Systemic Risk, Aggregate Demand, and Commodity Prices: An Application to Colombia

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Borradores de ECONOMÍA

Núm. 859
2014

BANCO DE LA REPÚBLICA COLOMBIA

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Systemic Risk, Aggregate Demand, and Commodity Prices: An Application to Colombia

Javier G. Gómez-Pineda and Juan M. Julio-Roman*

Abstract

We embed a small open economy model for Colombia into the systemic risk model of GGT (2014). The small open economy model is estimated by Bayesian methods and used for analysis and projections. The model enable us to give a consistent treatment of shocks to systemic risk, country risk, and oil and commodity prices. The treatment is consistent because the shocks affect the global economy, not only exogenous "rest of the world" variables. The priors are found by analyzing impulse response functions, the evolution of latent variables, equation fit, error decompositions, and model forecast performance. Among the findings are that the identified episodes of retrenchment and bouyancy in systemic risk were transmitted to Colombia's country risk premium and that systemic risk shocks are important drivers of Colombia's output and unemployment gaps. Finally, aggregate demand–related shocks are not important as drivers of non-core inflation in Colombia, in contrast with the findings for other countries.

JEL classification: F32; F37: F41; F31; F47; E58

Keywords: Global risk; Financial linkages; Commodity prices

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*December 26, 2014. The series Borradores de Economía is published by the Economic Studies Department at the Banco de la República (Central Bank of Colombia). The works published are provisional, and their authors are fully responsible for the opinions expressed in them, as well as for possible mistakes. The contents of the works published do not compromise Banco de la República or its Board of Directors.

I. Introduction

The paper studies the effect of systemic risk on a small open economy. The shock is dealt with consistently, meaning that the small open economy reacts not only to the systemic risk shock but also to the reaction of world output, interest rates, inflation, and exchange rates to the shock under study. This is in contrast with the approach that takes appends an exogenous "rest of the world" to a small open economy. The paper also deals with other shocks (to oil and commodity food prices) consistently.

To our knowledge, this is not the first time that a model of a small open economy is embedded into a global model. However, we are unaware of published papers on the topic as of now.

The paper has the following four sections: model, data, results, and conclusions. The model section briefly describes the model. The data section deals with all the data aspects of the model, namely, the data sources as well as the model calibration and estimation. The results section presents the impulse responses under the main shocks, the smoothing and error decomposition results, and the model forecasting properties. The conclusions deal mainly with the role of systemic risk shocks in explaining the output gap, unemployment, and country energy and food prices.

II. The Model

The model consists of a small open economy calibrated for Colombia embeeded into the systemic risk model of GGT (2014). As in GGT (2004), the model in this paper incorporates three topics. First, systemic risk and its transmission to the country risk premium. Second, the transmission from country risk premiums to demand-related variables such as the output gap, the trade balance and unemployment. Third, the transmission from commodity prices to country inflation. With these features, the model can be operated to analyze financial booms and busts (low and high risk premia), the effect of booms and boosts on output, unemployment, and the trade balance, as well as commodity-price shocks and their effect on inflation.

The model is in the spirit a simple gap model of the type central banks use in their inflation targeting procedures. A central bank gap model is normally based on two transmission channels, the aggregate demand channel and exchange rate channel. The former is the effect of interest rates on aggregate demand, inflation, and back again to the interest feedback rule. The later is the effect of interest rates on the exchange rate, aggregate demand, inflation, and then to the interest rate feedback rule. These standard transmission channels that originate in the interest rte may be extended to country risk premiums as follows. The *domestic aggregate demand channel* is the effect of a shock to the country risk premium on the country output gap, inflation, and finally on the interet rate feedback rule. The *domestic exchange rate channel* consists of the effect of the country risk premium on output and trade balance gaps via the exchange rate; the interest rate feedback rule then takes the economy back to equilibrium.

The small open economy model also uses the three transmission channels incorporated in the model in GGT, namely, the *systemic risk channel, the foreign aggregate demand channel, and the* *foreign exchange rate channel.*

The model has 22 core equations.[1] The number of equations in the small open economy model rises to 117 owing to the type of variables involved (in deviation and latent form), the several definitions used for growth and inflation, a set of equations for auto correlated residuals, and another equation for exogenous interventions on the output gap.

III. Model Estimation

Parameters, σ_ρ and σ_r, were calibrated so as to match the response of the output gap to country risk premium and interest rate shocks in the model and in a VAR.

The peak response of the output gap to country risk premium shocks in the model and in the VAR appears in Figure 1. The shocks is a unit, autocorrelated shock to the country risk premium. The figure shows that the response of the output gap to country risk premium shocks is similar in the model and in the VAR. In like fashion, the peak response of the output gap to interest rate shocks is also similar in the model and in the VAR.

Some key parameters were estimated. The remaining parameters related to persistence, error standard deviations, model steady state and other parameters were maintained as a calibration.

The priors for the estimated parameters were obtained from the calibration of the model. The calibration covered 80 parameters and 41 standard deviations; while the estimation covered 13 parameters. The calibration was obtained by analyzing impulse response functions, the evolution of latent variables, equation fit, error decompositions, and model forecast performance.

The calibrated parameters appear in Table 1 and the estimated parameters in Table 2.[2]

Parameter estimation was carried out by Bayesian methods, which help tackle some estimation issues that arise when working with big and complicated models like the one used in this paper. Simulation of the parameters' posterior distribution was carried out by the adaptive version of the Random Walk Metropolis Algorithm. By design, this simulation technique guaranties an adequate degree of sample mixing when coupled with a "good" choice for the parameters of the proposal distribution, in particular its variance co-variance matrix.

In order to obatin an appropriate estimate of the proposal distribution co-variance matrix, the posterior distribution was maximized as follows. First, a good approximation to the posterior distribution maximum (i.e. the regularized likelihood) was found through the Particle Swarm Algorithm, a time inexpensive maximization technique. In this algorithm, a population (swarm) of particles climbs the log posterior at a number of arbitrary points. At every iteration each particle

[1] The 22 core equations are on one hand behavioral equations for the following variables: risk premium, output gap, trade balance gap, capital flows, core inflation, energy prices, food prices, interest rates, unemployment, export prices, import prices, and real exchange rate; and on the other hand, identities for the variables foreign risk premiums, foreign real interest rates, real multilateral exchange rate, terms of trade, absorption, CPI inflation, nominal exchange rate, real interest rate, and a breakdown of the UIP residual.

