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Chapter 3

NARROWING THE US TWIN DEFICITS: SIMULATIONS WITH A WORLD MACROECONOMETRIC MODEL

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ABSTRACT

In this chapter we extend the macroeconometric model developed in Bagnai (2004) by linking it to a submodel for the Japanese economy, and we utilize this extended model to investigate several hypotheses of reduction in the US twin deficits. The Japanese submodel is specified and estimated along the lines set out in Bagnai and Carlucci (2003), using the "cointegration with endogenous structural break" estimation method of Gregory and Hansen (1996). The estimation results show that the Japanese economy underwent a major structural change after the first oil-price shock. The "twin deficits" simulations consider two policy instruments: a US dollar exchange rate devaluation, and a fiscal consolidation, carried out through a decrease in US government consumption. We analyze both different sizes and different timing of these policy measures, as well as their interactions, in order to evaluate their effectiveness, and the costs they impose on the partner countries (in particular, on the Euro area and Japan).

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INTRODUCTION

Starting in 1992 the United States experienced nine years of sustained growth: with an average real growth rate of 3.6%, the US economy outperformed both the euro area (2.0% average real growth in the same period) and Japan (1.3%). During this favorable cyclical phase the United States were able to consolidate their fiscal position, bringing the general government balance as a share of GDP from a historical low of -5.8 in 1992 to a historical peak of 1.4 in 2000 (see Figure 1). Meanwhile, the external position of the United States weakened, starting from a “close to balance” position of the current account in 1992 and reaching in 2000 a current account/GDP ratio of -4.1%.

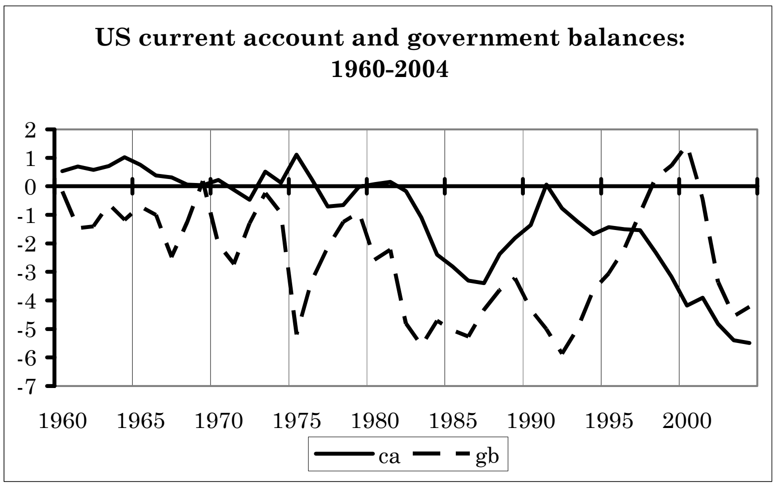


Figure 1 – The US current account balance and the general government net lending as a share of GDP, 1960-2004. Source: OECD (2004a).

A closer look at the data shows that the deterioration of the external balance started in 1998, in correspondence with two-digits rates of growth of real imports. The average growth rates of real imports and exports in the 1992-2000 period were 10.4% and 7.1% respectively. As figure 2 shows, this outcome was favored by a steady appreciation of the US dollar in real terms with respect to the currencies of the US trading partners, starting in 1996.

The recession started by mid-2000 and the terrorist attacks of September 2001, with the related security and military expenses, prompted for a more active fiscal policy which, together with the tax cuts policy, led to a 6 GDP points deterioration in the US fiscal position from 2000 to 2003, while the current account deficit kept widening, reaching 5.3 GDP points in 2003.

Therefore, since 2002 the United States face a “twin deficit” problem. As figure 1 shows, fiscal deficits of the present size were already experienced by the US economy in response to adverse cyclical conditions. However, they were rarely coupled with such a large external imbalance, the only possible exception being the biennium 1985-1986, were the US dollar reached a historical height (see Figure 2). This unpromising outlook is raising concerns in many observers, including multilateral agencies such as the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD). See for instance IMF (2004), which focuses mainly on the fiscal deficit, and OECD (2004b), which deals with the current account imbalance.

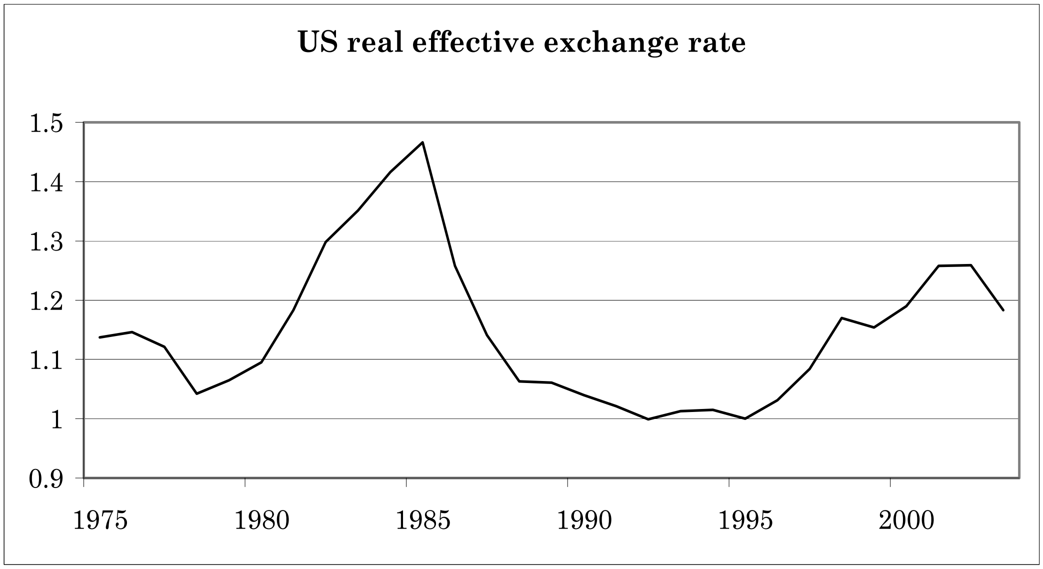


Figure 2 – The US real effective exchange rate, 1975-2004. Source: OECD (2004a).

The worries about the present situation are twofold: both the persistence of the United States on an unsustainable path of public and external indebtedness, and the strategies for reducing these imbalances, will necessarily affect other countries, with negative repercussions on their economic performances. The issue of sustainability of the fiscal deficit is tackled among others by IMF (2004), while the sustainability of the external deficit is dealt with in OECD (2004b). All in all, these studies, while recognizing that a simple and widely accepted metric for measuring sustainability is not available, broadly agree on the fact that public and external debt sustainability are not yet a major concern in the United States. At the same time, these studies conclude that some corrective action must be taken.

In fact, as far as the public debt sustainability is concerned, the US public debt/GDP ratio decreased by about 15 points between 1992 and 2000, as a result of fiscal consolidation and sustained economic growth, and appears still under control, especially if the US economy will keep growing at a satisfactory rate (see Figure 3). The IMF forecasts for 2005 a real growth equal to about 3.9%, and a general government fiscal balance of -3.5% GDP points (see IMF (2004)). If these values were to persist indefinitely, the public debt/GDP ratio of the United States would eventually converge to 93%. However, it would take about fifteen years for this ratio to reach 74%, namely, the value it took in 1992. In other words, public debt sustainability appears not to be a short term problem. The same applies to the external debt, which is presently at about 25% of GDP, well below the level reached by other OECD countries.

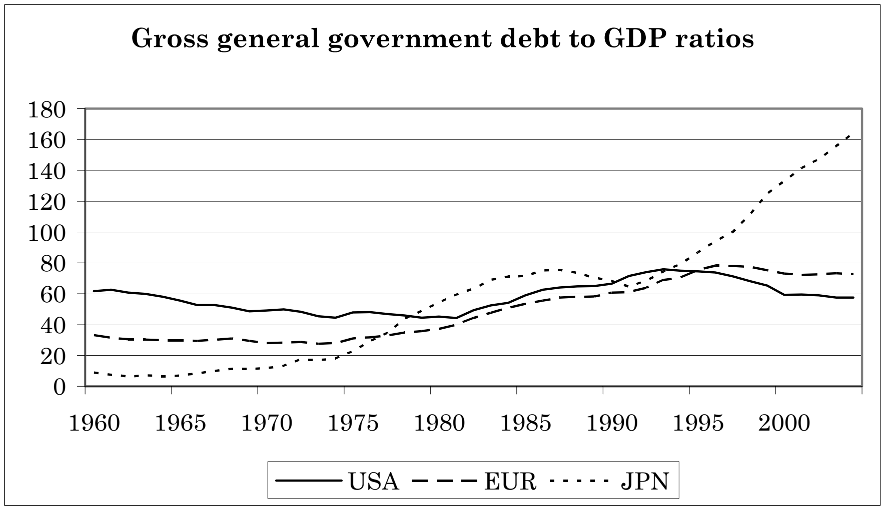


Figure 3 – The public debt/GDP ratios in the United States, the euro area and Japan, 1975-2004. Source: OECD (2004a) and model database.

This chapter focuses on the medium-term strategies for narrowing the US twin deficits, considering both their effectiveness, and the costs they impose on the two major partners of the United States, namely the euro area and Japan. Using the world macroeconometric model of Bagnai (2004), we simulate the effects on the US twin deficits of two policy instruments: a (nominal) exchange rate devaluation of the USD, and a fiscal consolidation, carried out through a reduction of the US government public consumption. We consider a medium-term horizon of four years, from 2004 to 2007, and evaluate these policy measures both separately and jointly, considering their impact on the macroeconomic framework in the United States and in the partner countries.

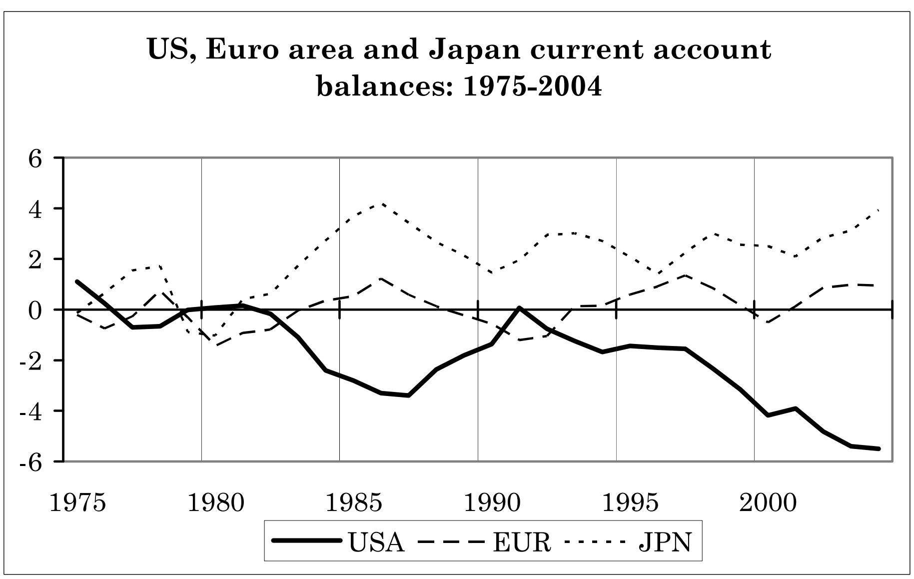


Figure 4 – The current account balances of the United States, the euro area and Japan as a share of GDP. Source: OECD (2004a).

As Figure 4 shows, a large counterpart of the US external deficit is represented by the external surplus of Japan. Therefore, a reliable assessment of the repercussions of the deficit reduction strategies requires the representation of the Japanese economy. To this end we linked to the model of Bagnai (2004), where Japan was taken as exogenous, a submodel of the Japanese economy specified and estimated along the lines set out in Bagnai and Carlucci (2003). The extended model now accounts for about 70% of world GDP.

The chapter falls in two main sections. Section 2 describes the structure and properties of the Japanese submodel. Section 3 describes the simulation experiments. Section 4 draws the main conclusions. Some appendices report detailed indications on the model structure and on the estimation and simulation results.

