</u></i>
ETA	79.2001	<i>Alberto PETRUCCI: <u>Consumption Taxation and Endogenous Growth in a Model with New Generations</u></i>
ETA	80.2001	<i>Pierre LASSERRE and Antoine SOUBEYRAN (li): <u>A Ricardian Model of the Tragedy of the Commons</u></i>
ETA	81.2001	<i>Pierre COURTOIS, Jean Christophe PÉREAU and Tarik TAZDAÏT: <u>An Evolutionary Approach to the Climate Change Negotiation Game</u></i>
NRM	82.2001	<i>Christophe BONTEMPS, Stéphane COUTURE and Pascal FAVARD: <u>Is the Irrigation Water Demand Really Convex?</u></i>
NRM	83.2001	<i>Unai PASCUAL and Edward BARBIER: <u>A Model of Optimal Labour and Soil Use with Shifting Cultivation</u></i>
CLIM	84.2001	<i>Jesper JENSEN and Martin Hoidt THELLE: <u>What are the Gains from a Multi-Gas Strategy?</u></i>
CLIM	85.2001	<i>Maurizio MICHELINI (liii): IPCC “Summary for Policymakers” in TAR. Do its results give a scientific support always adequate to the urgencies of Kyoto negotiations?</i>
CLIM	86.2001	<i>Claudia KEMFERT (liii): <u>Economic Impact Assessment of Alternative Climate Policy Strategies</u></i>
CLIM	87.2001	<i>Cesare DOSI and Michele MORETTO: <u>Global Warming and Financial Umbrellas</u></i>
ETA	88.2001	<i>Elena BONTEMPI, Alessandra DEL BOCA, Alessandra FRANZOSI, Marzio GALEOTTI and Paola ROTTA: <u>Capital Heterogeneity: Does it Matter? Fundamental Q and Investment on a Panel of Italian Firms</u></i>
ETA	89.2001	<i>Efrem CASTELNUOVO and Paolo SURICO: <u>Model Uncertainty, Optimal Monetary Policy and the Preferences of the Fed</u></i>
CLIM	90.2001	<i>Umberto CIORBA, Alessandro LANZA and Francesco PAULI: <u>Kyoto Protocol and Emission Trading: Does the US Make a Difference?</u></i>
CLIM	91.2001	<i>ZhongXiang ZHANG and Lucas ASSUNCAO: <u>Domestic Climate Policies and the WTO</u></i>
SUST	92.2001	<i>Anna ALBERINI, Alan KRUPNICK, Maureen CROPPER, Nathalie SIMON and Joseph COOK (lii): <u>The Willingness to Pay for Mortality Risk Reductions: A Comparison of the United States and Canada</u></i>
SUST	93.2001	<i>Riccardo SCARPA, Guy D. GARROD and Kenneth G. WILLIS (lii): <u>Valuing Local Public Goods with Advanced Stated Preference Models: Traffic Calming Schemes in Northern England</u></i>
CLIM	94.2001	<i>Ming CHEN and Larry KARP: <u>Environmental Indices for the Chinese Grain Sector</u></i>
CLIM	95.2001	<i>Larry KARP and Jiangfeng ZHANG: <u>Controlling a Stock Pollutant with Endogenous Investment and Asymmetric Information</u></i>
ETA	96.2001	<i>Michele MORETTO and Gianpaolo ROSSINI: <u>On the Opportunity Cost of Nontradable Stock Options</u></i>
SUST	97.2001	<i>Elisabetta STRAZZERA, Margarita GENIUS, Riccardo SCARPA and George HUTCHINSON: <u>The Effect of Protest Votes on the Estimates of Willingness to Pay for Use Values of Recreational Sites</u></i>
NRM	98.2001	<i>Frédéric BROCHIER, Carlo GIUPPONI and Alberto LONGO: <u>Integrated Coastal Zone Management in the Venice Area – Perspectives of Development for the Rural Island of Sant’Erasmo</u></i>