[2] The sources of the data are those specified in GGT (2014). In the particular case of Colombia, the country risk premium was measrued with Colombia's EMBI spread.

knows its own altitude, its maximum historical altitude and the maximum altitude historically attained in the population. When coupled with a behavioural rule and some degree of persistence, this algorithm is a time inexpensive alternative to find a *global.* Because he algorithm computes the function only once for each particle at every iteration, it enables us to solve the maximization problem using parallel computing, which in turn further improves the time savings. Second, a Newton-Raphson maximization algorithm is started after a pre-specified number of generations of the smarm algorithm. Therefore, the use of the time expensive Newton Raphson procedure is reduced and an estimate of the co-variance matrix at the posterior mode is obtained.

After the co-variance matrix is fed into the Random Walk Metropolis Algorithm, we obtain samples from the posterior distribution. These simulations are used to estimate the posterior density and its moments.

Table 3 contains the parameter values used for the simulation of the posterior of the 13 estimated parameters. The upper panel presents the parameters for the maximization of the posterior while the lower panel summarizes the set up of the Random Walk Metropolis simulator. Parameter priors were set up as independent normal with the parameters in Table 4, so that the regularized likelihood corresponds to the parameters posterior. The Particle Swarm Algorithm population runs in 4 parallel workers (processors) and contains 80 members who were programmed to climb the regularized log likelihood for up to 200 generations. Convergence to a maximum, with a one in a millionth parameter difference, was achieved after only 172 generations; thus, the Newton-Raphson procedure converged in but one step. This last procedure provided estimates of both the posterior mode as well as the co-variance matrix at the maximum.

These parameters were fed to the Random Walk Metropolis Algorithm with a burn in sample of 30% for a remaining 100.000 sample simulation. The resulting samples led to an acceptance ratio of 22.87 percent. On average, the variance ratio is 1.20, which seems to validate the simulations.

In order to test for convergence to the maximum, Figure 2 depicts the profiles of the negative log regularized likelihood along with the minimum (maximum) achieved. These plots confirm that a mode was reched and thus the posterior proposal can confidently use the Hessian at the maximum for its simulation parameters. Furthermore, a comparison of the posterior mode with the prior mean in Table 4 shows important similarities among the values of all parameters, except ν_3. Thus, at least from a $0-1$ loss perspective the data seems to provide information about the value of some parameters.

Figure 3 shows the path of a sample of four parameters. The upper left and right panels show that the marginal simulation of some parameters converge to a steady state distribution quite fast regardless of the starting point. In contrast, the lower panels show that the unconditional simulation of some parameters take longer to explore different sets of the corresponding parameter spaces to achieve the required degree of mixing regardless of the starting point. In order to test for an adequate degree of mixing a variance ratio among the two halves of the simulation were computed yielding a ratio of 1.0941 which is close enough to one. This suggests that the simulations is adequate to infer the posterior densities and moments.

Table 4 summarizes the results of the Bayesian estimation. Priors were set as independent truncated normal with means and standard deviations in the second and fifth columns and truncation limits in columns three and four, respectively. These parameters arise from a very careful cailibration of the impulse responses and historical decompositions of the model, and the standard deviation and truncation limits are set as wide as posible to reduce the amount information input to the estimation process. The final results of the estimation process under square loss are located in the right hand side panel of the table. Column seven contains the estimated parameter values and columns eight and nine show the corresponding High Probability Density confidence limits at 95% respectively.

The results in Table 4 and Figure 4 shows that the sample data does contain information about the parameters of interest. This information can be seen in slight mean shifts from the prior to the posterior in coefficients δ_2, ν_{12}, ν_2, ν_8 and σ_r and in an important shift in the mean of coefficient ν_3. Furthermore, the introduction of prior information reduced parameter uncertainty quite significantly for coefficients δ_3, $\nu_{12}, \nu_2, \nu_3, \nu_4, \nu_8, \theta_2$ and σ_r. Therefore, the sample data contains a big amount of information about coefficient ν_3 (reduced uncertainty and shifted its mean), and contains some information about coefficients δ_3, $\nu_{12}, \nu_2, \nu_3, \nu_4, \nu_8, \theta_2$ and σ_r (sharply reduced uncertainty).

IV. Results

The results deal with the three main topics developed in the paper: first, the transmission from systemic risk to the country risk premium; second, the transmission from the country risk premium to aggregated demand–related variables such as the output gap, the trade balance gap, and unemployment; and third, the transmission from commodity prices to country energy and food country prices.

In addition, impulse response analysis include a shock to the policy interest rate, given that this shock is an explanation of the transmission mechanisms of monetary policy.

A shock to systemic risk Figure 5, Panel A, shows the behavior of the country variables in response to a shock to systemic risk. Global risk is shown to affect Colombia's country risk premium, output gap, and trade balance gap. The country risk premium and the output gap respond according to the strength of the systemic risk and aggregate demand channels.

The trade balance gap deteriorates owing primarily to the strength of the systemic risk channel. As loading factor α_2 is small, the country risk premium rises less than abroad, the country risk premium differential drops, and the trade balance deteriorates.

A shock to the country risk premium Figure 5, Panel B, shows the response of the output gap to shocks to the country risk premiums. In response to an upward shock to the domestic risk premium, the output gap drops. Two channels are at work, the domestic aggregate demand and domestic exchange rate channels.

In response to an upward shock to a foreign risk premium, the output gap also drops. Both the foreign aggregate demand and foreign exchange rate channels help explain this response.

The output gap reacts to shocks to the domestic risk premium far more than to shocks to foreign risk premiums. In a relatively open economy, the output gap may react strongly to foreign risk premium shocks because the aggregate demand channel tends to be weak while the foreign aggregate demand channel tends to be strong. But this is not the case of the country unders study, Colombia.

Concerning the response of the trade balance gap to country risk premium shocks, Figure 5, Panel C, the trade balance gap improves with shocks to the domestic risk premium and drops with shocks to foreign risk premiums. The strength of the response of the trade balance gap to shocks to foreign risk premiums depends, mostly, on the export share of the country where the shock takes place.

Shock to commodity prices The response of country variables to a shock to the price of oil appears in Figure 5, Panel D. The response involves higher inflation and interest rates. The monetary policy rules at home and abroad prescribe larger interest rate increases in Colombia; hence, Colombia's currency appreciates causing output gap to drop further.

Altogether, a shock to the price of oil has effects on inflation and the output gap that may be important, but quantitatively not as important as the effect of a one standard deviation shock to systemic risk.

A shock to the commodity price of food appears in Figure 5, Panel E. The response of the output gap and inflation is similar in kind and extent to that of a shock to the price of oil. Some differences do arise as to the extent of the response of the nominal interest rate and in the persistence of CPI inflation. These differences are explained by the higher persistence of the country food and energy prices under shocks to commodity food prices and to the price of oil, respectively.

An interest rate shock The focus here is on the effect of interest rate shocks on the country output and trade balance gaps. As expected, the relevant shocks are those to the own interest rates while shocks to foreign interest rates are largely unimportant.

