DYNAMIC PATHS OF THE EUROPEAN ECONOMY: SIMULATIONS WITH AN EU AGGREGATE MODEL

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Model homepage: http://eumodel.net

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Abstract

Using an aggregate econometric model we investigate by simulation methods some dynamic paths of the European economy in the next five years under alternative hypotheses concerning the growth of world demand, the European currency/USD exchange rate, and the monetary policy.

Key words: Econometric model, Simulation, European economy

JEL Classification Codes: C53, O52

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1. Introduction

The development of the European economy constitutes a subject of remarkable interest in the current debate on world economy. One wonders why Europe has grown less than previously expected; why unemployment in the nineties has remained high, compared for instance to the USA; why the exchange rate Euro/$ is lower than expected, and so on. Some months ago a few independent economists only dared to criticize the economic construction of Europe. Nowadays, criticisms are generalized and concern almost every aspect of the European economy, from the fiscal constraints to monetary policy, from the structure of the labour market to welfare objectives, and so forth.

While the analysis focuses more and more on the aggregate outcomes of the European economic system (the European unemployment rate, the European rate of growth, and so on), empirical evidence on the behaviour of the European economy as a whole is still scarce. Thus, we believe it useful to take part in the extensive debate on these topics by putting forth some simulation experiments related to the future developments of the European economy, carried out with an aggregate model of the European Union (Bagnai and Carlucci, 1998, 2002a, 2002b). These simulations compare the dynamic paths of the European economy in the next five years under a set of alternative scenarios. The proposed scenarios are highly stylized. In our view, this does not reduce their likelihood, while it certainly increases the readability and transparency of the simulations outcomes. Our simulations, though, should not be considered as genuine forecasts. The latter, to be trustworthy, have to take into account among other things a more detailed characterization of likely economic-policy measures, which lies outside the scope of this work.

The scenarios under which simulations are performed regard events both outside (the first two hypotheses) and inside (the third one) the range of action of European government authorities.

The first one hypothesizes a more rapid recovery of world demand than expected. Its rationale lies on the possibility that world economic recovery, which nowadays essentially relies on US growth, may be accelerated by Europe and, most of all, by Japan.

The second scenario envisages an appreciation of the European currency/USD exchange rate and takes two possible events into account: the entry of the United Kingdom into the Euro area; the implementation, by US authorities, of measures aimed at reducing the foreign deficit. The first event should strengthen the European currency; the second should weaken the dollar.

The third simulation expounds the results the European economy would achieve following a more expansionary monetary policy. Such a policy is more and more requested by decision makers and scholars.

The simulations are carried out using our aggregate model for the European economy (Bagnai and Carlucci, 1998, 2002a)[1]. Its main feature is that it considers Europe as a single country, following an approach originally proposed by Dramais (1986) and then utilized by other authors, among which Meyermans and Van Brusselen (2000a,b) and Fagan *et al*. (2001)

[1] A full description of its current structure can be found in Bagnai and Carlucci (2002b); see also the model home page: http://eumodel.net.

2. Model structure and properties

By the end of 1996, when our research programme started, as well as in 1998, when the econometric model was first published, the EMU was still to come. Many doubts surrounded its feasibility, and nobody knew which countries would eventually take part in it (see for instance Eichengreen, 1993). The 12-countries European Union presented itself as the most natural (if not unique) choice for the reference European aggregate. Europe was then represented as a single country, with the consideration of a "virtual" aggregate economy, for which we imposed the strong hypothesis of a single currency over the whole estimation sample (originally 1970-1995, and then 1960-1997). The evidence available at that time (see for instance Kremers and Lane, 1990) was rather encouraging about the econometric viability of this aggregate approach.[2]

According to the single currency hypothesis, the aggregation was performed by converting the national data into the "virtual" European currency. Nominal flows were aggregated using the current exchange rates, and real flows using the exchange rates of a base year. Deflators were calculated as ratios of nominal to real variables, interest rates were aggregated as weighed averages of the domestic rates, and labour force statistics were simply summed.

The start of the EMU did not alter the "virtual" status of the model, because the United Kingdom and Denmark, included in the 12-countries EU, did not enter the EMU. To a certain extent this is a drawback and simulation experiments where the exchange rate is involved require careful interpretation. Furthermore, model outputs are not directly comparable with the published statistics describing the two current reference aggregates, namely the 15-countries EU and the Euro area. However, these shortcomings are transient in nature, as it is reasonable to suppose that Denmark and the United Kingdom will eventually join the EMU.

Theoretical framework and econometric structure

As far as its theoretical reference framework is concerned, the model is a post-Keynesian model where output is demand constrained and labour demand follows from cost minimization under Cobb-Douglas technology. The real-wage long-run dynamics is determined by productivity and the unemployment rate, while the price dynamics follows from a set of mark-up equations. The model includes a representation of the general government sector.

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[2] Further recent studies have confirmed the validity of the aggregate approach. See the references quoted in Bagnai and Carlucci (2002a).

This framework leads to an econometric model consisting of 34 equations (20 stochastic equations and 14 identities and definitory equations), with 14 exogenous variables, of which 6 refer to the public sector and 5 to the rest of the world.

The model stochastic equations were estimated on a sample of annual data from 1960 to 1997 by a two-stage procedure allowing for the nonlinearity and simultaneity of equations, for the non stationarity of variables, as well as for the presence of structural changes in parameters[3].

The design of the present simulation experiments required some minor changes to the model structure. First, in the ex ante simulations the European currency/USD exchange rate was taken as exogenous. This depends on the design of the simulation experiments, where the exchange rate is considered as a conditioning or "scenario" variable.

