TRADE AND QUALITY: THEORETICAL AND EMPIRICAL EVIDENCE FOR THE EURO ZONE

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Contents

1 Introduction

For a long time operational trade models have been developed within the so-called elasticities approach. Since the '50s, trade flows equations in which exports and imports were expressed as function of relative price and relative income variables obtained great success both at the theoretical and the empirical level (Houthakker and Magee, 1969; Leamer and Stern, 1970; Goldstein and Khan, 1985; Hooper, Johnson and Marquez, 2000).

These simple trade functions, based on the Armington (1969) hypothesis that each country produces a single good that is an imperfect substitute for goods produced in other countries, result easy to economically interpret and their estimation seems generally characterised by a good enough goodness to fit. Seen these appreciable properties, the traditional trade equations have become benchmarks of numerous macro-models, as well as useful tools to draw operational indications of economic policy. Let us think of the models focused on the existence of an external constraint to domestic growth, the IS/LM-based models on the international transmission effects of monetary, fiscal and exchange rate policies and again the models measuring the welfare effects of trade.

Nevertheless, the recent methodological advances, focusing on the export equations, have pointed out that their traditional macroeconomic estimates often seem to be time-unstable and the estimated elasticities may result either upward biased (it is the case of income elasticities) or downward biased (price elasticities).

The not infrequent unreliability of the estimated coefficients of export equations results from essentially three different drawbacks:

a. Usually they are estimated in isolation and not in a multiequational system framework. This generates potential endogeneity problems, since it is unlikely for relative prices to be exogenous with respect to trade flows and the same reasoning can be extended even to foreign income in the case in which the exporting country is not a small economy.

b. Usually they suffer a lack of microfoundations that limits their economic interpretation and partially jeopardizes the possibility of a correct and adequate econometric specification.

c. Usually they suffer of an "omitted variables" problem, attributable to the lack of consideration of potentially significant export determinants, as product differentiation, technology intensity, world globalisation processes and the quality level of exported goods.

The dangerous mix of elements (a) to (c) generates out-and-out interpretation puzzles on the estimated elasticities. With no claim of completeness, it is necessary to recall the "45-degree rule" puzzle studied from Krugman (1989): income elasticities differ substantially across countries and faster growing countries display higher export than import income elasticities of demand, so that in the long run each country obtains a balanced trade, with no need of steadily secular depreciating or appreciating trends in real exchange rates[1].

[1]Differently from models à la Armington which predict that greater output will be accom-

Other puzzles arise with respect to price elasticities: Ruhl (2005) shows that studies on price policy changes find larger export quantity responses than those expected to be coherent with the empirical low volatility of exports; Broda and Weinstein (2004) emphasize that price elasticities estimated at micro-data level are higher than in the "macro" studies.

An attempt to give problems (b) and (c) a joint solution has been made by the "new" trade theory which, through micro-dynamic foundations of the export equations, identifies a fundamental role for some phenomena ignored from the traditional theory. One of them is the horizontal product differentiation that stands out in contrast with the "national" differentiation à la Armington. Krugman (1979, 1980) in two cornerstone papers explains, through a micro-founded model of monopolistic competition, that larger and/or faster growing countries strongly expand the range of goods they export as they grow. Being that the representative global consumer exhibits preference for varieties, economic growth allows a country to produce more varieties and the latter fact triggers exports as a reflection of new foreign demand that makes room for the new goods. This way the new goods can be exported with no adverse effect on terms of trade.

An export equation in which the "variety" measure is omitted results being mis-specified and this generates an upward bias of the apparent income elasticity of foreign demand for home exports as already emphasised in the first of the puzzles previously presented. Krugman's intuition has started a new stream of research on the "extensive margin" (see Hummels and Klenow (2005) and the references therein) for exports: the possibility that economic growth leads to the development of new goods that can be exported without pushing down the prices of the existing ones.

In parallel, a large body of literature has been dedicated either to (1) constructing perfect measures of product differentiation typically based on disaggregated trade flows (Oliveira-Martins, 1992; Feenstra, 1994; Hummels and Klenow, 2005; Besedes et alii, 2006), or (2) to identify the most suitable country "size variable" to approximate the extensive margin effect (TFP growth in Feenstra et alii, 1999; per capita GDP in Funke and Ruhwedel, 2001; GDP and potential GDP in Bayoumi, 1999, Baier and Bergstrand, 2001, Gagnon, 2007; innovation and R&D in Anderton, 1999, Ledesma, 2002 and Barrel and Pomerantz, 2007). Lastly, the empirical literature (Gagnon 2004, 2007) has been oriented to widen the specification of export (and import) equations to include a right measure or a proxy of the horizontal differentiation phenomenon wrongly omitted from the standard specifications.

Nevertheless, specification and estimation of the export equations have remained confined to uniequational approaches[2] regardless of the fact that the exogeneity of the relative (home to foreign) country size variable with respect

panied by worse terms of trade.

[2] In the more recent literature focused on the elasticity puzzles (Ruhl, 2005; Engel and Wang, 2007; Drozd and Nosal, 2007) the choice is usually to simulate General Equilibrium models allowing for international trade, without an explicit specification of a standard export equation

to net export flows appears increasingly questionable.

Other more recent streams of research have aimed at improving the specification of trade equations surveying which is the most suitable measure of competitiveness (Ca' Zorzi and Schnatz, 2007) and introducing new price variables (Carlin et alii, 1999 for OECD countries) as well as measures of the economic cycle phase (Allard et alii, 2005).

Another quite large body of literature has concentrated on the role of vertical product differentiation, which is differentiation according to quality.

Since the famous papers by Linder (1961), Markusen (1986), Flam and Helpman (1987) and Rodrik (1988) it is commonly known that a process of vertical product differentiation, which widens the range of national goods and shifts production towards higher qualitative levels, is able, just like horizontal differentiation, to attract new international demand, boosting exports. The main players of this process are again the larger and richer countries (Linder, 1961; Hummels and Klenow, 2005) which, therefore, not only export a wider range of goods (exports on extensive margin), but also have a comparative advantage in the export of higher quality goods (exports on quality margin).

The importance of the quality variable in the study of the export flows is particularly interesting for three reasons:

1) quality raises exports and has a positive impact on the current account, but at the same time it is accompanied by higher values of prices of domestic goods and by a reinforcement of real exchange rates (Schott, 2004; Hummels and Klenow, 2005; Fabrizio et alii, 2007).

2) seen the previous remark, it seems evident that ignoring quality in trade equations leads to an underestimation of the size of (negative) price elasticities: in that case in fact the positive indirect influence of product quality through prices[3] could partially offset the direct relative price contribution which has an unambiguous negative impact on exports.

3) the quality of exported goods is hardly measurable in a direct way and the theoretical and empirical literature on trade equations generally described it through a proxy. A large body of papers links quality to technological innovation, which is measured by R&D investments or the number of patents (Oliveira-Martins, 1993; Greenhalgh et alii, 1994; Anderton, 1999; Eaton and Kortum, 2002), rather than the human capital endowments (Murphy and Shleifer, 1991).

However this approach does not seem completely convincing: that of innovation in fact represents only one of the many channels of product quality improvements and it is not necessarily even the main one. Quality also means: supporting services, customer loyalty, reputation, capability to meet trends, product reliability, and many more. Moreover, the concept of innovation cannot be dealt with homogeneously: product rather than process innovations can in fact produce opposite effects on product prices, on real exchange rates and on patterns of trade.

[3] Feenstra (1994) proposes a new price index taking into account the quality content of goods.

In a recent interesting paper Crozet and Erkel-Rousse (2004) develop an alternative approach, adopting a direct measure of quality perceptions ("images") derived from survey data, in order to enlarge the traditional import equations for the four main EU member states and find evidence of a significant increase in the price elasticities.

This paper reconnects to the debate on the product quality contribution to the (net) exports flows of an economic area and focuses on the Euro Zone-12 (henceforth EZ). Differently from previous contributions we do not use any weak measure of quality based on some indirect proxy, but we identify univocally the quality effect as the stochastic structural shock in a net export equation. To reach this result we tackled numerous issues which are still open in the literature on trade equations. In particular:

- In order to avoid mis-specification phenomena linked to omitted variables and to make robust the procedure of identification we adopt an eclectic approach, introducing in the (net) export equation all regressors that are considered relevant both from the standard theory and the "new theory" on trade. In particular we take into account, besides traditional variables, the existence of an extensive margin effect.
- To avoid endogeneity problems of price and income variables we introduce the export equation into a multiequational structural system, given by an enlarged version of a new-Keynesian microfounded open economy model à la Clarida, Gali and Gertler (1999, 2001) that we modify in order to be suitable for a large country as EZ.
- We estimate the reduced VAR form of the model and identify all the structural shocks, and especially the one describing the role of quality, through sign restrictions (Faust, 1998; Uhlig, 1999; Canova e De Nicolò, 2002) imposed to the Impulse Response Functions (henceforth IRFs) and suggested from the impact multipliers of the theoretical model.