THE JAPANESE SUBMODEL

An Outline of the World Model

The world econometric model of Bagnai (2004) considers a division of the global economy into five blocks: the European Monetary Union, the United States, the United Kingdom, Japan and the rest of the world.[1]

The first four blocks share a common post-Keynesian framework: output is demand constrained and labor demand follows from cost minimization under a standard neoclassical 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 provides a separate representation of the business and government sectors, thus distinguishing, for example, between government and business employment, investment, output and capital stock. The supply side of the model represents explicitly the accumulation of business sector capital stock. The government and households appropriation accounts are also specified in detail. Each country block (including the euro area block) consists of about 60 equations, of which about 20 are stochastic equation and the remaining are identities.[2] An important feature of the model is that it represents Europe as a single country, following an approach originally proposed by Dramais (1986), and utilized since then by other authors, including Meyermans and Van Brusselen (2000a,b) and Fagan, Henry and Mestre (2001).[3]

The country blocks described so far are linked through real trade flows, competitivity and interest rates. The trade and competitivity linkages were set up as in Multimod (Laxton et al. (1998)): there are two separate competitivity measures for exports and imports, and real exports depend in each block on a trade-weighed average of real imports of the remaining blocks. The measures of competitivity depend on prices and bilateral exchange rates. The latter are endogenised using the monetary approach of Frenkel (1976), which was recently

[1] A similar structure was already proposed by Dramais (1986) and Meyermans and Brusselen (2000). In the present version of the model the UK economy is represented only by a set of trade linkage equations, rather than a full structural model.

[2] The econometric specification of the submodels may actually differ according to the empirical results and to the structure of the available data. Thus, the supply side of the US submodel is based on a Cobb-Douglas production function, which proved superior to the CES in terms of empirical significance of the derived factor demand equations, while US government accounts consider a slightly different set of items than those of the euro area.

[3] Other examples of this aggregate approach are listed in Bagnai and Carlucci (2003).

shown by Kim and Mo (1995) to provide reliable medium-run forecasts of nominal exchange rates when implemented with cointegration estimators. Interest rate linkages occur both directly, because the US interest rate affects the monetary policy reaction function of other submodels, and indirectly, through inflation spillovers.

The rest of the world is represented by a set of trade and competitivity relations which ensures the consistency of trade flows at the global level.[4]

The Standard Reference Framework

Appendix A reports the equations of the standard theoretical framework on which the country/area submodels are based, while appendix B lists the variable names in alphabetical order. The equations of each country submodel are grouped in 7 blocks: aggregate demand, aggregate supply, wages and prices, foreign sector, monetary sector, households appropriation accounts, general government accounts. In this section we briefly highlight the main feature of each block.

The first block (equations [1.1] through [1.7]) comprises a set of standard equations specifying the components of aggregate demand. Private consumption depends on real households disposable income, private fixed capital formation on business sector value added and the real interest rate,[5] exports on world demand and competitivity, and imports on domestic demand and import relative prices.

The world demand, *YF*, is a "trade linkage" variable defined by equation [4.1] as a weighed average of the trading partner real imports flows. The competitivity measures are defined by equations [4.4] and [4.6] respectively. The export competitivity (i.e., the real effective exchange rate, *REER*) is evaluated as a ratio between the export price of the competitor countries, *PXF*, and the domestic export prices, *PXGS*. The import competitivity (i.e., the relative price of imports, *PMREL*) is calculated as a ratio between the domestic prices (proxied by the GDP deflator, *PGDP*) and the import prices, *PM*. Both the competitor export prices, *PXF*, and the import prices, *PM*, are weighed averages of the partner countries export prices, with two different sets of weights (broadly speaking, import shares for *PM* and export shares for *PXF*).

The aggregate supply block gathers the factor demand equations and the identity that represents the accumulation of private capital. Labor demand follows from cost minimization under CES technology.[6]

The wages and prices block begins with the identities that define total employment and the unemployment rate. Unemployment enters the Phillips curve (eq. [3.4]), which specifies the unit wage rate, *UWB*; this in turn affects the remaining wages and prices equations (the equations from [3.5] through [3.9], as well as the equation [4.3] that represents the exports

[4] We plan to further disaggregate the rest of the world block in a number of regional submodels. This extension, however, involves considerable data issues.

[5] In the euro area and US blocks the demand for investments is specified according to the model of Knight and Wymer (1978) as a function of the spread between the real interest rate and the marginal productivity of capital; the latter follows from a CES technology in the euro area and from a Cobb-Douglas technology in the United States. The Japan submodel features a more conventional specification of investments as a function of output and real interest rates.

[6] In some country blocks, including Japan, this approach proved unsatisfactory and alternative specifications were adopted.

deflator). The other variable that affects the price structure of the model is the import prices index, *PM*.

The foreign sector of the model was partly dealt with above in explaining the trade and competitivity linkage variables that represent the repercussions between the country blocks through aggregate demand and price spillovers. The last equation of the block specifies the nominal local currency/USD exchange rate. As stated before, the overall structure of the world model considers four country submodels and therefore three nominal local currency/USD exchange rates, which through the equations [4.2] and [4.5] of appendix A determine the real effective exchange rate of each country. Each nominal exchange rate equation is specified according to the monetary model of Frenkel (1976) by the output, money stock, and interest rate differentials between the reporting country and the US. In the present model version there is no explicit representation of the net factor incomes from abroad. The current account balance therefore coincides with the trade balance.

The monetary sector of the model (equations [5.1] through [5.4] of Appendix A) represents the money stock and the short- and long-term interest rates, along with the ex-post interest rate on government debt. The short-term interest rate obeys to a Taylor (1993) rule augmented with the US short-term interest rate. In the long-run interest rate equation the public deficit/GDP ratio was included and proved significant in all the country blocks.

Finally, the households and general government accounts blocks consist mainly of identities that define the revenues and expenditures of these sectors, representing in detail the channels of transmission of fiscal policy in the model.

Estimation Issues and Selected Results for the Japanese Submodel

The estimation of the Japanese model equations was performed on annual data from 1960 to 2004 coming from OECD (2004a), using a two-stage procedure that allows for the non-stationarity of variables, as well as for the presence of structural changes in the long-run parameters. This procedure, that was already utilized in the estimation of the euro area and US submodels, exploits the cointegration estimator proposed by Gregory and Hansen (1996), which detects structural breaks of unknown date in the long-run parameters of the estimated equations.

The variable included in the model were first tested for contegration with the customary CRADF statistic proposed by Engle and Granger (1987).[7] When this test failed to reject the null of no cointegration we adopted the procedure of Gregory and Hansen (1996), which tests the same null against the alternative of cointegration in the presence of structural breaks. The breaks are modeled using the dummy variable $\varphi_{\tau t} = I(t>[T\tau])$, where I is the indicator function, T is the sample size, τ the relative timing of the change point, and [.] the integer part function. Three kinds of break are considered:

Model C - level shift:	$y_t = \mu_1 + \mu_2\varphi_{\tau t} + \boldsymbol{\alpha}'\mathbf{x}_t + z_t$
Model C/T - level shift with trend:	$y_t = \mu_1 + \mu_2\varphi_{\tau t} + \beta t + \boldsymbol{\alpha}'\mathbf{x}_t + z_t$
Model C/S - regime shift:	$y_t = \mu_1 + \mu_2\varphi_{\tau t} + \boldsymbol{\alpha}_1'\mathbf{x}_t + \boldsymbol{\alpha}_2'\mathbf{x}_t\varphi_{\tau t} + z_t$

[7] Due to the limited size of the sample, the critical values of Blangiewicz and Charemza (1990) were used.

where y_t is the dependent variable, $\mathbf{x}_t$ a vector of k explanatory variables, α, β and the μ_j are parameters, $\varphi_{\tau t}$ is the shift dummy variable and z_t is the cointegrating residual. Models C and C/T allow the equilibrium relation to shift, while model C/S allows it to rotate as well.

The test statistic is evaluated as $ADF_i^* = \inf_{\tau} ADF_i(\tau)$, where $ADF_i(\tau)$ is the cointegrating ADF statistic calculated using the OLS residuals in model i (i = C, C/T, C/S). In other words, ADF_i^* is the smallest among the ADF statistics that can be evaluated in model i across all possible dates of structural break. As we generally had no *a priori* information on the shape of the relevant alternative, we calculated the ADF_i^* statistics for each of the three models C, C/T and C/S. Where the null of no cointegration was rejected in favor of more than one alternative, we chose either the model corresponding to the more significant statistic, or that with the more meaningful parameters from the point of view of economic theory. The lagged OLS residuals from this model were included as an error correction term in the short-run adjustment equation.

The cointegrating residuals of the long-run equations were then included in the estimation of short-run error correction equations, according to the standard Engle and Granger (1987) two-stage estimator.

Appendix C reports some selected estimation results for the Japanese submodel. We omitted the results related to auxiliary or linkage equations such as the equation of government wages, or the public consumption deflator (which are generally linked by a unit elasticity relationship with the respective explanatory variables).[8] A detailed account of these results goes beyond the scope of the present chapter. Nevertheless, we briefly stress some important features of the estimated equations.

First, the estimation results point out the presence of structural breaks in almost every long-run equation, as well as in a number of short-run equations. Most structural changes occurs in correspondence or in the aftermath of the first oil-price shock.

Second, the "endogenous structural change" estimation technology leads to equations with excellent statistical properties. The $\bar{R}^2$ is in most cases well above 0.7, which is a very good result considering that the equations are estimated in first and sometimes in second differences. The plots of the dynamic simulation paths reported in Appendix C confirm that the estimated equations track accurately the historical values. The diagnostic tests show that the standard hypotheses on the regression residuals are generally respected.

NARROWING THE US TWIN DEFICITS: SIMULATION RESULTS

The Baseline Scenario: Definition and Results

The Japanese submodel described in the previous section was linked to the US and euro area submodels utilized in Bagnai (2004). The US and euro area submodel share the same reference structure (see Appendix A) but were estimated on a slightly shorter sample of annual data, ranging from 1960 to 2002, using the time series provided by OECD (2002). The

[8] A full account of the estimation results can be downloaded from the model website: http://eumodel.net.

linkage of the three submodels resulted in a model of 185 equations with 110 exogenous variables, mostly related to the government sector and the rest of the world.

Table 1 - Table 1 – The baseline scenario. The table reports the paths of exogenous variables over the simulation period 2004-2007.

	2004	**2005**	**2006**	**2007**
US				
government sector				
government investment (real)	4.3	4.2	4.3	3.9
government intermediate consumption (nominal)	5.5	4.0	4.0	4.0
government employment	0.0	0.0	0.0	0.0
supply side				
labour force	0.9	1.2	1.6	2.0
EMU				
government sector				
government investment (real)	1.0	3.0	3.0	3.0
government intermediate consumption (nominal)	3.8	4.0	4.0	4.0
government employment	0.1	0.1	0.1	0.1
supply side				
labour force	0.0	1.0	1.0	1.0
Japan				
government sector				
government investment (real)	0.0	0.0	1.0	1.0
government intermediate consumption (nominal)	2.7	2.7	2.7	2.7
government employment	0.0	0.0	0.0	0.0
supply side				
labour force	-0.3	-0.3	-0.3	-0.3
Other blocks				
imports volume				
UK	5.5	4.5	4.5	4.5
Rest of the world	1.0	3.0	3.0	3.0
export prices				
UK	0.6	1.0	1.0	1.0
Rest of the world	5.4	5.5	5.5	5.5

The variables are measured in percentage changes. Growth rates for 2004-2005 come mostly from IMF (2004).

The main exogenous variables are the labour force, government consumption, government investment and government employment, the average tax and social security contribution rates, and the real imports and the export price index of the exogenous countries/areas (in the present version of the model, the United Kingdom and the rest of the world).

The model was first simulated over the sample 2004-2007 in order to construct a baseline path. The model database was extended over the simulation sample in two stages. In the first stage, the projections provided by IMF (2004) were used to extend the time series of the exogenous variables from 2004 to 2005. In the second stage, the exogenous variables of the two blocks were further extended over 2005-2007 using the hypotheses summarized in Table 1.

