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The transition to carbon neutrality: effects on price stability

Green transition policies could have effects on inflation through higher energy and industrial input prices, whether caused by increases in the price of carbon, by regulations or by tensions over critical minerals needed for renewable energy. Green transition policies could also affect inflation through delays in the relative price adjustment of energy-intensive goods, or through economic disruptions linked to the restructuring and adaptation of the productive system. On the whole, the magnitude and duration of the effects of the transition to carbon neutrality on inflation will depend on the transition strategy chosen. While a number of short and medium-term scenarios risk being inflationary, there are also factors that could curb inflation. Moreover, the earlier and more gradually the transition is implemented, the lower the inflation costs will be.

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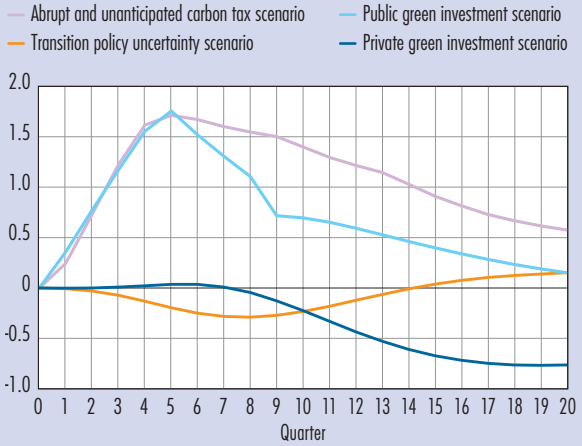
Between -0.8 and +0.6 percentage point
range of the impact on inflation after five years

Between -1.1% and +1.6%
range of the impact on GDP after five years

+1.2 percentage point of GDP
of additional annual investment required in France in the key transition sectors (private and public combined)

Effects of the green transition on inflation in France in four short and medium-term scenarios

(y-o-y change in inflation, in percentage points, relative to a baseline scenario without a transition; quarterly data)



Source: Authors' calculations.

The sixth assessment report of the United Nations Intergovernmental Panel on Climate Change (IPCC), published in 2022, states that human-induced greenhouse gas emissions have continued to increase over the decade 2010-19. The recent delays in implementing climate actions have heightened the risk of an abrupt and disorderly green transition,[1] which would have major consequences for both growth and inflation.

Raising the price of high-carbon goods and services in relation to that of other goods and services is desirable in order to send a dissuasive signal to consumers and encourage them to use alternative, decarbonised products that generate low greenhouse gas emissions. However, it could also result in more inflation. This phenomenon, known as "greenflation", reflects the difficulty of redirecting resources towards sustainable activities in the short and medium term, as well as the persistent effects of successive energy price shocks on inflation expectations.

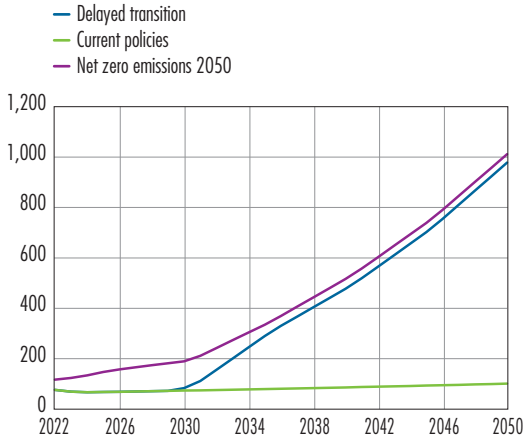
1 The transition will entail an increase in energy costs

Necessary increases in the price of fossil fuels

The effects of the green transition on consumer prices will be felt first and foremost as the direct impact of higher energy prices. Demand for fossil fuels (oil, gas and coal) is expected to decrease gradually with the transition to a low-carbon economy, which may lead to global price reductions. But if the energy mix does not change significantly, an ambitious carbon pricing policy will make using fossil fuels more expensive for the final consumer and increase the price of energy. The scenarios presented by the Central Banks and Supervisors Network for Greening the Financial System (NGFS, 2022) explore a number of possible transition trajectories, varying in ambition, and their different effects on fossil fuel prices. The scenarios for the price of oil (see Chart 1) show fairly rapid increases in France, notably as a result of the rise in the explicit and implicit price of carbon.[2]

C1 Change in the price of oil in the NGFS scenarios

(in constant 2017 USD, per barrel)



Source: NGFS (2022).

