Comment on “Modeling Regional Interdependencies using a Global Error-Correcting Macroeconometric Model” by M.H. Pesaran, T. Schuermann and S.M. Weiner

Kenneth F. Wallis
Department of Economics, University of Warwick, Coventry CV4 7AL, UK

Pesaran, Schuermann, and Weiner have proposed a new approach to global economic modeling in their GVAR model. Their article contains a clear exposition of the modeling principles that they espouse and the theoretical and practical problems that they have had to solve in implementing their approach. In addition to its intellectual contribution, the article represents a heroic data organization and management effort. It concludes with an application in which forecasts generated by an illustrative GVAR model feed into a credit risk management problem. This comment focuses on some econometric modeling and forecasting questions from a comparative standpoint, to help place the present contribution in a broader context. The comment draws on recent comparative research on multicountry models (Mitchell, Sault, Smith, and Wallis 1998; Wallis 2003), together with similar research on models of the U.K. economy (Jacobs and Wallis 2003) that includes the model of Garratt, Lee, Pesaran, and Shin (2000, 2003a) referred to by the authors.

GLOBAL ECONOMIC MODELS

Currently operating global models include the NiGEM model and the IMF’s MULTIMOD (Laxton, Isard, Faruqee, Prasad, and Turtelboom 1998), mentioned by the authors. Other multicountry models that have featured in the comparative research referred to earlier, along with these two, are the MSG2 model (see McKibbin and Sachs 1991), forerunner of the G-Cubed model (McKibbin and Wilcoxen 1999), and the QUEST model of the European Commission (Roeger and in’t Veld 1997). These models can be taken as typical modern-day representatives of the mainstream
structural global modeling tradition to which the present authors seek an alternative. Like the GVAR model, each of them is constructed, maintained, developed and used by a single research team, unlike Project LINK, mentioned by the authors, which, moreover, was never a continuously operational system in the same sense. Also like the GVAR model, they contain separate models of national economies of central interest, then aggregate the remaining economies into various groups. The basic Mark III version of MULTIMOD, for example, contains separate models for each of the G-7 countries – the U.S., Canada, Japan, France, Germany, Italy, and the U.K. – and for an aggregate grouping of 14 smaller industrial countries; the rest of the world is then aggregated into two separate blocks of developing and transition economies.

The GVAR model comprises a similar number of submodels, whereas NiGEM and QUEST are more disaggregated.

The mainstream multicountry models were developed from national economy models to facilitate the study of macroeconomic interactions among nations, principally the transmission of the effects of economic policy. To this end, explicit modeling of linkages through trade and financial flows is undertaken. Each country model is a structural model in the traditional sense, representing the behavior of households, firms, and the government and the markets in which they interact. Flows cumulate into stocks, and consistent global modeling requires that trade balances and net foreign asset positions sum to 0 at all times. The complete national economy submodels typically have a common theoretical structure, whereas the remaining blocks are modeled in much less detail, focusing on trade and payments in a more reduced-form than structural manner. Whereas some models are engaged in real-time forecasting, others eschew forecasting and concentrate exclusively on policy analysis.

In contrast, GVAR is a reduced-form forecasting model with a comparatively small number of variables per country; hence the important international linkages can only be implicit, not explicit. With respect to trade, for example, the dependence of exports and imports on income in the receiving country and relative prices is captured directly in the structural models. In the reduced-form model, however, it is solved out via the national income identity to yield a relationship between domestic and foreign GDP, \( y_i \) and \( y_i^* \), which also includes the price variables. Trade thus makes an
implicit contribution to the output equations of the country-specific models. This
collection is acknowledged by the use of trade weights to construct the aggregate
foreign variables. But linkages through trade remain in the background in GVAR, as
do those through financial flows.

The use of trade weights in aggregation reflects common practice in
mainstream multicountry models. These are typically nonlinear in variables and are
solved by numerical methods, with the various adding-up requirements and global
consistency constraints imposed by additional accounting relationships. In place of
numerical iteration, the link matrix defined in Section 3 of the article is a neat device
for achieving a globally consistent solution for the country-specific variables of the
GVAR model. This is, of course, facilitated by the model’s linearity.

