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The End of the Japanese Stagnation: An Assessment of the Policy Solutions

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Abstract

After more than a decade of stagnant growth, the Japanese economy is showing signs of full recovery, with deflation also having come to an end. Since the mid 1990s both supply side and demand side policy solutions to the Japanese stagnation have been suggested. By means of a Factor Vector Autoregressive Model, the paper aims to assess whether the real depreciation of the yen and the quantitative easying implemented by the Bank of Japan have contributed to the recovery of the Japanese economy and to halt deflationary dynamics. The results of the paper point to the effectiveness of these latter policies, as well as to the role exercised by domestic productivity improvements and the expansion of world economic activity.

Key words: factor vector autoregression, large scale macroeconometric model, Japan, monetary policy.

JEL classification: C22, E31, E52.

1 Introduction

Surely one of the most interesting macroeconomic phenomenon of the 1990s is the Japanese stagnation. This is for both the gravity of the phenomenon, i.e. "a lost decade of growth", and the likelihood that also other industrialized countries could be affected by a similar prolonged recession, given the similarity in the transmission mechanism of shocks found among G-7 countries.[1]

When assessing macroeconomic developments in Japan since the 1980's two key issues may be singled out, related to financial markets developments and monetary policy management, respectively. In fact, the stagnation of the 1990s followed a period of strong and non inflationary economic growth, coupled by an excessive collateralized credit expansion, also to risky segments of the market, and rapidly climbing land and stock prices. Once monetary policy turned contractionary, to halt financial unbalances, a banking crisis set in. As pointed out by Hoshi and Kashyap (1999) and Kanaya and Woo (2000), after the collapse of the stock market, due to non performing loans and the reduction in the value of collaterals and equity holdings, banks and financial institutions started facing solvency problems. Taking also into account the increase in the margins, following the downgrading of Japanese banks in 1992, and the adoption of more stringent cash-flows projections based evaluation criteria, the overall effect was an impaired banks' ability to lend and firms' ability to borrow, leading to a reduction in loans, investment, and output.[2] Moreover, also the contraction in potential output, due to the fall in productivity and shrinking labour force, may have contributed to the contraction in investment (Krugman, 1998). Negative effects on the potential output path due to revisions on labour laws, which determined the reduction of the workweek length from 44 hours to 40 hours between 1988 and 1993, and to policies which subsidized inefficient firms and declining industries, discouraging investment and the introduction of new and more productive technologies, have also been pointed out by Hayashi and Prescott (2002). Finally, inadequate economic policies, both monetary and fiscal, were also carried out.[3] Then, despite the gradual reduction in short term rates be-

[1] See for instance Bagliano and Morana (2006).

[2] Yet, while in the literature there is substantial agreement concerning the reduction of credit availability, particularly from 1997 onwards (Woo, 1999; Motonishi and Yoshikawa, 1999), there is much less agreement concerning the negative effects that the latter would have exercised on investment. For instance, according to Kuttner and Posen (2001), the contraction in bank lending would have affected small and medium sized enterprises, since large firms were able to finance themselves going directly to capital markets (see Morana (2004) for additional details).

[3] According to Krugman (1998), despite the setting in of a liquidity trap, monetary

tween 1991(:3) and 1995[4] and the zero interest rate policy started in 1999, coupled with a quantitative easing aimed at increasing banks reserves, real output growth stagnated, growing, over the period 1992:1-2005:2, at an annual rate of 1.2%[5], and CPI inflation steadily decreased, to turn to deflation since 1999[6]. Real stock market prices and bank loans stagnated as well, showing an annual average reduction of -3% and -1%, respectively. Finally, the real effective exchange rate for the Yen depreciated at an annual average rate of -3%.

Hence, both demand and supply side mechanics transmitted the financial/monetary policy shock to output and prices, i.e. the reduction in productivity and the shrinking labour force lead to a reduction in potential output, which, reinforcing the effects of the banking crisis, contributed to further depress investment. Moreover, supply side rigidities possibly magnified all these latter effects, slowing down the endogenous reaction of the macroeconomy to the unbalances. Finally, inadequate economic policies made the stagnation persistent, leading the economy to deflation.

Since recent macroeconomic figures for the Japanese economy seem to point to the end of the stagnation and deflation, an assessment of the mechanics of the recovery of the Japanese economy may be of interest. Different economic policies may have contributed to the recovery, as for instance the restructuring of the banking sector, the introduction of the quantitative easing policy by the Bank of Japan and the real depreciation of the exchange rate. These latter policies are theoretically well grounded in the literature. As far as the quantitative easing is concerned, in the literature two main non orthodox channels have been envisaged. Firstly, a quantitative easing could have been carried out through the depreciation of the exchange rate, leading to an expansion of external demand and an increase in inflation and inflationary expectations. The latter effect would have also lead to a reduction in the real

policy would have been mostly carried out in a conventional manner, being also overly restrictive. Similarly, Hetzel (1999) has pointed to the strong reduction in money growth as the key determinant of the slowdown in economic activity and the fall in the deflationary trap. Moreover, also fiscal policy would have been inadequate, tending to be contractionary over the 1990s. Finally, significant Ricardian effects have been pointed out by Krugman (1998).

[4] The overnight rate averaged at 5% in 1992, 3% in 1993, 2% in 1992 and 1% in 1995.

[5] One should not be mislead by this decorous figure for average annual real GDP growth. In Japan real growth since 1992 has been extremely volatile, with a standard deviation close to 3%. In fact the rate of growth of real GDP has been equal to 0.25% in 1992, -0.3% in 1993, 2% in 1994, 2.5% in 1995, 4% in 1996, 0.3% in 1997, -1.2% in 1998, 0.2% in 1999, 3.2% in 2000, -2% in 2001, 1.2% in 2002, 2% in 2003, 0.9% in 2004.

[6] The GDP deflator already points to deflation starting in 1995.

interest rate, boosting domestic demand (McCallum, 2000, 2001a,b; Svensson, 2000; Meltzer, 1999). Secondly, a quantitative easing could have been achieved by the Bank of Japan by purchasing long term government bonds or equities, leading, through portfolios rebalancing, to a fall in long term interest rates and an increase in asset prices. The latter, through Tobin's q and wealth effects, could have stimulated investment and consumption, respectively. In addition, investment could have also been boosted through the credit channel, since, as a consequence of the increase in asset prices, borrowers' balance sheets, the value of collaterals and the net corporate asset values of banks and financial institutions would have improved, increasing borrowing and lending abilities (Goodfriend, 2000). Thirdly, a quantitative easing could have been carried out by underwriting of government bonds in compensation for a tax cut. Then, the transfer of purchasing power to households could have stimulated aggregate demand through an increase in consumption. Yet, the effectiveness of this latter policy would be subject to the expectations concerning the temporary or permanent nature of the tax cut and Ricardian/debt neutrality conditions holding for the economy (Goodfriend, 2000).