Consider first the response of the output gap to a shock to the domestic interest rate in Figure 5, Panel F. The response is standard with the domestic aggregate demand and exchange rate channels being involved.

Next, consider the effect of foreign interest rate shocks on the output gap, also in Figure 5, Panel F. The response of the output gap to a foreign interest rate shock is the result of transmission channels that work in opposite directions. In response to an increase in a foreign interest rate, the foreign aggregate demand channel causes a drop in the output gap, the foreign exchange rate channel causes a rise in it. Both effects offset each other to the extent that the response of the output gap to a foreign interest rate shock is trivial.

Next, consider the effect of an interest rate shock on the trade balance gap in Figure 5, Panel G. The response to an upward shock in the domestic interest rate is a drop in the trade balance gap. By the aggregate demand channel, a rise in the domestic interest rate decreases aggregate demand and hence imports. Consequently, the trade balance improves. Through the exchange rate channel, a rise in the domestic interest rate appreciates the exchange rate; thus, the trade balance deteriorates. The later effect predominates.

Finally, consider the effect of a foreign interest rate shock on the trade balance gap also in Figure 5, Panels G. As explained in GGT, the sign of the response of the trade balance gap to a foreign interest rate shock is opposite to that of a shock to the domestic interest rate. Thus, in response to an upward shock to a foreign interest rate the trade balance gap rises.

Smoothing results Reported smoothing results also deal with the three topics dealt with in the paper.

The first of the topics is presented in Figure 6, Panel 1. The estimated, unobserved systemic risk marks periods of higher volatility during the end of the century crisis, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis.

Figure 6, Panel B also shows the country risk premium. In deviation form, the country risk premium moves with global and idiosyncratic events. In latent form, the country risk premiums drops during the transition to lower inflation that started in the early 2000s.

The second of the topics appears in Figure 6, Panels C and D. Two of the three peaks in systemic risk and the country risk premium (the end of the century crisis and the global financial crisis) correspond with busts in output and increases in unemployment. During these episodes, the trade balance improved. Because the trade balance improved at the time the output gap dropped, absorption dropped more than output; in this light the trade balance is understood to be pro cyclical.

The third of the topics appears in Figure 6, Panels I and J. Country energy prices have low correlation with the price of oil probably owing to the rule used to set gasoline prices in Colombia. Country food prices depict some correlation with commodity food prices.

Historical decomposition results The historical decomposition of systemic risk, estimated with the model in GGT (2014), appears in Figure 7, Panel A. Global risk points at four episodes of retrenchment: the end-of-the-century crisis, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis.

The historical decomposition of the Colombia's country risk premium gap appears in Figure 7, Panel B. Global risk shocks have a massive influence on the country risk premium. Peaks in the country risk premium are explained by systemic risk shocks in all episodes of global retrenchment. Note that the country risk premium is not explained by systemic risk during the burst of the dotcom bubble which is a US event.

As to the historical decomposition of Colombia's output gap in Figure 7, Panel C, systemic risk shocks are important while own and foreign risk premium shocks are trivial. Other demand-related shocks such as output and real interest rate shocks are also less important. Also, shocks to foreign variables are also trivial in explaining the output gap.

The decomposition of the unemployment gap also makes clear that systemic risk shocks are relevant and country risk premium shocks are trivial (Figure 7, Panel D). Global risk shocks help explain the rise in unemployment during the global financial crisis while interest rate shocks help explain the rise during the end of the century crisis. Again, foreign shocks are trivial.

The historical decomposition of the trade balance gap appears in Figure 7, Panel E. Recall that systemic risk shocks affect country risk premiums to different extents and that trade balance gaps depend on the country risk premium differential. In Colombia, an upward shock to systemic risk tends to cause a drop in the trade balance gap.

Country energy and food price gaps are broken down into the contributions from shocks in Panels F and G. Demand related shocks play a role in explaining country energy prices and to a minor extent country food prices. The role of demand related variables in explaining the relative price of non core inflation was emphasized in GGT. The same argument applies here to the relative price of energy.

However, the case is different regarding the aggregate of energy and food prices. Figure 7, Panel H, presents the decomposition of the aggregate of Colombia's energy and food prices. As noted in GGT, this aggregate is a measure of the deviation of CPI inflation from core inflation. The effect of demand related shocks is trivial on the aggregate. The reason is that while the effect of demand-related shocks on the country price of energy is large, the share of country energy prices in the CPI is small. In the aggregate, demand-related shocks are unimportant. Moreover, commodity food price shocks predominate.

Forecasting properties Table 5 compares the model forecasts with the forecasts of analysts.[3] Model growth forecasts are better at one and four quarter ahead horizons[4] (Table 5). As to inflation forecasts, model forecasts are better at one quarter horizon but worse at four and eight quarter horizons.

The relatively good performance of the model may in part be explained by the fact that analysts did not know the model, the shock, and the coefficients that we know after we set up, calibrate, and estimate the model throughout the sample. This is particularly relevant during the global financial crisis. The parameters do incorporate the effect of higher systemic risk on growth and inflation during the global financial crisis while it is fairly known that analysts permformed quite poorly.

Figure 8 shows the forecast variance of a handful of variables. The figure shows that systemic risk shocks are important in explaining the forecast variance of the country risk premium, output growth, trade balance, unemployment and energy and food price inflation.

V. Conclusions

The paper dealt with three main topics; first, the transmission of systemic risk to the Colombia's country risk premium; second, the effect of Colombia's the country risk premium on aggregated

[3] The survey of analysts' forecasts is taken from Consensus Economics.
[4] Except for the four quarter ahead growth forecast for the United States.

demand–related variables such as the output gap, the trade balance gap, and unemployment; and third, the transmission from commodity prices to country energy and food prices.

On the first topic, systemic risk shocks were transmitted to Colombia's country risk premium in all events of global retrenchment. Although country risk premium shocks also mark some periods of idiosyncratic risk, the bulk of the country risk premium was explained by systemic risk shocks.

On the second topic, systemic risk was relevant at explaining Colombia's output gap, particularly during the global financial crisis. The historical decomposition of the country output and unemployment gaps showed the relevance of systemic risk shocks and the more trivial role of country risk premium shocks.

It was in the trade balance gap where country, domestic risk premium shocks played a more relevant role. The reason is that the trade balance gap is explained by the country risk premium differential. During retrenchment, systemic risk permeated with different intensity to country risk premiums. In Colombia, where the systemic risk channel is weaker, the risk differential dropped and the trade balance deteriorated.

On the third topic, the paper showed that in Colombia supply shocks were more relevant that demand-related shocks, given the higher weight of food in the CPI.

The model performed relatively well in forecasting, as compared to a survey of analysts' forecasts. Global risk shocks helped explain the variance of the forecasts for a handful of Colombian macroeconomic variables.