Short-term pressures on the price of electricity and critical metals

The global price of carbon (price of a tonne of CO_2 emitted into the atmosphere) in 2021 was around USD 10 per tonne (Pisani-Ferry, 2021). The NGFS scenarios where warming remains below 2°C project carbon price trajectories of between USD 200 and USD 800 per tonne by 2050,[3] which could lead to increases in the end-price of electricity, depending on how it is produced. Under the current European wholesale market setup, the price of electricity is linked to the price of marginal generation capacity (the last capacity called to balance the grid)

1 A disorderly transition means a transition path that is insufficiently planned, and therefore both abrupt and poorly anticipated by economic agents.

2 Among the various methods of assigning a cost to carbon, taxes create an explicit price, while standards, regulations and bans create an implicit cost, raising prices for producers and consumers. The price set in the emission allowance market can also, by extension, be considered an explicit price.

3 "Divergent Net Zero", "Net Zero 2050", "Delayed Transition" and "Below 2°C" NGFS scenarios.

which is generally based on thermal energies that are sensitive to carbon pricing.[4] According to our estimates for France, the carbon price trajectory under an "NGFS carbon neutral"-type scenario[5] (with an increase concentrated in the first three years) would raise the year-on-year change in the Harmonised Index of Consumer Prices (HICP) by around 0.1 to 0.4 percentage point relative to a baseline scenario with no transition policy.

Tensions could also arise in the markets for key transition minerals. The International Energy Agency (IEA) estimates that transition-related demand for industrial minerals would increase sixfold by 2040 in a scenario with net-zero emissions.[6] Given the inelasticity of supply for these minerals in the short term, imbalances between supply and demand could become an additional source of macroeconomic instability, increasing price volatility (Miller et al., 2023).

The green transition will also have indirect effects on inflation.

2 Uncertain effects on inflation

Beyond the production of decarbonised energy, the green transition requires major adaptations of the economic system. Underlying structural transformations may be hampered by certain obstacles that have adverse effects on activity and inflation. In the labour market, for example, the reallocation of labour to low-carbon activities, or the need for upskilling in sectors that require major transformations (construction, transport, etc.), may produce labour shortages and lead to both wage increases and unemployment (Girard et al., 2022). In the market for goods and services, the transition requires carbon-based goods and services to become more expensive than other goods and services, causing uncertain effects on inflation. Consequently, the development of low-carbon technologies, especially in the field of renewable energies (production and use), could have disinflationary effects. Continued uncertainty about future transition policies would have downward effects on both prices and activity.

Four short and medium-term scenarios

The potential consequences for activity and inflation during the transition may therefore vary significantly depending on the shocks considered. To better understand these mechanisms, we analyse four standard scenarios corresponding to representative cases of transition-related shocks (see diagram below):

- A first group of scenarios focuses on the deterioration of supply conditions, which could lead to stagflation (rising inflation accompanied by falling growth). This first category is represented here by an abrupt increase in carbon pricing. The increase is abrupt because it has been delayed (Scenario 1).