Second, the stock/flow identities of the public-debt accumulation were modified in order to take into account the new rules of debt financing emerging from the adoption of the Maastricht treaty. In particular, the model structure employed in the simulation experiments rules out the monetization of public debt. This means that in our ex-ante simulations the stock of public-debt bonds is supply-, rather than demand-, determined, as it was in the ex-post simulations shown in Bagnai and Carlucci (2002a,b).

Third, the flow of public-debt interest was represented by an identity, rather than by a stochastic equation.

After these modifications, the model features 32 equations, of which 17 are stochastic, with 14 exogenous variables.[4]

Forecasting performance

Although the focus of this work is not in forecasting the European economy, but rather in investigating its dynamic structure, we performed some forecasting experiments in order to assess the reliability of the model.

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[3] The general properties of the model were investigated by stochastic simulation in Bagnai and Carlucci (2002a,b).

[4] The stochastic equations for the *public debt securities (b),* the *European currency/USD nominal exchange rate (usd)* and the *government interest payments (ipd)* were dropped (thus reducing the number of the stochastic equations to 17), one identity for *ipd* was included (increasing the number of identities to 15), *usd* was taken as exogenous, while the *US consumer price index* (pc^{US}) disappeared from the model (thus leaving the number of exogenous variables unaffected).

To this end, we carried out one-step ahead forecasting experiments in the two years after the estimation sample for which definitive data are available, namely 1998 and 1999.[5] Forecasts were made using the model equations estimated over 1960-1997 and the "true" (i.e., measured) values of the exogenous variables. Results are summarized in Appendix A.

[5] The main data source is the CD-ROM edition of the OECD Statistical Compendium. At the time of writing the last edition available is OECD (2001), which reports mostly provisional data for the years after 1999.

3. Results

Data and computational issues

As the OECD Statistical Compendium, the main source of data, reports most time series with a time lag of two years, the initial conditions of the experiments are based on provisional data, coming either from OECD (2001) or from model simulations.

Whenever possible, we supplemented these data with the most recent estimates or forecasts coming from publicly available sources. This is the case, for instance, of the labour force and interest rates statistics, where the projections provided in OECD (2001) were corrected using the last available estimates in the OECD "hot file" (see OECD, 2002)[6].

The basic scenario

In the first experiment the model was simulated over the years 2002-2006 in order to construct a baseline scenario, using the assumptions summarized in Table 1.

In the basic scenario we make "neutral" hypotheses about the general government sector, by assuming that the exogenous components of expenditure, the *government consumption* in real terms, *g90*, the *fixed capital formation* in real terms, *fcf90*, and the *other current expenditures, oce*, grow at rates close to their average growth rate over the period 1970-1999; the same applies to the *other current revenues, ocr*, while the average *indirect tax rate, itr*, is kept constant at its 2001 value.

The paths of the other exogenous variables were set mostly by analogy with their observed behaviour during the last recession of 1993, taking also into account the most recent forecasts of institutions such as the IMF (2002).

World demand, proxied by the volume of imports of the rest of the world, grows at a moderate rate in the first two years of the samples, and then reaches its average growth rate. This contrasts with the now widespread assumption that world (in particular, USA) demand will begin to grow faster in 2003.

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[6] The model was estimated using WinRats 4.20 (where we implemented the Gregory and Hansen (1996) estimation of the long-run equations) and Microfit 4.1 (dynamic equation estimation and diagnostics). Simulations were performed using Winsolve by Richard Pierse (2000).

Table 1 - The baseline scenario: exogenous variables

	2002	2003	2004	2005	2006
government gross fixed capital formation	1.5	1.5	1.5	1.5	1.5
government consumption	2	2	2	2	2
average indirect tax rate	0	0	0	0	0
labour force	0.1	0.2	0.5	0.5	0.6
world (excluding EU) imports of goods and services	1.4	2.4	4	5	6
other current expenditures of public sector	4.5	4.5	4.5	4.5	4.5
other current revenues of public sector	4.5	4.5	4.5	4.5	4.5
other capital expenditures of public sector	0	0	0	0	0
import prices (dollars)	2	2	2	2	2
world (excluding EU) export prices (dollars)	2	2	2	2	2
interest rate on US 3-month T-bills	*3*	*4*	*5*	*5*	*5*
European currency/USD nominal exchange rate	0	0	0	0	0
change in stocks (nominal)	0	0	0	0	0
change in stocks (real)	0	0	0	0	0

Table 1 – The baseline scenario. The table reports the paths of exogenous variables over the simulation period 2002-2006. Variables are measured in per cent changes, with the exception of the T-bills interest rates (in per cent points).

The labour force is supposed to grow at a slow rate in the first years of recovery, due to a "discouraged worker" effect,[7] and then to reach its average growth rate, which equals about 0.6% in the last forty years.

The inflation rate of dollar prices of the competitor countries exports, *pxrdm*, was set equal to 2%, very close to the IMF forecast of 1.9%. The same rate of inflation was imposed on the import prices in dollars, *pmd*.

The US short-run interest rate, *rtus*, decreases at the beginning of the sample, following the assumption that US monetary authorities will adopt a loose monetary policy in an attempt to reinforce the recovery of the US economy, and then increases gradually.

The European currency/USD exchange rate is taken as exogenous in the simulation. In the baseline scenario we assume that the exchange rate will remain constant for the whole simulation period. A counterfactual hypothesis, envisaging an appreciation of the European currency, is investigated later on in this Section.

Finally, inventories and statistical discrepancies are set constant to their historical value at the end of 2001.

[7] This kind of behaviour was observed, for instance, after the last recession in 1993.

