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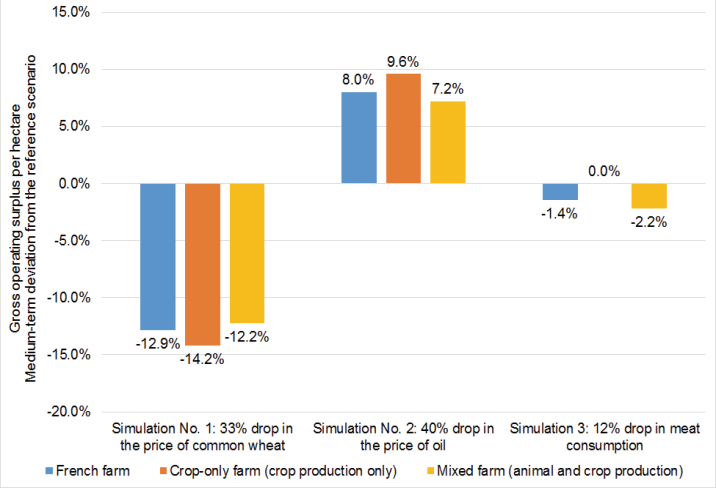
French agriculture and external shocks

- The French agricultural sector is the largest in the European Union. Total production came to €72bn in 2017, of which 57% was crop production (cereals, viticulture, etc.) and 36% animal production (milk, meat, etc.). This sector is particularly exposed to external shocks, climatic shocks (summer droughts in 2015 and 2018, poor spring weather in 2016, a late frost in 2017), economic shocks (prices of animal and vegetable production and agricultural commodities), as well as changes in food preferences (reduced meat consumption). These events affect world prices. Thus, the average price of common wheat can fall by one third for lengthy periods, as was the case between 2011-2013 and 2014-2017.
- In addition, the consumption of fossil fuels (fuel oil, diesel and natural gas) and derivatives (nitrogen fertilisers) by agriculture makes it highly dependent on energy prices. Although the sector has benefited from lower oil prices in recent years (from $96 per barrel in 2011-2014 to an average of $58 per barrel in 2015-2018), it remains highly exposed to price increases.
- The sector also receives numerous farm subsidies - mainly from the Common Agricultural Policy (CAP) – which amounted to €8 billion in 2017. The amount and distribution of these subsidies could change with the revision of the multiannual financial framework and the CAP for 2021-2027.
- The Magali 2.0 is an econometric model allowing to assess the medium-term effects of these various shocks, both actual and potential, on the French agriculture's production and economic performance. For example, it is estimated that the 12% drop in meat consumption per capita in France between 2007 and 2016 accounted for 0.6% of the decline in permanent grassland areas and was responsible for a 1.4% drop in the gross agricultural surplus in France, particularly in the livestock production sector. The effects of this shock are of course offset or amplified by other shocks that occurred over the same period, such as the fall in oil prices and the fall in common wheat prices (see chart opposite).

Reaction of the agricultural sector to exogenous shocks



Source: DG Trésor.

1. A macroeconomic model of the French agriculture's supply [1]

1.1 Farmers take economic signals into account when defining production

Every year, the drive to boost a farm's gross operating surplus (EBITDA) and income means that farmers must factor in macroeconomic and sectoral realities to focus on producing what is most profitable. Farm managers decide how to use the land and allocate livestock (between continued breeding and slaughter), based on the expected margin from each production and the inertial constraints on it, for example linked to crop rotation or the length of breeding cycles.[2]

Some farms may shift away from livestock to focus solely on crops or, conversely, begin to breed animals should the economy so dictate.

1.2 A model based on observed agricultural data

The Magali model, which was created in 1983, has been gradually adapted to changes in French agriculture and agricultural policies. A structural revision of the model was undertaken starting in 2014 to better distinguish the various animal and crop productions and to detail the demographics of the cattle population. Magali 2.0 shows the evolution of French agriculture in terms of physical production (acreages, yields, livestock, volumes, etc.), production constraints (intermediate consumption, subsidies, wage costs, etc.) and revenue (value added, gross operating surplus, etc.).