The exogenous variables pertaining to the government sector were extrapolated under a set of “neutral” hypotheses: average tax and social security contribution rates were held constant at their historical value, while the other revenues and transfers, which generally show a constant relation to nominal GDP, were “endogenized” as a ratio of nominal GDP, using the 2003 historical values. Government investment (in volume), government intermediate consumption (in value) and government employment were allowed to grow at a rate close to their average long-run growth rate. The nominal exchange rates were taken as exogenous and held constant at their current levels in the baseline scenario.

Although this set of hypotheses appears reasonable, this scenario should not be construed as a “forecast”, but rather as a convenient benchmark against which to assess some alternative dynamic paths induced by the policy measures aimed at reducing the US deficits. The main features of the baseline path are summarized in Table 1, which reports the sample average of the main endogenous variables over the simulation period.[9]

Table 2 – A sinthesis of the baseline path

	USA	**EUR**	**JPN**
Real GDP	4.12	1.98	1.37
Nominal GDP	6.12	2.64	1.41
Households disposable income	6.94	2.37	1.64
Real private consumption	3.84	1.69	0.68
Real government consumption	0.92	0.82	0.86
Real total investment	6.11	2.31	2.70
Real exports	4.76	3.37	1.44
Resl imports	5.36	2.70	0.62
Consumer prices	2.98	1.68	1.20
Unit wages	5.71	1.54	1.54
Unemployment rate (level)	4.36	10.74	5.77
Total employment	2.10	0.57	-0.30
Public deficit/GDP ratio (level)	3.72	3.83	8.24
Short term interest rate (level)	5.40	4.70	1.03
Long term interest rate (level)	6.31	6.38	1.81
Money stock	4.20	2.81	2.74
Local currency/USD exchange rate (level)		0.83	111.47
Trade balance/GDP ratio (level)	-5.45	1.94	2.58

Sample average over the simulation period 2004-2007; all the variables are expressed in percent rate of growth, unless otherwise specified.

The results for the first two years are in line with the current (spring 2004) projections of the IMF and OECD, which is not surprising, since the simulations share the same hypotheses on the exogenous variables. However, the growth forecasts of our model are rather prudential in comparison to those of the multilateral agencies. For instance, the real growth rate for 2004 in the baseline are 4.1% for the US (4.6% in IMF (2004), 4.7% in OECD (2004b)), 0.92% for

[9] A complete description of the baseline path can be found on the model website: http://eumodel.net.

the euro area (1.7% in IMF, 1.6% in OECD (2004b)), and 1.4% for Japan (3.4% in IMF (2004), 3.0% in OECD (2004b)). In fact, our baseline scenario does not take into account the recent increase in the oil price. If this increase was considered, the growth estimates would certainly fall.[10]

The medium-term scenario shows a stable growth prospect in the US, where the public deficit/GDP is expected to shrink gradually, reaching about 3 GDP points at the end of the simulation period, with an average value of 3.72 GDP points, as a result of both the sustained growth and the reduction in the rate of growth of government consumption. The trade balance, on the contrary, is expected to deteriorate slightly, reaching -5.9 GDP points at the end of the simulation period.

The Alternative Scenarios: Definition

As stated before, we consider two kind of policy measures aimed at reducing the current account deficit: a devaluation of the US dollar against the other leading currencies (Euro, Yen and Pound), and a fiscal consolidation carried out through a reduction in public expenditure. In order to assess their relative merits and their interactions, these measures are considered both separately and jointly. Moreover, in order to evaluate what an appropriate timing of the intervention could be, for each measure we consider two hypotheses of implementation: a “sudden” implementation, and a “gradual” implementation, phased over the next four years, starting in 2004.

The devaluation hypothesis is defined as a devaluation of the nominal exchange rates of the US dollar against the other currencies, starting in 2004 and equal to 20% from 2003 onwards (“sudden devaluation” scenario), or phased in four cumulative steps of 5% each (namely, 5% in 2004, 10% in 2005, 15% in 2006 and 20% in 2007; this is the “gradual devaluation” scenario). The path of the exchange rates in the baseline and in the two alternative scenarios is set out in Table 3. OECD (2004b) considers a sudden devaluation hypothesis similar to ours, by studying the impact of a 22.5% nominal devaluation of the USD starting in 2004. An unrealistic feature of these scenarios is that they assume that the US dollar will move in an equal way against all the other currencies. This is unlikely to happen in practice, and should be seen as a convenient working hypothesis, rather than as a forecast.

The fiscal consolidation hypothesis is implemented through a reduction by 2 points in the rate of growth of the US government intermediate consumptions USACGNW and a reduction by 1 point in the rate of growth of government wages USACGW. Also in this case two different timing are considered: in the “sudden consolidation” scenario the reduction is applied in its entirety starting in 2004; in the “gradual consolidation” scenario the reduction is phased in four years, as specified in Table 4. Table 4 reports also the size of the overall public expenditure reduction in the two scenarios as a share of baseline nominal GDP. In the gradual consolidation the reduction goes from 5 basis points of GDP in 2003 to 46 basis points in 2007, while in the sudden consolidation the reduction equals 20 basis points in the first years and reaches about 72 basis points at the end of the simulation period.

[10] The simulations in Bagnai (2004) show that a transitory increase by 20% of the rest of the world export prices (a shock similar to the oil price shocks of the Seventies) induces a fall by about 50 basis points in the real rate of growth of the euro area and by about 10 points in the real rate of growth of the US.

Table 3 – The baseline and alternative hypotheses on nominal exchange rates

		2004	2005	2006	2007
EUR/USD	baseline	0.8319	0.8319	0.8319	0.8319
	gradual devaluation	0.7903	0.7488	0.7072	0.6656
	sudden devaluation	0.6656	0.6656	0.6656	0.6656
JPY/USD	baseline	111.47	111.47	111.47	111.47
	gradual devaluation	105.90	100.32	94.75	89.18
	sudden devaluation	89.18	89.18	89.18	89.18
GBP/USD	baseline	0.5487	0.5487	0.5487	0.5487
	gradual devaluation	0.5213	0.4938	0.4664	0.4390
	sudden devaluation	0.4390	0.4390	0.4390	0.4390

We performed eight different simulations by considering first each scenario separately (“sudden devaluation”, “gradual devaluation”, “sudden consolidation”, “gradual consolidation”), then each possible combination of the two scenarios (“sudden devaluation with gradual consolidation”, “sudden devaluation with sudden consolidation”, “gradual devaluation with sudden consolidation”, “gradual devaluation with gradual consolidation”).

Table 4 – The rates of growth of US public expenditure components in the baseline and alternative scenarios

		2004 (%)	2005(%)	2006(%)	2007(%)
USACGNW	baseline	5.52	4.00	4.00	4.00
	gradual	5.02	3.00	2.50	2.00
	sudden	3.52	2.00	2.00	2.00
USACGW	baseline	3.05	3.31	3.65	3.99
	gradual	2.80	2.81	2.90	2.99
	sudden	2.05	2.31	2.65	2.99
size of the fiscal consolidation as a share of baseline GDP	gradual	-0.05	-0.15	-0.29	-0.46
	sudden	-0.20	-0.39	-0.57	-0.72

The Alternative Scenarios: Results

The “Gradual” and “Sudden” Devaluation Scenarios

We first consider the effects of a devaluation of the US dollar. The devaluation is expected to affect directly the trade balance through the competitivity effects in the export and import demand functions, thus fuelling economic growth in the US, with a beneficial effect also on the fiscal deficit. However, in a global model these effects are dampened by international repercussions. In fact, the devaluation of the US currency is mirrored by an appreciation of the other currencies, which slows the recovery of the partner countries, thereby dampening the increase in US exports. Moreover, the devaluation puts a pressure on US prices, which prompts for an increase in interest rates. Higher interest rates determine an increase in the external debt service, thus reducing the benefits of the trade balance improvement.[11]

Table 5 – Selected results from the gradual and sudden devaluation scenarios

	average 2004-2007			deviations from the baseline in 2007	
	baseline	**gradual**	**sudden**	**gradual**	**sudden**
United States					
Real GDP	*4.12*	4.40	4.47	1.12	1.42
Consumer prices	*2.98*	3.39	3.74	1.66	3.05
Trade balance	*-5.45*	-5.15	-4.91	0.52	0.56
Short-term rate	*5.40*	5.78	6.11	0.68	0.89
Euro area					
Real GDP	*1.98*	1.75	1.65	-0.93	-1.32
Consumer prices	*1.68*	1.07	0.66	-2.41	-4.07
Trade balance	*1.94*	1.20	0.57	-1.38	-1.78
Short-term rate	*4.70*	4.39	4.02	-0.68	-1.20
Japan					
Real GDP	*1.37*	1.55	1.77	0.71	1.60
Consumer prices	*1.20*	0.79	0.52	-1.65	-2.71
Trade balance	*2.58*	2.42	2.27	-0.65	-0.45
Short-term rate	*1.03*	0.86	0.79	-0.69	-0.14

The sample average over 2004-2007 refers to growth rates for real GDP and consumer prices and to levels for the trade balance (which is expressed in GDP points) and the short-term interest rate. The deviations from the baseline are either percentage deviations of level (for real GDP and consumer prices) or absolute deviations of percentage values (for trade balance and short-term interest rates).

These effects feature in the selected results reported in Table 5. The effect on the US current account at the end of the simulation period ranges between 52 (gradual devaluation) and 56 (sudden devaluation) GDP basis points. Our simulations thus confirm the findings of other studies, such as Obstfeld and Rogoff (2000) and OECD (2004b), according to which a substantial correction of the US external imbalances requires a very large swing in the USD exchange rate.

As far as the timing of the depreciation is concerned, while the effects on the trade balance are quite similar, the impacts on GDP growth and inflation are substantially larger in the case of a sudden devaluation. In particular, this scenario penalizes heavily economic recovery in the euro area.[12] On the contrary, the real growth rate of Japan increases slightly. This result depends on a number of factors. First, as shown in Appendix C, the Japanese import function does not feature a relative prices impact multiplier.[13] This implies that the

[11] As stated before, in the present version of the model the net factors incomes from abroad are not represented. Therefore, the simulations do not take into account this effect. OECD (2004b) represents this linkage by assuming that a third of US debt servicing accrues to non residents.

[12] OECD (2004b) finds that the sudden devaluation scenario penalizes more heavily Japan. However, the same study recognizes that the results for Japan could be “unduly negative” because the baseline assumes steady deflation over the simulation period. Our baseline, on the contrary, assumes a moderate inflation on average, and therefore leaves more scope for countercyclical monetary policy in Japan.

[13] The estimated parameter proved statistically insignificant.

appreciation of the JPY does not foster an immediate increase in imports, thus dampening the contractionary effects of the exchange rate appreciation. Second, the baseline path envisages a moderate inflation by the end of the simulation period. This leaves scope for a decrease of the real interest rate which pushes up investments.

Table 6 – Selected results from the gradual and sudden fiscal consolidation scenario

	Average 2004-2007			Percentage deviations from the baseline in the last year	
	baseline	**gradual**	**sudden**	**gradual**	**sudden**
United States					
Real GDP	4.12	3.86	3.69	-1.04	-1.71
Real consumption	3.84	3.62	3.46	-0.87	-1.52
Real investment	6.11	5.67	5.34	-1.78	-3.11
Consumer prices	2.98	2.85	2.68	-0.52	-1.18
Fiscal deficit	3.72	3.71	3.74	0.01	0.14
Trade balance	-5.45	-5.27	-5.08	0.37	0.63
Short-term rate	5.40	5.28	5.13	-0.27	-0.52
Euro area					
Real GDP	1.98	1.95	1.93	-0.15	-0.22
Consumer prices	1.68	1.62	1.57	-0.21	-0.44
Trade balance	1.94	1.89	1.84	-0.10	-0.16
Short-term rate	4.70	4.65	4.58	-0.12	-0.25
Japan					
Real GDP	1.37	1.33	1.31	-0.16	-0.22
Consumer prices	1.20	1.13	1.06	-0.27	-0.56
Trade balance	2.58	2.55	2.52	-0.13	-0.11
Short-term rate	1.03	0.99	0.94	-0.16	-0.15

The sample average over 2004-2007 refers to growth rates for all variables except the fiscal deficit and the trade balance (which are expressed in GDP points) and the short-term interest rate (expressed in percent points). The deviations from the baseline are either percentage deviations of level, or absolute deviations of percentage values (for the fiscal deficit, the trade balance and the short-term interest rates).