Through the uncovering of key macroeconomic mechanics of the Japanese economy, an empirical assessment of the above policies, with particular reference to the role of a real depreciation of the exchange rate and an expansion in the money supply, has been carried out. The empirical analysis is novel under many points of view. Firstly, differently from previous work carried out in the literature, the analysis is performed in the framework of a large scale macroeconometric model for the G-7. This latter framework should allow to account for the interactions among G-7 countries when assessing the response of the Japanese economy to policy interventions, leading to more reliable results. For instance, when assessing the effects of a real depreciation of the yen on domestic output, the current framework allows to control for possible policy responses in the other non-Japan G-6 countries. Secondly, the analysis is carried out in the framework of a factor vector autoregressive model (F-VAR), allowing to distinguish common dynamics among the G-7 countries from country specific dynamics. The accurate identification of shocks allowed by the current framework should then lead to a more reliable picture concerning the effects of policy shocks, also given the larger information set exploited.

The main results of the paper are as follows. Firstly, it is found that the real depreciation of the yen is likely to have lead to a significant expansion in real output. Secondly, it is found that the quantitative easing policy carried out by the Bank of Japan is likely to have contributed to contrast deflationary dynamics. Moreover, no evidence of negative effects of deflationary shocks on real output has been found. Finally, both the world economic expansion and domestic supply side restructuring policies are likely to have contributed to the recovery of the economy as well.

After this introduction the rest of the paper is organized as follows. In section two the econometric methodology is described, while in sections three and four the data are discussed and the empirical results are reported, respectively. Finally, in section five conclusions are drawn.

2 Econometric methodology

Following Stock and Watson (2005), consider the following factor model

$$\begin{aligned} X_t &= \Lambda F_t + D(L)X_{t-1} + v_t & (1) \\ F_t &= \Phi(L)F_{t-1} + \eta_t, & (2) \end{aligned}$$

where X_t is a n-variate vector of variables of interest, F_t is a r-variate vector of global factors, v_t is a n-variate vector of idiosyncratic i.i.d. shocks, η_t is a r-variate vector of common or global i.i.d. shocks, $E\left[\eta_t v_{is}\right] = 0$ all i, t, s, Λ is a $n \times r$ matrix of loadings, and $D(L)$, $\Phi(L)$ are matrices of polynomials in the lag operator of order p, i.e.

$$D(L) = \begin{bmatrix} \delta_{1,1}(L) & ... & \delta_{1,n}(L) \\ \vdots & \ddots & \vdots \\ \delta_{n,1}(L) & \dots & \delta_{n,n}(L) \end{bmatrix}, \; \Phi(L) = \begin{bmatrix} \phi_{r,r}(L) & ... & \phi_{1,r}(L) \\ \vdots & \ddots & \vdots \\ \phi_{r,1}(L) & \dots & \phi_{r,r}(L) \end{bmatrix}.$$

By substituting (2) into (1), the vector autoregressive form (F-VAR) of the factor model can be written as

$$\begin{bmatrix} F_t \\ X_t \end{bmatrix} = \begin{bmatrix} \Phi(L) & 0 \\ \Lambda\Phi(L) & D(L) \end{bmatrix} \begin{bmatrix} F_{t-1} \\ X_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{F_t} \\ \varepsilon_{X_t} \end{bmatrix}, \tag{3}$$

where

$$\begin{bmatrix} \varepsilon_{F_t} \\ \varepsilon_{X_t} \end{bmatrix} = \begin{bmatrix} I \\ \Lambda \end{bmatrix} \eta_t + \begin{bmatrix} 0 \\ v_t \end{bmatrix},$$

with variance covariance matrix

$$E\varepsilon_t\varepsilon_t' = \Sigma_\varepsilon = \begin{bmatrix} \Sigma_\eta{}' & \Sigma_\eta{}'\Lambda' \\ \Lambda\Sigma_\eta{}' & \Lambda\Sigma_\eta{}'\Lambda' + \Sigma_v \end{bmatrix},$$

where $E\eta_t\eta_t' = \Sigma_\eta$.

The inversion of the FVAR form yields the vector moving average form

(VMA) for the X_t process

$$X_t = B(L)\eta_t + u_t,$$

where $B(L) = [I - D(L)L]^{-1}\Lambda [I - \Phi(L)L]^{-1}$ and $u_t = [I - D(L)L]^{-1} v_t$.

2.1 Estimation

The estimation problem may be written as follows

$$\min_{F_1,...,F_T,\Lambda,D(L)} T^{-1}\sum_{t=1}^{T} [(I - D(L)L)X_t - \Lambda F_t]' [(I - D(L)L)X_t - \Lambda F_t],$$

and solved following an iterative process. Since a priori information concerning the economic interpretation of the factors, i.e. global GDP rate, global inflation rate, global short and long term interest rates, global money growth, and global stock prices growth, is available, the estimation of the F_t factors can be carried out considering the relevant sub-set of variables. Therefore, given a preliminary estimates of $D(L)$, the r static factors F_t can be estimated as the first principal component of each of the r-subset of variables $(I_i - D_i(L)L)X_{i,t}$ $i = 1, ..., r$; then, conditional to the estimated static factors, an estimate of Λ and $D(L)$ can be obtained by OLS estimation of the block of equations corresponding to X_t in (1). The procedure is then iterated until convergence. Once the final estimate of F_t is available, the $\Phi(L)$ matrix in (3) can be obtained by OLS estimation of the block of equations corresponding to F_t. Then, by also employing the final estimate of the Λ and $D(L)$ matrices the restricted VAR coefficients in (3) can be computed.

The F-VAR model employed in the paper can be considered as a special case of the F-VAR approach of Stock and Watson (2005), holding when the number of static and dynamic factors is equal, albeit, given the a priori information available on the global factors, the latter are estimated using the relevant sub-set of variables, rather than the entire data set. Relatively to the original Stock and Watson approach, the proposed approach has the advantage of allowing for a more clear-cut interpretation of the global shocks, as well as for the identification of all the idiosyncratic shocks. Moreover, the use of the principal components estimator for the estimation of persistent processes has been justified by recent theoretical developments of Bai (2002, 2003) and Bai and Ng (2001), allowing therefore for an accurate estimation of the factors in the current framework.[7]

[7] In particular, Bai (2003) has considered the generalization of PCA to the case in

2.2 Identification of structural shocks

The identification of the structural shocks in the F-VAR model can be carried out as follows. By denoting ξ_t the r structural global shocks, the relation between reduced form and structural form global shocks can be written as $\xi_t = H\eta_t$, where H is square and invertible. The identification of the structural shocks amounts then to the estimation of the elements of the H matrix. It is assumed that $E[\xi_t\xi_t'] = I_r$, and hence $H\Sigma_\eta H' = I_r$. Moreover, by denoting ψ_t the n structural idiosyncratic shocks, the relation between reduced form and structural form idiosyncratic shocks can be written as $\psi_t = \Theta v_t$, where Θ is square and invertible. The identification of the structural idiosyncratic shocks amounts then to the estimation of the elements of the Θ matrix. It is assumed that $E[\psi_t'\psi_t] = I_n$, and hence $\Theta\Sigma_v'\Theta = I_n$.