We specify that, although this set of hypotheses on the exogenous variables appears reasonable to us, and although the experiments shown in the previous Section provide encouraging results on the model forecasting ability, we do not interpret this scenario as a "forecast" of the European economy, but rather as a convenient benchmark against which to assess some alternative dynamic paths.

Table 2 reports some selected results of the simulation, conditional on the hypotheses set out in Table 1.

Table 2 – The baseline scenario: results

	units	2002	2003	2004	2005	2006
Private consumption (c90)	% change	1.07	1.19	1.85	2.33	2.75
Public deficit/GDP ratio (gbgdp)	level	0.57	0.51	0.59	0.56	0.50
Private investment (inpr90)	% change	1.56	1.48	1.49	2.15	3.21
Money demand (m2)	% change	10.32	6.87	4.86	6.03	7.26
Imports of goods and services (m90)	% change	-0.19	0.91	2.17	3.30	4.46
Total employment (n)	% change	-0.09	0.09	0.64	0.85	0.88
Private-consumption deflator (pc)	% change	2.55	2.37	2.33	2.55	2.83
Long-run interest rate (rl)	level	5.19	4.53	5.23	5.77	5.83
Unemployment rate (u)	level	8.89	8.99	8.86	8.54	8.29
Nominal wages (w)	% change	4.80	4.53	4.61	5.25	5.85
Export of goods and services (x90)	% change	2.50	2.49	3.12	3.72	4.43
Nominal GDP (y)	% change	4.80	4.60	4.63	5.09	5.75
Real GDP (y90)	% change	2.06	2.04	2.20	2.41	2.70

Table 2 – The baseline simulation results.

In the basic scenario the European economy experiences a slow recovery, with a growth rate of real GDP, *y90*, at about 2% in the first two years. This contrasts with most forecasts currently available, who envisage a slower growth in 2002 (with a growth rate at about 1.5%; see IMF, 2001a), followed by a swift recovery starting in 2003 with growth rates around 3%. In our simulations the effects of the current recession are less severe but more persistent. This outcome depends on our hypotheses about world demand (see Table 1), as well as on the dynamic structure of the model, where demand shocks are shown to have persistent effects. Real investments, *inpr90*, appear to be the less dynamic component of demand at this stage. This depends partly on the dynamics of the long-run interest rate, *rl*, that in the first year remains almost constant, before decreasing in 2003.

Unemployment reaches a maximum of about 9% in 2003 before decreasing towards 8%. This reflects the well-known persistence of European unemployment

in response to adverse shocks (see for instance Bean, 1994). The employment level is almost stationary in the first two years.

Money demand acts in a countercyclical way. The increase in nominal M2 reaches a maximum at the beginning of the simulation, and then reverts to its long-run average.

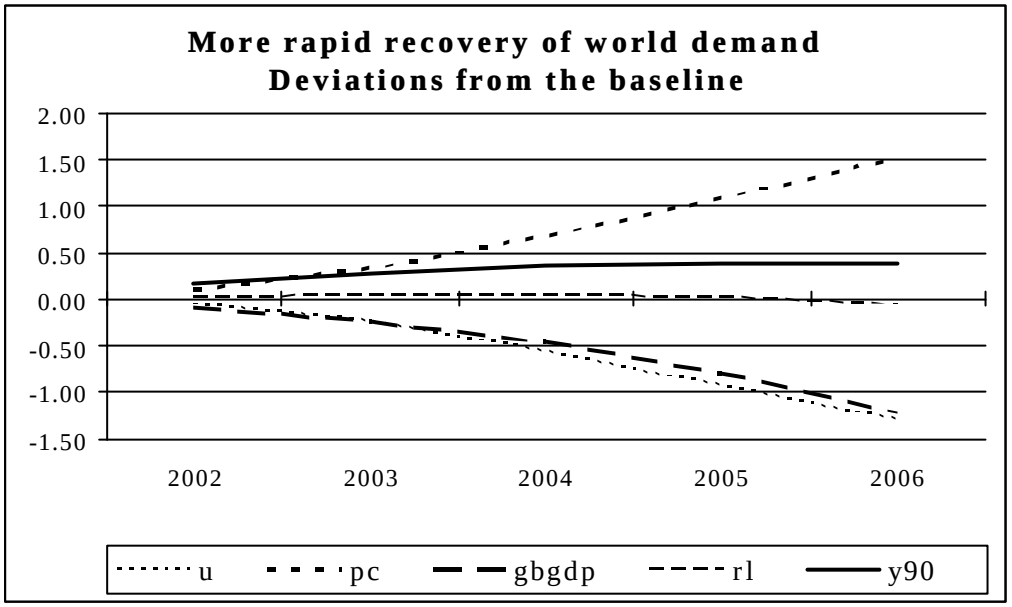

Figure 1 – Dynamic multipliers (deviations from the baseline) of some endogenous variables under the alternative scenario described in Table 3. u is the unemployment rate, pc the inflation rate, gbgdp the PSBR-to-GDP ratio, rl the long-run interest rate, y90 the real growth rate.

The "neutral" hypotheses about the conduct of fiscal policy lead to an almost constant government balance-to-GDP ratio, at about 0.5% over the whole simulation.

A more rapid recovery of world demand

In the remainder of this Section we investigate the sensitivity of the baseline path to deviations from the basic assumptions set out in Table 1, analyzing the response of the European economy to different paths of world demand, the European currency/USD exchange rate and the interest rate.

As stressed before, our baseline envisages a slow growth of demand in the first two years. The relevance of this assumption was investigated by simulating the

effects of a more sustained increase in world demand. This was done by adding one percentage point of growth to the dynamic path of *m90rdm* specified in Table 1.

The resulting path of *m90rdm* is set out in Table 3.