The choice of EZ as the region of interest is due to two stylized facts. First it has experienced since 2000 a reduction of its export shares in the world, but its negative trend has been weaker than what expected in the light of the large Euro appreciation. Second, a recent Constant Market Share analysis run by an ECB task force (ECB, 2005) has revealed that the only component that has contributed to sustain the trade performance of EZ since 1985 is represented by some "product effect". It seems therefore that, regardless of the differences in industrial specializations among member countries, there is a general phenomenon of qualitative upgrading of products that has a favourable impact on the European capacity of penetrate foreign markets.

Our results confirm these preliminary predictions: a positive shock to quality stimulates net exports and GDP and generates an appreciation of real exchange rates. The analysis of Impulse Response Functions (IRFs) proves that such effects are produced in the short run as much as in the long run; Forecast Error Variance Decomposition (FEVD) reveals that vertical differentiation is the most important factor to explain the variance of net exports in the short run as well as having, in the long run, a remarkable incidence which is just slightly inferior to that of a monetary shock.

The remainder of the paper is organised as follows: in section 2 we present our New Keynesian theoretical model suitable to the analysis of a large open economy, whereas section 3 is dedicated to estimation issues. Empirical results and comments are presented in section 4. Section 5 concludes.

2 A structural New Keynesian model for a large open economy

2.1 The theoretical model: short and long-run properties

In the choice of the theoretical model we pursued two goals. First, the model should be suitable to feature the frictions that seem to be at the basis of the empirical persistence in the main EZ macroeconomic data and to reflect the typical behaviour of the Euro system in terms of degree of market competition, monetary policy stance and trade openness. Moreover, the model should allow the joint modelling of output, inflation, real interest rate and trade flows through a flexible scheme whose indications are robust across a large class of macroeconomic frameworks.

A valid response to such needs can be found in a New-Keynesian dynamic general equilibrium model, with money and nominal rigidities, where the domestic good is a composite of a continuum of differentiated goods, each produced by an associated monopolistically competitive firm. The cornerstone closed economy versions of such a model, proposed by Rotemberg and Woodford (1997), Clarida, Galì and Gertler (1999) (henceforth CGG99) and Woodford (2003), being micro-founded and characterized by optimizing agents and rational expectations[4], have become increasingly popular for the analysis of monetary policy and the comprehension of the inflation-output-exchange rate relationships (Christiano, Eichenbaum and Evans, 1997 and 2005, and the references therein; Ravenna and Walsh, 2006).

New Keynesian models have been extended to the small open economy case by Clarida, Galì and Gertler (2001; henceforth CGG01) and McCallum and Nelson (2000) and share the basic features[5] of the large literature on open economy DSGE models engendered by Obstfeld and Rogoff (1995, 2000) and then developed for small economies by Justiniano and Preston (2004), Galì and Monacelli (2005), Lubik and Schorfeide (2006).

Within this line of research Smets and Wouters (2003) focus on EZ and estimate with Bayesian techniques a DSGE model with nominal and real rigidities in order to simulate the effects of relevant shocks (monetary policy, cost push, productivity shocks and so on) and their contribution to business cycle fluctuations. An analysis of the channels through which real balances affect output and inflation in EZ is made in Coenen *et alii* (2001) and Andrès, Lopez-Salido

[4]That make it less susceptible to the Lucas critique

[5]Nominal price rigidities, a sticky but forward looking price setting mechanism, a large role for micro-foundations and so on

and Vallès (2006). Beetsma and Jensen (2005), Ferrero (2006) and Galì and Monacelli (2008) lay out models for fiscal and/or monetary policy analysis in a currency union like EZ.

Unfortunately all these papers treat the EZ like a closed economy, whereas on the other side their open economy counterparts (even the more recent ones) are usually conceived for small economies (Justiniano and Preston, 2003 for Canada, New Zealand and Australia; Ambler *et alii*, 2004 for Canada; Adolfson *et alii*, 2006 for Sweden; Liu, 2006 for New Zealand) which is not a reasonable assumption if the goal is to study the EZ performance.

As a consequence, we keep as main theoretical references CGG01 and McCallum and Nelson (2000) and try to extend their model to the case of a large open economy - the home economy EZ - which is not price taker and is able to export goods and services towards another large economy representing the rest of the world (RW). Since the basic structure of the model is not new, only the key macroeconomic extensions developed in this paper are presented here.

Let us suppose for simplicity that EZ and RW are characterized by the same deep behavioral structural parameters and that in both the economies the variables assume the same values in correspondence to the frictionless equilibrium that would arise if prices were perfectly flexible; based on these assumptions we express all the variables in the model as deviations of domestic levels from foreign levels of the corresponding variables. Thus, in what follows "output" will refer to domestic output relative to foreign output and coherently all the stochastic shocks should be intended as relative shocks. The "relative" transformation of course does not apply to the exchange rate. Lastly, all variables, except the interest rate, are expressed in logarithms.

The first key equation of the model is represented by a New Keynesian IS curve. In the typical closed economy framework (CGG99) this curve derives from the log-linearization of the consumer Euler equation under the economy budget constraint and has a typical formulation describing the demand side of the economy through a negative relationship between output (Y_t) and real interest rate ($i_t - (E_t P_{t+1} - P_t)$):

$$Y_t = E_t Y_{t+1} - \beta(i_t - (E_t P_{t+1} - P_t)).$$

Current output level depends also on the expected future output level: whenever the latter is growing, individuals anticipate a higher level of consumption next period and, as a consequence, spend more today in order to smooth out their consumption path.

Denominated RER_t the real exchange rate and switching to the usual case of a small open economy an enlarged IS curve is usually proposed (CGG01) :

$$Y_t = E_t Y_{t+1} - \beta(i_t - E_t \Pi_{t+1}) + \varsigma(E_t RER_{t+1} - RER_t),$$

which simplified version is by McCallum and Nelson (2000) and Yu-Leu (2004):

$$Y_t = E_t Y_{t+1} - \beta(i_t - E_t \Pi_{t+1}) + \varsigma RER_t$$

Two remarks are worth noting: in this case the consumption equation lying behind the IS curve refers to both foreign and domestically produced goods. Moreover, current output depends also on real exchange rate (RER_t) whose depreciation is expected to boost it through an expenditure switching effect that moves the home consumption from foreign to domestically produced goods.

In a small open economy framework the switching effect should be the only way movements in real exchange rate affect demand; nevertheless, referring to a large economy, as in our case, we should in addition take into account that a higher competitiveness should produce also a direct effect on output triggering a growth of foreign demand for home exports[6]. We think that both the effects triggered from real exchange rates movements - home consumption switching and triggering home exports - may be accounted for through a two steps strategy.

Firstly we specify a large open economy IS curve extending CGG01 in order to include a net exports term (NX_t):

$$Y_t = E_t Y_{t+1} - \beta(i_t - E_t \Pi_{t+1}) + \varsigma RER_t - [E_t(NX_{t+1}) - NX_t] + \eta_t^{RD} \quad (1)$$

By analogy with the closed economy case, equation (1) may be obtained from the good market clearing condition (see CGG99, note11, page 1665 and CGG01 eqs (1) and (2)) and the log-linear approximation of the Euler equation referred to total consumption[7]. η_t^{RD} is a real demand shock that should capture shocks to public consumption (fiscal policies). It has to be kept in mind that in this paper the theoretical model is applied to the study of EZ as a whole and therefore the concept of fiscal policy should be understood in a "weak" sense: cross-country coordination of fiscal tools for stabilization goals in presence of shocks that are common to all member states[8].

The second step of our strategy aims to "close" equation (1) on the trade side, taking into account our final goal: to indirectly identify the structural contribution given from the quality factor to the EZ trade performance. For this purpose, we add (differently from CGG01) to our model a net exports equation in which, with a kind of eclectic approach, we include all significant exports determinants suggested by the literature, enabling therefore the quality factor to be captured residually from the stochastic structural shock of this equation.

Following this approach the trade performance of a country can be described as a positive function of three factors: a terms of trade variable that we measure with the real effective exchange rate, the relative trend of foreign demand compared to the domestic one, proxied through relative foreign-to-home GDP

[6] In the small open economy case domestic exports are usually assumed to form an insignificant portion of foreigners' consumption and thus their reaction to real exchange rate perturbations is negligible.