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Table 1. Some Calibrated Parameters

$1/\sigma_{\rho,CO}$	0.333	$1/\sigma_{r,CO}$	0.143	$\sigma_{1,CO}$	0.040	$\sigma_{2,CO}$	0.780
$\alpha_{1,CO}$	0.630	$\delta_{1,CO}$	0.200	$\nu_{1,CO}$	0.850	$\vartheta_{1,CO}$	0.780
$\nu_{7,CO}$	0.550	$\sigma_{6,CO}$	0.600	$\sigma_{11,CO}$	0.600	β_1	0.500
λ_{CO}	0.005	$\bar{x}_{CO}$	0.171	$\bar{m}_{CO}$	0.194	β_4	0.700

Table 2. Estimated Parameters

Parameter	Prior mode	Posterior mode	Parameter	Prior mode	Posterior mode
$\alpha_{2,US}$	0.495	0.267	$\delta_{2,US}$	0.082	0.084
$\delta_{3,US}$	0.275	0.304	$\vartheta_{2,US}$	0.266	0.215
$\nu_{2,US}$	0.082	0.084	$\nu_{3,US}$	0.020	0.028
$\nu_{5,US}$	0.624	0.119	$\nu_{8,US}$	0.486	0.643
$\nu_{4,EU}$	0.040	0.038	$\nu_{12,EU}$	0.040	0.042
ν_{US}	0.200		β_2	6.959	7.373

Table 3. Parameters for Posterior Simulation

Process	Feature	Value
Maximizing the Posterior	Parameters	13
	Population Size	80
	Generations	200
	Generations to convergence	172
	Parallel workers	4
	Newton Raphson Iterations	1
Adapative Metropolis	Iterations	100000
	Burn in Sample	0.3
	Acceptance Ratio	0.2287
	Average Variance Ratio	1.0941

Table 4. Prior and Posterior Parameter Information

	Prior				Posterior			
Par	Mean	Min	Max	Std	Mode	Mean	$HPD_{l,95}$	$HPD_{u,95}$
α_2	0,80	0,00	1,60	0,080	0,8000	0,7939	0,6635	0,9302
δ_2	1,00	0,00	2,00	0,100	1,0836	1,0835	0,9199	1,2286
δ_3	0,50	0,00	1,00	0,050	0,5137	0,5170	0,5157	0,5192
ν_{12}	0,04	0,00	0,08	0,004	0,0400	0,0409	0,0385	0,0429
ν_2	0,10	0,00	0,20	0,010	0,1013	0,0922	0,0860	0,0995
ν_3	0,04	0,00	0,08	0,004	0,0503	0,0502	0,0476	0,0520
ν_4	0,04	0,00	0,08	0,004	0,0400	0,0394	0,0384	0,0409
ν_5	0,08	0,00	0,16	0,008	0,0800	0,0798	0,0668	0,0930
ν_8	0,05	0,00	0,10	0,005	0,0500	0,0548	0,0530	0,0569
ν	0,20	0,00	0,40	0,020	0,2039	0,2038	0,1718	0,2371
σ_ρ	4,80	0,00	9,60	0,480	4,8246	4,8089	4,0555	5,5593
σ_{rr}	15,00	0,00	30,00	1,500	14,6967	14,7293	14,6764	14,7802
θ_2	0,20	0,00	0,40	0,020	0,1999	0,1964	0,1895	0,2023

Table 5. Goodness of Fit

Root mean squared errors in percentage points

	One quarter ahead		Four quarters ahead		Eight quarters ahead	
	Consensus Forecast	Global risk model	Consensus Forecast	Global risk model	Consensus Forecast	Global risk model
			Growth			
Colombia	1.019	0.280	2.273	1.887	1.902	2.720
			Inflation			
Colombia	0.943	0.875	2.292	3.615	1.596	3.987

To make Consensus Forecast (CF) and systemic risk model forecasts (GR) broadly comparable we approximated the CF and GR forecasts as follows: the one quarter ahead forecast is the October forecast for the end of the year; the four quarters ahead forecast is the October forecast for the end of the following year; and the eight quarters ahead forecasts is the October forecast two years ahead. The sample is 1996 — 2013.

Figure 1. Model Calibration

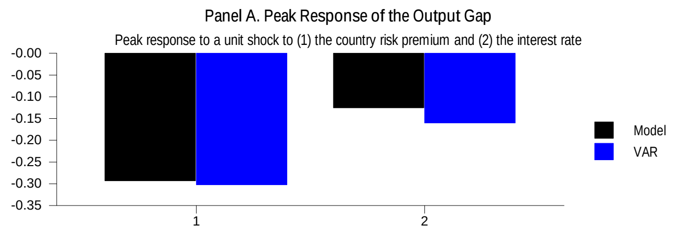


Figure 2. Negative log posterior profiles (line) and minimum achieved (red dot)

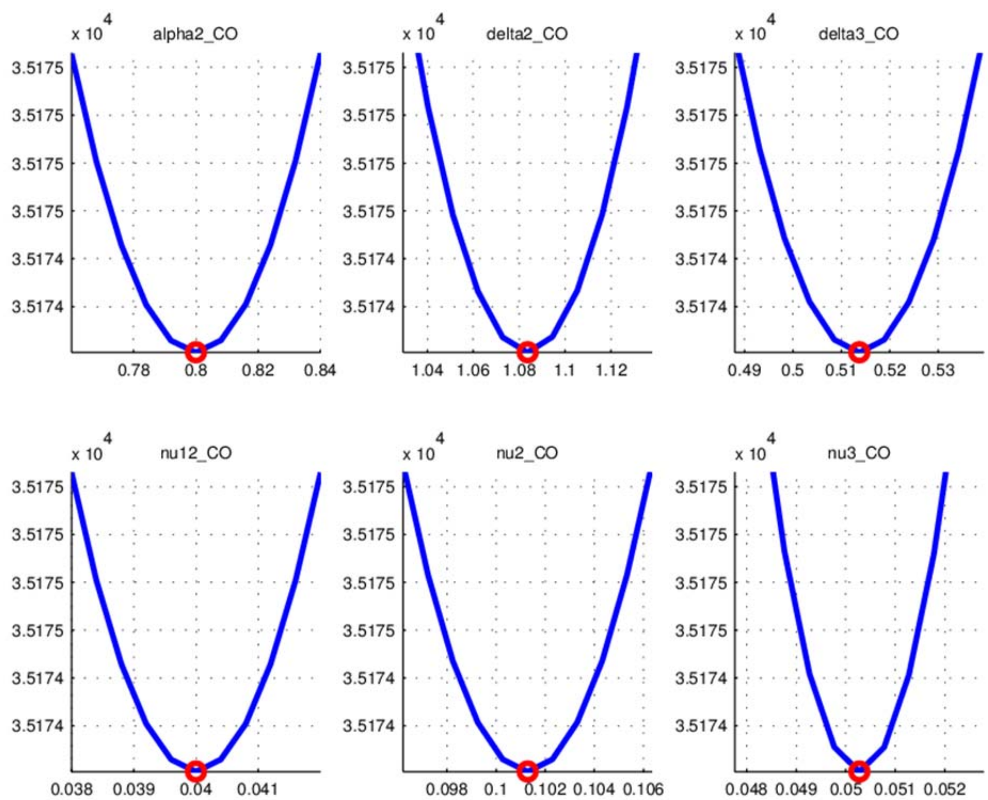


Figure 2 (Continued). Negative log posterior profiles (line) and minimum achieved (red dot)