Table 3 – A more rapid recovery of world demand

	2002	2003	2004	2005	2006
world (excluding EU) imports of goods and services	2.4	3.4	5	6	7

Table 3 – The dynamic path of world demand under the alternative assumption of swift recovery.

We stress that this experiment performs a simple sensitivity analysis, rather than the evaluation of a proper alternative scenario. The latter would involve some additional hypotheses about the behaviour of such exogenous variables as the international prices *pmd* and *pxrdm*, as well as the US interest rate, *rtus*, in response to the alternative path of *m90rdm*. The experiment considered here, on the contrary, is subject to a *ceteris paribus* clause on all other exogenous variables.

Table 4 – A more rapid recovery of world demand: deviations from the baseline

	units	2002	2003	2004	2005	2006
Private consumption (c90)	% change	0.09	0.19	0.28	0.32	0.32
Public deficit/GDP ratio (gbgdp)	level	-0.09	-0.24	-0.47	-0.79	-1.22
Private investment (inpr90)	% change	0.41	0.75	1.00	1.17	1.24
Money demand (m2)	% change	0.32	0.76	1.28	1.90	2.51
Imports of goods and services (m90)	% change	0.43	0.65	0.81	0.91	0.95
Total employment (n)	% change	0.07	0.20	0.34	0.41	0.40
Private-consumption deflator (pc)	% change	0.11	0.33	0.67	1.08	1.50
Long-run interest rate (rl)	level	0.02	0.04	0.05	0.03	-0.05
Unemployment rate (u)	level	-0.06	-0.25	-0.56	-0.94	-1.31
Nominal wages (w)	% change	0.27	0.74	1.40	2.13	2.78
Export of goods and services (x90)	% change	0.53	0.66	0.74	0.79	0.81
Nominal GDP (y)	% change	0.30	0.68	1.18	1.75	2.30
Real GDP (y90)	% change	0.17	0.27	0.34	0.38	0.39

Table 4 – A more rapid recovery of world demand. The table reports the deviations of some endogenous variables from the paths reported in Table 2 under the assumptions specified in Table 3.

Table 4 and Figure 1 report the results of the simulation measured as deviations from the baseline paths reported in Table 2.

An additional per cent point of growth in world demand (measured by real imports of the rest of the world, m90rdm), exerts a relevant impact on European growth through exports and investments, whose rates of growth increase respectively by 0.53 and 0.41 per cent points in the first year. By the end of the simulation horizon real GDP, y90, increases at a rate of 3.1% per annum (i.e., 0.39 per cent points above the baseline). This increase in demand influences both unemployment (the unemployment rate at the end of the simulation period is 1.31 points below the baseline), as well as prices (the inflation rate is 1.5 points above the baseline).

The favourable dynamics of growth allows the government balance to reach a surplus of about 0.7 points at the end of the simulation.

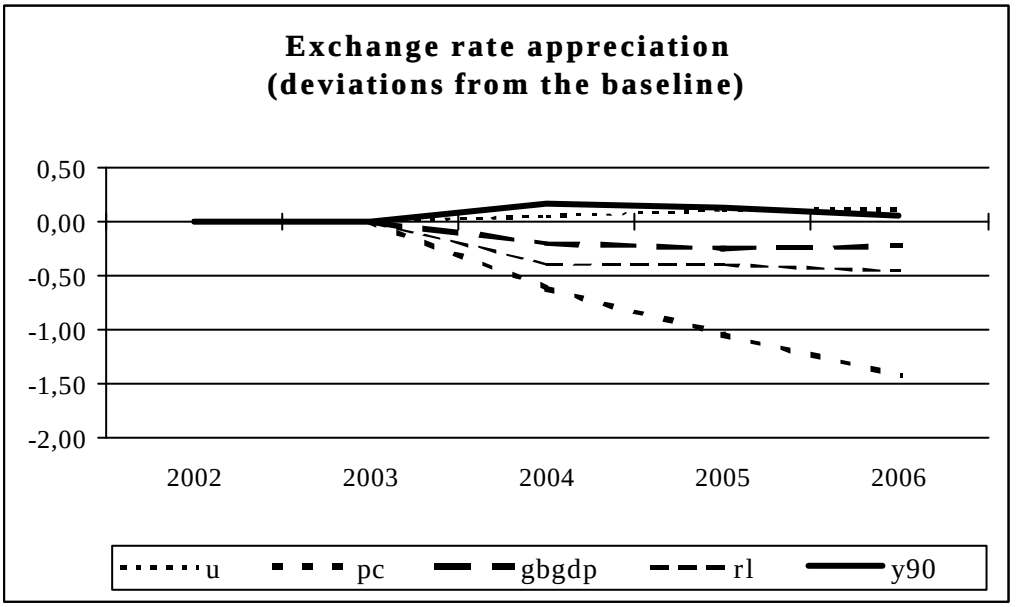

Figure 2 – Dynamic multipliers (deviations from the baseline) of some endogenous variables under the alternative scenario described in Table 5. u is the unemployment rate, pc the inflation rate, gbgdp the PSBR-to-GDP ratio, rl the long-run interest rate, y90 the real growth rate.

Exchange rate appreciation

As stated in the previous Section, the reference to the Euro in this model should be considered as "virtual", because the model does not consider the Euro area, but the 12-countries EU. The "virtual" currency of the model is, broadly speaking, a

mixture of the Euro and the British pound (the Danish crown has a negligible impact on this compound currency). In this Section we hypothesize that this virtual currency appreciates and reaches a parity with the USD in three years, starting in 2004. This requires an appreciation of about 4% per annum. Therefore, the baseline hypotheses are modified as specified in Table 5, while Table 6 and Figure 2 report the simulation results.