The "Gradual" and "Sudden" Fiscal Consolidation Scenarios

A reduction in US public expenditure is expected to improve directly the US fiscal deficit. Moreover, this reduction induces through the Keynesian multiplier a slowdown in real growth, which dampens real imports growth, and in prices, which fosters real exports, thus leading to an improvement of the current account balance. However, the negative demand spillover to the partner countries is expected to reduce the beneficial effects of the fiscal consolidation on the external balances.

The simulation results show that the fiscal consolidation scenario has a sizeable effect on the trade balance, which at the end of the simulation period increases in a range between 37 (gradual) and 63 (sudden consolidation) GDP basis points.[14] However, the simulation also

[14] We recall that the cut in public spending at the end of the simulation period equals 46 GDP basis points in the gradual and 72 GDP basis points in the sudden consolidation scenario, so that more than 80% of the fiscal retrenchment translates into a current account improvement.

illustrates that the spending cut has little or no effect on the overall fiscal stance of the US government, which means that the improvement in current account balance comes mainly from a reduction in investment and an increase in private saving. As far as the partner countries are concerned, Table 6 shows that the effects on the euro area and Japan of the negative demand spillover determined by the US fiscal contraction are quite similar.

The "Mixed" Scenarios

The results of the mixed scenarios are reported in Table 7 using the same format as in Table 6.

While it is certainly not easy to find a simple metric for evaluating this alternative scenarios, it appears that a gradual implementation of both the fiscal devaluation and the fiscal retrenchment would allow the Unites States to reach an acceptable result in term of reduction of the deficits, without putting an excessive pressure on the main trading partners.

Table 7 – Selected results from the mixed simulation scenarios

	baseline	sudden devaluation				gradual devaluation			
		consolidation		consolidation		consolidation		consolidation	
		gradual	sudden	gradual	sudden	gradual	sudden	gradual	sudden
		average 2004-2007		deviations		average 2004-2007		deviations	
United States									
Real GDP	*4.12*	4.22	4.05	0.40	-0.27	4.14	3.97	0.09	-0.58
Real consumption	*3.84*	3.74	3.58	-0.40	-1.05	3.68	3.52	-0.63	-1.28
Real investment	*6.11*	6.56	6.23	1.79	0.46	6.27	5.94	0.62	-0.71
Consumer prices	*2.98*	3.61	3.45	2.53	1.87	3.26	3.10	1.14	0.48
Fiscal deficit	*3.72*	2.99	3.01	-1.16	-1.04	3.38	3.40	-0.68	-0.56
Trade balance	*-5.45*	-4.73	-4.54	0.93	1.19	-4.97	-4.77	0.89	1.15
Short-term rate	*5.40*	5.99	5.84	0.62	0.36	5.66	5.51	0.41	0.16
Euro area									
Real GDP	*1.98*	1.62	1.60	-1.46	-1.54	1.72	1.70	-1.07	-1.14
Consumer prices	*1.68*	0.61	0.56	-4.27	-4.48	1.02	0.97	-2.62	-2.83
Trade balance	*1.94*	0.52	0.46	-1.88	-1.94	1.15	1.10	-1.49	-1.55
Short-term rate	*4.70*	3.97	3.90	-1.32	-1.45	4.34	4.28	-0.80	-0.93
Japan									
Real GDP	*1.37*	1.73	1.72	1.44	1.38	1.51	1.50	0.56	0.51
Consumer prices	*1.20*	0.46	0.39	-2.98	-3.25	0.72	0.65	-1.91	-2.18
Trade balance	*2.58*	2.24	2.20	-1.39	-0.57	2.39	2.35	-0.78	-0.42
Short-term rate	*1.03*	0.75	0.71	-1.11	-0.30	0.82	0.77	-0.85	-0.44

CONCLUSIONS

This chapter aimed at evaluating some possible strategies for narrowing the US "twin deficits", focusing in particular on the costs that these strategies impose on the main partner of the United States, namely, the euro area and Japan. The evaluation was carried out by simulating a world econometric model which represents the three main poles of the world economy: the United States, the euro area, and Japan.

Our results suggest that the amount of nominal devaluation required to obtain an appreciable reduction in the US current account deficit is larger than assumed in previous studies. For instance, OECD (2004b) finds that a 22.5 nominal depreciation of the dollar would suffice to achieve in six years a 2 GDP point reduction in the current account deficit. In our simulations a devaluation of comparable magnitude determines an improvement of only 0.5 GDP points in four years. These results are more in line with the revised estimates provided by Obstfeld and Rogoff (2004). The devaluation of the US dollar proves costly for the trading partners of the United States, and especially for the euro area, which in the "sudden devaluation" scenario experiences a reduction in the average rate of growth by about 33 basis points over the simulation period.

The fiscal consolidation appears to be relatively more effective in improving the external position of the US economy: a public expenditure cut of 0.72 GDP points induces a trade balance improvement of 0.63 GDP points, which implies, assuming a linear behavior of the model, that a 2.3 GDP points fiscal retrenchment could achieve a current account improvement of about 2 GDP points. However, the fiscal contraction penalizes heavily the real growth of the US economy, with a reduction in the average real growth rate ranging from 26 to 43 basis points in the simulation period.

The best strategy appears to be a combination of gradual devaluation and gradual fiscal consolidation. This is not unprecedented in the US recent economic history. For instance, following the relatively large current account imbalance in the mid-Eighties, the United States engaged in a real depreciation of about 30% phased in five years (from 1985 to 1989), and coupled with a gradual fiscal consolidation by about two GDP points, which brought the current account close to balance at the beginning of the Nineties. A strategy of this kind would allow the United States to keep the twin deficits under control, without putting an excessive strain on world economy.

APPENDICES

A. The Standard Framework Equations

[1] Aggregate Demand

[1.1] $CPV = f_1[YDH/PCP]$

[1.2] $IBV = f_2[GDPBV, IRL - \dot{P}GDP]$

[1.3] $ISKV = f_3[\Delta GDPBV]$

[1.4] $XGSV = f_4[YF, REER]$

[1.5] $MGSV = f_5[GDPV, PMREL]$

[1.6] $GDPV = CPV + CGV + IBV + \overline{IHV} + \overline{IGV} + XGSV - MGSV + ISKV$

[1.7] $GDP = CPV \times PCP + CG + IBV \times PIB + \overline{IHV} \times \overline{PIH} + \overline{IGV} \times PIG + XGSV \times PXGS - MGSV \times PMGS + \overline{ISK}$

[2] Aggregate Supply

[2.1] $GDPBV = GDPV - \dfrac{CGW}{PCGW} - \dfrac{TIND - \overline{TSUB}}{\overline{\overline{PNIT}}} - \dfrac{\overline{CFKG}}{PIG}$

[2.2] $EEP = A^{-1}\left[1+\left(\dfrac{\delta}{1-\delta}\right)^{-\sigma}\left(\dfrac{PIB}{UWB}\right)^{1-\sigma} e^{(1-\sigma)\lambda_L t}\right]^{\frac{\sigma}{1-\sigma}} \delta^{\frac{\sigma}{1-\sigma}} e^{-\lambda_L t} GDPBV$

[2.3] $KBVD = A^{-1}\left[1+\left(\dfrac{\delta}{1-\delta}\right)^{\sigma}\left(\dfrac{PIB}{UWB}\right)^{\sigma-1} e^{(\sigma-1)\lambda_L t}\right]^{\frac{\sigma}{1-\sigma}} (1-\delta)^{\frac{\sigma}{1-\sigma}} GDPBV$

[2.4] $KBV = KBV_{-1} \times \left(1 - \dfrac{\overline{RSCRB}}{100}\right) + IBV$

[3] Wages and Prices

[3.1] $ET = EEP + \overline{ES} + \overline{EG} + \overline{ECSA}$

[3.2] $UNR = 100 \times \left(1 - \dfrac{ET}{\overline{\overline{LF}}}\right)$

[3.4] $\dot{UWB} - \dot{PCP} - \left(\dfrac{\dot{GDPBV}}{EEP}\right) = f_6[\, UNR \,]$

[3.5] $UWG = f_7(\, UWB \,)$

[3.6] $\left[\dfrac{\dot{PCP}}{1+\overline{\overline{RTIND}}}\right] = f_8[\dot{UWB},\ \dot{PM}\,]$

[3.7] $\left[\dfrac{\dot{PCGW}}{1+\overline{\overline{RTIND}}}\right] = f_9[\ \dot{UWB}\ ]$

[3.8] $\left[\dfrac{\dot{PIB}}{1+\overline{\overline{RTIND}}}\right] = f_{10}[\dot{UWB},\ \dot{PM}\,]$

[3.9] $\left[\dfrac{\dot{PIG}}{1+\overline{\overline{RTIND}}}\right] = f_{11}[\ \dot{PIB}\,]$

[3.10] $PGDP = GDP/GDPV$

[4] Foreign Sector

[4.1] $YF = EXCHUD_{95} \cdot \sum_{j \neq i} \mu_{ij,95} \dfrac{MGSV_j}{EXCHUD_{j,95}}$

[4.2] $$PXF = \frac{EXCHUD}{EXCHUD_{95}} \sum_{j \neq i} \varphi_{ij,95} \frac{EXCHUD_{j,95}}{EXCHUD_j} PXGS_j$$

[4.3] $$\dot{PXGS} = f_{12}[\dot{UWB},\ \dot{PXF}]$$

[4.4] $$REER = \frac{PXF}{PXGS}$$

[4.5] $$PM = \frac{EXCHUD}{EXCHUD_{95}} \sum_{j \neq i} \mu_{ji,95} \frac{EXCHUD_{j,95}}{EXCHUD_j} PXGS_j$$

[4.6] $$PMREL = \frac{PGDP}{PM}$$

[4.7] $PMGS = f_{13}[\ PM\ ]$

$EXCHUD =$

[4.8] $$= f_{14}[\dot{MONEYS} - \dot{USAMONEYS},\ \dot{GDPV} - \dot{USAGDPV},\ IRS - USAIRS\ ]$$

[5] Monetary Sector

[5.1] $MONEYS/PGDP = f_{15}[\ GDPV, IRS, IRL\ ]$

[5.2] $IRS = f_{16}\ [\ \dot{PCP}\ , GDPV, USAIRS]$

[5.3] $IRL = f_{17}[\ IRS, PSBR/GDP\ ]$

[5.4] $IRGOV = f_{18}[\ IRS, IRL\ ]$

[6] Households Appropriation Accounts

[6.1] $YRH = WSSS + YOTH + TRRH - \overline{INTDBT}$

[6.2] $WSSS = WAGE + \overline{TRPBTH}$

[6.3] $WAGE = UWB \times \overline{WR_{95}} \times EEP + CGW$

[6.4] $YOTH = GGINTP + \overline{YPEX}$

[6.5] $TRRH = SSPG + \overline{TRPG} + \overline{TRRHX}$

[6.6] $YDH = YRH - TYH - TRPH$

[6.7] $TRPH = SSRG + \overline{TROPH}$

[7] General Government Accounts

[7.1] $YPG = CGW + \overline{CGNW} + GGINTP + \overline{YPEPGX} + \overline{TSUB} + SSPG + \overline{TRPG}$

[7.2] $CGW = UWG \times \overline{WRG_{95}} \times \overline{EG}$

[7.3] $CG = CGW + \overline{CGNW} + \overline{SDCG}$

[7.4] $CGV = \frac{CGW}{PCGW} + \frac{\overline{CGNW}}{\overline{PCGNW}} + \overline{SDCGV}$

[7.5] $GGINTP = \frac{IRGOV}{100} \times GGFL$

[7.6] $SSPG = f_{19}[\ GDP, UNR, AGE\ ]$

[7.7] $YRG = TYH + TYB + TIND + SSRG + \overline{TRRG} + \overline{YPERG}$

[7.8] $TYH = \overline{RTYH} \times YRH$

[7.9] $PROF = GDP - WSSS - TIND + \overline{TSUB}$

[7.10] $TYB = \overline{RTYB} \times PROF$

[7.11] $TIND = \overline{RTIND} \times (CPV \times PCP + CG + IBV \times PIB + \overline{IHV} \times \overline{PIH} + \overline{IGV} \times PIG)$