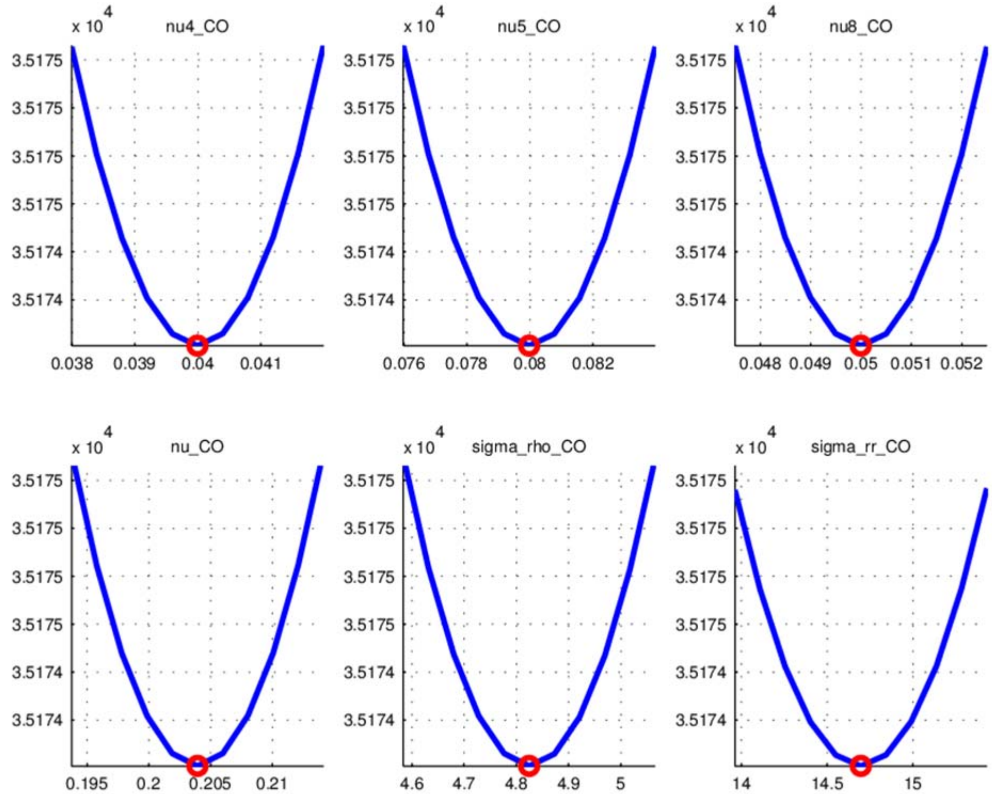


Figure 2 (End). Negative log posterior profiles (line) and minimum achieved (red dot)