The conditional or partial VECM form (see Johansen 1995, chap. 8) adopted
for the submodels of GVAR, in which foreign variables are treated as weakly
exogenous, also reflects common practice in mainstream modeling of small open
economies. Both assume that the feedback from the domestic economy to the rest of
the world is negligible. In contrast, the VECM model of the U.K. economy of Garratt
et al. (2000, 2003a) follows the original VAR tradition and abandons an
endogenous/exogenous classification of variables (except for the world price of oil),
and so treats corresponding domestic and foreign variables in the same way. Much of
the early VAR work related to the U.S. economy, treated as a closed economy, and
the argument about abandoning a prior exogeneity assumption related principally to
policy variables. That argument appears to have been won, even among mainstream
macroeconometric models, where policy feedback rules are now the standard
specification. Once VAR analysis was extended to small open economies, however,
the treatment of foreign variables still seemed open to debate, and the conditional
VECM of GVAR seems to be a more appropriate specification than the VECM model
of the U.K. economy of Garratt et al. in this respect.

Economic theory may contribute to the specification of a model in various
ways. There is broader acceptance of a range of long-run or steady-state propositions
than of theory-based short-run dynamic specifications, but their implementation also
varies. At one extreme is MULTIMOD, in which each dynamic equation has an
explicit steady-state analog equation. The complete system of steady-state analog
equations is maintained separately from the system of dynamic equations, to provide
an interpretative device for understanding long-run comparative statics and to
facilitate model handling by providing terminal conditions for model-consistent
expectations solutions. In other mainstream models there may be no complete system
of equations describing the steady state, but instead a set of propositions describing its
properties, such as price level and inflation neutrality, intertemporal budget
constraints, and long-run sustainability of debt and deficit positions. In their VECM
model of the U.K. economy, Garratt et al. (2003a) presented a theoretical framework
that delivers five long-run equilibrium relationships among the variables of the model.
The economic theory says nothing about the statistical characteristics of the variables,
but it is then assumed that they are difference-stationary, whereupon these equilibrium
relationships become the cointegrating relationships of the error-correction
representation. This is described as long-run structural modeling (Pesaran and Shin
2002), because identifying restrictions on the cointegrating relationships are based on
an underlying structural model, whereas a reduced-form VAR describes the short-run
dynamics.

The GVAR authors, having selected the variables to be modeled, likewise
treat them all as integrated of order 1. The cointegration rank, \( r \), is estimated from the
data and takes values between 2 and 5 in the different submodels. No theoretical
interpretation of the cointegrating relationships has yet been developed; instead, an
arbitrary just-identifying normalization on the first \( r \) variables is used. Thus little can
be said about the long-run properties of the GVAR model, and one suspects that
several of them may be implausible. In general, transitory shocks have permanent
effects on the individual \( I(1) \) variables, which may seem unreasonable in respect of
inflation and interest rates in the current monetary policy environment in many
countries. On the other hand, transitory shocks have no permanent effect on the
cointegrating combinations of variables, and the cointegration of inflation and the
domestic interest rate in the U.K. VECM (Garratt et al. 2003a) implies that the ex-
post real interest rate is invariant to shocks to the variables of the model in the long
run, which is more reasonable. The authors report that the U.K. block of GVAR has
the same cointegrating rank as the U.K. VECM – 5, more than anywhere else – but
one suspects that the same restrictions may not hold, neither here nor in other blocks.
with less cointegration. Another cointegrating relationship in the U.K. VECM corresponds to purchasing power parity – the real exchange rate is invariant to shocks to the variables of the model in the long run – and again this would be a desirable property for the blocks of the GVAR model.

**DYNAMIC PROPERTIES**

The dynamic properties of large-scale systems are usually summarized by dynamic multipliers or impulse response functions, which describe the effects on the endogenous variables over time of a unit shock to an exogenous variable or an equation of the model. These correspond to partial derivatives of the dynamic system and are in widespread use in model comparisons. The authors’ practice differs in two respects. First, they consider shocks of 1 standard error, rather than 1 unit or 1% of the variable in question; hence the reader interested in the magnitude of multipliers or spillovers has to scale the reported responses. It is not clear that interpretability is improved by scaling the shocks in inverse proportion to the goodness of fit of the equations of the VECM.