[7.12] $SSRG = \overline{RSSRG} \times WAGE$

[7.13] $CDG = YPG - YRG$

[7.14] $CAPOG = \overline{IGV} \times PIG + \overline{TKPG} - \overline{TKTRG} - \overline{CFKG}$

[7.15] $PSBR = CDG + CAPOG$

[7.16] $GNFL = GNFL_{-1} + PSBR + \overline{SDGNFL}$

[7.17] $GGFL = GNFL + \overline{GA}$

[7.18] $PSBRQ = 100 \times PSBR/GDP$

[7.19] $GGFLQ = 100 \times GGFL/GDP$

B. Legend of the Variables

CAPOG	Net capital outlays, government
CDG	$CDG = YPG - YRG$
CFKG	Consumption of fixed capital, government
CG	$CG = CGW + \overline{CGNW}$
CGNW	Government consumption excluding wages

CGV	Government consumption, volume
CGW	Government consumption, wage
CPV	Private consumption, volume
EEP	$EEP = ETB - ES$
ECSA	Employment, country specific
EG	Employment, government
ES	Self-employed
ET	Total employment
ETB	Employment, business
EXCHUD	Exchange rate, units of local currency per USD
GA	$GA = GFAR \times GDP/100$
GDP	Gross domestic product, value, market prices
GDPBV	$GDPBV = GDPV - \frac{CGW}{PCGW} - \frac{TIND - \overline{TSUB}}{\overline{PNIT}} - \frac{\overline{CFKG}}{PIG}$
GDPV	Gross domestic product, volume, market prices
GFAR	Ratio of government assets to GDP
GNFL	Government net financial liabilities
GGFL	Gross government debt
GGFLQ	$GGFLQ = 100 \times GGFL/GDP$
GGINTP	Gross government interest payments
IBV	Gross fixed capital formation, business sector (narrow definition)
IGV	Government investment, volume
IHV	Private residential fixed capital formation, volume
INTDBT	Interest on consumer debt
IPV	Private fixed investment
IRGOV	$IRGOV = 100\frac{GGINTP}{GGFL}$
IRL	Interest rate, long term
IRS	Interest rate, short term
ISK	$\overline{ISK} = GDP - CPV \times PCP - CG - IBV \times PIB - \overline{IHV} \times \overline{PIH} - \overline{IGV} \times PIG +$ $- XGSV \times PXGS + MGSV \times PMGS$
ISKV	Stockbuilding, private, volume
ITV	Total fixed investment (excl. stockbuilding)
KBV	Capital stock, business
KBVD	$KBVD = A^{-1}\left[1+\left(\frac{\delta}{1-\delta}\right)^{\sigma}\left(\frac{PIB}{UWB}\right)^{\sigma-1} e^{(\sigma-1)\lambda_L t}\right]^{\frac{\sigma}{1-\sigma}} (1-\delta)^{\frac{\sigma}{1-\sigma}} GDPBV$
LF	Labour force, total

MGSV	Imports for goods and services, n.a. basis
MONEYS	Money stock
NITV	Net indirect tax volume
NLG	Net lending, government
PCG	Deflator, public consumption
PCGNW	$PCGNW = \dfrac{CGNW}{CGV - \dfrac{CGW}{PCGW}}$
PCGW	Deflator, government consumption of goods and services, wages
PCP	Deflator, private consumption
PGDP	Deflator, GDP at market prices
PIB	Deflator for business investment
PIG	Deflator, fixed investment, government
PIH	$PIH = \dfrac{ITV \times PIT - IBV \times PIB - IGV \times PIG}{IHV}$
PIT	Deflator for total investment
PM	$PM = \dfrac{EXCHUD}{EXCHUD_{95}} \sum_{j \neq i} \mu_{ji} \dfrac{EXCHUD_{j,95}}{EXCHUD_j} PXGS_j$
PMGS	Import price goods and services, local currency
PMREL	$PMREL = \dfrac{PGDP}{\dfrac{EXCHUD}{EXCHUD_{95}} \sum_{j \neq i} \mu_{ji,t} \dfrac{EXCHUD_{j,95}}{EXCHUD_j} PXGS_j}$
PNIT	$PNIT = \dfrac{TIND - TSUB}{NITV}$
PROF	$PROF = GDP - WSSS - TIND + TSUB$
PSBR	$PSBR = CDG + CAPOG \equiv - NLG$
PSBRQ	$PSBRQ = 100 \times PSBR/GDP$
PXF	$PXF = \dfrac{EXCHUD}{EXCHUD_{95}} \sum_{j \neq i} \varphi_{ij,95} \dfrac{EXCHUD_{j,95}}{EXCHUD_j} PXGS_j$
PXGS	Export price goods and services, local currency
REER	$REER = \dfrac{PXF}{PXGS}$
RSCRB	$RSCRB = 100 \dfrac{IBV - \left(KBV - KBV_{-1}\right)}{KBV_{-1}}$
RSSRG	$RSSRG = \dfrac{SSRG}{WAGE}$

RTIND	$RTIND = \frac{TIND}{CPV \times PCP + CG + IT}$ dove $IT = IBV \times PIB + \overline{IHV} \times \overline{PIH} + \overline{IGV} \times PIG$
RTYB	$RTYB = \frac{TYB}{PROF}$
RTYH	$RTYH = \frac{TYH}{YRH}$
SDCG	$SDCG = CG - CGW - CGNW$
SDCGV	$SDCGV = CGV - \frac{CGW}{PCGW} - \frac{\overline{CGNW}}{\overline{PCGNW}}$
SDGNFL	$SDGNFL = GNFL - GNFL_{-1} - PSBR$
SSPG	Social benefits paid by government
SSRG	Social security contributions received by government
TIND	Indirect taxes
TKPG	Capital transfers and transactions paid
TKTRG	Capital tax and transfers receipts
TROPH	$TROPH = TRPH - TRSSH$
TRPBTH	$TRPBTH = WSSS - WAGE$
TRPG	Other current transfers paid by government
TRPH	Total transfers paid by households
TRRG	Other current transfers received by government
TRRH	Total transfers received by households
TRRHX	$TRRHX = TRRH - SSPG - TRPG$
TRSSH	Social contributions by households
TSUB	Subsidies
TYB	Direct taxes, business
TYH	Direct taxes, households
UNR	Unemployment rate
UWB	$UWB = WR/WR_{95}$
UWG	$UWG = WRG/WRG_{95}$
WAGE	Wages and salary
WR	Wage rate (business sector)
WRG	$WRG = CGW/EG$
WSSS	Compensation of employees
XGSV	Exports for goods and services, n.a. basis
YDH	Households disposable income
YF	$YF = EXCHUD_{95} \cdot \sum_{j \neq i} \mu_{ij,95} \frac{MGSV_j}{EXCHUD_{j,95}}$
YOTH	Income from property and other

YPEPG	Property income paid by government
YPEPGX	*YPEPGX = YPEP - GGINTP*
YPERG	Property income received by government
YPEX	*YPEX = YOTH-GGINTP*
YPG	Current disbursement, government
YRG	Current receipts, government
YRH	Current receipts households

C. The Japanese Model Estimation Results

The following tables and graphs provide detailed information on some selected simulations results for the Japanese model.

For each equation we report first the specification of the long-run (cointegrating) and short-run (error correction) equations. In the long-run equations the $\varphi_{s,t}$ variables are shift dummy variables representing a structural change occurring in the year *s*, while the $\hat{z}_{j,t}$ are the cointegrating residuals of the *j*-th equation. The $\varphi_{s,t}$ takes value zero from the beginning of the sample to year *s*, and value one from *s*+1 onwards (therefore the year *s* is the last year of the first regime). In the short-run equations the DXX_t variables are dummy variables taking the value one in year *XX* and zero elsewhere.

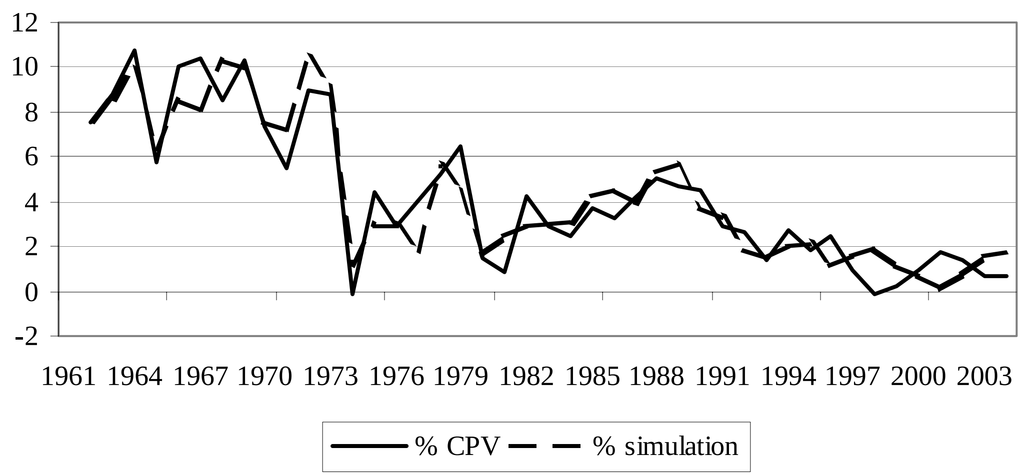
The estimated parameters of the equations are listed separately in a table, along with their *t* statistics. For each equation we report also a set of goodness of fit measures (the adjusted $\bar{R}^2$ and the standard error of the regression, SER) and of diagnostic tests. For the long-run equation we provide the statistic of the Engle and Granger (1987) or Gregory and Hansen (1996) cointegration tests. If the latter is reported, we specify also the endogenously determined date of the structural break (which coincides with the last year of the first regime). For the short-run equation we report a set of standard Lagrange multiplier statistics for the hypotheses of serial independence (LMI), omoskedasticity (LMO) and normality (LMN) of the residuals, as well as a test for the linearity of the regression function (LMF). These test statistics are accompanied by their respective *p*-values (a *p*-values smaller than 0.05 indicates that the respective null hypothesis is rejected at the 5% significance level). Moreover, we also report the smallest *p*-value among the *p*-values of all the Chow test statistics evaluated for every possible structural break in the sample. A *p*-value greater than 0.05 provides evidence of parameter constancy in the short-run equation.

For each equation we report a graph representing the path of the in-sample dynamic simulation.