Table 5 – An appreciation of the European currency

	2002	2003	2004	2005	2006
European currency/USD nominal exchange rate	0	0	4	4	4

Table 5 – The dynamic path of the European currency/USD exchange rate.

Table 6 – An appreciation of the European currency: deviations from the baseline

	units	2002	2003	2004	2005	2006
Private consumption (c90)	% change	0.00	0.00	0.40	0.59	0.56
Public deficit/GDP ratio (gbgdp)	level	0.00	0.00	-0.20	-0.25	-0.23
Private investment (inpr90)	% change	0.00	0.00	0.47	0.16	-0.16
Money demand (m2)	% change	0.00	0.00	0.79	-0.14	-0.49
Imports of goods and services (m90)	% change	0.00	0.00	0.41	0.54	0.48
Total employment (n)	% change	0.00	0.00	-0.05	-0.06	-0.01
Private-consumption deflator (pc)	% change	0.00	0.00	-0.62	-1.04	-1.42
Long-run interest rate (rl)	level	0.00	0.00	-0.39	-0.40	-0.45
Unemployment rate (u)	level	0.00	0.00	0.05	0.10	0.11
Nominal wages (w)	% change	0.00	0.00	-0.51	-0.97	-1.38
Export of goods and services (x90)	% change	0.00	0.00	0.00	-0.08	-0.12
Nominal GDP (y)	% change	0.00	0.00	0.05	-0.47	-0.97
Real GDP (y90)	% change	0.00	0.00	0.16	0.13	0.06

Table 6 – An appreciation of the European currency. The table reports the deviations of some endogenous variables from the paths reported in Table 2 under the assumptions specified in Table 5.

The exchange rate appreciation has a moderate expansionary effect in the simulation, with a transitory increase of the real GDP rate of growth, *y90*, by about 0.16 per cent points above the baseline in the first year. This outcome results from the combination of two opposite effects on the demand components: on the one hand, there is an increase in imports, determined by the fall in their relative

prices; on the other hand, the fall of import prices determines a fall in the inflation rate, which, in turn, leads to an increase in real disposable income and to a decrease in interest rate. These effects stimulate the growth of consumption and investments respectively, thus offsetting the "leakages" determined by the growth of imports.

A more expansionary monetary policy

In the last simulation experiment we studied the impact of an expansionary monetary policy, defined as a 100 basis points decrease of the short-run interest rate, *rb*, with respect to its path in the baseline scenario. We performed this simulation with a Type 1 fix, namely, by considering *rb* as exogenous in simulation.

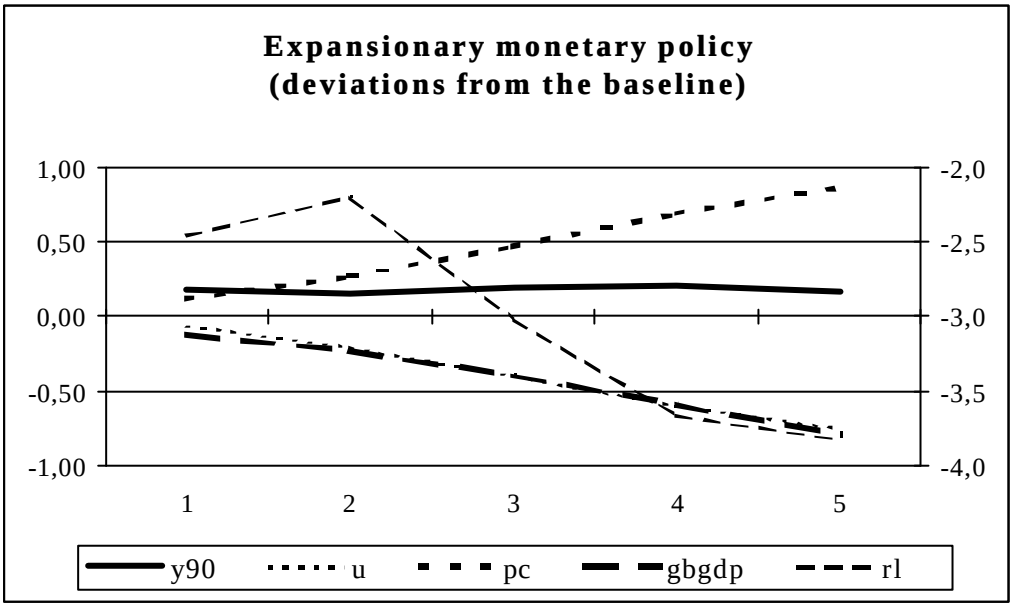

Figure 3 – Dynamic multipliers (deviations from the baseline) of some endogenous variables under the alternative scenario described in Table 5. u is the unemployment rate, pc the inflation rate, gbgdp the PSBR-to-GDP ratio, rl the long-run interest rate (right scale), y90 the real growth rate.

The results of this simulation experiment are reported in Table 7 and Figure 3. The channel of transmission of monetary policy to the real sector is represented in our model by the investment function. Real investment reacts quickly to the decrease in the real long-run interest rate, with an increase of 1.61 per cent points above the baseline in the first year. This effect is persistent, and is reinforced by the favourable dynamics of the public deficit, which feeds back on the long-run interest rate, and by a moderate increase in the inflation rate.

At the end of the simulation horizon these expansionary effects determine a reduction of the unemployment rate by about -0.76 per cent points below the baseline.