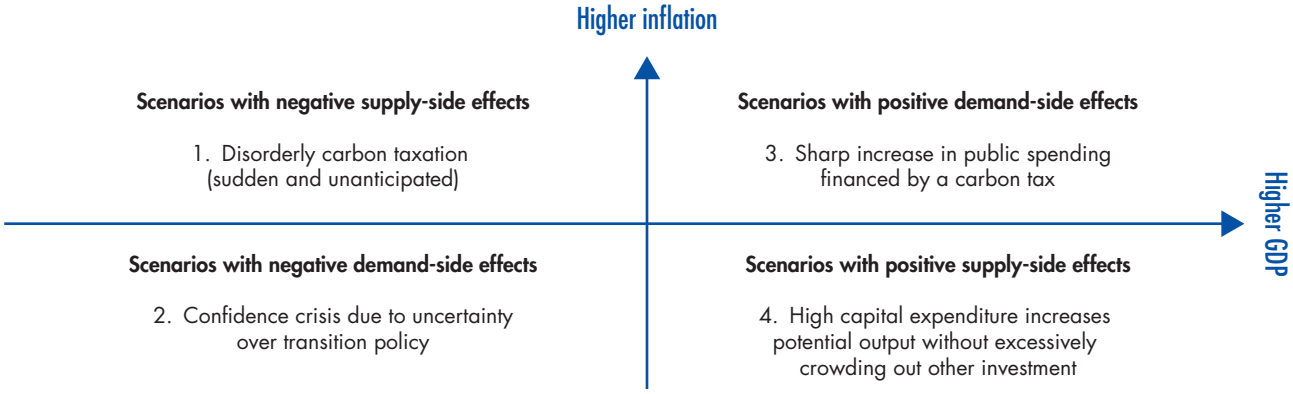
- A second category focuses instead on shocks that can negatively affect demand, and thus lead to deflation (simultaneous decline in inflation and growth). The category is represented here as an uncertainty shock to transition policies (Scenario 2).

- A third category looks at the transition as a succession of positive shocks to demand, triggered for example by sustainable public investments financed by a carbon tax, with a positive effect on growth and inflation (Scenario 3).

- The last category is based on the assumption of an improvement in supply, thanks to elevated private capital expenditure with no crowding out of other investments, which increases output with no inflationary effects (Scenario 4).

4 Coal, gas, fuel oil; in ascending order according to fuel cost at the start of 2023.
5 The "Net Zero 2050" NGFS scenario projects an increase of USD 100 per tonne by 2025.
6 See IEA (2021), "Net Zero by 2050".

Four categories of short and medium-term scenarios



Source: Authors.
Note: The different scenarios are ranked according to their expected impact on inflation and GDP, not according to their emission reduction potential, which is not reflected in the short-term horizon.

The overall effect of the transition on inflation involves combining these different scenarios according to probabilities that are extremely difficult to calculate at this stage, in addition to the uncertainty surrounding technical progress.

These four scenarios have been calibrated to reflect abrupt but plausible transitions – those most likely to create significant effects on activity and prices (see Chart 2). Their impacts on the economy are quantified on the basis of simulations carried out with the FR-BDF model for France and the NiGEM model for the rest of the world (see box for a brief presentation of the models). The effects on GDP and inflation are calculated as deviations from a baseline scenario with no additional transition policies beyond those already implemented.[7]

BOX

Presentation of the models used in the simulations

- The Banque de France model (FR-BDF) is a large semi-structural model, used both for the Eurosystem medium-term projection exercises for France and for the analysis of variants (notably economic policies). This model combines an explicit role for expectations (both for financial and non-financial variables), estimates that are similar to observed data, a variety of financial channels and a balanced growth path towards which it converges in the long run in simulations (see Lemoine et al., 2019, for a detailed description).

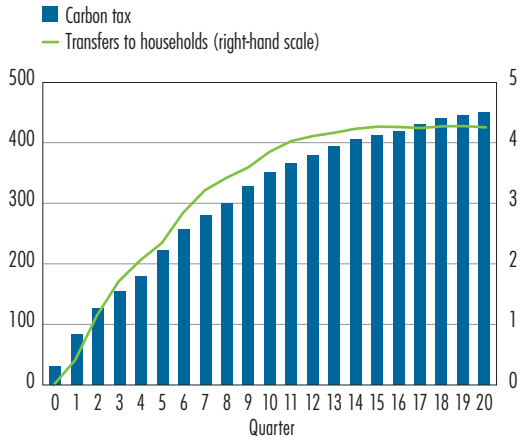
- NiGEM (National Institute Global Econometric Model) is a global macroeconomic model with a neo-Keynesian structure. Each country/region is modelled by a set of dynamic equations where agents are assumed to have rational expectations and where there are nominal rigidities that slow down the process of adjustment to external shocks (see Hantzsche et al., 2018, for a detailed introduction). Although NiGEM is not a climate model, extensions have been added to simulate macroeconomic scenarios analysing the effects of the climate transition, mainly associated with public policy action (e.g. carbon tax or border tax adjustments).