Private Consumption

$$\ln(CPV)_t = \pi_1 + \pi_1^* \varphi_{76,t} + (\pi_2 + \pi_2^* \varphi_{76,t}) \ln(YDH/PCP)_t +$$
$$+ (\pi_3 + \pi_3^* \varphi_{76,t}) \ln(MONEYS/PCP)_t + \hat{z}_{1,t}$$
$$\Delta \ln(CPV)_t = \beta_1 + \beta_2 \Delta \ln(YDH/PCP)_t + \beta_3 \Delta \ln(MONEYS/PCP)_t + \beta_4 \hat{z}_{1,t-1} + \hat{u}_{1,t}$$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	0.989	5.43	β_1	0.006	2.52
π_1^*	-3.163	-4.87	β_2	0.635	11.80
π_2	0.670	8.72	β_3	0.190	4.62
π_2^*	0.281	2.44	β_4	-0.377	-3.41
π_3	0.221	3.50			
π_3^*	-0.019	-0.26			
sample	1960-2004		sample	1961-2004	
$\bar{R}^2$	0.999		$\bar{R}^2$	0.893	
SER	0.015		SER	0.010	
ADF	- 3.60 *(C/S)*		LMI	1.98	[0.15]
	[break date: 1976]		LMF	0.43	[0.50]
			LMN	1.72	[0.42]
			LMO	0.00	[0.94]
			Chow	break 1997:1	[0.05]



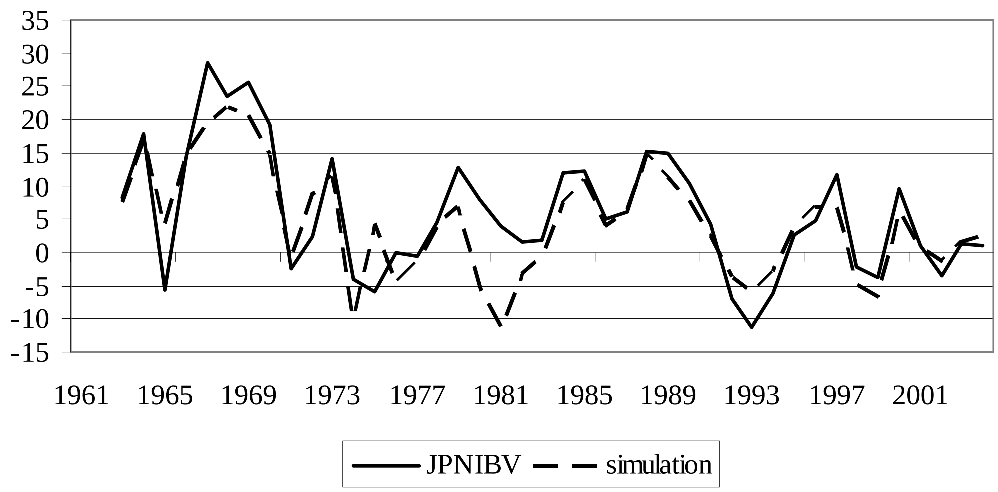
Private Investment

$$\ln(IBV)_t = \pi_1 + \pi_1^* \varphi_{74,t} + \pi_2 \ln(GDPBV)_t + \pi_3(IRLR) + \hat{z}_{2,t}$$

$$\Delta\ln(IBV)_t = \beta_1 + \beta_1^* \varphi_{79,t} + \beta_2 \Delta\ln(IBV)_{t-1} + \beta_3 \Delta\ln(GDPBV)_t + \beta_4 \varphi_{79,t} \Delta(IRLR)_t +$$
$$+ \beta_5 D75 + \beta_6 \hat{z}_{2,t-1} + \hat{u}_{2,t}$$

where $IRLR = IRL - 100 \times \Delta\ln(PIB)$

	Long-run equation			Short-run equation	
	estimate	t test		estimate	t test
π_1	-6.201	-12.84	β_1	-0.1169	-6.39
π_1^*	-0.191	-3.75	β_1*	0.0879	5.68
π_2	1.3669	33.11	β_2	0.1941	2.689
π_3	-0.004	-1.10	β_3	2.3981	10.127
			β_4	-0.0138	-2.3062
			β_5	0.054	1.27
			β_6	-0.353	-5.02
sample	1961-2004		sample	1962-2004	
$\bar{R}^2$	0.661		$\bar{R}^2$	0.85	
SER	0.04996		SER	0.033	
ADF	- 4.03 *(C)*		LMI	0.71	[0.39]
	[break date: 1973]		LMF	0.57	[0.44]
			LMN	13.69	[0.001]
			LMO	0.31	[0.57]
			Chow	break 1973:1	[0.047]

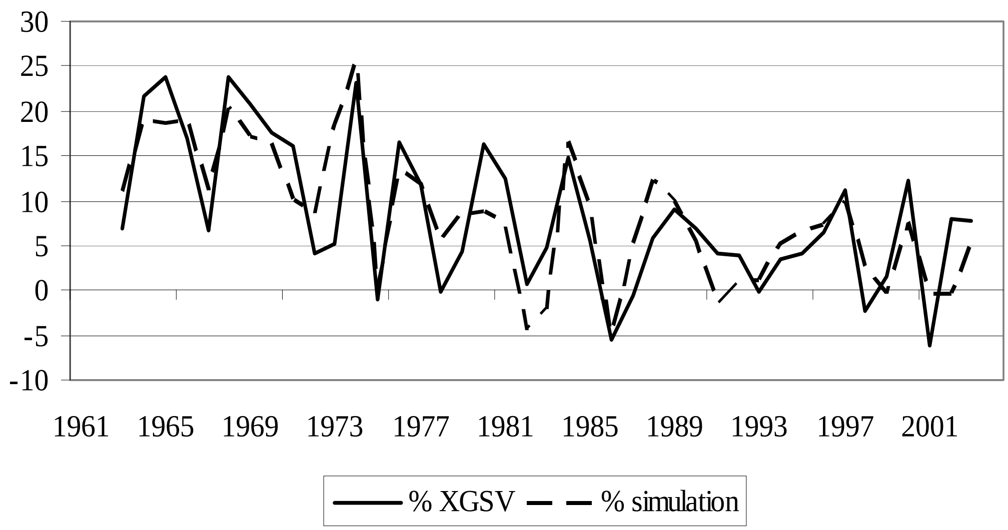


Export of Goods and Services

$$\ln(XGSVX)_t = \pi_1 + \pi_1^* \varphi_{88,t} + (\pi_2 + \pi_2^* \varphi_{88,t}) \ln(YF)_t + \hat{z}_{4,t}$$

$$\Delta\ln (XGSVX)_t = \beta_1 + \beta_2 \Delta\ln(XGSVX)_{t-1} + (\beta_3 + \beta_3^* j_{88,t})\Delta\ln(YF)_t + \beta_4 \Delta\ln(REER)_t + +\beta_5 \hat{z}_{4,t-1} + \hat{u}_{4,t}$$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	-7.751	-30.18	β_1	-0.023	-1.56
π_1^*	12.298	17.18	β_2	0.220	2.22
π_2	1.782	66.67	β_3	1.83	9.17
π_2^*	-1.203	-17.86	β_3*	-0.977	-4.91
			β_4	0.208	1.84
			β_5	-0.297	-2.56
sample	1960-2003		sample	1961-2003	
$\bar{R}^2$	0.995		$\bar{R}^2$	0.69	
SER	0.070		SER	0.040	
ADF	- 3.69 *(C/S)*		LMI	0.32	[0.57]
	[break date: 1988]		LMF	4.71	[0.02]
			LMN	0.28	[0.86]
			LMO	0.94	[0.334]
			Chow	break 1972:1	[0.093]



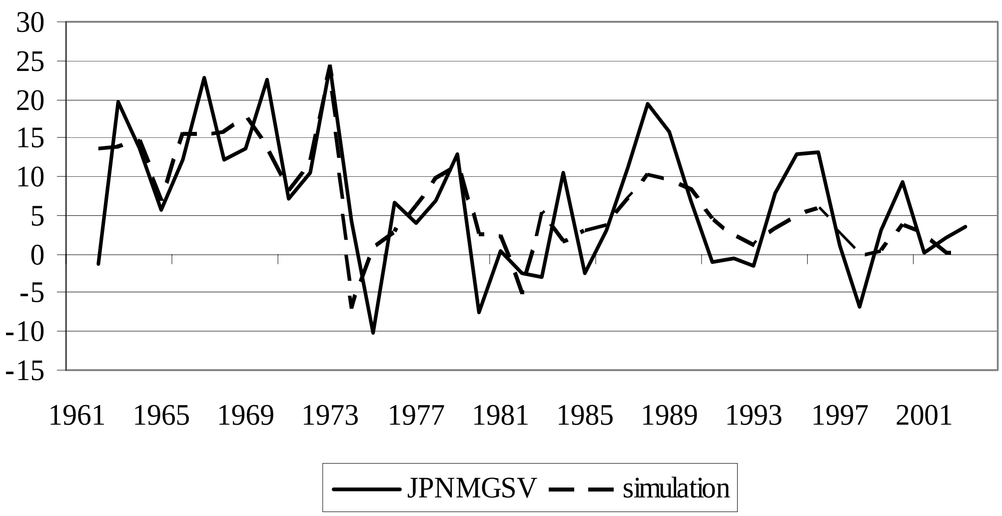
Import of Goods and Services

$\ln(MGSV)_t = \pi_1 + \pi_1^* \varphi_{82,t} + \pi_2 \ln(X1)_t + \pi_3 \ln(PMREL) + \hat{z}_{5,t}$

$\Delta\ln(MGSV)_t = \beta_1 + \beta_2 \Delta\ln(X1)_t + (\beta_3 + \beta_3^* \varphi_{82,t}) \hat{z}_{5,t-1} + \beta_4 D73 + \beta_5 D82 + \hat{u}_{5,t}$

where $X1 = CPV+CGV+IBV+IGV$

	Long-run equation			Short-run equation	
	estimate	t test		estimate	t test
π_1	-7.272	-9.93	β_1	0.0065	0.48
π_1^*	-0.2332	-5.02	β_2	1.429	5.94
π_2	1.385	25.10	β_3	-0.84	-3.78
π_3	0.266	3.01	β_3*	0.62	2.39
			β_4	0.072	1.36
			β_5	-0.098	-1.84
sample	1960-2003		sample	1961-2003	
$\bar{R}^2$	0.98		$\bar{R}^2$	0.61	
SER	0.079		SER	0.051	
ADF	- 3.36 *(C)*		LMI	0.87	[0.35]
	[break date: 1982]		LMF	2.19	[0.13]
			LMN	0.036	[0.98]
			LMO	0.82	[0.36]
			Chow	break 1994:1	[0.98]



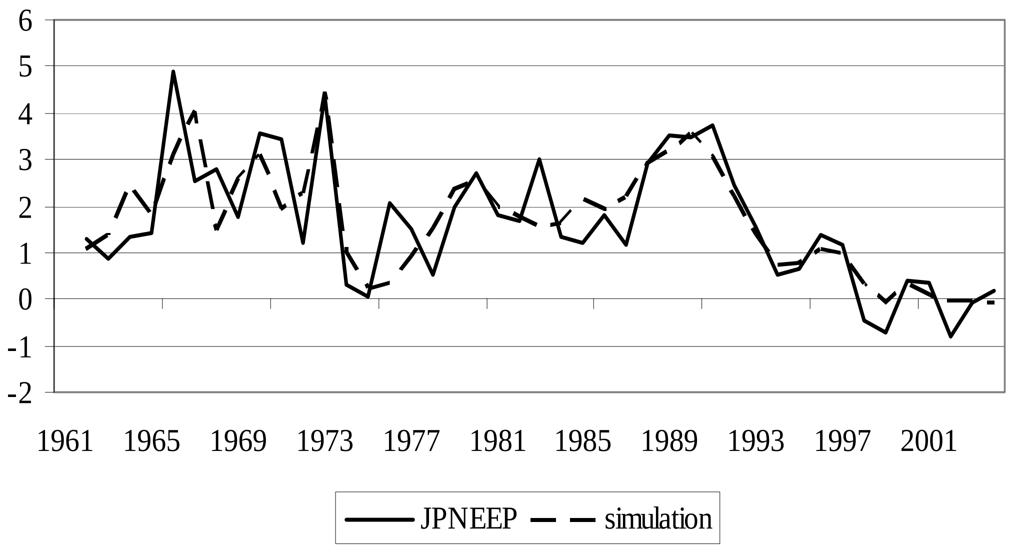
Total Employment

$$\ln(EEP)_t = \pi_1 + \pi_1^* \varphi_{66,t} + \pi_2 \ln(GDPBV)_t + \pi_3 \ln(UWBR)_t + \hat{z}_{6,t}$$

$$\Delta\ln (EEP)_t = \beta_1 + \beta_2 \Delta\ln(GDPBV)_t + \beta_3 \Delta\ln(UWBR)_t + \beta_4 D73 + \beta_5 \hat{z}_{6,t-1} + \hat{u}_{6,t}$$

where $UWBR = 100*UWB/PIB$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	8.54	19.41	β_1	0.01	5.75
π_1^*	-0.092	-4.93	β_2	0.26	5.65
π_2	0.847	16.33	β_3	-0.125	-3.14
π_3	-0.385	-7.35	β_4	0.014	1.97
			β_5	-0.332	-7.01
sample	1960-2003		sample	1961-2003	
$\bar{R}^2$	0.69		$\bar{R}^2$	0.71	
SER	0.0072		SER	0.007	
ADF	- 3.56*(C)*		LMI	0.62	[0.42]
	[break date: 1966]		LMF	1.61	[0.20]
			LMN	2.13	[0.34]
			LMO	0.28	[0.59]
			Chow	break 1970:1	[0.09]