[7] In a large open economy total consumption is the sum of consumption of domestic goods and imports $C_t = C_{ht} + Q_t$. Output is divided among goods sold to domestic residents, exports and public consumption $Y_t = C_{ht} + X_t + G_t$

Combining and rearranging the previous conditions we have:

$C_{ht} + Q_t = C_t == Y_t - G_t - X_t + Q_t = Y_t - G_t - NX_t$

and the [1] is immediately obtained thinking of G_t as described by the permanent real demand shock ε_t^{RD}

[8] For the definition of optimal fiscal policies at the Monetary Union level in presence of idiosyncratic shocks check Ferrero (2005) and Galì and Monacelli (2008)

$(Y_t^{RW} - Y_t^{EZ})$ and lastly the relative size of the home country compared to the rest of the world $(Y_t^{EZ} - Y_t^{RW})$. The inclusion of the relative foreign demand variable sticks to the traditional Armington (1969) framework and is in line with the standard elasticities approach to the trade equations. On the other side, the relative size variable highlights the "extensive" margin phenomenon whose role has been stressed by Krugman (1989) in a cornerstone paper and more recently by Hummels and Klenow (2005) and Kehoe and Ruhl (2002): in presence of monopolistic competition and preference for varieties economies twice the size will produce and export twice as many goods[9]. As a consequence, ceteris paribus, economies that result larger in terms of their relative GDP[10] (Gagnon, 2004) expand the range of goods they export as they grow and trade more than smaller economies.

Summarizing, EZ exports can be described as follows [11]:

$$X_t^{EZ} = \alpha_1 RER_t \quad \underbrace{+\alpha_2 Y_t^{RW}}_{\text{(standard foreign demand effect)}} \quad \underbrace{+\alpha_3(Y_t^{EZ} - Y_t^{RW})}_{\text{(extensive margin effect)}} + \eta_t^{X_{EZ}}$$

and symmetrically for the rest of the world

$$X_t^{RW} = -\alpha_1 RER_t + \alpha_2 Y_t^{EZ} - \alpha_3(Y_t^{EZ} - Y_t^{RW}) + \eta_t^{X_{RW}}$$

so that,

$$X_t^{EZ} - X_t^{RW} = NX_t = 2\alpha_1 RER_t + (2\alpha_3 - \alpha_2)(Y_t^{EZ} - Y_t^{RW}) + (\eta_t^{X_{EZ}} - \eta_t^{X_{RW}})$$

and then, expressing the variables in relative terms:

$$NX_t = \gamma RER_t + \lambda Y_t + \eta_t^{nx} \tag{2}$$

It is clearly observable that a decrease in a country relative size (relative home GDP on foreign GDP) can influence the trend of its net exports in two ways. On one side it can trigger a driving force (pulling effect) from foreign demand, whereas on the other, there will be a reduction in the pushing mechanism linked to the extensive margin [12]. Hence, the theoretical sign of parameter λ is uncertain: in Krugman's view exports on the extensive margin of the faster growing countries should near-offset greater imports and maintain balanced trade on the basis of the "45-degree rule" on imports and exports elasticities. However the empirical literature (Gagnon 2004) suggests that in countries for which manufactured goods and services comprise more than 50 percent of total exports[13] the foreign demand elasticity of exports strongly exceeds the relative exporter GDP elasticity which, even if indirectly, suggests negative empirical values for λ.

[9] In a partially different and not fully comparable framework Corsetti, Martin and Pesenti (2007) focus on the current account adjustment problem and revisit the macroeconomics of trade taking into account net exports of new varieties of goods and services. Moreover, using a transfer-model approach where the set of exportables, importables and non traded goods is endogenous they find that consumption is not highly sensitive to product differentiation

[10] For other proxies of extensive margin see the introduction to this paper.

[11] Our specification of export demand function may be micro-founded like in Gagnon (2004).

[12] Anyways this paper focuses on the impact of quality on net exports and is not interested in disentangling the distinct contribution of the pulling and the pushing effect. So, we only consider the net effect.

[13] As this is the case for EZ and all the countries being its main trade partners in terms of shares of total EZ imports and exports.

Given the specification of equation (2), η^{nx} should capture the role of the only export determinant we have not explicitly modeled: the quality level of the exported goods. Carrying on with this section we will see that on the basis of the sign of the impact multipliers η^{nx} can be actually identified in a univocal manner just as a quality shock.

Third equation in the model is a new Keynesian forward looking Phillips Curve describing the supply short run behavior of the economy:

$$\Pi_t = \chi E_t \Pi_{t+1} + \kappa Y_t + \eta_t^S \tag{3}$$

This equation relates inflation positively to output and comes from the solution of the profit maximization problem of a firm that operates in a monopolistic competition framework characterized by staggered nominal price setting. Equation (3) is a loglinear approximation about the steady state of the aggregation of the individual firm pricing decision. η_t^S is a cost push shock that generates variation in inflation independently of movements in excess demand.

A (relative) monetary policy rule compatible with equations [1 to 3] may be derived as the optimal solution of a Central Banker problem under discretion. In the typical CGG99 approach, the aim of the Central Banker is to minimize an intertemporal quadratic loss function which arguments are the gap between current inflation and its target value and the distance between current and potential output. Assuming that both home and foreign country fix the same target levels for inflation and exhibit similar levels for potential output we have:

$$i_t = \phi E_t \Pi_{t+1} + \theta Y_t + \eta_t^m \tag{4}$$

The optimal monetary policy summarized by equation (?? follows a kind of simple interest rule *à la* Taylor (1993) but it also embeds a weak form of inflation targeting in the sense that it implies a gradual reversion to the optimal inflation rate. Following the general principle of Taylor, parameter ϕ should exceed unity revealing that under the optimal policy, in response to a rise in expected inflation, nominal rates should rise sufficiently to increase real rates.

The most appealing property of the monetary rule described in equation (4) is mainly its adaptability: it is reasonably applicable to the EZ case, being the behavior of the European Central Bank mainly inspired by an inflation targeting scheme, altough not to be intended in a narrow sense: in the loss function to be minimized the EZ Central Banker gives also other variables, both real (output gap) and monetary (M3), a strictly positive weight (even if small). This eclectic approach to the management of the Monetary Policy is in a certain sense common to many countries in the world, although the hypothesis - adopted in this paper - of equality of structural parameters between home country and foreign country could in this case appear to be too restrictive.

Just a positive shift of (relative) M3 from its implicit target value gives rise to the monetary shock (η_t^m) and triggers a positive adjustment of nominal interest rate.

Finally, as in CGG99, an interest parity condition has to hold both in the short and in the long run:

$$i_t - E_t\Pi_{t+1} = E_tRER_{t+1} - RER_t \qquad (5)$$

As for its basic features, our model is similar to that proposed by Bergin (2004) but results being more thrifty and less complex. Also the purposes are partially different : Bergin (2004) focuses mainly on the exchange rate[14] effects of deviations from interest rate parity and on their link with monetary and financial factors, whereas this paper uses a structural system to assess the consequences on current account of a real shock, that is a product quality shock.

The final four equations version of the model is obtained by substituting equation (5) into equations (1) and (4) and by generalizing the IS and the Phillips curves (CGG99) in order to enrich the dynamic structure of the model:

$$\begin{array}{l} Y_t = (1-\rho)E_tY_{t+1} + \rho Y_{t-1} - \beta(E_tRER_{t+1}) + (\beta+\varsigma)RER_t + \\ -[E_t(NX_{t+1}) - NX_t] + \eta_t^{RD}, \beta > 0, \varsigma > 0, 0 < \rho < 1 \\ NX_t = \gamma RER_t + \lambda Y_t + \psi Y_{t-1} + \eta_t^{nx}, \gamma > 0, \lambda < 0, \psi > 0 \\ \Pi_t = (1-\chi)E_t\Pi_{t+1} + \chi\Pi_{t-1} + \kappa Y_t + \varepsilon_t^S, \eta_t^S, 0 < \chi < 1, \kappa > 0 \\ RER_t = E_tRER_{t+1} + (1-\phi)E_t\Pi_{t+1} - \theta Y_t + \eta_t^m, \phi > 1, \theta > 0 \end{array} \qquad (6a)$$

