THE MACROECONOMIC EFFECTS OF CLIMATE SHOCKS IN EUROPE

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Overview

It has been recognized that agriculture is highly dependent on weather and climate. Waves of excessive heat and excessive cold can interrupt crop growth and reduce yields. Climate change is expected to have an impact on food production, energy consumption, food and energy prices and, finally, on the inflation. Accordingly, weather shocks may drive significant variations in agricultural and energy prices and, hence, of the business cycles. In this work we provide empirical evidence on the impact of temperature anomalies on gross value added of agricultural sector, energy production, food prices, energy prices and the consumer price index of the Euro-Area. Specifically, we estimate a Bayesian VAR for Euro-Area countries, in order to explore the effects of a negative temperature shock and a positive temperature shock on agricultural production, energy production and prices. We also examine heterogeneous responses of the shocks across countries and find significant differences. Overall, our results suggest that temperature shocks lead to changes in prices through agricultural production and energy and food prices' expectations. The inclusion of these shocks among the sources of variation of the inflation may help central banks to deal with climate risks in setting their stabilization policy.

Methods

To examine the dynamic effects of changes in the values of temperature (i.e. the deviation of average monthly temperature from its historical sample monthly average value) on the economy, we have estimated a Bayesian Vector AutoRegressive model (B-VAR) for ten Eurozone countries. Vector autoregressive models are used to perform empirical and practical work and to investigate the dynamic relations in macroeconomic variables. Moreover, they allow to decompose movements in macroeconomic data into contribution of structural shocks. We estimate for each country a reduced VAR-system of simultaneous equations:

$$Y_t = A(L)Y_{t-1}u_t$$

The models consist of eight equations. On the right hand side there are the lags of all the variables included in the model. Y_t is a vector of endogenous variables representing the individual country's economy in month t. For the estimation, the vector of endogenous variables Y_t contains eight variables which are variance of the vapour pressure, temperature, gross value-added of agricultural sector, energy production (in terms of electricity, gas, steam and air conditioning supply), consumer price index of food, consumer price index of energy, harmonized consumer price index for each country and the Eurozone core inflation. All the variables are measured in level and are seasonally adjusted - except for temperature. $A(L)$ is a polynomial in the lag operator L. u_t is a vector of reduced form residuals, related to the structural shocks by

$$u_t = A_0^{-1}\epsilon_t$$

In the estimation we focus on identifying only the temperature shock. Indeed, we do not aim to identify all structural shocks. In particular, the identification is achieved imposing sign restrictions to identify a negative temperature shock and a positive temperature shock, while on the remaining structure of the variance-covariance matrix of the VAR we impose a standard recursive (Cholesky) decomposition.

We exploit the direct relation between temperature and vapour pressure to separate positive temperature shocks from negative ones. Such a relation implies an increase in the variance of vapour pressure for both positive and negative temperature shocks, enhancing identification strategy. At the same time, contemporaneous correlations for the macroeconomic variables follow a standard recursive structure.

Results

The preliminary results highlight non-linearities within the countries with respect to a positive and negative temperature shocks, but also among countries in terms of entity of variables' response to both temperature shocks. Indeed, the effects to positive and negative deviations from historical values on macroeconomic variables are different among countries.

In particular, negative temperature shocks trigger a stronger response of production and prices across all countries in the study. There are evidences of significant heterogeneity in the cross-country responses. The effect of negative temperature shocks is negative on agricultural production, while energy production is significantly positively affected by this shock. The response of domestic prices is positive in Italy and Spain. In Greece, the effect of negative temperature shocks generate an increase in agricultural and energy production, food and energy prices, while the response of consumer price index expected of all items is negative.

With respect to a positive deviation of temperature from its historical values, all the countries responses on agricultural production are positive, while energy production decreases significantly only in Spain. In terms of prices responses' to a positive temperature shock, the increase in energy price is statistically significant only in Greece.

Conclusions

Overall, the estimated responses of output and prices to temperature shocks are generally statistically meaningful. Results signal that climate shocks (to the degree to which they can be summarized by generic temperature shocks) may be conceived as an additional source of heterogeneity for EZ countries. This posit a further challenge for the conduct of monetary policy: should the central bank target variations in inflation triggered by climate shocks? We leave the answer to this question to further research.