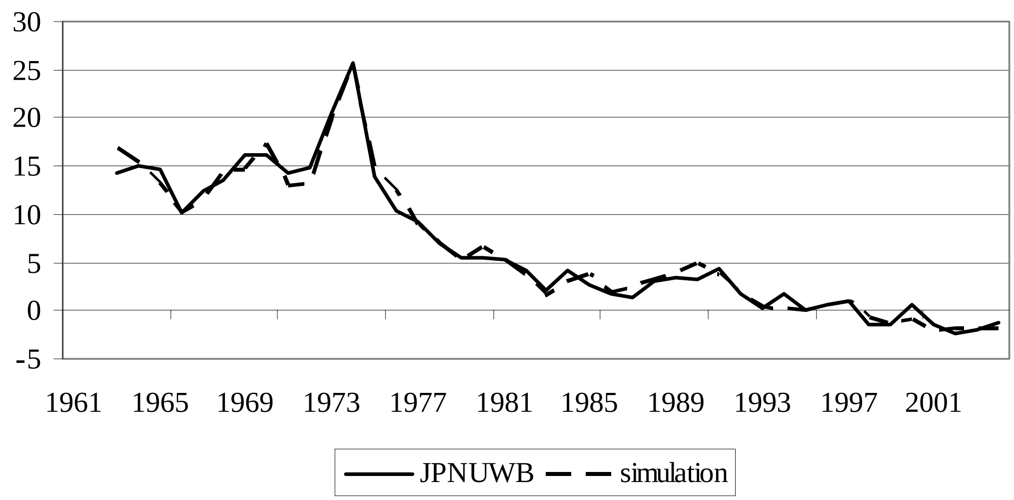


Phillips Curve

$$\ln(UWB)_t = \pi_1 + \pi_1^* \varphi_{68,t} + \pi_2 \ln(PCP)_t + \pi_3 \ln(APL)_t + \pi_4 (UNR)_t + \hat{z}_{7,t}$$

$$\Delta\ln (UWB)_t = \beta_1 + \beta_2 \Delta\ln(UWB)_{t-1} + (\beta_3 + \beta_3^* \varphi_{76,t}) \Delta\ln(PCP)_t + \beta_4 \Delta\ln(APL)_t +$$
$$+ (\beta_5 + \beta_5^* \varphi_{76,t}) \Delta(UNR)_t + \beta_6 \hat{z}_{7,t-1} + \hat{u}_{7,t}$$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	4.734	286.35	β_1	-0.005	-1.68
π_1^*	0.089	4.82	β_2	0.267	3.32
π_2	1.000	//	β_3	1.071	9.91
π_3	1.000	//	β_3^*	-0.263	-3.14
π_4	-0.031	-5.42	β_4	0.573	6.08
			β_5	-0.075	-3.41
			β_5*	0.075	3.53
			β_6	-0.172	-4.24
sample	1960-2004		sample	1962-2004	
$\bar{R}^2$	0.43		$\bar{R}^2$	0.97	
SER	0.044		SER	0.009	
ADF	- 2.79 *(C)*		LMI	2.93	[0.08]
	[break date: 1968]		LMF	0.01	[0.91]
			LMN	1.26	[0.53]
			LMO	2.78	[0.09]
			Chow	break 1972:1	[0.53]

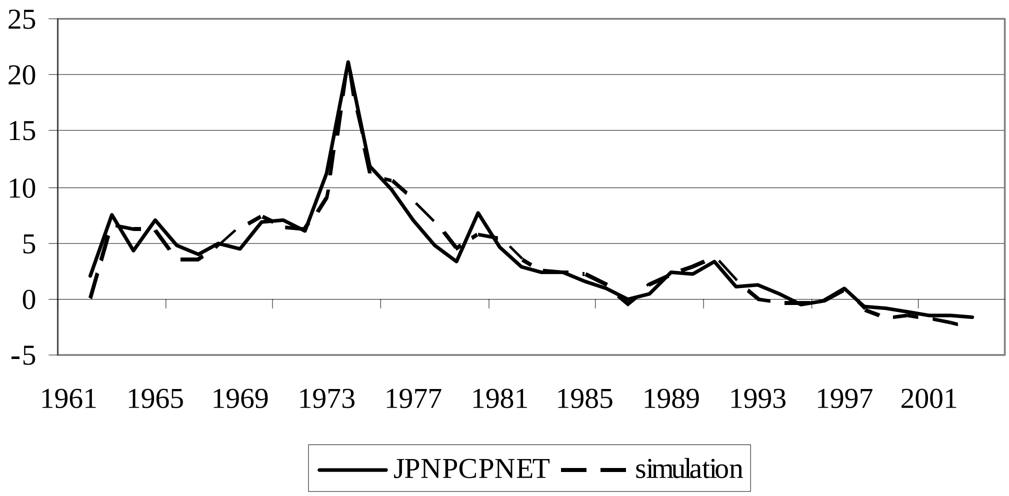


Deflator of Private Consumption

$$\Delta\ln(PCPNET)_t = \pi_1 + \pi_1^* \varphi_{74,t} + \pi_2 \Delta\ln(UWB)_t + \pi_3 \Delta\ln(PM)_t + \hat{z}_{9,t}$$

$$\Delta^2\ln(PCPNET)_t = \beta_1 + \beta_2 \Delta^2\ln(UWB)_t + \beta_3 D74 + \beta_4 \hat{z}_{9,t-1} + \hat{u}_{9,t}$$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	-0.070	-17.05	β_1	-0.0008	-0.55
π_1^*	0.065	14.38	β_2	0.6117	9.37
π_2	0.948	47.25	β_3	0.059	5.87
π_3	0.051	2.57	β_4	-0.914	-8.07
sample	1960-2004		sample	1962-2004	
$\bar{R}^2$	0.89		$\bar{R}^2$	0.78	
SER	0.013		SER	0.009	
ADF	- 7.31 *(C)* *[break date: 1974]*		LMI	0.075	[0.78]
			LMF	1.95	[0.16]
			LMN	0.13	[0.93]
			LMO	0.26	[0.60]
			Chow	break 1973:1	[0.09]

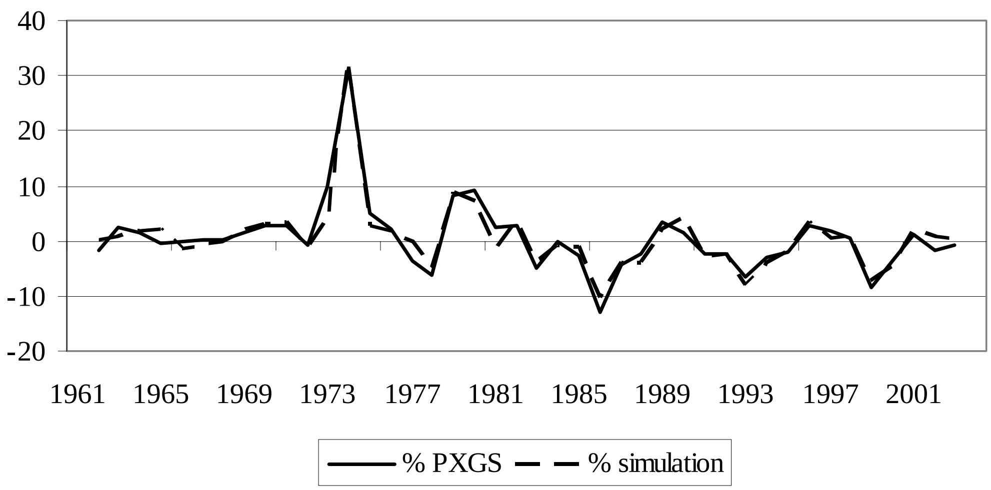


Deflator of Exports of Goods and Services

$$\ln(PXGS)_t = \pi_1 + \pi_1^* \, j_{64,t} + \pi_2 \, trend + \pi_3 \ln(UWB)_t + \pi_4 \ln(PXF)_t + \hat{z}_{13,t}$$

$$\Delta\ln(PXGS)_t = \beta_1 + \beta_2 \Delta\ln(UWB)_t + \beta_3 \Delta\ln(PXF)_t + \beta_4 D74_t + \beta_5 \hat{z}_{13,t-1} + \hat{u}_{13,t}$$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	0.511	7.17	β_1	-0.014	-3.66
π_1^*	-0.117	-4.97	β_2	0.18	3.98
π_2	-0.011	-8.03	β_3	0.39	12.91
π_3	0.238	8.67	β_4	0.108	5.02
π_4	0.49	13.73	β_5	-0.296	-3.12
sample	1960-2003		sample	1961-2003	
$\bar{R}^2$	0.97		$\bar{R}^2$	0.91	
SER	0.037		SER	0.017	
ADF	- 4.57 *(C/T)*		LMI	2.97	[0.08]
	[break date: 1965]		LMF	1.99	[0.15]
			LMN	3.09	[0.21]
			LMO	0.37	[0.54]
			Chow	break 1973:1	[0.01]



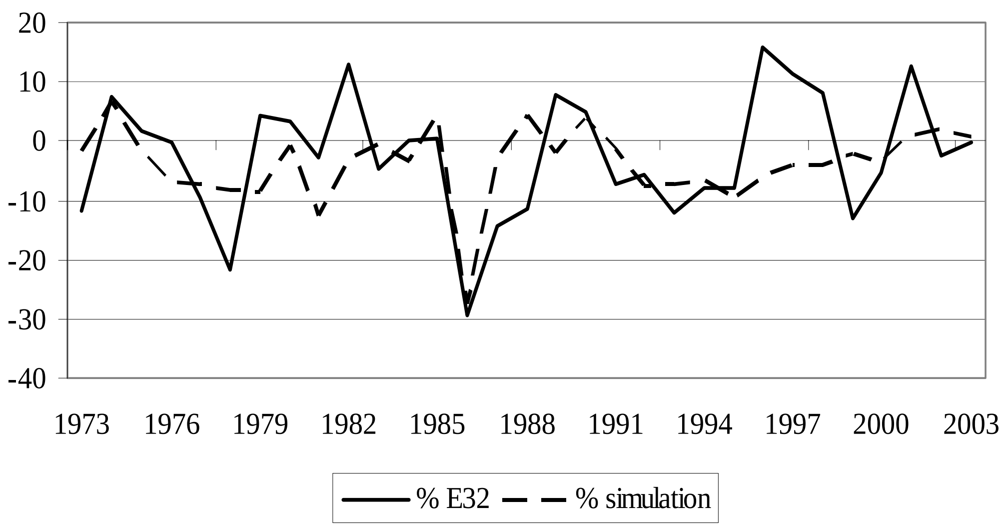
JPY/USD Exchange Rate

$RATE_t = \pi_1 + \pi_1^* j_{87,t} + \pi_2 YDIF_t + \pi_3 (IRS\text{-}USAIRS)_t + \pi_4 (IRL\text{-}USAIRL)_t + + \hat{z}_{15,t}$

$\Delta(RATE)_t = \beta_1 + \beta_2 \Delta(RATE)_{t-1} + \beta_3 \Delta(IRS\text{-}USAIRS)_t + \beta_4 D86_t + \beta_5 \hat{z}_{15,t-1} + \hat{u}_{15,t}$

where RATE = ln E32 – [ln (MONEYS) –(ln (USAMONEYS)]
and YDIF = ln (GDPV) – ln (USAGDPV)

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	3.021	2.17	β_1	-0.0066	-0.36
π_1^*	-0.73	-10.45	β_2	0.388	2.57
π_2	-1.70	-3.402	β_3	0.0204	2.50
π_3	0.021	1.09	β_4	-0.319	-3.30
π_4	0.0327	1.077	β_4	-0.132	-1.05
sample	1971-2003		sample	1972-2003	
$\bar{R}^2$	0.86		$\bar{R}^2$	0.41	
SER	0.18		SER	0.09	
ADF	- 4.90 *(C)*		LMI	2.05	[0.15]
	[break date: 1987]		LMF	0.22	[0.63]
			LMN	0.76	[0.68]
			LMO	0.2	[0.65]
			Chow	break 1996:1	[0.14]