The VMA representation of the factor model in structural form can then be written as

$$X_t = B^*(L)\eta_t + C^*(L)\psi_t,$$

where $B^*(L) = B(L)H^{-1} = [I - D(L)L]^{-1}\Lambda[I - \Phi(L)L]^{-1}H^{-1}$, $u_t = C^*(L)\psi_t$, $C^*(L) = C(L)\Theta^{-1}$, $C(L) = [I - D(L)L]^{-1}$, and $E\left[\psi_{i,t}\xi_{j,t}'\right] = 0$ any i,j. Given r factors, then $r(r-1)/2$ restrictions need to be imposed in order to exactly identify the structural global shocks. Moreover, exact identification of the n structural idiosyncratic shocks requires the imposition of additional $n(n-1)/2$ zero restrictions. In this paper, instead of employing the double Choleski strategy proposed by Bagliano and Morana (2006), generalized impulse response analysis (Pesaran and Shin, 1998) has been implemented in the framework of the thick modelling estimation approach of Granger and Jeon (2004).[8] The proposed approach should allow to draw robust conclusions not only to the ordering of the variables, but also to potential misspecification of the econometric model.

which the series are weakly dependent processes, establishing consistency and asymptotic normality when both the unobserved factors and idiosyncratic components show limited serial correlation, also allowing for heteroschedasticity in both the time and cross section dimension in the idiosyncratic components. In Bai (2002) consistency and asymptotic normality has been derived for the case of I(1) unobserved factors and I(0) idiosyncratic components, also in the presence of heteroschedasticity in both the time and cross section dimension in the idiosyncratic components. Moreover, Bai and Ng (2001) have established consistency also for the case of I(1) idiosyncratic components. As pointed out by Bai and Ng (2001), consistent estimation should also be achieved by PCA in the intermediate case represented by long memory processes, and Monte Carlo results reported in Morana (2006b) support this conclusion.

[8] See Stock and Watson (2005) for details on alternative identification strategies.

3 The data

In the study quarterly time series data for five countries/regions, i.e. the US, Japan, the Euro-12 Area, the UK, and Canada, over the period 1980:1-2005:2, have been employed. Eight variables for each country/region have been considered, i.e. real GDP, the real oil price, the real stock market price index, the real effective exchange rate, the CPI price index, nominal money balances[9] and the nominal short and long term interest rates.[10] The persistence properties of the data have been assessed by means of unit roots tests. In addition to the standard ADF test (Said and Dickey, 1984), also the KPSS test (Kwiatkowski et al., 1992) has been employed. Differently from the ADF test, which assumes difference stationarity under the null, the KPPS test assumes stationarity around either a constant term or a constant plus a linear deterministic trend process. In order to account for an adaptive non linear trend, also the Enders and Lee (2004) ADF test and a modified version of the KPSS have been employed. As for the Enders and Lee (2004) test, the modified KPSS test accounts for a deterministic adaptive non linear trend, modelled by means of the Gallant (1984) flexible functional form ($\mu_t = \mu_0 + \mu_1 t + \mu_2 \sin(2\pi t/T) + \mu_3 \cos(2\pi t/T)$). The critical values of the tests have been tabulated by means of Monte Carlo simulation with 10,000 replications.

The tests have been carried out directly on the series of interest, i.e. real GDP and oil prices growth, real stock prices and effective exchange rate returns, nominal money growth, inflation, and the short and long term interest rates. The above mentioned definition for the variables of interests allows to overcome the problem of a different unit of accounts for the international variables considered. In fact, while one would not be allowed to extract a global factor, for instance, from the GDP series in levels, unless all the series are formerly expressed in the same units of account, say US$, the use of rates of growth avoids such a shortcoming. The results of the unit root tests are reported in Table 1, Panels A and B. As is shown in the tables, real and nominal variables show slightly different results. As far as the real variables are concerned, the ADF and KPSS tests yield coherent results, pointing to the rejection of the hypothesis of I(1) non stationarity and the non rejection of the null of I(0) stationarity at the 5% level in all the cases. Only for real output growth for Japan the tests point to conflicting results, i.e. to the rejection of both the I(1) and I(0) null hypothesis. The rejection of the null

[9] Nominal money balances are given by M2 for the US, M2+CD for Japan, M3 for the euro area and Canada, and M4 for the UK. The aggregates employed are the one usually employed to measure broad money in each of the countries investigated.

[10] The short term rate refers to three-month government bills, while the long term rate to ten-year government bonds.

of I(0) stationarity for real output growth for Japan detected by the KPSS test may be explained on the basis of the slowdown in economic growth for Japan at the beginning of the 1990s since, once a non linear trend is included in the KPSS auxiliary equation, the null of I(0) stationarity is not any longer rejected. Moreover, for the euro area and the UK output growth series the findings point against the inclusion of a non linear trend in the auxiliary equation, coherent with previous results of structural stability in the euro area series (see Morana, 2006).

On the other hand, for the nominal variables the outcome of the tests is less clear-cut. As far as the nominal interest rates series are concerned, the findings are inconclusive, since in general the ADF tests never point to the rejection of the null of I(1) non stationarity, while the KPSS tests never point to the rejection of I(0) stationarity.[11] On the other hand, for nominal money growth and inflation, the null of I(1) non stationarity can always be rejected when the non linear trend is accounted for, apart from nominal money growth for Japan. Yet, while the null of I(0) stationarity is never rejected for money growth at the 1% level, for inflation violations are found for the US, Japan and the euro area.

Economic explanations for the presence of a non linear deterministic trend in nominal variables for the US and the euro area have been suggested by Bierens (2000) and Morana (2006), noting that successful long-run monetary policy management should shape the trend behavior of the nominal variables, and that policy decisions cannot be understood in terms of a stochastic process, but rather in terms of a deterministic process. For instance, the fixation of the policy interest rate by the central bank renders the latter a step wise deterministic process, yielding a non linear deterministic trends both in short and long term interest rates series. Moreover, the presence of long memory in the nominal variables, in addition to structural breaks, has been widely documented in the literature (see for instance Morana, 2006, for the euro area, and Bagliano and Morana, in press, for the US). This latter feature may actually explain why the KPSS test tends to reject the null of I(0) stationarity for the inflation rate in particular. As found by Morana (2006), deviations of nominal interest rates from the non linear trend may be still strongly persistent, and determined not only by long-memory dynamics but also by short memory (ARMA) dynamics. In this paper the determination of the order of fractional integration of the series investigated, which, by the way, would benefit of the use of a larger sample than the one available, or of data sampled at a higher frequency data, i.e. monthly, and, preferably,

[11] Yet, the ADF test points to the rejection of the unit root hypothesis for the US long term interest rates, while for Canada the evidence is more mixed.

of the use of semiparametric estimators, can be neglected, since, given the scope of the study, we may rely on the autoregressive representation of a fractional autoregressive moving average process (ARFIMA) for estimation. Yet, structural change should be accounted for. Therefore, the stationary representation of the F-VAR model has been augmented by an adaptive specification for the deterministic component, expressed in terms of a sine and cosine expansions, following the Gallant (1984) flexible functional form. Hence, the deterministic component in the F-VAR, to be included in the ith equation of (1) , has been specified as $\mu_{i,t} = \mu_{i,0} + \mu_{i,1}t + \mu_{i,2}\sin(2\pi t/T) + \mu_{i,3}\cos(2\pi t/T)$.