At a macroeconomic level, the agricultural sector is represented as a "French farm" divided into two sub-farms ("crop-only" and "mixed", the first growing only crops, the second producing crops and animals). Allocations are made between the two farms as well as within them according to expected margins, subject to the availability of fixed factors such as farmland (see Box 1). Economic relationships are expressed in a simplified way through "behavioural equations", whose coefficients are based on data gathered annually since about 1975.

Box 1: Description of Magali 2.0

Total Useful Agricultural Area (UAA) in France (total area taken up by the farming sector) is divided between the portions assigned to the "crop-only" and the "mixed" farms. The total UAA is fixed in the model; however, the portions assigned to each farm may change. Within each type of farm, areas are reallocated according to production and use (between cash crops and feed crops).

The trade-off between crops depends on margin ratios: the higher a crop's gross margin, the more the farmer will tend to devote more land to it at the expense of others whose margin is relatively lower. Moreover, for certain mixed farm crops, farmers must decide between selling the crop and using it for animal feed. This trade-off depends on the relative profitability of livestock vs. crop production.

For livestock production, the model includes a meat demand component and calculates meat prices. Total per-capita meat consumption, an exogenous parameter, is allocated amongst the various types of meats based on their relative price. For beef, production is broken down using a demographic model that factors in, for each age and sex group (cow, bull, etc.), a balance between resources (initial herds, new entrants to the age group, animal imports) and employment (animal exports, slaughter, exit from the age group and final herds).

Finally, the model estimates intermediate management balances, particularly gross operating surplus per hectare.

(1) For an in-depth presentation of Magali 2.0, see Ory X. and O. Touze (2019), "Le modèle de simulation du secteur agricole français Magali 2.0", *DG Trésor Working Paper* No. 2019/2.

(2) Crop rotation: sequence of crops on the same plot of land, generally optimised for fertilisation management and pest control.

2. Magali 2.0 is used to simulate the agricultural sector's response to exogenous shocks

Magali 2.0 is used to assess the agricultural sector's reaction to changes in the economic climate. The results are expressed as a percentage deviation on average over the medium term from the actual observed values that constitute the reference scenario.

2.1 Simulation no. 1: 33% drop in the price of wheat

France is the leading producer of common wheat in Europe and is often among the world's top five exporters. The price of common wheat fell by 33% between 2011-2013 and 2014-2017.[3] Magali simulates the effect of this fall-off on the French agricultural production sector, all other things being equal.

The fall in common wheat prices encourages farmers to reduce their consumption of inputs (nitrogen fertilisers, etc.), which leads, on the one hand, to a fall in yields (−1.3%) and in production costs (−5.6%). The margin[4] for common wheat per hectare falls, leading to a reassignment of wheat-growing areas (a 10.6% decrease in hectares planted with common wheat), which is the equivalent of 1.7% of the total UAA of the French farm.

On the mixed farm, the fall in the price of common wheat leads to a drop in the price of animal feed and therefore in the cost of production per ton of animals (−8.3%). The decline in the relative margin of cash crops encourages farmers to reduce the areas planted with cash crops and boost the areas used for feed crops. The margin for animal products thus increased (0.7%). The volume of livestock production is increasing very slightly, but less significantly than the area under livestock production – the sector is expanding, with a 2.0% decrease in the number of livestock units (LU) per hectare.

Overall, the agricultural sector is penalised by this fall in common wheat prices, with a decrease in the gross operating surplus per hectare of 12.9%.

Thus, the fall in common wheat prices is eroding the profitability of the French farm, although livestock production is benefiting. Over the period studied, the fall in common wheat prices contributed to the fall in the gross operating surplus per hectare (observed decrease of 2.7%) and to a 2% fall-off in common wheat yields. In addition, price decreases would curtail the increase in the area under common wheat (observed increase of +2.5%).