NRM	99.2001	<i>Frédéric BROCHIER, Carlo GIUPPONI and Julie SORS: <u>Integrated Coastal Management in the Venice Area – Potentials of the Integrated Participatory Management Approach</u></i>
NRM	100.2001	<i>Frédéric BROCHIER and Carlo GIUPPONI: <u>Integrated Coastal Zone Management in the Venice Area – A Methodological Framework</u></i>
PRIV	101.2001	<i>Enrico C. PEROTTI and Luc LAEVEN: <u>Confidence Building in Emerging Stock Markets</u></i>
CLIM	102.2001	<i>Barbara BUCHNER, Carlo CARRARO and Igor CERSOSIMO: <u>On the Consequences of the U.S. Withdrawal from the Kyoto/Bonn Protocol</u></i>
SUST	103.2001	<i>Riccardo SCARPA, Adam DRUCKER, Simon ANDERSON, Nancy FERRAES-EHUAN, Veronica GOMEZ, Carlos R. RISOPATRON and Olga RUBIO-LEONEL: <u>Valuing Animal Genetic Resources in Peasant Economies: The Case of the Box Keken Creole Pig in Yucatan</u></i>
SUST	104.2001	<i>R. SCARPA, P. KRISTJANSON, A. DRUCKER, M. RADENY, E.S.K. RUTO, and J.E.O. REGE: <u>Valuing Indigenous Cattle Breeds in Kenya: An Empirical Comparison of Stated and Revealed Preference Value Estimates</u></i>
SUST	105.2001	<i>Clemens B.A. WOLLNY: <u>The Need to Conserve Farm Animal Genetic Resources Through Community-Based Management in Africa: Should Policy Makers be Concerned?</u></i>
SUST	106.2001	<i>J.T. KARUGIA, O.A. MWAI, R. KAITHO, Adam G. DRUCKER, C.B.A. WOLLNY and J.E.O. REGE: <u>Economic Analysis of Crossbreeding Programmes in Sub-Saharan Africa: A Conceptual Framework and Kenyan Case Study</u></i>
SUST	107.2001	<i>W. AYALEW, J.M. KING, E. BRUNS and B. RISCHKOWSKY: <u>Economic Evaluation of Smallholder Subsistence Livestock Production: Lessons from an Ethiopian Goat Development Program</u></i>
SUST	108.2001	<i>Gianni CICIA, Elisabetta D'ERCOLE and Davide MARINO: <u>Valuing Farm Animal Genetic Resources by Means of Contingent Valuation and a Bio-Economic Model: The Case of the Pentro Horse</u></i>
SUST	109.2001	<i>Clem TISDELL: <u>Socioeconomic Causes of Loss of Animal Genetic Diversity: Analysis and Assessment</u></i>
SUST	110.2001	<i>M.A. JABBAR and M.L. DIEDHOU: <u>Does Breed Matter to Cattle Farmers and Buyers? Evidence from West Africa</u></i>
SUST	1.2002	<i>K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW: <u>Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa</u></i>
ETA	2.2002	<i>Efrem CASTELNUOVO and Paolo SURICO: <u>What Does Monetary Policy Reveal about Central Bank's Preferences?</u></i>

- (xlii) This paper was presented at the International Workshop on "Climate Change and Mediterranean Coastal Systems: Regional Scenarios and Vulnerability Assessment" organised by the Fondazione Eni Enrico Mattei in co-operation with the Istituto Veneto di Scienze, Lettere ed Arti, Venice, December 9-10, 1999.
- (xliii) This paper was presented at the International Workshop on "Voluntary Approaches, Competition and Competitiveness" organised by the Fondazione Eni Enrico Mattei within the research activities of the CAVA Network, Milan, May 25-26, 2000.
- (xliv) This paper was presented at the International Workshop on "Green National Accounting in Europe: Comparison of Methods and Experiences" organised by the Fondazione Eni Enrico Mattei within the Concerted Action of Environmental Valuation in Europe (EVE), Milan, March 4-7, 2000
- (xlv) This paper was presented at the International Workshop on "New Ports and Urban and Regional Development. The Dynamics of Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, May 5-6, 2000.
- (xlvi) This paper was presented at the Sixth Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, January 26-27, 2001
- (xlvii) This paper was presented at the RICAMARE Workshop "Socioeconomic Assessments of Climate Change in the Mediterranean: Impact, Adaptation and Mitigation Co-benefits", organised by the Fondazione Eni Enrico Mattei, Milan, February 9-10, 2001
- (xlviii) This paper was presented at the International Workshop "Trade and the Environment in the Perspective of the EU Enlargement", organised by the Fondazione Eni Enrico Mattei, Milan, May 17-18, 2001
- (xlix) This paper was presented at the International Conference "Knowledge as an Economic Good", organised by Fondazione Eni Enrico Mattei and The Beijer International Institute of Environmental Economics, Palermo, April 20-21, 2001
- (l) This paper was presented at the Workshop "Growth, Environmental Policies and + Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001
- (li) This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on "Property Rights, Institutions and Management of Environmental and Natural Resources", organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001
- (lii) This paper was presented at the International Conference on "Economic Valuation of Environmental Goods", organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001
- (liii) This paper was circulated at the International Conference on "Climate Policy - Do We Need a New Approach?", jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001