4 Empirical results

The specification of the F-VAR model follows Bagliano and Morana (2006), where four common factors have been found among the 35 endogenous variables of interest. After data analysis, the factors have been extracted from four groups of variables, namely real GDP growth series, real stock prices returns, real oil prices growth series and all the nominal series, i.e. inflation rates, nominal short and long term interest rates and nominal money growth series. Hence, the estimated factors have a clear-cut macroeconomic interpretation, being associated with global real out growth, global stock market dynamics, real oil price growth and global nominal/monetary developments, respectively.[12] On the basis of misspecification tests, the lag length of the F-VAR has been set to one lag. In total the econometric model is composed of 39 equations. The first 35 equations refer to the 35 endogenous variables, i.e. real output growth, inflation, the nominal short term rate, the nominal long term rate, nominal money growth, real exchange rate returns, and real stock returns for the five countries in the system. Each of these latter equations contains 43 parameters, of which 35 parameters are for the lagged endogenous variables, 4 parameters for the lagged endogenous factors, i.e. the oil price growth factor, the output growth factor, the nominal factor and the stock market return factor, and 4 parameters for the deterministic components. 4 additional equations refer to the global factors. These latter equations contain 26 parameters each, of which 4 parameters are for the lagged endogenous factors and 4 parameters are for the deterministic compo-

[12]The proportion of total variance explained by the first principal component for each group of variables is equal to 0.57 for real stock market returns, 0.40 for real output growth, 0.95 for real oil price growth and 0.65 for the nominal variables. In all the cases the first principal component bears the interpretation of global factor since all the corresponding variables react as expected. On the other hand, all the other principal components tend to capture idiosyncratic dynamics.

nents. The estimation period is 1980:1-2005:2. The F-VAR model has been estimated following the iterative procedure, described in the methodological section.

4.1 Impulse response functions

In Figures 1-5 the generalized impulse response functions to unitary global and idiosyncratic shocks are reported. In both cases impulse response functions have been cumulated for all the variables, apart from the interest rates series. Moreover, in addition to the median response, also a 95% confidence interval, obtained by means of Monte Carlo simulation, is plotted.

4.1.1 Global shocks

As shown in Figure 1, a positive global output shock would exercise a permanent positive impact on the output level and on money balances. While the impact on the price level would be negative and significant only in the short term, i.e. within one year, the impact on real stock prices is not significant at any forecast horizon. A temporary increase in both the short and long term interest rates can also be noted, possibly pointing to a contractionary monetary policy reaction, leading to an increase in the short term rate, transmitted along the term structure to the long term rate. Finally, following the global economic expansion, the yen would tend to appreciate permanently in real terms. Given the positive correlation between output and interest rates and the lack of correlation between output and the price level in the long term, the global output shock could be possibly interpreted in terms of a global demand shock.

Since a non linear deterministic trend has been included in the F-VAR specification, and this latter component has in general been found to be relevant to explain trend dynamics in the nominal variables, the interpretation of the shock associated with global monetary developments is less clear-cut. Also in the light of the work of Bierens (2000) and Morana (2006), in fact, the global monetary factor could be associated with the common non linear deterministic component, capturing the medium to long term monetary policy management. Therefore, the shock to the residual component obtained by detrending the nominal factor can not be associated with global monetary developments. Yet, in the light of recent results of Gordon (2006), pointing to a strong contribution of productivity growth to the determination of US inflation, a tentative interpretation of the second global shock in terms of global productivity shock can be provided. In fact, as shown in Figure 1, a negative global productivity shock would exercise a negative and permanent impact on real output, leading to an increase in the price level and in nominal money balances, triggering a temporary contractionary monetary policy response as well. On the other hand, no significant effects can be found for both the real exchange rate and real stock prices.

Moreover, a negative supply side shock, i.e. an increase in the real oil price, would lead to a short term contraction in real output and to a permanent increase in the price level and money balances. While, no significant effects can be found for both real stock prices and the exchange rate, a contractionary monetary policy response can be noted, with interest rates temporarily increasing over benchmark values.

Finally, a positive global stock market expansion would lead to a permanent and significant expansion in the Japanese stock market and in real output, pointing to significant wealth/Tobins'q effects. The shock would also lead to a real appreciation of the yen in the short term, while no significant effects can be found for all the other variables.

Interestingly, coherent with Bagliano and Morana (2006), very similar generalized impulse responses have been found for all the non-Japan G-6 countries, pointing therefore to similar transmission mechanisms for the G-7 economies.[13] Moreover, the positive response of output to the global demand and productivity shocks suggests that the recovery of the Japanese economy could have benefited from the recent phase of world economic expansion, and not only from improved domestic economic policies.

4.1.2 Idiosyncratic domestic shocks

Having controlled for the effects of global shocks, the analysis should then allow for an accurate assessment of the response of the Japanese economy to domestic policy shocks. In particular, the assessment concerns whether nominal money growth shocks may be expected to have inflationary effects, whether a real depreciation of the yen could lead to an expansion in real output, whether a moderate deflation, as the one experienced in Japan, may contribute to the economic depression, and whether a domestic productivity increase may contribute to the recovery of the economy.

As shown in Figures 2-5, the findings allow for a clear-cut evaluation of the above issues. Firstly, a real depreciation of the exchange rate is likely to lead to a permanent expansion in the output level, without affecting significantly none of the other variables, apart from nominal money balances and the short term rate in the short term. This finding is of particular interest since, while from a theoretical point of view the Bank of Japan, through open market

[13] The results are availble upon request from the author.

operations aimed at purchasing foreign currencies or bonds, could depreciate the yen and restore growth through external demand, as well as reduce the real interest rate by raising inflation, in practice, the depreciation of the yen may fail to exert its expected effects, given the likely protectionist measures and depreciation of the currency of trading partners. However, since the modelling framework employed allows to control for policy responses in the other non-Japan G6 countries, the above findings would not be subject to this latter criticism. Yet, the impact on export and output could be small, given that the real depreciation of the yen may be bounded by the expectations of the real exchange rate converging back to its equilibrium value, i.e. of a stronger real exchange rate in the future, which stimulates investment in domestic assets and purchases of the currency (Krugman, 1998). However, in the light of the magnitude of the estimated effects, i.e. a real depreciation of 14% of the yen is associated with a permanent increase of about 0.5% in real GDP, also this latter criticism does not seem to be empirically supported. Yet, what would seem to be missing is a significant positive impact of a real depreciation on the price level, and therefore a negative impact on the real interest rate. From the above findings it is therefore possible to conclude that the real depreciation of the yen may have played an important role in the recovery of the Japanese economy, by stimulating mainly the external demand.

Secondly, as shown in Figure 3, an expansion in the money supply is likely to lead to an increase in the price level, which is still significant in the medium term, i.e. at the three-year horizon. Yet, the impact on the price level is much smaller in size than the one on nominal money balances, i.e. a permanent increase of 3% in the money supply is matched by a permanent increase of 0.1% in the price level, suggesting that, although nominal money balances can exercise an inflationary impact, the increase in nominal money balances, in order to contrast deflationary dynamics, should be robust. The shock also exercises positive effects on real stock prices, pointing to rebalancing of investor portfolios, following the increased liquidity, as well as a short term effect on interest rates and the exchange rate. Finally, real output is negatively affected by the shock in the medium to long term, possibly as a consequence of the real appreciation of the exchange rate and the increase in the short and long term rates.

Thirdly, as shown in Figure 4, a deflationary shock is not likely to affect negatively real output at any forecast horizon. In fact, following a negative inflation shock, real output tends to increase. Both interest rates and the money supply are negatively affected, albeit in the short term only, while the stock market in the long term as well.