2.2 Simulation no. 2: 40% drop in oil prices

There have been long-term variations in oil prices over the past decade, with oil prices falling from an average of USD 96 per barrel between 2011 and 2014 to an average of USD 58 per barrel from 2015 to mid-2019 – a 40% decrease.

Falling oil prices, taken in isolation, lead to a fall in the prices of energy products – in particular fuel used for mechanisation[5] – and fertilisers and an increase in their consumption (an 18% decrease in nitrogen fertilizers prices and a 2.8% increase in consumption). Crop yields would increase slightly due to a drop in intermediate consumption prices. However, there would be an increase in the quantity of inputs used, which partially offsets lower production costs. For example, for common wheat, production costs fell by 3.6%, yields would increase by 0.4% and the margin per hectare by 5.2%.[6] Production costs per ton of animals would fall by 4.8%, leading to a 2.4% drop in consumer prices.

The gross operating surplus per hectare would rise by 8.0%, with a more marked increase for the crop-only farm (+9.6%) than for the mixed farm (+7.2%).

Table 1: Changes following simulations

Simulation	Production cost per hectare of common wheat	Area for the production of feed consumed within the farm	Production cost per ton of animals	Gross operating surplus per hectare for the French farm
33% drop in the price of common wheat	−5.6%	+2.0%	−8.3%	−12.9%
40% drop in the price of oil	−3.6%	−0.1%	−4.8%	+8.0%
12% drop in meat consumption	0.0%	−0.7%	−1.2%	−1.4%

Source: DG Trésor.

(3) 2011-2013 average: 305 USD/ton. 2014-2017 average: 206 USD/ton. International Grains Council, fob price in Rouen.
(4) The margin per hectare corresponds to the difference between turnover and the cost of intermediate consumption.
(5) Mechanisation: motorised equipment, mainly tractors.
(6) Moreover, the area under common wheat is decreasing because this crop benefits less than others from lower oil prices.

Lower oil prices mean lower production costs, which improves the profitability of the French farm. Thus, the agricultural sector is exposed to fluctuating oil prices, both for mechanisation and for nitrogen fertilisers, and policies to reduce the sector's dependence on fossil fuels help boost its economic resilience.

Over the period studied, lower oil prices helped to curb the observed decline in the gross operating surplus per hectare (−0.3%) and the observed decline in common wheat yields (−5.1%). In addition, the fall in oil prices limited the increase in the area under common wheat (observed increase of +1.4%).

2.3 Simulation no. 3: 12% drop in meat consumption

Per capita meat consumption in France, which was stable in the 1990s, has been on the decline since the beginning of the 2000s. This decline has sharpened in recent years, with a 12% fall-off in per capita meat consumption between 2007 and 2016. Awareness of the health effects of meat consumption and its impact on the environment may exacerbate this trend in coming years.

According to Magali 2.0, a 12% decrease in meat consumption impacts the consumption of both red meat (−10.7%) and white meat (−12.6%). Since the demand price elasticity is very different for different products, the price of beef falls by 7.7% whereas that of pork or poultry falls by only 0.3%. These decreases lead to a drop in margins per hectare of 8.8% for large cattle, resulting in less livestock (−2.2% in LUs). The area dedicated to animals decreases by 0.7% on the mixed farm, or 0.4% of the total UAA. Half of this land is transferred to the crop farm, and the other half is developed within the mixed farm to produce cash crops. In particular, permanent grassland areas decrease by 0.6%.

The agricultural sector's gross operating surplus per hectare decreases by 1.4%. For the livestock production sector alone, the loss of EBITDA/ha is 5.0%. Over the period studied, the decrease in meat consumption limited the observed increase in EBITDA/ha to +4.2% between 2006-2008 and 2015-2017, and contributed to the decrease in permanent grassland areas, down by 5.5%.

Changing consumption habits should encourage the sector to adapt in order to offer products with a lower environmental and health impact, with appropriate public support.

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