7 For NiGEM deviation from NIESR projections (v2.2022), for FR-BDF deviation from a balanced growth path.

C2 Calibration of shocks corresponding to the four short and medium-term scenarios

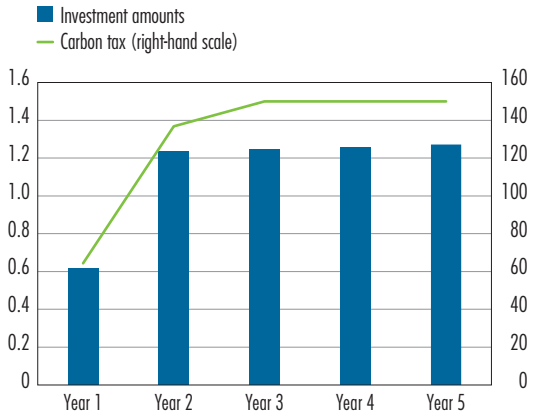
Scenario 1 Carbon tax and transfers to households

(left-hand scale: in constant 2010 USD; right-hand scale: % of GDP; quarterly data)



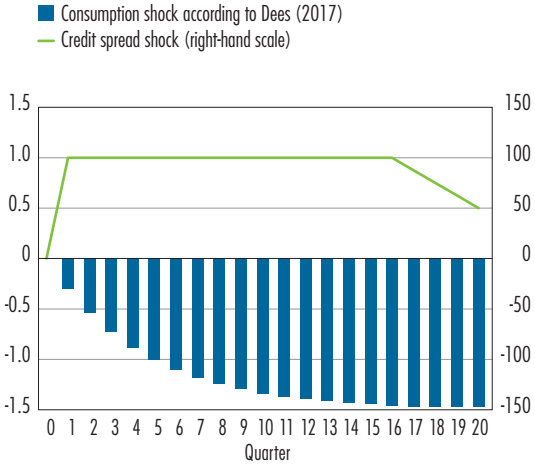
Scenario 3 Public investment financed by a carbon tax

(left-hand scale: % of 2020 GDP; right-hand scale: in constant 2010 USD)



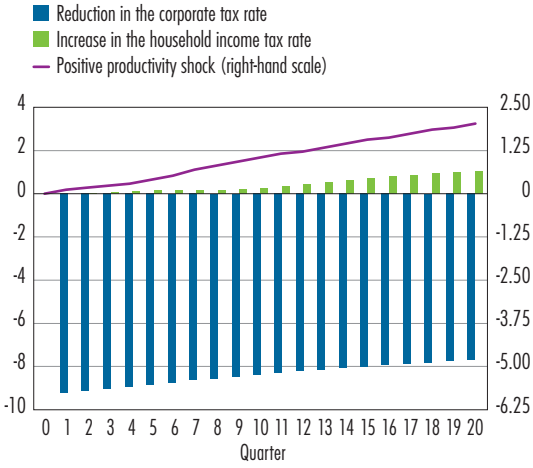
Scenario 2 Uncertainty shock: rise in the cost of corporate credit and decline in household consumption

(left-hand scale: %; right-hand scale: in basis points; quarterly data)



Scenario 4 Private investment: reduction in corporate tax financed by household taxation

(left-hand scale: percentage points; right-hand scale: %; quarterly data)



Source: Authors' calculations.

Quantification of potential effects on inflation in France

Chart 3 below presents the impact of the four types of transition policies on GDP and inflation in France:

- **Scenario 1: Abrupt and unanticipated increase in the price of carbon.** This scenario has been calibrated using the carbon price targets of the NGFS carbon neutral scenarios (here we use the "delayed" carbon neutral scenario) but with a more concentrated and sudden implementation (an increase of USD 400 per tonne in the carbon tax over the first three years). The revenue from this tax is redistributed to households in the form of cash transfers. This scenario leads to a rapid rise in inflation in France of up to 1¾ percentage points in the annual rate in the first year, and of 0.6 percentage point after five years.[8] The effect on