Let us collect the endogenous variable in the (4×1) vector $X_t = \begin{bmatrix} NX & Y & \Pi & RER \end{bmatrix}'$; the matrix representation of the structural system (6a) is:

$$A_0X_t + A_1X_{t-1} + \Gamma X_t^e = \Xi, \Xi = \begin{bmatrix} \eta_t^{nx} & \eta_t^{RD} & \eta_t^S & \eta_t^m \end{bmatrix}' \qquad (7)$$

with: $A_0 = \begin{bmatrix} 1 & -\lambda & 0 & -\gamma \\ -1 & 1 & 0 & -\varsigma-\beta \\ 0 & -\kappa & 1 & 0 \\ 0 & \theta & 0 & 1 \end{bmatrix}$, $A_1 = \begin{bmatrix} 0 & -\psi & 0 & 0 \\ 0 & -\rho & 0 & 0 \\ 0 & 0 & -\chi & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$,

$\Gamma = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & \rho-1 & 0 & \beta \\ 0 & 0 & \chi-1 & 0 \\ 0 & 0 & \phi-1 & -1 \end{bmatrix}$

Taking expectations of equation (7) and solving, we obtain:

$$X_t^e = -(A_0 + \Gamma)^{-1}A_1X_{t-1} = A_1^*X_{t-1} \qquad (8)$$

and by substitution of (8) into (7) we can solve the model with respect to the expectations:

$$A_0X_t + A_1^{**}X_{t-1} = \Xi, \quad A_1^{**} = A_1 + \Gamma A_1^* \qquad (9)$$

Starting from (9), the static long run equilibrium solution of the model is obtained by setting $X_t = X_{t-1} = X^*$ so that:

[14] And current account effects

$$X^* = (A_0 + A_1^{**})^{-1}\Xi = Q\Xi \qquad (10)$$

The derivation of matrix Q and some comments on the equilibrium multipliers are reported in the **Appendix**

2.2 The impact coefficients: how to define a set of theory-instigated sign restrictions

It is of particular interest to examine the impact multipliers collected in matrix A_0^{-1}; they show the instantaneous responses of the endogenous variables with respect to the structural shocks of the model. Their sign may be used to build sign restrictions on which basis it is possible to identify both in the formal and in the economic sense the shocks of a (Structural) VAR representing the reduced form of the theoretical model. Once that identification has been obtained, simulating the dynamic behavior of our system is straightforward.

Let us look at matrix A_0^{-1} :

$$A_0^{-1} = \begin{bmatrix} \frac{\theta\varsigma+\theta\beta+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & \frac{\lambda-\theta\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & 0 & \frac{\gamma+\varsigma\lambda+\beta\lambda}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} \\ \frac{1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & \frac{1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & 0 & \frac{\varsigma+\beta+\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} \\ -\frac{\kappa}{\lambda-\theta\varsigma-\theta\beta-\theta\gamma-1} & -\frac{\kappa}{\lambda-\theta\varsigma-\theta\beta-\theta\gamma-1} & 1 & \frac{\varsigma\kappa+\kappa\beta+\kappa\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} \\ -\frac{\theta}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & -\frac{\theta}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} & 0 & \frac{-\lambda+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} \end{bmatrix}$$

We observe that:

- $\frac{\partial NX}{\partial \eta_t^{nx}} = \frac{\theta\varsigma+\theta\beta+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$; $\frac{\partial Y}{\partial \eta_t^{nx}} = \frac{1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$;

$\frac{\partial \Pi}{\partial \eta_t^{nx}} = \frac{\kappa}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$; $\frac{\partial RER}{\partial \eta_t^{nx}} = -\frac{\theta}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} < 0$

A positive shock η_t^{nx}, besides stimulating net exports and relative output is expected to produce a positive impact on inflation and a real exchange rate appreciation. This picture clearly identifies this shock as the expression of an increase in the quality of goods produced from the home country: in fact both common sense as well as trade literature (Linder, 1961; Flam and Helpman 1987; Rodrik, 1988; Fabrizio et alii, 1997; Hummels and Klenow, 2005; Schott, 2004) stress that vertical differentiation and growth of quality margins are the main factors originating an increase of exports that is accompanied from a growth in prices [15] of the goods produced and exported and a consequent reinforcement of the real terms of trade.

- $\frac{\partial NX}{\partial \eta_t^{RD}} = \frac{\lambda-\theta\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} < 0$; $\frac{\partial Y}{\partial \eta_t^{RD}} = \frac{1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$;

$\frac{\partial \Pi}{\partial \eta_t^{RD}} = \frac{\kappa}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$; $\frac{\partial RER}{\partial \eta_t^{RD}} = -\frac{\theta}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} < 0$

By tradition in the popular IS/LM based models, a real demand fiscal policy shock[16] η_t^{RD} stimulates instantaneously the output but crowds out exports due

[15] Usually measured as export unit values

[16] Typically a growth of public consumption

to the fact that it causes an excess of real demand that overheats prices and reduces the country competitiveness as pointed out from the exchange rate appreciation. In this case our model differs from Redux Model by Obstfeld and Rogoff (1995) because it does not take into account a possible increase of fiscal pressure needed to finance the higher public expenditure. There is therefore no reduction in home consumption caused by a lower level of disposable income, and no shrinking in home money demand that could lead to a relative depreciation of home currency.

- $\frac{\partial NX}{\partial \eta_t^S} = \frac{\partial Y}{\partial \eta_t^S} = \frac{\partial RER}{\partial \eta_t^S} = 0; \frac{\partial \Pi}{\partial \eta_t^S} = 1$

A cost push shock η_t^S does not generate any impact consequence on output, real exchange rate and net exports and it translates entirely in a stronger inflation pressure.

- $\frac{\partial NX}{\partial \eta_t^m} = \frac{\gamma+\varsigma\lambda+\beta\lambda}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} \lesseqgtr 0; \frac{\partial Y}{\partial \eta_t^m} = \frac{\varsigma+\beta+\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0;$

$\frac{\partial \Pi}{\partial \eta_t^m} = \frac{\varsigma\kappa+\kappa\beta+\kappa\gamma}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0; \frac{\partial RER}{\partial \eta_t^m} = \frac{-\lambda+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0$

The impact multipliers relative to a monetary shock are coherent to the short term findings of the Redux Model by Obstfeld and Rogoff (1995). Inflation reacts positively to an instantaneous monetary shock η_t^m, but its growth is more than compensated by a depreciation of the nominal exchange rate so that real exchange rate raises. Even output has a positive impact reaction and everything suggests that it is traceable back to a better export performance. Unfortunately the sign of the impact multiplier of net exports is uncertain.

Disregarding the uncertain sign of $\frac{\partial NX}{\partial \eta_t^m}$, the whole of impact multipliers allows to fully identify the four shocks: in fact none of them generates an identical impact (in terms of its sign) on the four endogenous variables. Moreover, the interpretation of the elements of matrix A_0^{-1} is completely supported from the indications coming from the theoretical equations and more in general from the extensive literature relative to the neo Keynesian models.

3 The empirically estimated model

3.1 Specification issues

We estimate a unrestricted VAR model with deterministic variables that can be thought as the reduced form of our structural model described in equation (9):

$\Phi(L)X_t = \Psi d_t + \epsilon_t, \epsilon_t \sim VWN(0, H^{-1}), \qquad X_t = \begin{bmatrix} NX & Y & \Pi & RER \end{bmatrix}'$

We are interested in conducting inference on the dynamic responses of the endogenous variables with respect to the structural shocks identified within the theoretical model, with a particular attention on the quality shock. For this purpose we need to structuralize the VAR system and identify a set of orthogonal shocks that admit a structural economic interpretation. Different identification strategies, usually based on zero restrictions on the impulse responses, have been proposed in the structural VAR literature: Christiano, Eichenbaum and Evans (2005) adopt a recursive identification scheme based on restrictions on the impact multipliers whereas Blanchard and Quah (1989) and Clarida and Galì (1994) impose long run restrictions. Exclusion restrictions are often criticized in the literature: Faust and Leeper (1997) show that small sample bias and measurement errors may induce substantial distortions in the estimations when using long run zero restrictions. On the other side, short run restrictions may be to much stringent and misleading: in many cases they are introduced not due to theoretical reasonings but they are imposed from the necessity to respect order and rank conditions for identification; moreover Peersman (2004) shows that a number of impulse responses based on zero restrictions are located in the tails of the distributions of all possible impulse responses.

In order to avoid technical problems of this sort in this paper we follow an identification strategy based on sign restrictions (Faust, 1998; Uhlig, 1999; Canova e De Nicolò, 2002): different shocks are identified according to the direction of their impact on the variables in the system as it is suggested by the multipliers contained in matrix A_0^{-1}. Canova and Paustian (2007) show the many advantages of this strategy compared to an alternative one based on classical or Bayesian structural estimation especially when the theoretical framework of reference is a business cycle based model. Firstly it is not necessary to assume that the model is the true DGP of the data, like in classical estimation; on the other side we can avoid the large computational costs and the difficulties of interpretation of misspecified estimates not infrequent in the structural Bayesian approach. Anyway, in order to unambiguous deliver the correct sign of the impulse responses a sufficiently large number of restrictions must be imposed. In our case this condition is largely met: in fact the theoretical model returns the precise sign of $(n^2-1)/n^2$ impact multipliers,and only the sign of $\frac{\partial NX}{\partial \eta_t^m}$ is uncertain, so that it is possible to disentangle all the shocks on the basis of sign restrictions.