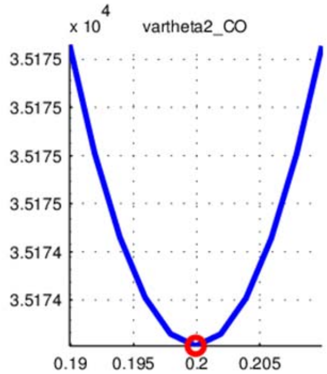


Figure 3. Simulated paths of selected parameters

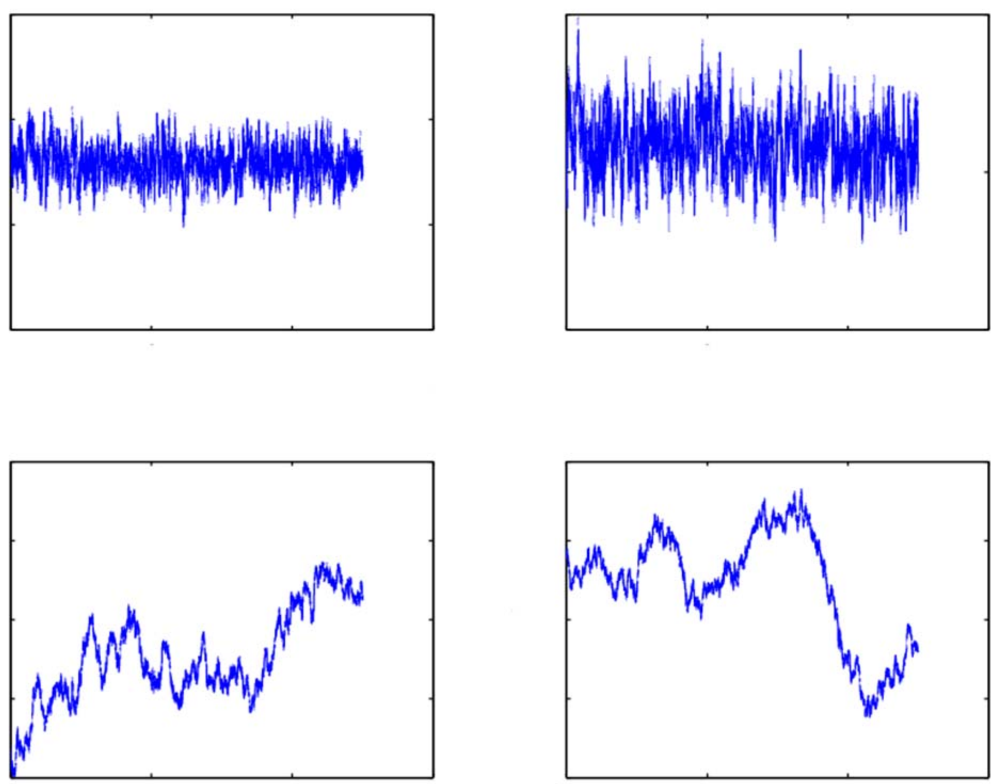


Figure 4. Prior and Posterior parameters marginal

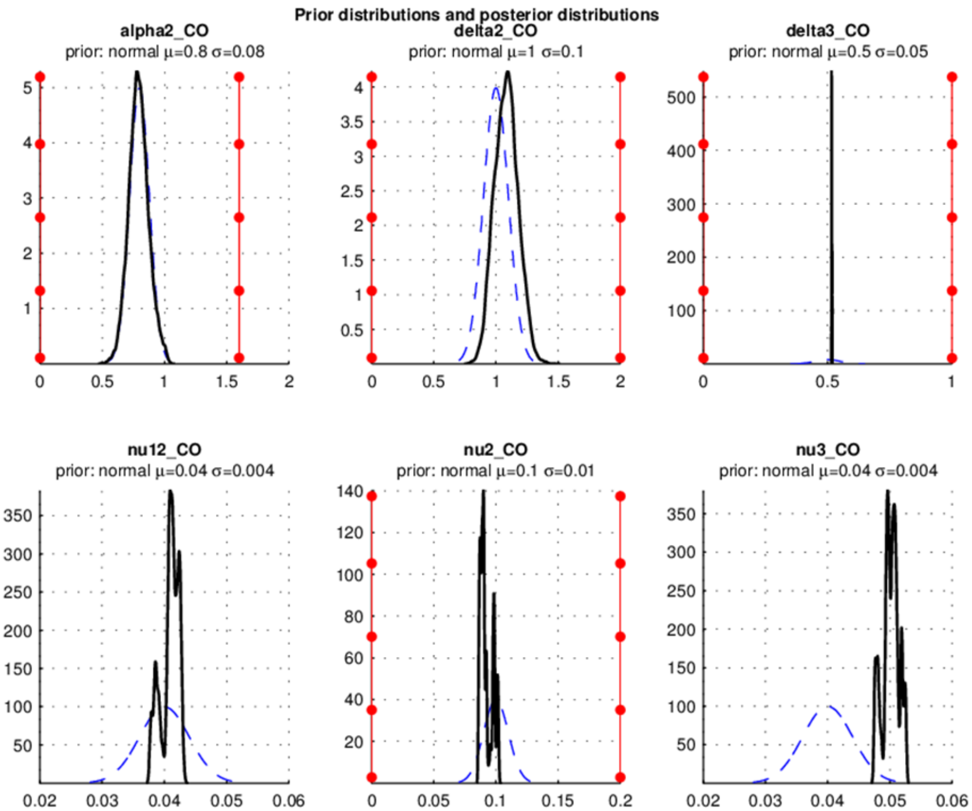


Figure 4 (Continued). Prior and Posterior parameters marginal

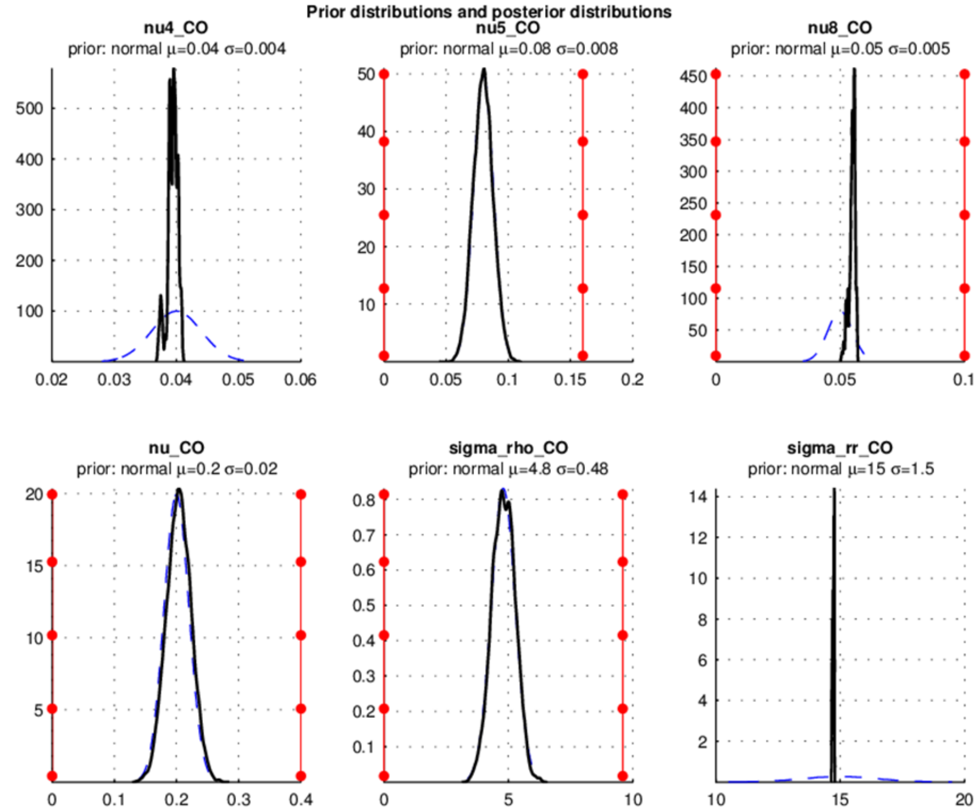


Figure 4 (End). Prior and Posterior parameters marginal

Prior distributions and posterior distributions

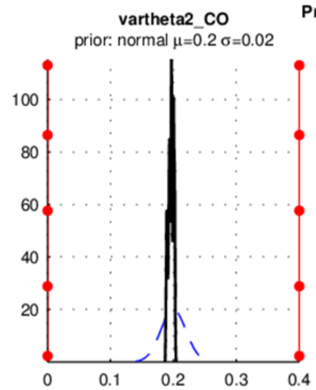


Figure 5. Impulse Responses

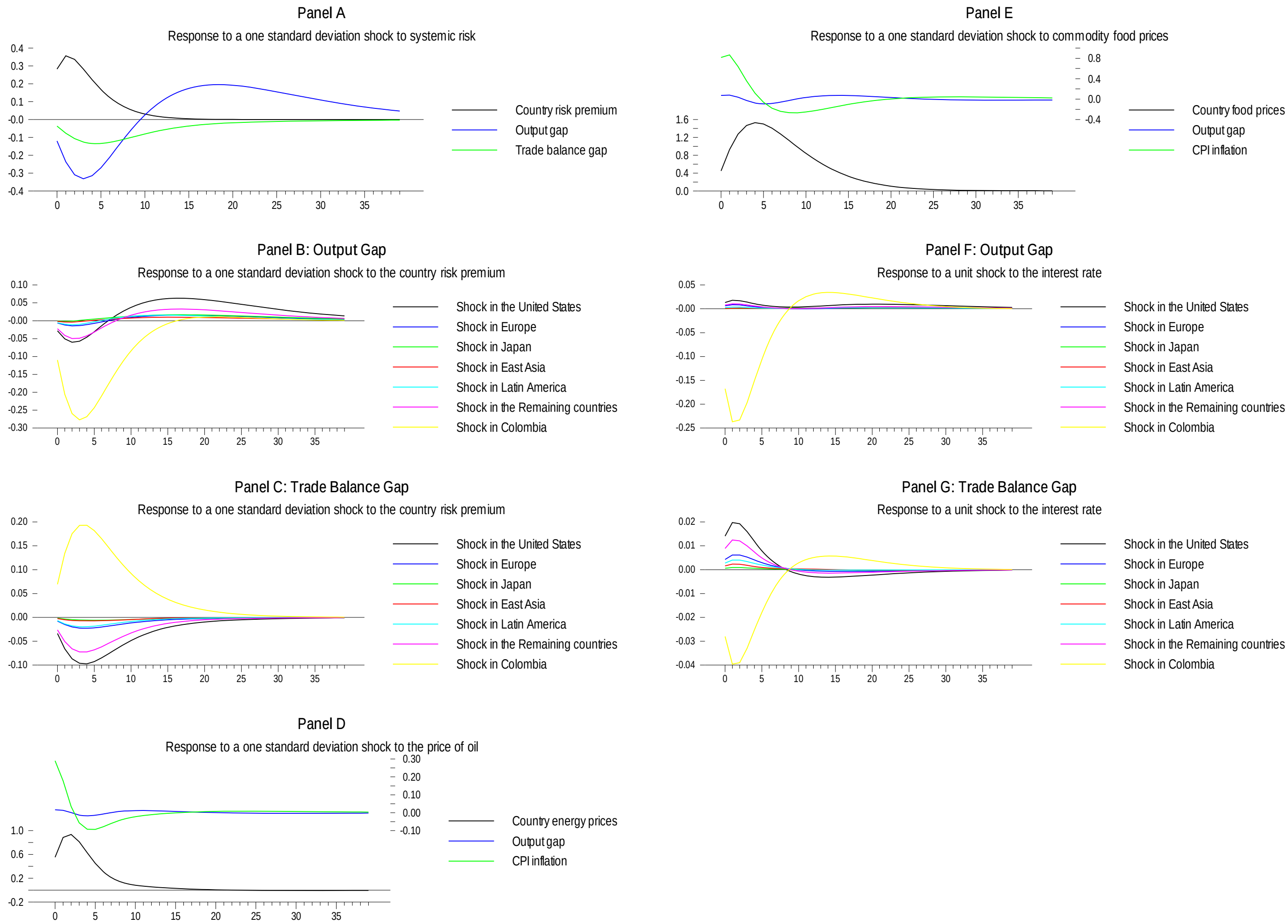
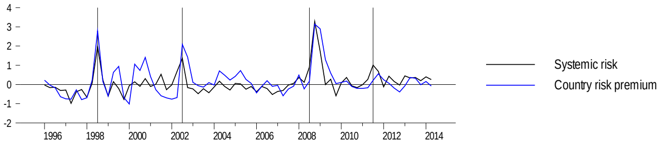


Figure 6. Smoothing Results

Panel A: Systemic Risk and Country Risk Premium

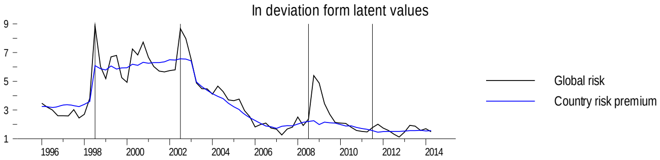
In deviation form latent values



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel B: Country Risk Premium and Latent Country Risk Premium

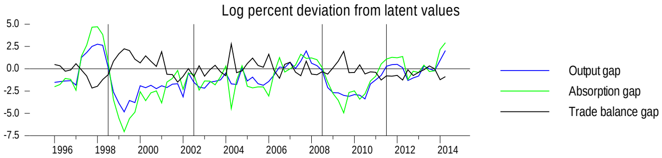
In deviation form latent values