Interestingly, these latter two findings, i.e. the inflationary effects of an increase in nominal money balances and the lack of negative effects on output of a moderate deflation, as the one experienced by Japan, are fully coherent with previous findings of Morana (2005), obtained using a small scale macroeconometric model for Japan. These latter results allow therefore to draw robust conclusions concerning the effects of the quantitative easing policy carried out by the Bank of Japan, pointing to a significant contribution of the policy to halt deflationary dynamics. Moreover, the lack of a negative impact of a deflationary shock on real activity remind the theoretical argument pointed out by Friedman (1969) about the optimal rate of deflation necessary to achieve an efficient allocation of resources.[14] In fact, in such a case negative consequences for real economic activity should not be expected. While the empirical results of the paper would be coherent with this latter hypothesis, it is also possible that deflation in Japan has not been deep enough to exercise the expected negative effects on real activity.

Fourthly, as shown in Figure 5, an idiosyncratic productivity shock is likely to affect real output positively and the price level negatively at any forecast horizon, also affecting positively the stock market and the real exchange rate. On the other hand, neither interest rates nor money balances are significantly affected by the shock. Hence, policies stimulating technical progress could contribute significantly to the recovery of the Japanese economy, also leading to a reduction of the real interest rate, which, by increasing investment, could help to restore the macroeconomic equilibrium and to increase the rate of expansion of potential output. The positive contribution of domestic productivity advances to the recovery is coherent with the supply side interpretation of the Japanese slow down, as for instance Hayashi and Prescott (2002). In addition to demographic effects (revisions in labour laws) and wrong policies which subsidized inefficient firms and declining industries, as pointed out by Hayashi and Prescott (2002), Yamaguchi (1999) has suggested that also firms' inability to adapt to changes and globalization could have contributed to the stagnation. In particular, laws, regulations and the tax structure did not allow firms to benefit fully of the ICT revolution, while the rigid labour market prevented the necessary flow of labour

[14] As found by Friedman (1969), zero nominal interest rates are necessary for efficient resource allocation, implying an optimal rate of deflation equal to (minus) the real interest rate. This latter argument follows from the equalisation of the marginal cost of printing money and the opportunity cost of holding money. More recently, Cole and Kocherlakota (1998) have also shown that zero nominal interest rates is also a sufficient condition. Although, in the presence of nominal rigidities, theoretical results point to an optimal inflation rate equal to zero, or as large as the real interest rate when the costs from holding money balances are taken into account, as shown by the recent Asian experience, it is possible that nominal rigidities matter more in an inflationary environment than in a deflationary one.

from declining to ascendant industries and from inefficient to efficient firms. Therefore, also in the light of the supply side reforms carried out in Japan in the last decade[15], it is likely that the domestic productivity channel may have contributed positively to the recovery.[16]

5 Conclusions

Using a large scale macroeconometric model for the G-7 economy, set in the framework of a F-VAR model, in this paper the response of the Japanese economy to some key policy shocks, as exchange rate shocks and nominal money balances shocks, has been assessed by means of generalized impulse response analysis. Even controlling for the interactions among G-7 countries, it is found that the real depreciation of the yen is likely to have lead to a significant expansion in real output since the mid 1990s, while the increase in the money supply, associated with the quantitative easing policy, is likely to have partially contrasted deflationary dynamics. Moreover, no evidence of negative effects of a deflationary shock on real output have been found, possibly suggesting that a deflation must be deeper than what observed for the Japanese economy in order to exercise the expected negative effects on real activity. Moreover, productivity increases associated with domestic supply side structural reforms, as well as world economic expansion dynamics, are likely to have further contributed to the recovery of the Japanese economy.

[15] The awerness that the inefficient allocation of resources was one of the key causing factors of the Japanese stagnation has lead the Koizumi cabinet to the proposal and implementation of various supply side measures, concerning competition, deregulation and privatization, complementing existing restructuring policies for the banking system. The reforms aimed to incresase efficiency and productivity by enhancing the role of the market mechanism for the allocation of resources, industrial competitiveness, and technological advances, as well as to create a more favourable business environment by revising corporate and taxation laws and promoting foreign investments.

[16] For reason of space we do not report graphs for the impluse responses to a stock market shock and to a short and long term interest rates shock. These latter results are available upon request from the author. In synthesis, it is found that an idiosyncratic positive stock market shock is likely to lead to positive effects on nominal money balances and output and inflation in the short term, i.e. up to the one year horizon, albeit the long term impact on output may be negative. Moreover, the effects of a short term or a long term rate shocks are very similar, leading to a negative medium to long term impact on output, a depreciation of the real exchange rate, and to an increase in the money supply and the price level. No signficant effects are found for real stock prices.

References

[1] Bai, J. and S. Ng, 2002, Determining the Number of Factors in Approximate Factor Models, Econometrica, 70, 191-221.

[2] Bai, J., 2003, Inferential Theory for Factor Models of Large Dimensions, Econometrica, 71(1), 135-171.

[3] Bai, J., 2002, Estimating Cross-Section Common Stochastic Trends in Nonstationary Panel Data, mimeo, Boston College, NYU.

[4] Bai, J. and S. Ng, 2001, A Panick Attack on Unit Roots and Cointegration, mimeo, Boston College, NYU.

[5] Bagliano, F.C. and C. Morana, 2006, Common Macroeconomic Dynamics in the G-7: A Factor Vector Autoregressive Analysis, mimeo.

[6] Bierens, H.J., 2000, Non Parametric Nonlinear Cotrending Analysis, with an Application to Interest and Inflation in the United States, Journal of Businness and Economic Statistics, 18(3), 323-37.

[7] Cole, H. L. and N. Kocherlakota, 1998, Zero Nominal Interest Rates: Why They're Good and How to Get Them, Federal Bank of Minneapolis Quarterly Review, 22(2), 2-10.

[8] Enders, W. and J. Lee, 2004, Testing for a Unit-Root with a Non Linear Fourier Function, mimeo, University of Alabama.

[9] Friedman, M., 1969, The Optimum Quantity of Money, in "*The Optimum Quantity of Money and Other Essays*", M. Friedman ed., Aldine, Chicago.

[10] Gallant, R. 1984, The Fourier Flexible Form, American Journal of Agicultural Economics, 66, 204-08.

[11] Granger, C.W. and Y. Jeon, 2004, Thick Modelling, Economic Modelling, 21, 323-43.

[12] Hayashi, F. and E.C. Prescott, 2002, The 1990s in Japan: a lost decade, Review of Economic Dynamics, 5, 206-35.

[13] Hetzel, R.L., 1999, Japanese Monetary Policy: A Quantity Theory Perspective, Federal reserve Bank of Richmond Economic Quarterly, 85(1), 1-25.

[14] Hoshi, T. and A. Kashyap, 1999, The Japanese banking crisis: where did it come from and how will It end?, NBER Working Paper Series, No. 7250.

[15] Kanaya, A. and D. Woo, 2000, The Japanese banking crisis of the 1990s: sources and lessons, IMF Working Paper Series, No. 00/7.

[16] Krugman, P., 1998, It's baaack! Japan's slump and the return of the liquidity trap, Brookings Papers on Economic Activity, 2, 137-205.

[17] Kuttner, K.N. and A.S. Posen, 2001, The great recession: lessons for macroeconomic policy from Japan, Brooking Papers on Economic Activity, 2, 93-143.