Table 7 – Expansionary monetary policy: deviations from the baseline

	units	2002	2003	2004	2005	2006
Private consumption (c90)	% change	0.10	0.15	0.18	0.22	0.23
Public deficit/GDP ratio (gbgdp)	level	-0.13	-0.24	-0.40	-0.59	-0.80
Private investment (inpr90)	% change	1.61	1.08	1.34	1.42	1.12
Money demand (m2)	% change	2.87	-0.81	1.72	1.44	1.23
Imports of goods and services (m90)	% change	0.45	0.35	0.43	0.48	0.42
Total employment (n)	% change	0.07	0.16	0.21	0.22	0.17
Private-consumption deflator (pc)	% change	0.11	0.26	0.47	0.69	0.87
Long-run interest rate (rl)	level	-2.46	-2.20	-3.02	-3.67	-3.83
Unemployment rate (u)	level	-0.06	-0.21	-0.41	-0.60	-0.76
Nominal wages (w)	% change	0.28	0.57	0.94	1.30	1.52
Export of goods and services (x90)	%change	0.00	0.00	0.00	-0.01	-0.01
Nominal GDP (y)	% change	0.32	0.49	0.79	1.09	1.31
Real GDP (y90)	% change	0.18	0.15	0.19	0.20	0.17

Table 7 – The table reports the simulation of an expansionary monetary policy, defined as a 100 basis point decrease of the short-term interest rate from its baseline value. The results are reported as deviations from the paths reported in Table 2.

4. Conclusions

This work aimed at evaluating quantitatively by simulation methods some alternative development paths of the European economy under various hypotheses concerning the rate of growth of world demand, the European currency/USD interest rate, and the conduct of monetary policy.

The simulations presented in this work provide several interesting outcomes, among which two seem to be especially remarkable.

First, the simulations show that an appreciation of the European currency would not necessarily depress the level of the European aggregate economic activity. This contrasts the now widespread view that a weak Euro could fuel the recovery of the European economy through the channel of exports. On the contrary, the simulations show that in the present conditions a stronger European currency could sustain the aggregate European economic growth through the channel of prices and interest rates, in particular by contrasting the inflationary effects of a buoyant world demand.

Second, our results confirm that monetary policy exerts a considerable impact on the level of the economic activity and employment. Similar results, although with a somewhat higher order of magnitude in the response, emerge from the work of Fagan *et al.* (2002, par. 4.1), even if their model is based on a quite different theoretical framework. Clear directions for the European central authorities seem thus to stem from applied empirical work.

These results need to be carefully evaluated, especially because the estimation of the structural parameters of the aggregate European economy was carried out on data preceding the structural break determined by the inception of the EMU. Needless to say, every piece of applied empirical work on the aggregate European economy shares at present this feature, whose impact is at present uncertain and will be empirically verifiable only when a reasonably large set of fresh (i.e., post-1999) data will be available.

The interest and the reliability of these experiments could be improved by supplementing the model with some alternative policy feedback rule, and by considering it in the context of a model of the global economy, in order to take into account the repercussions from the other poles of the world economy (especially the US and Japan).

We plan to improve our experiments in such a way in the near future.

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Appendix A. The model one-step ahead forecasts

We report in this Appendix the results of the one-step ahead forecasts of the model for the years 1998 and 1999. The forecasts were carried out without any add factors, using the measured values of the exogenous variables.

Table A.1 – One-step forecast errors for 1998

variable	description	per cent error
b	public debt bonds	-1.868
c90	real consumption	1.771
dt	direct taxes	3.624
gbgdp	government balance/GDP	-1.403
growth	real growth rate	0.898
inpr90	real investments	3.933
ipd	interests on public debt	-16.178
m2	nominal M2	-0.353
m90	real imports	6.333
mk	capital movements	51.500
n	total employment	1.140
pc	deflator: consumption	-3.030
pg	deflator: public consumption	-3.290
pin	deflator: investments	-2.675
px	deflator: exports	-7.985
py	deflator: GDP	-1.092
r	official reserves	-7.175
rb	interest rate: short run	-2.138
rl	interest rate: long run	-2.660
sb	social benefits	-3.720
sc	social security contributions	-6.616
u	unemployment rate	-1.023
usd	EUR/USD exchange rate	-14.827
w	compensation of employees	-1.128
x90	real exports	3.651
y	nominal GDP	-0.207
y90	real GDP	0.875
yd	nominal disposable income	-1.146
	overall mean per cent error	**-0.171**
	overall mean absolute per cent error	**5.437**
	overall per cent root mean square error	**11.293**

Table A.2 – One-step forecast errors for 1999

variable	description	per cent error
b	public debt bonds	-3.385
c90	real consumption	-3.555
dt	direct taxes	2.459
gbgdp	government balance/GDP	-0.086
growth	real growth rate	0.519
inpr90	real investments	-2.454
ipd	interests on public debt	12.239
m2	nominal M2	-6.801
m90	real imports	-2.681
mk	capital movements	3.182
n	total employment	0.158
pc	deflator: consumption	3.124
pg	deflator: public consumption	2.934
pin	deflator: investments	5.017
px	deflator: exports	10.616
py	deflator: GDP	1.414
r	official reserves	-20.420
rb	interest rate: short run	3.914
rl	interest rate: long run	1.467
sb	social benefits	-4.195
sc	social security contributions	-1.994
u	unemployment rate	-0.906
usd	EUR/USD exchange rate	5.953
w	compensation of employees	1.636
x90	real exports	-0.515
y	nominal GDP	-0.691
y90	real GDP	-2.135
yd	nominal disposable income	-0.819
	overall mean per cent error	**0.143**
	overall mean absolute per cent error	**3.760**
	overall per cent root mean square error	**5.801**

Appendix B. Graphs

We report in this Section a set of figures representing the dynamic paths of some selected endogenous variables under the alternative scenarios set out in Section 3. These figures represent in absolute terms the same paths that are reported in Figures 1-3 as deviations from the baseline. For greater convenience each figure in this appendix refers to a single variable considered under four alternative hypotheses, and the graphs also report the historical data in 2000-2001, i.e., two years before the beginning of the simulation experiment. The reported paths, therefore, differ starting from 2002 (i.e., from the first year of our simulation horizon).