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel C: Output, Absorption, and Trade Balance Gaps

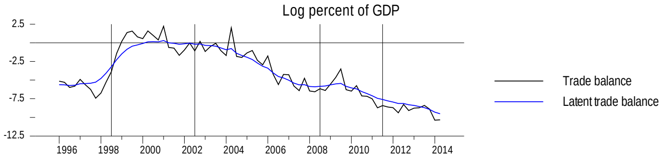
Log percent deviation from latent values



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel D: The Trade Balance

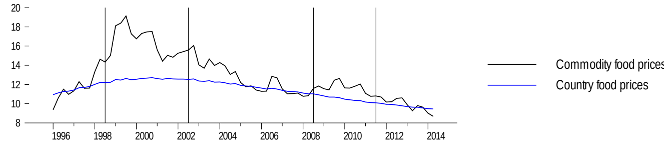
Log percent of GDP



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel E: Unemployment and Latent Unemployment

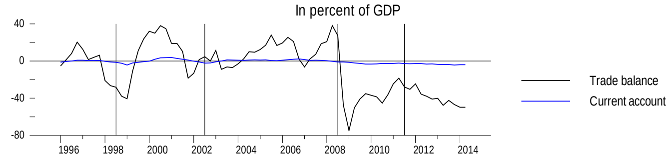
Percent deviation from latent values



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel F. The Price of Oil and Country Energy Prices

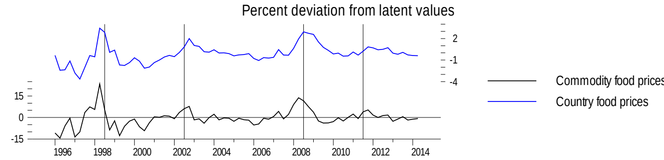
In percent of GDP



The grid indicates the end-of-the-century crisis, the burst of the dotcom bubble, the global financial crisis, and the Euro zone crisis

Panel G: Commodity Food Prices and Country Food Prices

Percent deviation from latent values

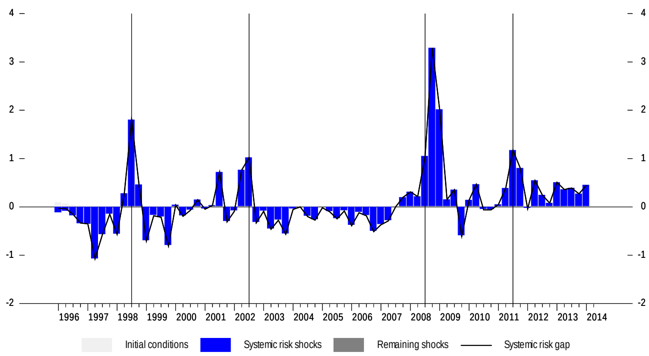


The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Figure 7. Historical Decompositions