More fundamentally, the authors report generalized impulse response functions (GIRFs, see Pesaran and Shin 1998). GIRFs describe dynamic responses to a generalized shock, in which a shock to the equation in question is accompanied by shocks to the other equations of the submodel according to their residual correlations. It is argued that GIRFs describe the effect of “realistic” shocks, meaning shocks of the type that are typically or at least historically observed, as described by the sample estimate of the error covariance matrix. However, their interpretation as reduced-form partial derivatives is difficult for readers familiar with shock-one-thing-at-a-time exercises, even when they are informed of the components of the generalized shock, which is not always done. It is also difficult to interpret responses to shocks of different composition in different models in comparative studies. For these reasons GIRFs have not replaced conventional dynamic multipliers in the macro modeling community. A final difficulty is that a reduced-form VAR in a small number of variables provides few stories about the source of the shock, whether univariate or composite, which may limit its interpretability.
The positive shock to German output reported in Section 9.7.2 illustrates these points. The source of the output shock could be a fiscal or monetary policy shock or an increase in productivity, for example. These feature in the recent comparison of empirical models of the Euro area economy summarized by Wallis (2003), and they can be expected to have different second-round effects. However, comparison with these results is hindered by the perturbations to the other German variables in GVAR in proportion to their residual covariance with output. The impulse of 1 standard error corresponds to an increase of .74% in output in the first quarter, and the composite shock or generalized impulse also includes an increase of 2.50% in real equity prices, a fall in inflation of .12%, and an increase of .21% in the real exchange rate, defined as the DM-US$ rate deflated by the German CPI. (These impulses are taken from the quarter 0 column of Table 9. It is inappropriate to describe them as “the effect of the increase in Germany’s output” in the same way as its effect in other regions. The German “impact effects” are components of the generalized impulse, whereas the effects in other regions are the contemporaneous responses to the German shocks, which form part of the weakly exogenous foreign variables in those regions.)

Interpretation of the responses then requires the hybrid nature of the shock to be borne in mind, but this is difficult to do in the absence of information about the dynamic responses to individual shocks. One surprise among the long-run (quarter 20) results from a European perspective is the difference in exchange rate responses in France, Germany, and Italy, remembering that the sample period saw several realignments of rates within the various phases of the Exchange Rate Mechanism of the European Monetary System. (Contemporary forecasting would require adjustment to the model to take into account of final stage of European Monetary Union and the recent introduction of a common currency among these countries.) Another surprise is the difference in output spillovers, with a 1% increase in output in Germany associated with increases between .28% and .37% in other countries of continental Europe, but virtually no change in the U.K. Unfortunately, generalized impulses in a reduced-form VAR tell few stories.

FORECASTING

Emphasis on the forecasting purpose of the model reduces the need for economic analysis and story-telling. It is well established that the best forecasting
model and the best policy analysis model are unlikely to coincide, and that the VAR in differences is a relatively robust forecasting device in the face of endemic structural breaks (see Hendry and Clements 2003 for a recent review). Cointegration restrictions may improve forecasts, unless shifts in their means are the manifestation of structural change. The test of a forecasting model is its out-of-sample track record, and evidence on GVAR’s performance is eagerly awaited. This could include not only point forecasts, but also density forecasts, as the authors note.

Although VARs have become the standard benchmarks used in forecast evaluation, Watson (2003) noted that such small-scale models have had little effect on practical macroeconomic forecasting: “There are several reasons for this, but the most obvious is the inherent defect of small models: they include only a small number of variables. Practical forecasters and policymakers find it useful to extract information from many more series than are typically included in a VAR.” Whereas the complete GVAR model is substantially larger, each of its component blocks, separately estimated, is “typically” sized and contains a typical selection of variables. The nine-variable U.S. VAR of Sims (1993), for example, contains equivalent variables to the seven variables in the U.S. block of GVAR, together with business fixed investment and unemployment; the main difference is that Sims includes a more general commodity price index in place of the oil price. The GVAR could thus be regarded as a natural benchmark for use in global economic forecast evaluation.

CONCLUSION

Pesaran et al. have presented a new approach to modeling for forecasting on a global scale. They have further extended a line of development from VAR to VARX to VECM models, and have advanced an elegant yet practical solution to the problem of consistent global closure of their model. The relative simplicity of the model contributes to its tractability, but limits the depth of economic analysis that it can sustain compared with the competing structural models. The construction of the model in its present form is already a considerable achievement by the authors, but much further development is needed before the model can support analysis of substantive economic issues, such as those that tantalize the reader of the article’s closing paragraph.
ADDITIONAL REFERENCES