[18] Motonishi, T. and H. Yoshikawa, 1999, Causes of the long stagnation in Japan during the 1990s, Journal of Japanese and International Economies, 13, 181-200.

[19] Morana, C., 2004, The Japanese Stagnation: an Assesment of the Productivity Slowdown Hypothesis, Japan and the World Economy, 16, 193-211.

[20] Morana, C., 2005, The Japanese Deflation: Has it Had Real Effects? Could It Have Been Avoided?, Applied Economics, 37, 1337-52.

[21] Morana, C., 2006, A Small Scale Macroeconometric Model for the Euro-12 Area, Economic Modelling, 23(3), 391-426.

[22] Morana, C, 2006b, Multivariate Modelling of Long Memory Processes with Common Components, mimeo, University of Piemonte Orientale.

[23] Pesaran, M.H. and Y. Shin, 1998, Generalised Impulse Response Analysis in Linear Multivariate Models, Economics Letters, 58, 17-29.

[24] Stock, J.H. and M.W. Watson, 2005, Implications of Dynamic Factor Models for VAR Analysis, NBER Working Paper, no. 11467.

[25] Woo, D., 1999, In Search of "Capital Crunch": Supply Factors Behind the Credit Slowdown in Japan, IMF Working Paper No. 99/3.

[26] Yamaguchi, Y., 1999, Monetary Policy and Structural Policy: a Japanese Perspective, mimeo, Bank of Japan.

Table 1, Panel A: Unit roots tests

	ADF_m	ADF_t	ADF_{nlt}	$KPSS_m$	$KPSS_t$	$KPSS_{nlt}$
o_{US}	-7.89^{**}	-7.96^{**}	-8.79^{**}	0.32	0.03	0.02
o_{JA}	-7.48^{**}	-7.84^{**}	-8.41^{**}	0.30	0.04	0.03
o_{EA}	-7.38^{**}	-7.96^{**}	-8.54^{**}	0.22	0.05	0.03
o_{UK}	-7.96^{**}	-7.43^{**}	-8.74^{**}	0.23	0.04	0.03
o_{CA}	-8.13^{**}	-8.14^{**}	-9.04^{**}	0.31	0.03	0.02
g_{US}	-3.82^{**}	-3.53^{**}	-6.86^{**}	0.12	0.08	0.07^{*}
g_{JA}	-8.15^{**}	-8.90^{**}	-10.04^{**}	0.87^{**}	0.16^{*}	0.04
g_{EA}	-8.02^{**}	-8.18^{**}	-8.01^{**}	0.20	0.18	0.09^{**}
g_{UK}	-6.49^{**}	-6.49^{**}	-6.48^{**}	0.20	0.10	0.09^{**}
g_{CA}	-5.96^{**}	-5.93^{**}	-5.46^{**}	0.09	0.05	0.05
π_{US}	-8.07^{**}	-8.60^{**}	-7.68^{**}	1.31^{**}	0.17	0.08^{**}
π_{JA}	-2.86	-3.52^{*}	-8.79^{**}	0.49^{*}	0.14	0.12^{**}
π_{EA}	-3.37^{*}	-2.84	-7.55^{**}	0.26	0.09	0.10^{**}
π_{UK}	-3.45^{**}	-3.37	-5.01^{**}	0.86^{**}	0.08	0.05
π_{CA}	-6.93^{**}	-7.95^{**}	-6.98^{**}	0.44	0.10	0.04
s_{US}	-1.52	-2.92	-3.89	0.39	0.05	0.02
s_{JA}	-1.53	-2.37	-3.57	0.35	0.01	0.01
s_{EA}	-1.17	-2.36	-2.81	0.35	0.03	0.02
s_{UK}	-1.13	-2.04	-2.80	0.24	0.04	0.04
s_{CA}	-1.66	-4.27^{**}	-2.90	0.19	0.03	0.03

Table 1, Panel B: Unit roots tests

	ADF_m	ADF_t	ADF_{nlt}	$KPSS_m$	$KPSS_t$	$KPSS_{nlt}$
l_{US}	-2.20	-4.26^{**}	-5.80^{**}	0.27	0.07	0.02
l_{JA}	-1.73	-2.06	-2.14	0.33	0.03	0.03
l_{EA}	-1.56	-3.16	-3.57	0.37	0.02	0.02
l_{UK}	-1.17	-2.79	-3.66	0.24	0.03	0.03
l_{CA}	-2.08	-4.88^{**}	-4.91	0.20	0.05	0.03
m_{US}	-5.39^{**}	-5.45^{**}	-7.72^{**}	0.41	0.25^{**}	0.07^{*}
m_{JA}	-1.95	-3.02	-4.16	0.28	0.10	0.06^{*}
m_{EA}	-2.39	-2.15	-7.48^{**}	0.35	0.13	0.04
m_{UK}	-2.35	-1.90	-6.06^{**}	0.40	0.05	0.03
m_{CA}	-3.10^{*}	-3.08	-8.07^{**}	0.20	0.13	0.06^{*}
e_{US}	-8.30^{**}	-8.26^{**}	-8.88^{**}	0.17	0.15	0.03
e_{JA}	-7.51^{**}	-7.77^{**}	-7.87^{**}	0.21	0.03	0.03
e_{EA}	-6.98^{**}	-6.93^{**}	-7.50^{**}	0.12	0.07	0.02
e_{UK}	-7.81^{**}	-7.86^{**}	-7.96^{**}	0.05	0.04	0.03
e_{CA}	-6.95^{**}	-6.97^{**}	-7.51^{**}	0.15	0.15^{*}	0.04
f_{US}	-9.28^{**}	-9.36^{**}	-9.59^{**}	0.10	0.08	0.04
f_{JA}	-11.49^{**}	-11.67^{**}	-12.54^{**}	0.25	0.08	0.05
f_{EA}	-6.35^{**}	-6.46^{**}	-6.55^{**}	0.08	0.05	0.05
f_{UK}	-10.61^{**}	-10.83^{**}	-11.26^{**}	0.18	0.04	0.04
f_{CA}	-8.93^{**}	-8.88^{**}	-8.96^{**}	0.06	0.03	0.03

The table reports the results of the unit roots tests. ADF_i denotes the augmented Dickey and Fuller (1984) test for the constant only case ($i = m$), the constant plus linear trend case ($i = t$), and the constant plus non linear trend case (Enders and Lee, 2004) ($i = nlt$). The critical values are -2.89, -3.46, and -4.35, respectively, for the 5% significance level tests, and -3.5, -4.06, -4.95, respectively, for the 1% significance level tests. KPSS_i denotes the Kwiatkowski et al. (1992) test for the constant only case ($i = m$), the constant plus linear trend case ($i = t$), and the constant plus non linear trend case ($i = nlt$). The critical values are 0.46, 0.15, and 0.06, respectively, for the 5% significance level tests, and 0.73, 0.22, 0.08, respectively, for the 1% significance level tests. The critical values for the KPSS test for the constant plus non linear trend case have been tabulated by means of Monte Carlo simulation with 10.000 replications.