Panel A. World: Systemic Risk Gap

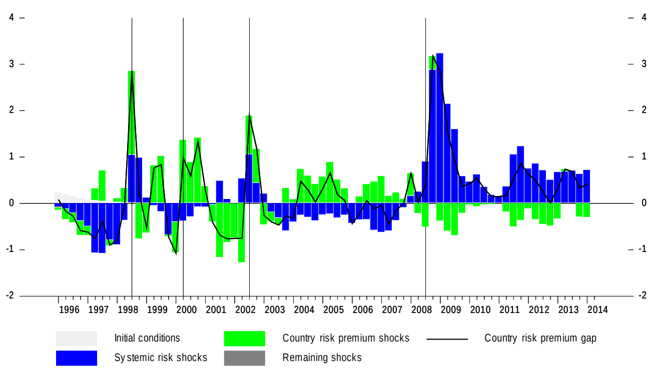
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the stock market downturn of 2002, the global financial crisis, and the Euro zone crisis

Panel B. Country Risk Premium Gap

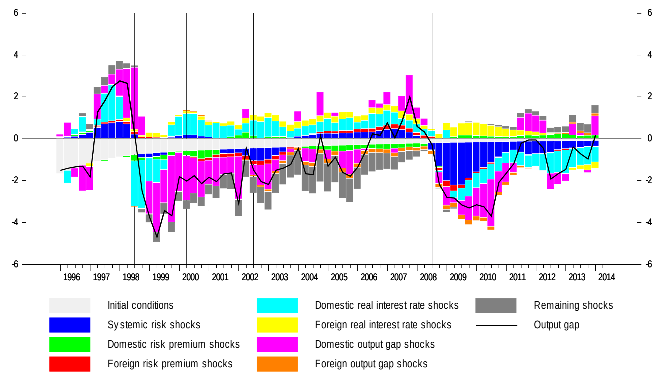
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Panel C. Output Gap

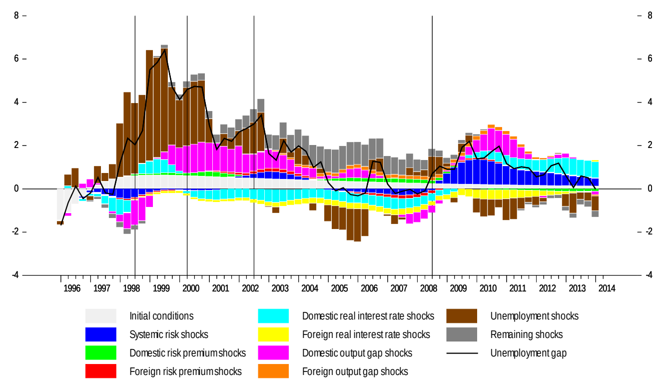
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Panel D. Unemployment Gap

Historical decomposition into percent contributions from shocks

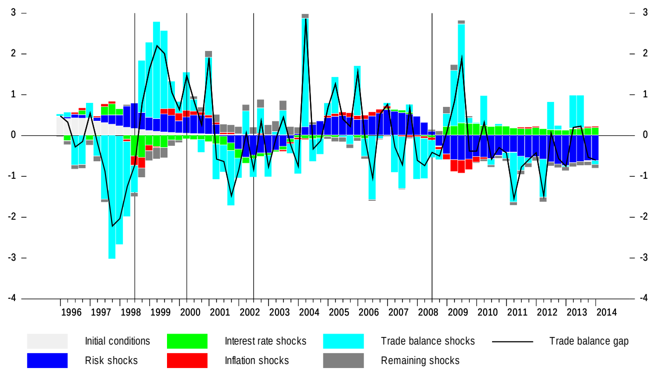


The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Figure 7 (Continued). Historical Decompositions

Panel E. Trade Balance Gap

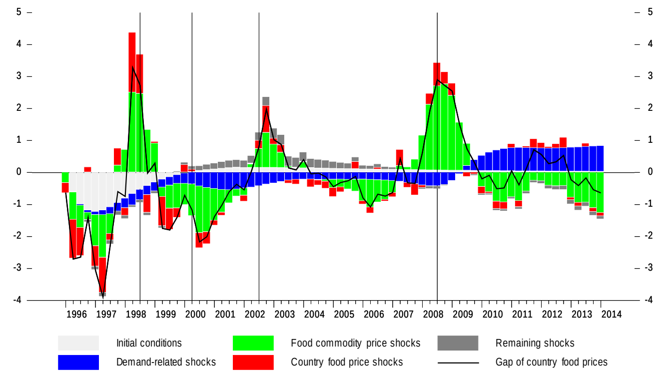
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Panel G. Gap of Country Food Prices

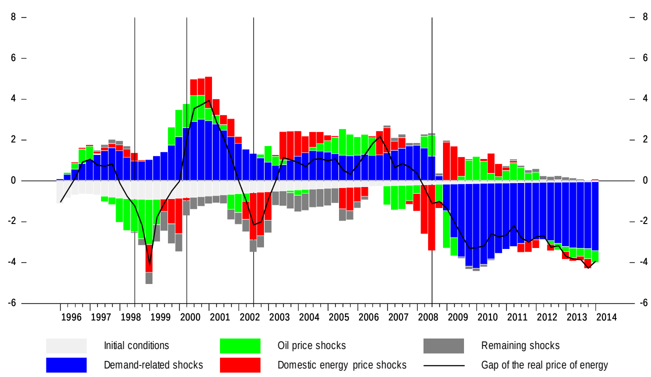
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Panel F. Gap of Country Energy Prices

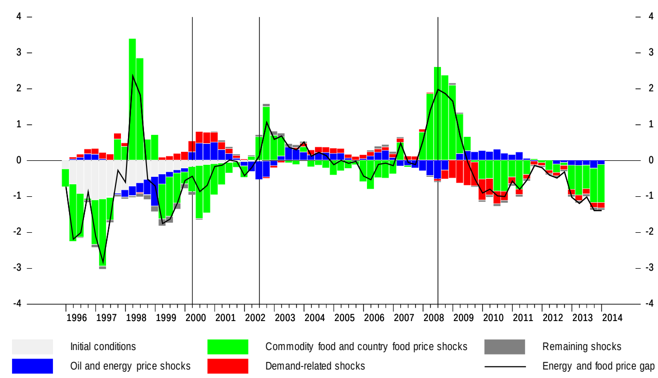
Historical decomposition into percent contributions from shocks



The grid indicates the end of the century crisis, the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Panel H. Energy and Food Price Gap

Historical decomposition into percent contributions from shocks



The grid indicates the burst of the dotcom bubble, the stock market downturn of 2002, and the global financial crisis

Figure 8. Forecast Error Variance Decomposition