8 In order to moderate the central bank's response in Scenario 1, which is essentially characterised by a supply shock, we use a price-level targeting policy rule instead of the default Taylor rule of NiGEM. The inertia coefficient of the rule is increased (from 0.5 to 0.9), and the sensitivity to the inflation differential reduced (from 0.7 to 0.2). The result is a more gradual increase in policy rates (up to 100 basis points after three years and 140 basis points after five years).

growth is initially neutral, because the negative impact on activity caused by the carbon tax (due to the increase in the price of high-carbon goods and services) is partially offset by a positive effect on household income linked to the redistribution of the tax proceeds in the form of direct transfers. Nevertheless, the impact on activity becomes negative after two years, resulting in a decline in GDP of around 1.2% over five years. This scenario shows that a carbon pricing policy must be progressive to be less inflationary and to limit its impacts on activity.

- **Scenario 2: Temporary increase in uncertainty regarding transition policies.** This scenario combines an increase of 100 basis points in firms' cost of financing in the financial markets and a decrease in household consumption, calibrated according to Dees (2017). This double shock initially reduces aggregate demand (the annual growth rate is reduced by 0.7 percentage point at the beginning of the period) as well as inflation (reduction of up to 0.3 percentage point). The longer the uncertainty over the transition policy, the longer the downward pressures on prices and GDP would last. Nevertheless, after five years, this scenario shows a moderate increase in inflation (0.2 percentage point) and in GDP (0.3%) compared to a trajectory without a transition, thus illustrating the fact that uncertainty about transition policies could translate into volatility in inflation and growth.

- **Scenario 3: Strong increase in public investment financed by a carbon tax.** The increase is calibrated using the additional investment needs of an IEA carbon neutrality scenario tailored by country or region (around EUR 27 billion per year for France), which are assumed to be covered by public expenditure.[9] This public expenditure is financed by a carbon tax which is not set according to the NGFS targets as in Scenario 1, but calculated to cover only the revenues needed to finance public investment.[10] In this scenario, inflation gradually increases up to 1.¾ percentage point higher than in the baseline scenario, but declines in the second year of the simulation horizon due to the productivity gains generated by the investment. These productivity gains have been calibrated according to Bom and Ligthart (2014). The significantly lower carbon tax levels seen in Scenario 3 as compared to Scenario 1 result in a more favourable impact on activity.