As for the estimation technique we opt for a Bayesian approach. At first we follow the Sims and Zha (2005a) methodology to obtain the posterior of the model parameters in an exactly identified SVAR (a recursive system). Then we use a MCMC multi step procedure (Sims and Zha, 2005; Rubio-Ramirez *et alii*, 2005). At first step we draw from the SVAR posterior distribution. Then at the second step we draw an independent standard normal (4×4) matrix Z and decompose it so that $Z = WR$, with diagonal elements of R being positive. In the last step we use W as rotation matrix in order to generate a new set of impulse responses. If they do not satisfy the sign restrictions we repeat the second step, otherwise we store them and return to step 1. Given all the stored draws one can compute the first and second moments of the dynamic multipliers and also their $s\%$ percentiles and use them to provide the whole shape of the impulse response functions and their confidence bounds.

We run 1000 replications of the three steps algorithm and report the median responses, together with their 84th and 16th percentiles error bands; the time period over which sign restrictions are set to be binding is one quarter, i.e. we are constraining only the impact multipliers.

3.2 Data and sources

In this sub-section we describe the construction of the variables used in the empirical work, their statistical properties and the basic specification of the VAR model.

Recall that the theoretical model delivered implications for domestic output, inflation and exports relative to their foreign counterparts and for the real exchange rate. Home country EZ whereas the rest of the world (RW) is represented by the aggregation of twenty-four countries[17] identified as the main trade partners of EZ on the basis of the weight they represent (export plus import shares) over the total EZ external trade.

We set the GDP index for RW as the trade weighted average of the real GDP in the other twenty-four countries; the logarithm of this index has then been subtracted from the logarithm of the real EZ GDP in order to derive relative output. The same procedure was followed to obtain the logarithm of the relative price index, whose Year on Year differences have been used as measure of relative inflation. The effective real exchange rate (RER) is a CPI deflated EZ exchange rate with respect to the 24 partner states, whereas net exports have been generated as the difference of the logarithms of the extra-EZ real exports of goods and services and real imports of good and services from extra EZ countries. By construction, the RER is defined as the price of domestic consumption basket per unit of the foreign consumption basket so an increase in the rate represents a real depreciation.

The time horizon we consider comes from 1981Q1 to 2007Q3; the source of all data is Datastream for the years following 1998, whereas for the previous years we used the data set obtained through aggregation of single country data from Fagan, Henry and Mestre (2001). All data are seasonally adjusted.

Figure 1 plots the four recreated relative variables.

A preliminary exam of the statistical properties of the series has revealed that all four result in being characterized by the presence of a Unit Root; the result appears to be robust with respect to the specific unit root test we run and table 1 reports for simplicity the values of the ADF test [18]. We also performed a Johansen cointegration trace test but we found no evidence of cointegration among these variables for any of the relevant specifications.

Keeping into consideration the evidence emerged during the preliminary analysis we have fit the VAR to first differences of the four endogenous variables and we have imposed sign restrictions to cumulated IRFs. The adopted

[17] U.S, UK, Japan, Czech Republic, Poland, Sweden, Turkey, Switzerland, Russian Federation, China, Norway, South Africa, Canada, Mexico, Brasil, South Korea, Taiwan, India, Hong Kong, United Arab Emirates, Australia, Singapore, Saudi Arabia.

[18] For all variables were run ADF regressions with a constant, a linear trend and four lags of the dependent variable

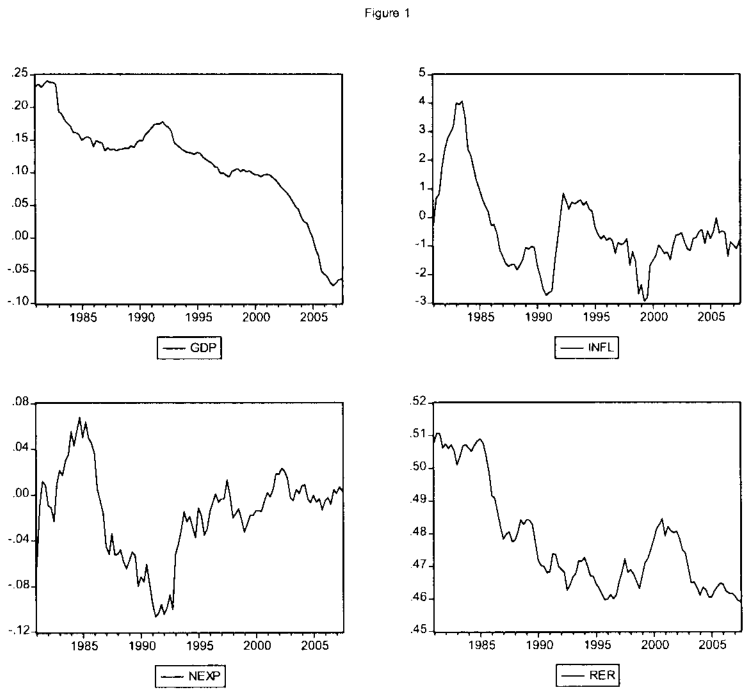

Figure 1:

TABLE 1		
	ADF Test	
	t-Statistic	
GDP	-2.299423	
infl	-2.160027	
nexp	-1.960564	
rer	-2.097877	
	Critical Values	
1% level	5% level	10% level
-4.050509	-3.454471	-3.152909

Figure 2:

final specification allows for five lags of the endogenous variables and does not include any deterministic dummy variable[19]

4 Estimation results and comments

While commenting on the empirical findings it is necessary to remind again that all variables and shocks should be intended as relative ones (home to foreign) and that the home country is made up by the Euro Zone. Figure 2 reports the panel of simulated Impulse Response Functions (IRFs) together with their confidence bounds.

It is important to stress that our empirical strategy is not intended to provide the estimation of the structural model, but of its reduced form: the role reserved to the indications coming from the theory is limited to the definition of the sign restrictions on the basis of which is identified the structural Bayesian VAR. Such a way a relevant weight in the estimation is attributed to the information contained in the data on which they lie upon only "light" constraints so that a-priori it would not be possible to exclude that some findings could be in contrast with the theoretical predictions (more than what is considered to be "physiological" for any empirical exercise). However, in this case the results of our estimation do not seem to be affected by this specific type of drawback and they appear theory-consistent both in the short and also in the long run.

Let us start with the comments over the IRFs relative to the quality shock (first row of graphs in the panel) that represent the main focus of this work and describe an overall picture which is coherent with what was suggested by the literature on vertical differentiation and from our theoretical model. Useful indications emerge from their analysis both regarding firm positioning and investments strategies as well as in terms of macro and industrial policy. Indeed it seems clear that a progressive upgrade of the quality of produced goods is one of the determinants that really sustain the EZ export shares and in perspective can represent a significant boosting factor for its competitiveness: first it has a positive influence on the current account that reveals itself already in the very short run and that tends to consolidate in the long run. Higher quality means therefore intensification of intra-industry trade with the most industrialized regions and on the other hand, higher capability of penetrating emerging markets that gradually, with the improvement of their living standars, switch their consumption tastes from standard goods towards highly differentiated and highly quality intensive goods.

Furthermore no unfavorable trade off emerges between the trend of net exports and real exchange rate: the latter shows a clear and persistent tendency to appreciation, highlighting also a sort of light short run overshooting linked to

[19]The statistical significance of various dummy variables, created in order to control for a set of *una tantum* political events (German Unification, withdrawal of the Lira from the European Monetary system, start up of European Monetary Union and others..), has been surveyed. None of them results being significant.