The paths are labelled respectively as "baseline" (the dynamic simulation under the hypotheses specified in Table 1, as reported in Table 2), "monetary expansion" (the dynamic path under the hypothesis of reduction of the short-run interest rate by 100 basis points under the baseline), "appreciation" (appreciation by 4% per annum of the European currency/USD exchange rate starting in 2004), and "swift growth" (increase of one point in the per cent growth rate of world demand, starting in 2002 – see Table 3).

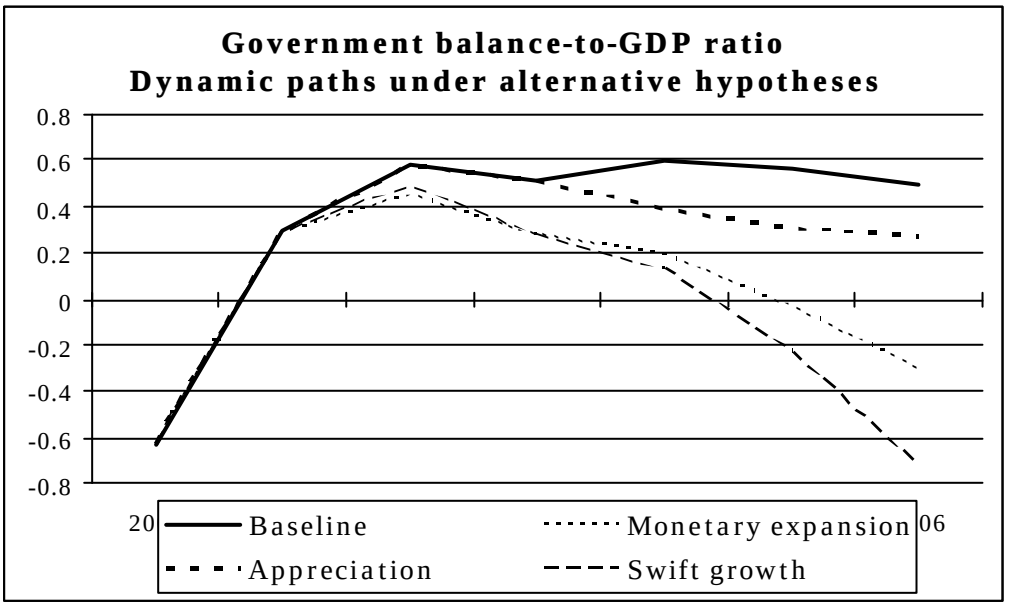

Figure B.1 – Alternative paths of the government balance-to-GDP ratio.