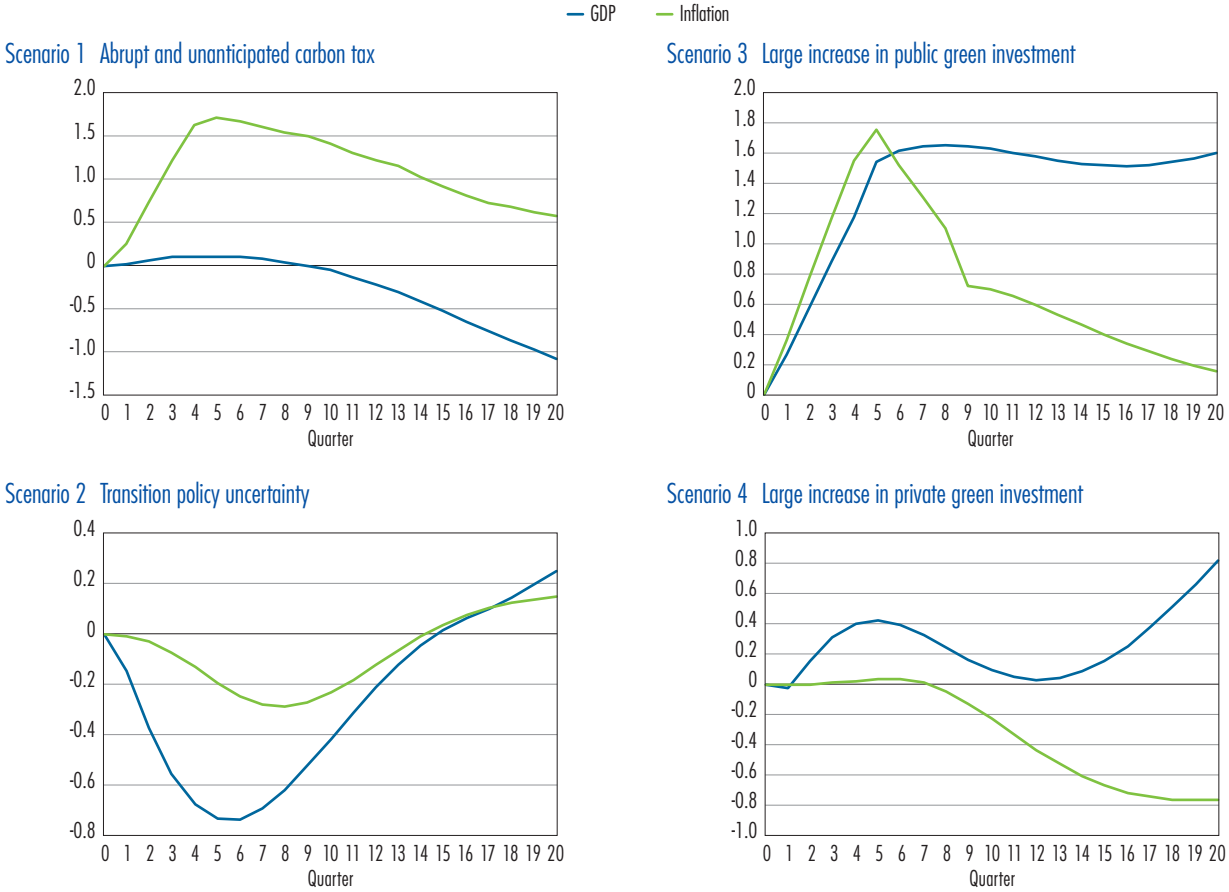
- **Scenario 4: Sharp rise in private investment at the expense of consumption.** The considerable increase in private investment is calibrated according to the same amounts used in Scenario 3. It is the result of tax credits to companies, which are themselves financed by an increase in household income tax (so that the policy is neutral for public finances). The private investment scenario is also based on the same assumptions as in Scenario 3 for the efficiency gains generated by the investments. However, household consumption is reduced here by higher taxation and an incentive to save. The financing of private green investment is thus ensured by the household savings surplus. Such a scenario would be disinflationary and expansionary: France's GDP would be 0.8% higher after five years and inflation would be 0.8 percentage point lower year-on-year.

9 These scenarios are based on the IEA's estimates of additional global annual investment needs in key transition sectors over the period 2020-30 (i.e. USD 2.69 trillion), distributed by regional block according to the latest NGFS estimates for the energy sector over the period 2020-25, and at country level according to a distribution key defined by national emissions levels. For France, the resulting figure of 27 billion 2014 euro is within the range of estimates from Institut Rousseau, I4CE and Rexecode.

10 Under the same monetary policy assumption as Scenario 1, because this scenario also includes a carbon tax shock that is similar to a supply shock. See note 8 for the definition of the monetary policy rule used.

C3 Effects on French inflation and GDP of the four short and medium-term scenarios

(% deviation in GDP and percentage-point deviation in the y-o-y change in the HICP, compared with a baseline scenario without a transition; quarterly data)



Source: Authors' calculations.
Notes: In Scenario 1, the maximum impact on inflation would be +1.7 percentage point after five quarters, year-on-year. It would be slightly less than -1.0% for GDP after 20 quarters.
HICP, Harmonised Index of Consumer Prices.

Challenges for economic policy

The above simulations show that a disorderly transition triggered by a very abrupt (as it is too late) increase in the price of carbon, or too weak a shift to green technologies could be inflationary in the medium term.[11] In contrast, the earlier and more gradually the transition is implemented, the lower the risks to inflation. These different scenarios also illustrate the importance of private and public investment and support for low-income households in limiting the macroeconomic cost of the transition.

If not properly anticipated, the transition to carbon neutrality could also lead to a rapid succession of shocks, increasing price volatility. This increased volatility could disrupt the decisions of economic agents, weaken inflation expectations and therefore constitute a real challenge for the conduct of a monetary policy adapted to the challenges of transition.

11 Few assumptions about productivity gains have been made in these scenarios: none in the carbon tax scenario and relatively conservative assumptions in the investment scenarios.

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