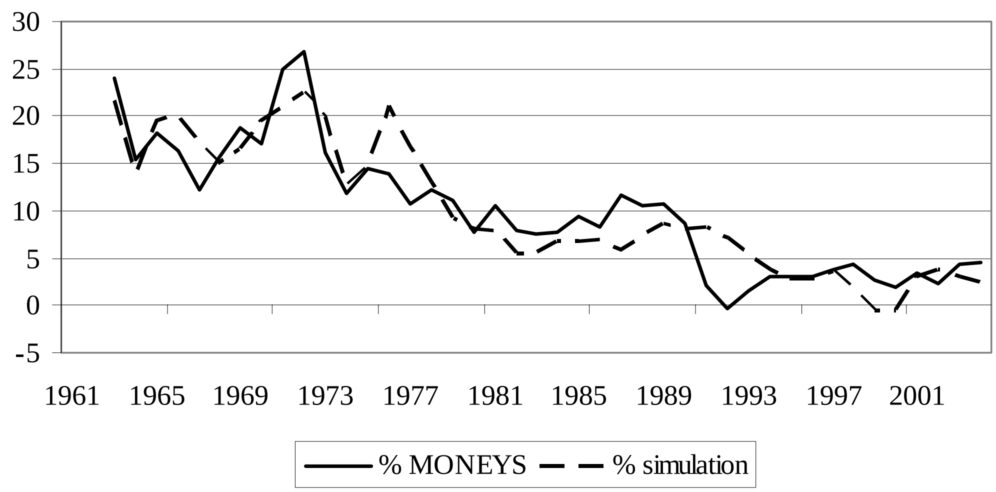
Demand for Money

$\ln(MONEYS/PGDP)_t = \pi_1 + \pi_1^* \varphi_{99,t} + \pi_2 \ln(GDPV)_t + \pi_3 (IRS)_t + \hat{z}_{16,t}$

$\Delta\ln (MONEYS/PGDP)_t = \beta_1 + \beta_2 \Delta\ln (MONEYS/PGDP)_{t-1} + \beta_3 \Delta\ln(GDPBV)_t +$

$+(\beta_4 + \beta_4^* \varphi_{76,t}) \Delta (IRS)_t + \beta_5 \hat{z}_{16,t-1} + \hat{u}_{16,t}$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	-3.513	-12.68	β_1	0.0122	1.81
π_1^*	0.174	5.02	β_2	0.528	4.59
π_2	1.277	61.14	β_3	0.331	2.14
π_3	-0.014	-3.91	β_4	-0.0184	-7.69
			β_4*	0.0137	3.507
			β_5	-0.192	-2.87
sample	1960-2004		sample	1961-2004	
$\bar{R}^2$	0.99		$\bar{R}^2$	0.75	
SER	0.057		SER	0.023	
ADF	- 3.51 *(C)*		LMI	1.21	[0.26]
	[break date: 2000]		LMF	0.89	[0.34]
			LMN	1.64	[0.43]
			LMO	1.09	[0.29]
			Chow	break 1976:1	[0.43]



Short-term Interest Rate

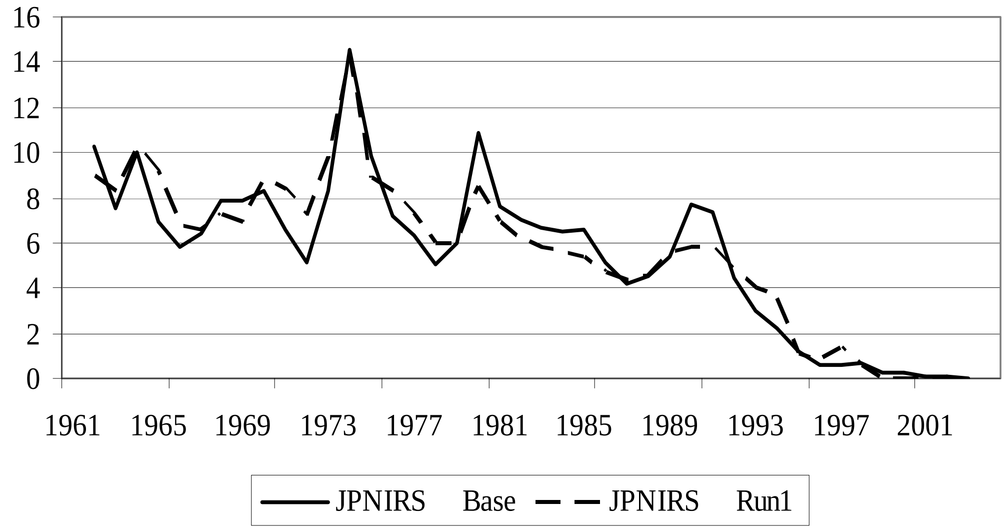
$IRS_t = \pi_1 + \pi_1^* \varphi_{93,t} + \pi_2\, USAIRS_t + \pi_3\, INFL_t + \pi_4\, GROWTH_t + \hat{z}_{17,t}$

$\Delta IRS_t = \beta_1 + \beta_2\, \Delta INFL_t + \beta_3\, D64_t + \beta_4\, \hat{z}_{17,t\text{-}1} + \hat{u}_{17,t}$

where $INFL = 100\times\Delta \ln(PCP)$

and $GROWTH = 100\times\Delta \ln(GDPV)$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	3.265	3.67	β_1	-0.26	-1.75
π_1^*	-3.093	-4.11	β_2	0.53	8.26
π_2	0.110	1.44	β_3	3.947	3.94
π_3	0.467	7.17	β_4	-0.694	-5.95
π_4	0.138	1.88			
sample	1961-2003		sample	1962-2003	
$\bar{R}^2$	0.84		$\bar{R}^2$		0.76
SER	1.38		SER		0.96
ADF	- 5.33 ©		LMI	7.52	[0.006]
	[break date: 1993]		LMF	1.29	[0.25]
			LMN	0.32	[0.85]
			LMO	0.00	[0.98]
			Chow	break 1977:1	[0.07]

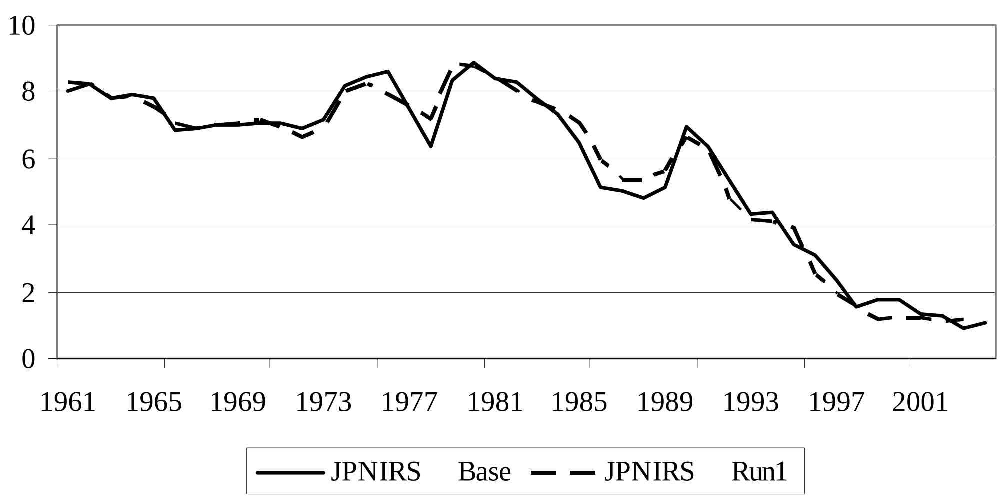


Long Term Interest Rate

$IRL_t = \pi_1 + \pi_1^* \varphi_{96,t} + \pi_2 IRS_t + \pi_3 PSBRQ + \hat{z}_{18,t}$

$\Delta IRL_t = \beta_1 + \beta_1^* \varphi_{84,t} + (\beta_2 + \beta_2^* \varphi_{84,t})\,\Delta(IRS)_t + \beta_3 \hat{z}_{18,t-1} + \beta_4 D79_t + \hat{u}_{18,t}$

	Long-run equation			*Short-run equation*	
	estimate	*t* test		estimate	*t* test
π_1	3.857	8.66	β_1	0.013	0.17
π_1^*	3.162	-5.58	β_1^*	-0.275	-2.27
π_2	0.432	7.45	β_2	0.147	4.84
π_3	0.158	2.20	β_2*	0.350	4.13
			β_3	-0.417	5.17
			β_4	1.674	4.50
sample	1960-2004		sample	1961-2004	
$\bar{R}^2$	0.895		$\bar{R}^2$	0.719	
SER	0.802		SER	0.358	
ADF	- 5.27 *(C)*		LMI	1.68	[0.19]
	[break date: 1996]		LMF	7.45	[0.00]
			LMN	0.25	[0.87]
			LMO	2.35	[0.12]
			Chow	break 1996:1	[0.07]



REFERENCES

Bagnai, A. (2004), 'Dynamic paths of the European economy: simulations with an aggregate model of the EMU as a part of the world economy', chap. 9 in A. Deardorff (ed.), *The Past, Present, and Future of the European Union*, New York: Palgrave MacMillan.

Bagnai, A. and F. Carlucci (2003) 'An aggregate model for the European Union', *Economic Modelling*, vol. 20, pp. 623-649.

Blangiewicz, M. and W.W. Charemza (1990) 'Cointegration in small samples: empirical percentiles, drifting moments and customized testing' *Oxford Bulletin of Economics and Statistics*, vol. 52(3), pp. 303-315.

Dramais, A. (1986) 'COMPACT - A prototype macroeconomic model of the European Community in the world economy', *European Economy*, vol. 27.

Engle, R.F. and C.W.J. Granger (1987) 'Cointegration and error correction: representation, estimation, and testing', *Econometrica*, vol. 55, pp. 251-276.

Fagan, G., J. Henry, and R. Mestre (2001) 'An area-wide model (AWM) for the euro area', *European Central Bank Working Paper*, No. 42.

Frenkel, J. (1976) 'A monetary approach to the exchange rate: doctrinal aspects and empirical evidence', *Scandinavian Journal of Economics*, vol. 78, pp. 200-224.

Gregory, A.W. and B.R. Hansen (1996) 'Residual-based tests for cointegration in models with regime shifts', *Journal of Econometrics*, vol. 70, pp. 99-126.

IMF (2004) *World Economic Outlook – Advancing structural reforms* http://www.imf.org/external/pubs/ft/weo/2004/01/index.htm

Kim, B.J. and S. Mo (1995) 'Cointegration and the long-run forecast of the exchange rate', *Economics Letters*, vol. 48, pp. 353-359.

Knight, M.D. and C. Wymer (1978) 'A macroeconomic model of the United Kingdom', *IMF Staff Papers*, vol. 15.

Laxton, D., Isard, P., Faruquee, H., Prasad, E., Turtelboom, B. (1998) *MULTIMOD Mark III, The core dynamic and steady-state models*, IMF Occasional Paper no. 164.

Meyermans, E. and P. Van Brusselen (2000a) 'The NIME Model – Specification and estimation of the demand equations of the households sector', Brussels: *Federal Planning Bureau Working Paper*, no. 8.

Meyermans, E. and P. Van Brusselen (2000b) 'The NIME Model – Specification and estimation of the enterprise sector', Brussels: *Federal Planning Bureau Working Paper*, no. 10.

Obstfeld, M. and K. Rogoff (2000) 'Perspectives on OECD economic integration: implications for US current account adjustment', in *Global Economic Integration: Opportunities and Challenges*, Federal Reserve Bank of Kansas City, Annual Monetary Policy Symposium.

Obstfeld, M. and K. Rogoff (2004) 'The unsustainable US current account position revisited', http://emlab.berkeley.edu/users/obstfeld/ca_v2.pdf.

OECD (2002) *OECD Statistical Compendium*, 2002#2 CD-ROM edition.

OECD (2004a) *OECD Statistical Compendium*, 2004#1 CD-ROM edition.

OECD (2004b), *OECD Economic Outlook*, no. 75, June.

Taylor, J. (1993) 'Discretion versus policy rules in practice', *Carnegie-Rochester Conference on Public Policy*, vol. 39, pp. 195-214.