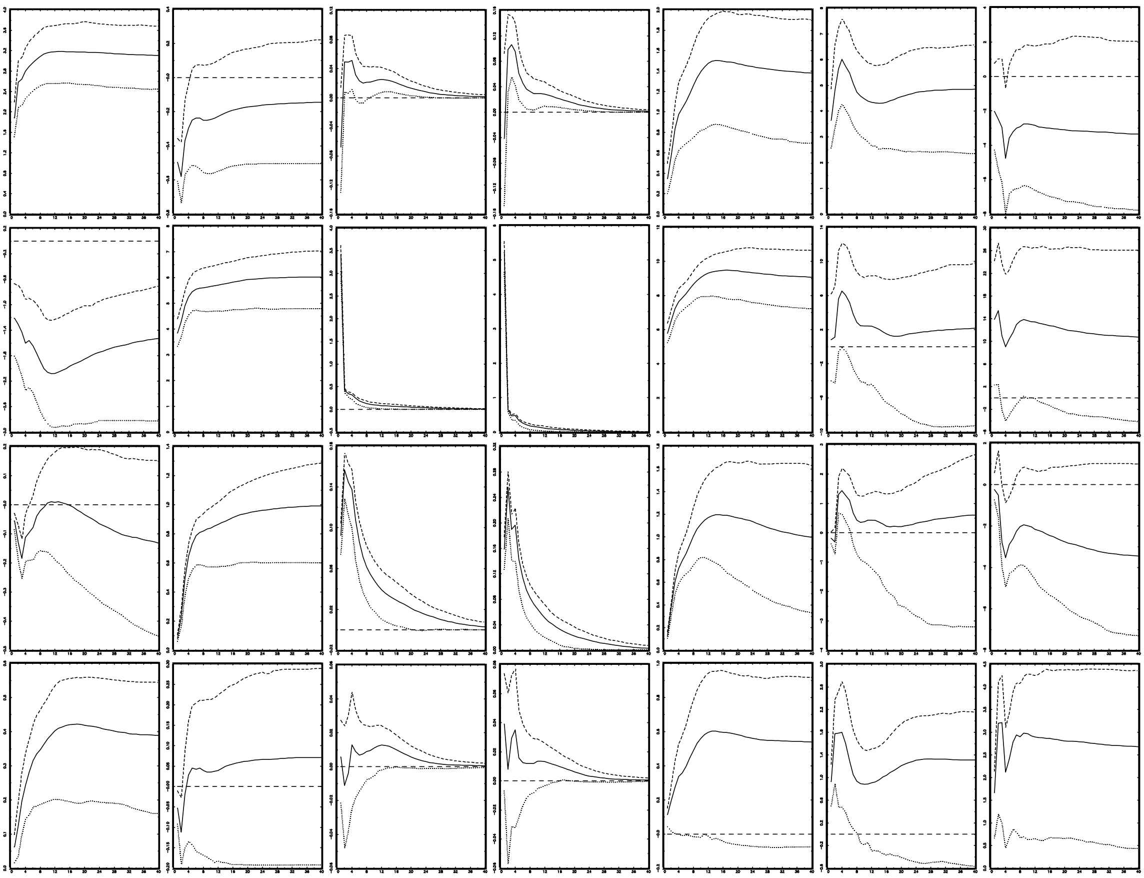

Figure 1: Generalised impulse responses of output, prices, short and long term interest rates, money balances, real effective exchange rate, stock market prices (columns) to global output shock, global productivity shock, oil price shock, global stock market shock.

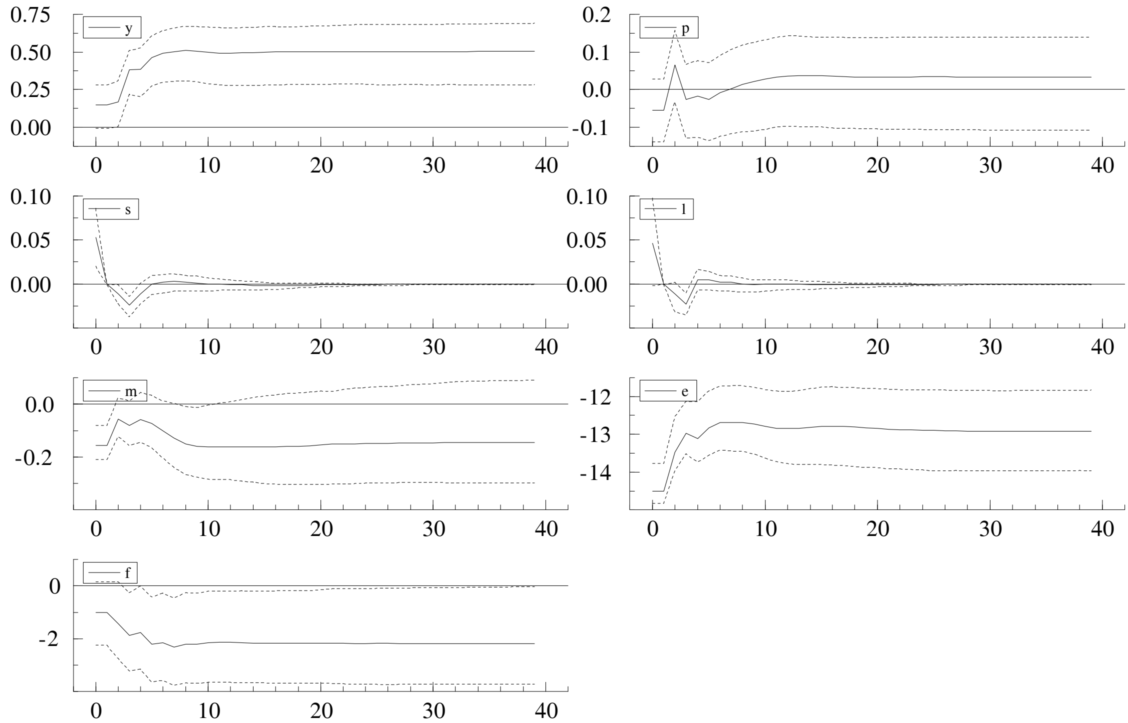

Figure 2: Generalised responses of output (y), prices (p), short and long term interest rates (s,l), money balances (m), real effective exchange rate (e), real stock prices (f) to a real exchange rate (depreciation) shock.