Figure 2. Impulse Response Functions

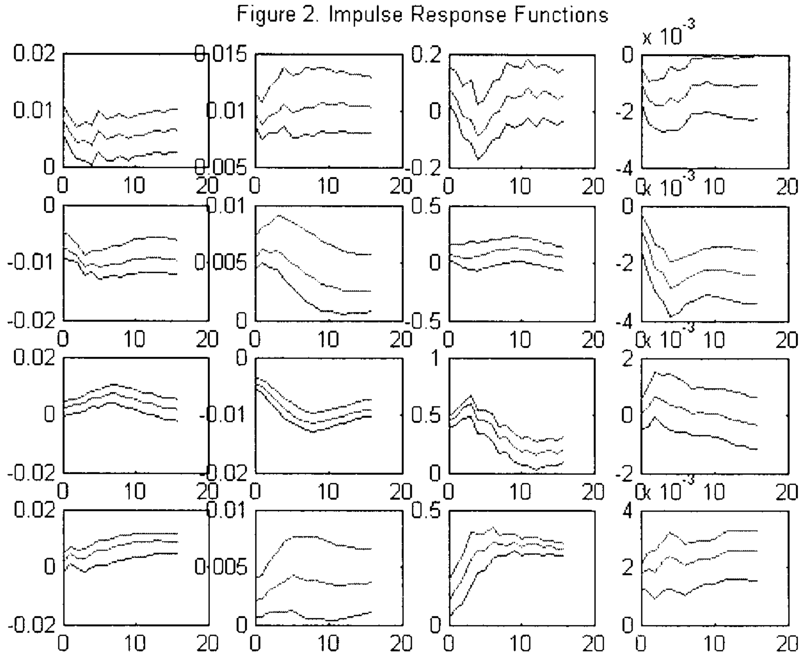

Figure 3:

a peak of positive inflationary reaction that exhausts itself within two quarters. In essence, a greater non price competitiveness more than compensates a lower price competitiveness which does not seem of crucial importance for an area having narrow margins of action with respect to prices .

Lastly it is worth noting that the combined effect of these responses over the GDP is positive, both in the short and long run, creating the conditions for a virtuous loop: a richer country can invest more in quality becoming therefore even more rich through the international trade channel.

In the case of permanent monetary shocks (fourth row of the panel of graphs) the empirical evidence is totally in line with what has emerged from the previous literature: they seem to overstress the economic system, generating an obvious increase of inflation that appears permanent and a stable loss of real purchasing power of the Euro due to the fact that the depreciation of the nominal exchange rate exceeds the relative increase of internal prices compared to foreign ones. The switch in the home consumption moving from imported goods to domestically produced ones and the higher price competitiveness of exports produce positive persistent effects over net exports, as well as on the GDP. Such effects do not wear out even after four years and therefore in the long run money seems not to be neutral.

A real demand shock (graphs of the second row, Figure 3) leads to a permanent appreciation of the real exchange rate and through this crouds out net exports; the net GDP effect of the opposite behavior of public expenditure and exports is positive and significant in the short run, but tends to run out in the long run. As we have already explained in section 2 these findings are completely in line with our model predictions, but differ partially from what suggested by DSGE models à la Obstfeld and Rogoff (1995, 2001), in which, due to different hypothesis, a permanent rise of public consumptions may generate either a current account surplus or a deficit. In our case, public expenditure raises total home consumption and money demand leading to currency appreciation. The latter one along with higher consumption, that partially refers to foreign goods, causes an unfavorable effect on the current account.

Cost push shocks (graphs placed on the third row), that describe permanent negative supply shocks, lead to a foreseeable situation of stagflation: it is possible to notice an output contraction accompanied by an inflationary peak, only partially reabsorbed in the long run because of the monetary tightening that follows the shock; the monetary policy reaction is also at the origin of the substantial stability of the real exchange rate both in the long and short run.

Stepping back to the analysis of the quality factor, of whom we have already examined the effects, a natural question is how important is this shock to our results. To address this question we consider the simulated Forecast Error Variance Decompositions (FEVDs) reported in figure 3.

First row of the panel of plots reported in Figure 3 shows the percentage share of the movements of the four endogenous variables of the VAR explained by quality shocks. First of all it is important to underline that a higher level of quality is the most important factor to explain the variance of net exports in the short run as well as having, in the long run, a remarkable incidence which is just slightly inferior to that of a monetary shock. It is reasonable to claim that it would be desirable a higher degree of coordination of policy makers of the member states to elaborate joint strategies of industrial policy that favour vertical differentiation and the qualitative upgrade of products. The hypothesis is supported also by the visual inspection of plots in the second column of the panel in Figure 3: in the long run this strategy should be able to condition the long term trend of the EZ GDP as much as joint fiscal policies would and its effectiveness would only be slightly lower than the monetary policy one; differently form both however its implementation does not seem to present any unpleasant collateral effect, nor is in contrast with the achievement of other policy targets. On the contrary, it leads to an appreciation of the real exchange rate that would have the well-known positive effects on inflation without jeopardizing the competitiveness of the system.

Completing the examination of the FEVD column by column (meaning variable by variable), it is possible to notice that in the long run the movements of the GDP are more affected by perturbations on the supply side, instead of the demand side; monetary and fiscal policies have a similar explicative capacity (in terms of both size and shape) that diminishes with the growth of the considered

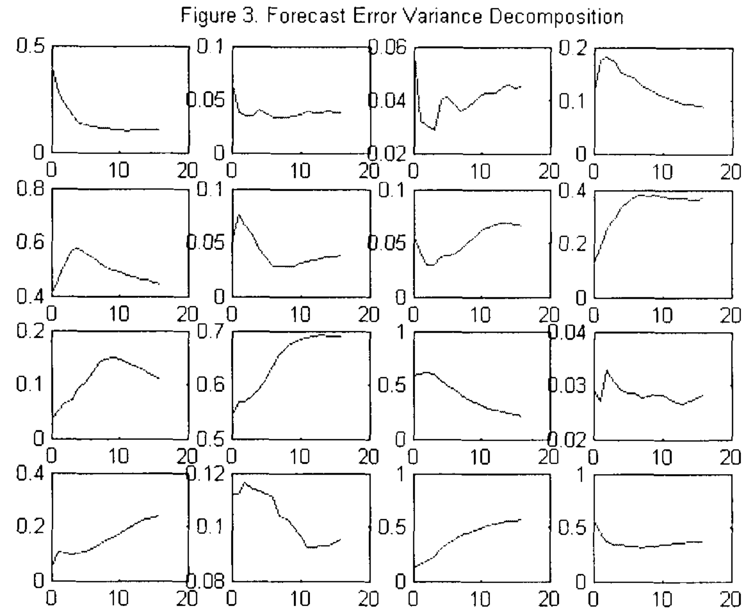

Figure 4:

time horizon. As expected, furthermore it does emerge that inflationary shocks in the short run and the monetary stance in the long run are the main sources of inflation variability. Considering that in most cases the new Keynesian open economy models are used to explain the movements of real exchange rate (RER), it is interesting to evaluate the last column of the panel of graphs in Figure 3. The main contribution to the movements of RER comes from the two main institutional policies: the monetary one explains prevailingly the short-medium run movements of the RER, whereas the fiscal one affects longer horizons. In the long term equilibrium there is almost a perfect balance of percentage contributions. It is important to observe, as a further evidence of what has already been mentioned, that even the quality factor has an explicative capability of about 10% in equilibrium with peaks of 18% in the short run.

5 Concluding remarks

Since the fundamental contributions of Linder (1961) and Flam and Helpman (1987) a typical issue in the literature on international trade is considering product quality as constituting one of the potentially most significant determinants of exports, especially in the most industrialized countries, for which the importance of intraindustry trade is higher. On the other hand, the empirical studies on this issue that adopt a macroeconomic approach are not very numerous and have not always produced clear-cut results: this is partially traceable back to the fact that the analysis of vertical differentiation has developed mainly through microeconomic models, whose empirical counterpart often results complex to estimate; moreover one should not forgive that quality is a very difficult phenomen to be directly measured.

In this paper we shed some light on the role (at a macroeconomic level) of product quality in influencing the trade performance of an economic area. To avoid problems of mis-specification and endogeneity frequently present in the empirical literature dedicated to export equations we have modelled them as jointly endogenous with GDP, inflation and real exchange rate. To achieve this goal we have modified and enlarged a new Keynesian open economy model *in the spirit* of Clarida, Galì and Gertler (2001) to adapt it to the case of a large open economy characterized by nominal rigidities and monopolistic competition, as the EU-12 zone that we choose as framework for our empirical exercise. Theoretical impact multipliers have been used to identify, through sign restrictions, the structural shocks of a VAR model that can be seen as the reduced form of the structural model and that has been estimated and simulated with Bayesian techniques. Such procedure has enabled the univocal identification of the role of quality as one of the structural shocks of the model, avoiding drawbacks connected to the choice of an incomplete, partial or biased proxy of the phenomenon.