2001 SERIES

MGMT	<i>Corporate Sustainable Management</i> (Editor: Andrea Marsanich)
CLIM	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
PRIV	<i>Privatisation, Antitrust, Regulation</i> (Editor: Bernardo Bortolotti)
KNOW	<i>Knowledge, Technology, Human Capital</i> (Editor: Dino Pinelli)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
SUST	<i>Sustainability Indicators and Environmental Evaluation</i> (Editor: Marialuisa Tamborra)
VOL	<i>Voluntary and International Agreements</i> (Editor: Carlo Carraro)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)

2002 SERIES

MGMT	<i>Corporate Sustainable Management</i> (Editor: Andrea Marsanich)
CLIM	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
PRIV	<i>Privatisation, Antitrust, Regulation</i> (Editor: Bernardo Bortolotti)
KNOW	<i>Knowledge, Technology, Human Capital</i> (Editor: Dino Pinelli)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
SUST	<i>Sustainability Indicators and Environmental Evaluation</i> (Editor: Marialuisa Tamborra)
VOL	<i>Voluntary and International Agreements</i> (Editor: Carlo Carraro)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)

SUBSCRIPTION TO "NOTE DI LAVORO"

Starting from January 1998 Fondazione Eni Enrico Mattei issues a Periodic E-mail "Note di Lavoro" Bulletin listing the titles and the abstracts of its most recent Working Papers.

All the "Note di Lavoro" listed in the Bulletin are available on the Internet and are downloadable from Feem's web site "www.feem.it".

If you wish to receive hard copies you may choose from the payment options listed in the following table (minimum order: 10 papers)*.

*Orders for individual papers should clearly indicate the "Nota di Lavoro" number and can therefore be issued for published papers only.

All orders must be sent by fax to:

"Publications Office" - Fondazione Eni Enrico Mattei: Fax +39+2+52036946

PAYMENT OPTIONS

How many papers?	What's the price?	How to pay?
10 or more*	US\$ 4.00 each Euro 5,00 each	By Credit card or Bank transfer
Annual subscription (approx. 100 papers/year)	US\$ 250.00 Euro 219,00	By Credit card or Bank transfer

***Please fill out the Working Paper Subscription Form indicating your preferences (Periodic E-mail "Note di Lavoro" Bulletin, Annual subscription, Order for individual papers - minimum 10*)!**

☞.....

WORKING PAPER SUBSCRIPTION FORM

Name: _____

Affiliation(if applicable): _____

Address: _____

Phone: _____ Fax: _____ E-mail: _____

I wish to: _____ Amount due: _____

receive the Periodic E-mail Working Papers Bulletin

place a full annual subscription for 2002 (US\$ 250.00/Euro 219,00) _____

order no.....individual papers (minimum 10 papers at US\$ 4.00/Euro 5,00 each)* _____

Total _____

I will pay by:

VISA American Express Card No. _____ Expiration Date: _____

Signature: _____

Bank transfer in US\$ (or Euro in Italy) to Fondazione Eni Enrico Mattei - account no. 39341-56 -

SWIFT ARTIITM2 - ABI 03512 - CAB 01614 - Credito Artigiano - Corso Magenta 59, 20123 Milano, Italy.

Copy of the bank transfer should be faxed along with the order.

Please return this duly completed form to:

"Publications Office" - Fondazione Eni Enrico Mattei - Corso Magenta, 63 - 20123 Milano, Italy