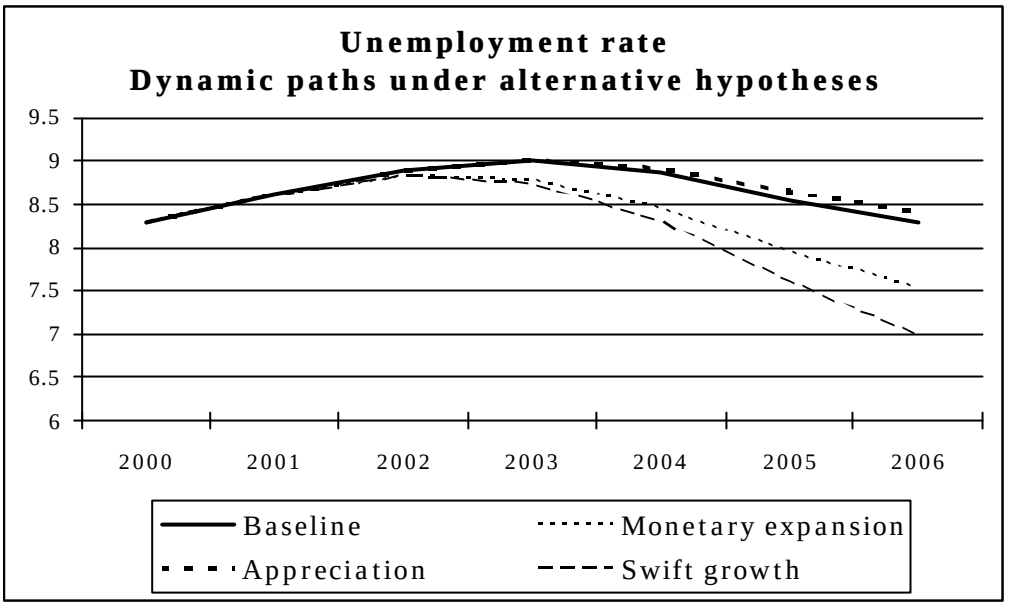

Figure B.2 – Alternative paths of the unemployment rate

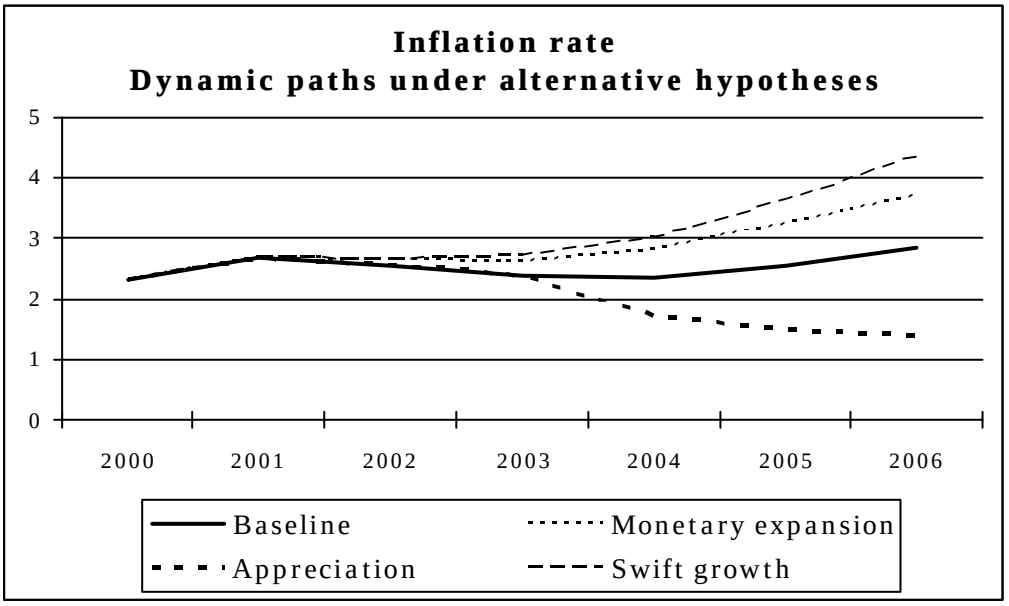

Figure B.3 – Alternative paths of the inflation rate

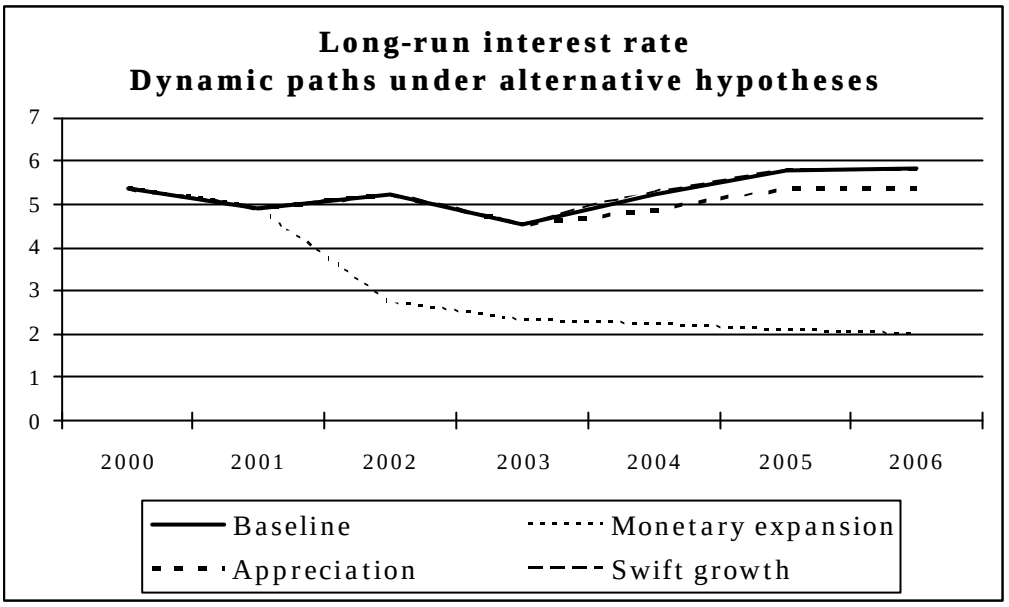

Figure B.4 – Alternative paths of the long-run interest rate

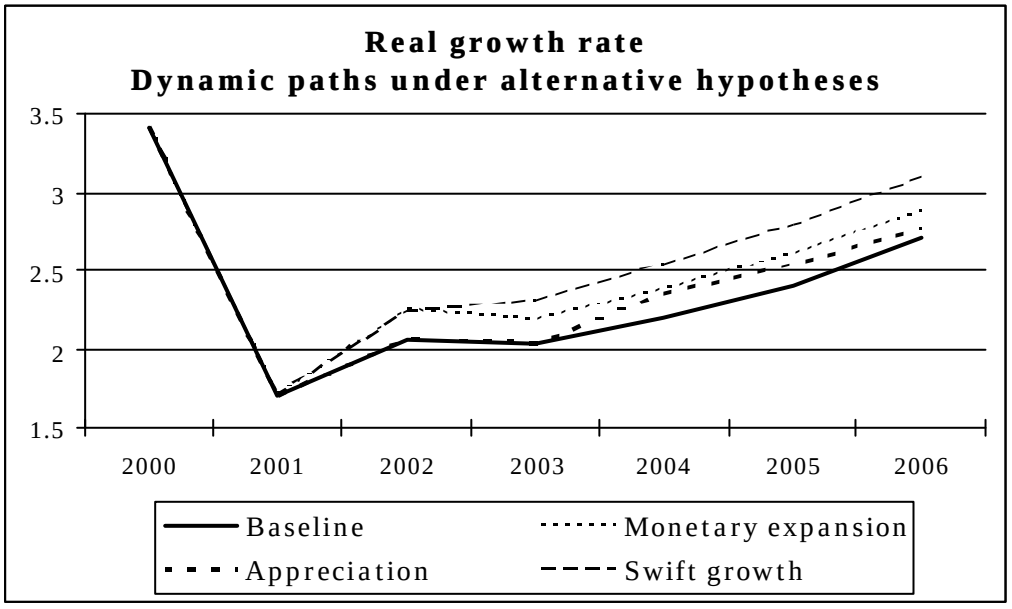

Figure B.5 – Alternative paths of the real growth rate