Our empirical evidence (IRFs) is in accordance both with our structural model and with the traditional theory in showing that an upgrade in the quality of produced goods can reinforce export competitiveness of the EZ leading to an improvement of the current account both in the short and long run. On the other hand, no unfavorable trade off emerges between the trend of net exports and the real exchange rate. The latter shows an evident and persistent tendency to appreciation: a higher non price competitiveness more than compensates a lower price competitiveness which appears to be crucial for an area having very narrow margins for price reduction. Lastly it is worth noting that the effect of quality on GDP is positive, both in the short and long run, creating the conditions for a virtuous loop mechanism: a richer country can invest more in quality becoming therefore even richer through the international trade channel. On the basis of the FEVD we can conclude that a higher level of quality is the most important factor to explain the variance of net exports in the short run as well as having a remarkable affect in the long run, which is just slightly lower than that of a monetary shock.

We do not intend to propose any miraculous solution to the European competitiveness and/or growth problem in addition to those contained in the large literature on this topic. Nevertheless, on the basis of our empirical findings, it is inevitable to observe that it should be desirable to have a higher degree of coordination among the policy makers of member states in order to create joint strategies of industrial policy that favour vertical differentiation and qualitative upgrade of products. Seen our experiment, this option should be able to influence the trends of long run of GDP of the EZ as much as coordinated fiscal decisions would and its impact would only slightly be lower than that of monetary policy; differently from both however its implementation does not seem to present any unpleasant collateral effect, nor is in contrast with the achievement of other policy targets. On the contrary, it leads to an appreciation of the real exchange rate that would produce shrinking effects on inflation without jeopardizing the competitiveness of the system.

Different future lines of research are open: on the methodological side, some improvements could derive from the estimation of the original structural model (and not its reduced form); furthermore, following Bergin (2004), it could be interesting to extend the theoretical model in a way to admit the possibility of deviations from interest rate parity rule. From the practical point of view it would be interesting to apply sign restrictions non only to impact multipliers but also to short run interim multipliers.

6 References

Ambler, S., Nooman R. and Ali Dib (2004), "Optimal Taylor Rules in an Estimated Model of a Small Open Economy," *Econometric Society 2004 North American Summer Meetings 627*, Econometric Society

Adolfson, M., Laséen,S., Lindé, J. and M. Villani (2006), "Evaluating and estimated New Keynesian small open Economy model", mimeo, Sveriges Riksbank

Anderton, B. (1999), "Innovations, product quality, variety and trade performance: an empirical analysis of Germany and UK", *Oxford Economic Papers*, 51, 152-167

Andrés, J., Lopez-Salido, J. and J.Vallés (2006), "Money in an estimated business cycle model of the Euro Area", *Economic Journal*, 116, 457-77

Armington, P.S. (1969), "A Theory of Demand for Product distinguished by Place of Production", *IMF Staff Papers*, 16, 159-178

Baier, S. and Bergstrand, J.H. (2001), "The growth of World Trade: Tariffs, Transport Costs, and Income Similarity", *Journal of International Economics*, 53, 1-27

Barrell, R. and Pomerantz O. (2007), "Globalisation and Technology Intensity as determinants of Exports", NIESR

Bayoumi, T. (1999), "Estimating trade equations from aggregate bilateral data", *IMF Working Paper* 99/74, IMF

Bergin, P. (2004), "How well can the New Open Macoreconomics explain the Exchange Rate and Current Account?", mimeo, University of California at Davis.

Beetsma, R. and H. Jensen (2005), "Monetary and Fiscal Policy interactions in a Micro-Founded model of a Monetary Union", *Journal of International Economics*, 67, 320-52

Besedes, T. and Prusa, T. (2006), "The role of extensive and intensive margins and export growth", Louisiana State and Rutgers University

Blanchard, O. and D. Quah (1989), "the dynamic effects of aggregate demand and supply disturbances", *American Economic Review*, 79, 655-673

Broda, C and Weinstein, D (2003), "Globalization and the gains from variety", mimeo

Carlin, W, Glyn, A and J. van Reenen (1999), "Export market performance of OECD countries: an empirical examination of the role of cost competitiveness", *IFS wp* n. 99/21

Canova, F and De Nicolò, G (2002), "Monetary disturbances matter for business fluctuations in the G-7" *Journal of Monetary Economics*, 49,131-159

Canova, F and M. Paustian (2007), "Measurement with Some Theory: Using Sign Restrictions to Evaluate Business Cycle Models', mimeo, ICREA-UPF, CREI, AMeN, CEPR and Department of Economics, 302 Business Admin. Bldg, Bowling Green State University,

Ca' Zorzi, M and Schnatz, B (2008), Explaining and forecasting Euro Area Exports. Which competitiveness indicator perform best?, *European Central Bank Working paper Series*, n.833

Christiano, L. Eichenbaum, M and C. Evans (1997),"Sticky price and limited participation models of money: a comparison", *European Economic Review*, 41(6), 201-49

Christiano, L. Eichenbaum, M and C. Evans (2005), "Nominal rigidities and the dynamic effects of a shock to monetary policy" *Journal of Political Economy*, 113, 1-46

Clarida, R, and Galì, J (1994), "Sources of real Exchange Rate fluctuations: how important are nominal shocks?", *Carnegie-Rochester Conference Series in*

Public Policy, 41, 1-56

Clarida, R, Galì, J and M. Gertler (1999), "The science of Monetary Policy: a New keynesian Perspective", *Journal of Economic Literature*, XXXVII, 1661-1707

Clarida, R, Galì, J and M. Gertler (2001), "Optimal monetary policy in closed versus open economies: an integrated approach", *NBER WP* n. 8604

Coenen, G:, Levin, A. and V. Wieland (2001), "Data uncertainty and the role of money as an information variable for monetary policy", *ECB Working Paper* n.84

Corsetti, G., Martin, P. and P. Pesenti (2007), "Varieties and the transfer problem: the extensive margin of current account adjustment", mimeo, *CEPR*

Crozet, M and Erkel-Rousse, H (2004), "Trade performances, product quality perceptions and the estimation of trade price elasticities", *Review of International Economics*, 12(1), 108-129

Eaton, J and Kortum, S (2002), "Technology, Geography and trade", *Econometrica*, 70, 1741-79

ECB (2005), "Competitiveness and the export performance of the Euro area", by a task force of the Monetary Policy Committee of the European System of Central Banks, *Occasional Paper Series n.30*

Fabrizio, S, Igan, D. and A. Mody (2007), "The dynamics of product quality and International competitiveness", *IMF WP* 07/97

Faust, J (1998), "The robustness of identified VAR conclusions about money", *Carnegie-Rochester Conference Series in Public Policy*, 49, 207-44

Faust, J and E Leeper (1997), "When do long run identifying restrictions give reliable results?", *Journal of Business and Economic Statistics*, 15(3), 345-53

Feenstra, R.C. (1994), "New Product Varieties and the Measurement of International Prices", *American Economic Review*, 84(1), 157-77

Ferrero, A. (2006), "Fisacl and Monetary rules for a Currency Union", mimeo, New York University

Flam, H. and Helpman, E (1987), "Vertical Product Differentiation and North-South Trade", American Economic Review, 77(5), 810-822

Funke, M and Ruhwedel, R. (2001), "Export Variety and Export Performance: Empirical Evidence from East Asia", *Journal of Asian Economics*, 12, 493-505

Gagnon, J.E.(2004), "Growth-led Exports: is variety the spice of trade?", *International Finance Discussion Paper*, 822, Board of Governors of the Federal Reserve System.

Gagnon, J.E.(2007), "Productive capacity, Product Varieties and the Elasticities Approach to the Trade Balance", *Review of International Economics*, 15(4), 639-659

Galì, J and T. Monacelli (2005), "Monetary Policy and Exchange rate volatility in a small Open Economy", Review of Economic Studies, 72(3), 707-734.

Galì, J and T. Monacelli (2008), "Optimal Monetary and Fiscal Policy in a Currency Union", mimeo, IGIER-Bocconi University

Goldstein, M and Khan, M (1985), "Income and Price effects in Foreign Trade", in R.Jones and P. Kenen eds. "*Handbook of International Economics*", vol. 2, Elsevier, 1041-1105

GreenHalg, C, Taylor, P. and Wilson R. (1994), "Innovation and export volumes and prices: a dis-aggregated study", *Oxford Economic Papers*, 46, 102-34

Hooper, P, Johnson, K and Marquez, J (2000), "Trade Elasticities for the G-7 Countries", *Princeton Studies in International Economics*, n.87.

Houthakker, H and Magee, S (1969), Income and price elasticities in World Trade", *Review of Economics and Statistics*, 51, 111-125

Hummels, D and Klenow, P (2005), "The Variety and Quality on a Nation's Exports", American Economic Review, 95, 704-23

Justiniano, A. and B. Preston (2004), "Small open economy DSGE models: specificaion, estimation and model fit", Unpublished, IMF and Columbia University

T. J. Kehoe and K. J. Ruhl, "How Important is the New Goods Margin in International Trade?" *University of Minnesota*, 2002.