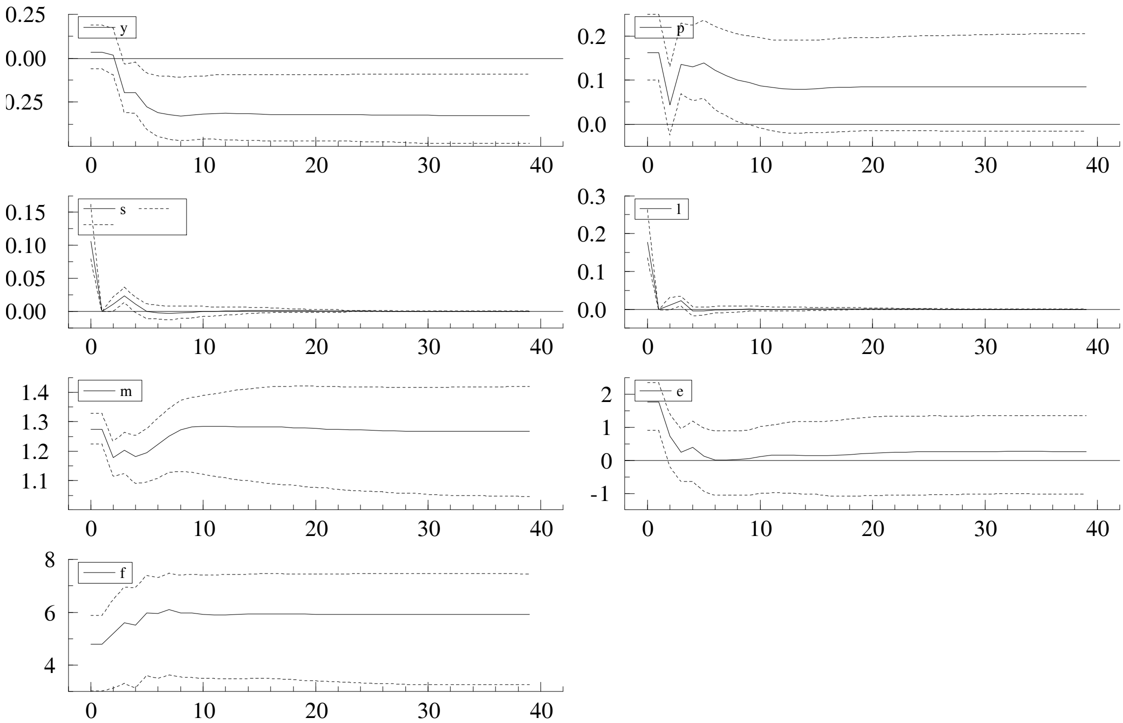

Figure 3: Generalized responses of output (y), prices (p), short and long term interest rates (s,l), money balances (m), real effective exchange rate (e), real stock prices (f) to a positive idiosyncratic nominal money balance shock.

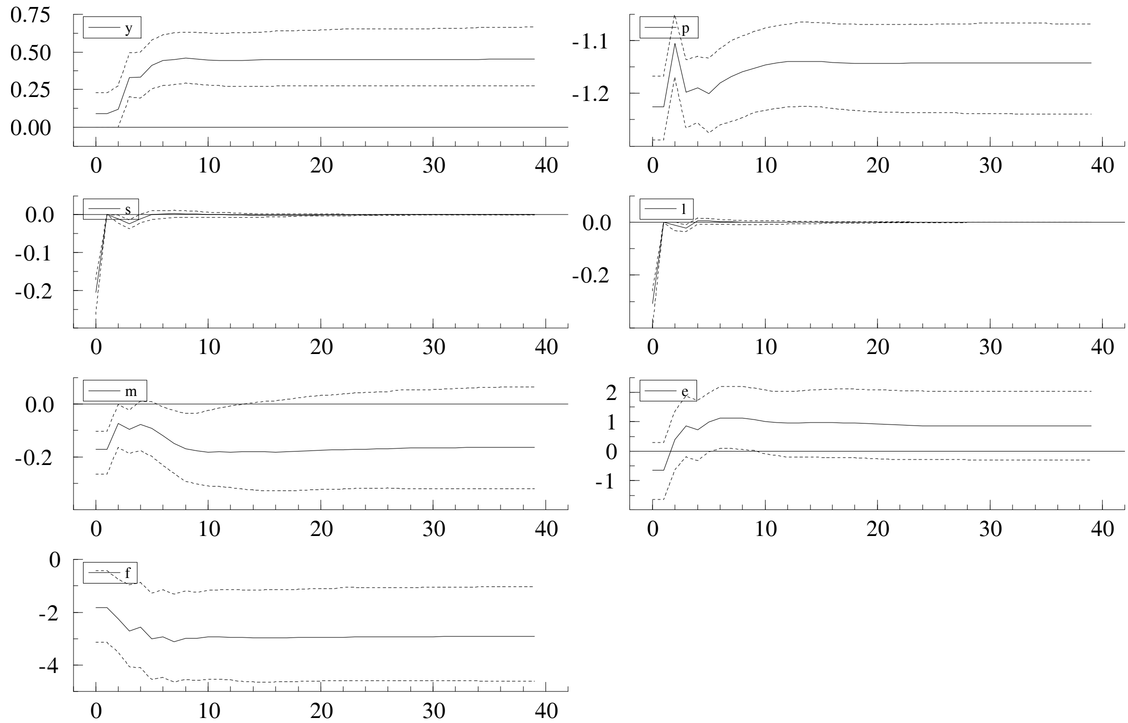

Figure 4: Generalized responses of output (y), prices (p), short and long term interest rates (s,l), money balances (m), real effective exchange rate (e), real stock prices (f) to an idiosyncratic deflation shock.

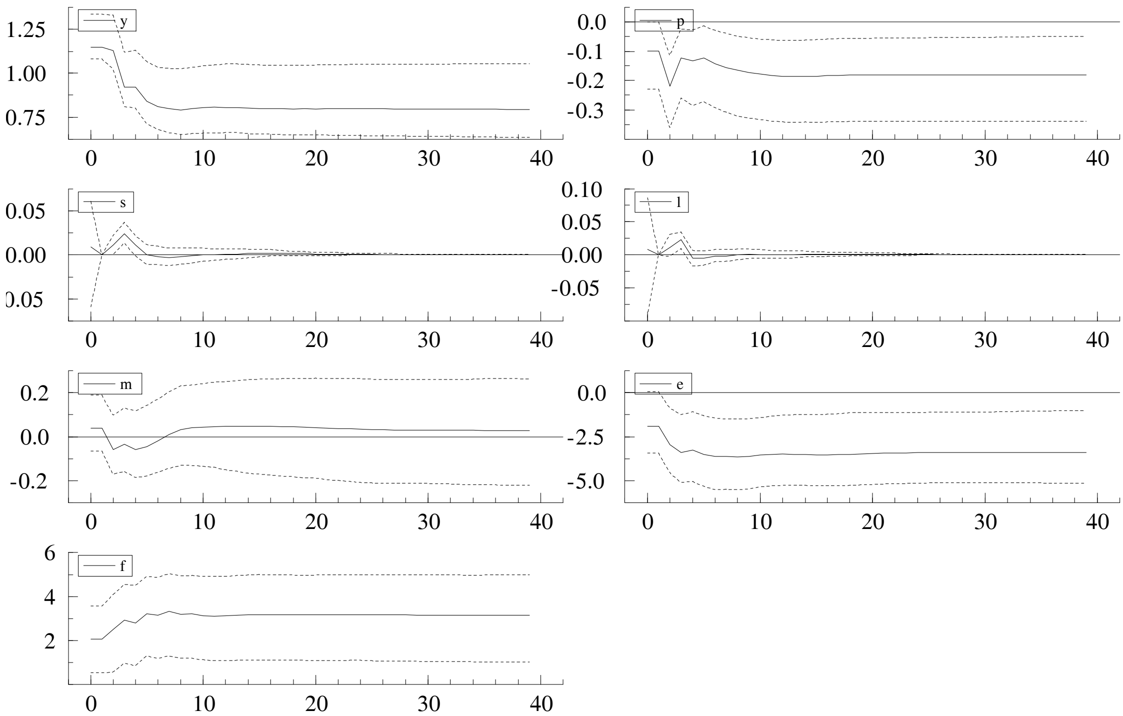

Figure 5: Generalised responses of output (y), prices (p), short and long term interest rates (s,l), money balances (m), real effective exchange rate (e), real stock prices (f) to a positive idiosyncratic productivity shock.