Krugman, P.(1979), "Increasing Returns, Monopolistic Competition and International Trade", *Journal of International Economics*, 9(4), 469-79

Krugman, P.(1980), "Scale Economies, Product Differentiation and the Pattern of Trade", *American Economic Review*, 70(5), 950-59

Krugman, P. (1989), "Differences in Income Elasticities and Trends in Real Exchange Rates", *European Economic Review*, 33(5), 1031-1046

Ledesma, M.L. (2002), "Exports, Product Differentiation and Knowledge Spillovers", University of Kent.

Linder, S.B. (1961), "An essay on Trade and Transformation", *Uppsala: Almqvist & Wiksell.*

Liu, P. (2006), "A small New Keynesian model of the New Zealand Economy", *Reserve Bank of New Zealand, Discussion Paper series*, n.2006/03

Lubik, T.A. and F. Schorfeide (2006), "Do Central banks respond to exchange rate movements? A structural investigation" *Journal of Monetary Economics,* 50, 1109-1146

Markusen, J. (1986), "Explaining the Volume of Trade: an Eclectic Approach", *American Economic Review*, 76, 1002-1011

McCallum, B.T. and E. Nelson (2000), "Monetary policy for an open economy: an alternative framework with optimizing agents and sticky prices", *Oxford Review of Economic Policies* 16(4), 74-91

Murphy, K. and Shleifer, A. (1997), "Quality and Trade", *Journal of International Economics*, 48, 7-35

Obstfeld M and K. Rogoff (1995), "Exchange Rate Dynamics Redux", *Journal of Political Economy*, 103(3), 624-60

Obstfeld M and K. Rogoff (2000), "New directions for stochastic open economy models", *Journal of International Economics*, 50(1), 117-53

Oliveira-Martins, J (1992), "Export behaviour with differentiated products: Exports of Korea, Taiwan and Japan to the US Domestic Market", in Dagenais and Muet eds, "*International Trade Modeling*", London, Chapman & Hall

Peersman, G. (2004), "What caused the early millennium slowdown? Evidence based on vector autoregressions", *CEPR DIscussion Papers*, n.4087

Ravenna, F. and C. E. Walsh (2006): "Optimal Monetary Policy with the Cost Channel", *Journal of Monetary Economics* 53, 199-216.

Rodrik, D. (1988), "Industrial Organization and Product Quality: evidence from South Korean and Taiwanese Exports", *NBER WP* n. 2722.

Rotemberg, J and M. Woodford (1997), "An optimization-based econometric framework for the evaluation of monetary policy", in B. Bernanke and J. Rotemberg eds, *NBER Macroeconomic Annual* 1997, 297-346, Cambridge MIT Press.

Rubio-Ramirez, J. Waggoner, D. and T. Zha (2005), "Markov-Switching Structural Vector Autoregressions: Theory and Application", *Federal Reserve Bank of Atlanta WP* 2005-27

Ruhl, K.J. (2005), "Solving the Elasticity Puzzle in International Economics", mimeo, *University of Texas*

Schott, P. (2004), "Across product versus within product specialization in international trade", *Quarterly Journal of Economics*, 119, 647-678

Sims, C. and T. Zha (2005), "Were there Regime Switches in U.S. Monetary Policy", *American Economic Review*, forthcoming.

Smets, F. and R. Wouters (2003), "An estimated dynamic stochastic general equilibrium model of the Euro Area", *Journal of the European Economic Association*, 1(5), 1123-75

Taylor, J. (1993), "Discretion versus Policy Rules in practice", *Carnegie-Rochester, Conf.Ser.Public Policy*, 39, 195-214

Uhlig, H (1999), "What are the effects of monetary policy: results from an agnostic identification approach", *Tilburg University WP* n. 9928

Woodford, M (2003), "*Interest and prices*", Princeton. Princeton University Press

Yu-Leu, S.C. (2004), "A New keynesian perspective of Monetary Policy implementation in Australia", mimeo, University of Sidney

7 Appendix

$Q(\text{columns 1 and 2}) =$

$$= \begin{matrix} \frac{\left(\varsigma-\rho\gamma+\varsigma\psi+\theta\varsigma\beta-\varsigma\lambda\chi-\varsigma\chi\psi+\theta\varsigma^2\right)}{\varsigma-\varsigma\lambda+\theta\varsigma\beta+\theta\varsigma\gamma+\theta\varsigma^2} > 0 & \frac{(-\rho\gamma+\varsigma\lambda+\varsigma\psi-\theta\varsigma\gamma-\varsigma\lambda\chi-\varsigma\chi\psi)}{\varsigma-\varsigma\lambda+\theta\varsigma\beta+\theta\varsigma\gamma+\theta\varsigma^2} < 0 \\ \frac{-\chi+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0 & \frac{-\chi+1}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0 \\ \frac{\kappa-\theta\chi-\kappa\phi}{-\lambda-\phi+\theta\varsigma+\theta\beta+\theta\gamma+\lambda\phi-\theta\varsigma\phi-\theta\beta\phi-\theta\gamma\phi+1} > 0 & \frac{\kappa-\theta\chi-\kappa\phi}{-\lambda-\phi+\theta\varsigma+\theta\beta+\theta\gamma+\lambda\phi-\theta\varsigma\phi-\theta\beta\phi-\theta\gamma\phi+1} > 0 \\ \frac{\rho+\theta\varsigma}{-\varsigma+\varsigma\lambda-\theta\varsigma\beta-\theta\varsigma\gamma-\theta\varsigma^2} < 0 & \frac{\rho+\theta\varsigma}{-\varsigma+\varsigma\lambda-\theta\varsigma\beta-\theta\varsigma\gamma-\theta\varsigma^2} < 0 \end{matrix}$$

$Q(\text{column 3}) =$

$$= \begin{matrix} \frac{1}{\kappa}\left(-\lambda\chi-\chi\psi\right) \lesseqgtr 0 \\ -\frac{1}{\kappa}\chi < 0 \\ \frac{(-\kappa+\theta\chi+\kappa\phi)}{-\kappa+\kappa\phi} > 0 \\ 0 \end{matrix}$$

$Q(\text{column 4}) =$

$$
\begin{aligned}
& \frac{(\varsigma\gamma-\rho\varsigma\gamma-\rho\beta\gamma+\varsigma\beta\lambda+\varsigma\beta\psi+\varsigma\gamma\psi-\varsigma\beta\lambda\chi-\varsigma\lambda\gamma\chi-\varsigma\beta\chi\psi-\varsigma\gamma\chi\psi-\rho\gamma^2+\varsigma^2\lambda+\varsigma^2\psi-\varsigma^2\lambda\chi-\varsigma^2\chi\psi)}{\varsigma-\varsigma\lambda+\theta\varsigma\beta+\theta\varsigma\gamma+\theta\varsigma^2} \lesseqgtr 0 \\
= & \frac{(\varsigma+\beta+\gamma-\varsigma\chi-\beta\chi-\gamma\chi)}{-\lambda+\theta\varsigma+\theta\beta+\theta\gamma+1} > 0 \\
& \frac{(\varsigma\kappa+\kappa\beta+\kappa\gamma-\theta\varsigma\chi-\varsigma\kappa\phi-\theta\beta\chi-\theta\gamma\chi-\kappa\beta\phi-\kappa\gamma\phi)}{-\lambda-\phi+\theta\varsigma+\theta\beta+\theta\gamma+\lambda\phi-\theta\varsigma\phi-\theta\beta\phi-\theta\gamma\phi+1} > 0 \\
& \frac{(\varsigma-\rho\varsigma-\rho\beta-\rho\gamma-\varsigma\lambda)}{\varsigma-\varsigma\lambda+\theta\varsigma\beta+\theta\varsigma\gamma+\theta\varsigma^2} \lesseqgtr 0
\end{aligned}
$$

We report the signs of the equilibrium multipliers into the matrix Q. Notice that:

- The quality shock generates in the long run a set of effects which are similar to the short run ones: positive on net exports, GDP, Inflation and negative (appreciation) on Real exchange rate.
- Even the long run effects of real demand shocks have all the same sign they have in the short run: negative on net exports (crouding out) and real exchange rate, positive on GDP and inflation.
- Supply shocks generates long run inflation and have a small long run contractionary effect on GDP describing a phenomenon of stagflation
- Money is not neutral: it raises long run GDP and inflation values, whereas the direction of trade and exchange rate effects is uncertain