Carbon Tax, Pensions and Public Deficits: The hidden cost of the compartmentalization of expertise

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Abstract

This paper aims at raising attention to two intertwined issues. The first one concerns the consequences of the prevailing intellectual compartmentalization between questions related to energy and climate on the one hand, and to the viability of social security systems on the other (in many industrial countries like France the viability of those systems is challenged by the increasing exposure to international competition and the ageing of the population). The second issue is about the fact that expertise on the funding of pensions are conducted under partial equilibrium analysis and ignore the general equilibrium effects of the various funding options on competitiveness, employment and wages.

We take the methodological venture of building a general equilibrium vision of France for 2020 that is consistent with a scenario of the Conseil d’Orientation des Retraites (the French pension advisory board). We first emphasize the limitations of policies that either i) use only one of the present instruments of the pension system (social security contributions on wage incomes, retirement age), or ii) look for new resources by only considering an increase of income tax or VAT. Then we present a way to remove those limitations by introducing a carbon tax as a component of a policy package designed to absorb the deficits of the social accounts. We show that the current compartmentalization of expertise is dangerous, both for the funding of the pension system as well as for removing the obstacles to an ambitious climate policy.

Keywords

Tax Reform; Pensions; Carbon Tax; Public Deficits; General Equilibrium
1 Introduction

In order to avoid any misunderstanding, we would note from the start that our objective is not to provide a concrete reform scheme for funding the pension systems. Against the background of an ageing population and high exposure to international competition, our aim is to raise attention to the risks of an intellectual compartmentalization between issues related to “climate-energy transitions” on the one hand, and to “the sustainability of social protection systems” on the other.

In France, it was quite remarkable that two recent reports (Quinet, 2008, and Rocard, 2009) have clearly recommended the implementation of a carbon tax, while the following year, the existence of a carbon tax has been totally absent from the forecasting exercises carried out by the French Pension Advisory Board (Le Conseil d’orientation des retraites, the COR). This is even more surprising knowing that many economists has been stressing the importance of linking carbon taxation with the need of funding public and social expenditures (Godard and Beaumais, 1993; Artus, 2004; Aglietta and Jospin, 2010). Beyond the specific case of France, this has been advocated as well in many international reports: from the IPCC (IPCC, 1995, 2001 et 2007), the European Union (EC, 1992, 1994, 2012), the United Nations (PNUE, 2011) and the OECD (OCDE, 1995 and 2011).

This intellectual compartmentalization is also reinforced in the analysis by some methodological choices that are questionable. The work of the COR, like usual analysis of pension systems, is carried out within a partial - not a general - equilibrium framework. While the citizen is wondering how to pay the pension benefits without adversely impacting competitiveness, employment and wages, within the COR’s analysis framework, no funding mechanism affects the macroeconomic state of the country (except, we will see later, the increase of retirement age). Therefore, such an evaluation approach prevents us from detecting the impacts on growth of different contributions patterns of firms, workers and retired, and in particular, reform schemes that include a carbon tax component.

In this paper, we take the methodological venture of building a general equilibrium vision of France for 2020 that is consistent with one forecasting scenario of the COR. First, we show that including this analysis of the pension system into a comprehensive framework that also represents energy and demand constraints allows us to better understand the deadlocks of a “do-nothing” scenario (§ II). Then, we use this framework to precise the limitations of public policies that do not change the structure of the tax system (§ III), and to show how a carbon tax reform may contribute to reduce those difficulties, while removing the obstacles to an ambitious climate policy (§ IV).

2 Introducing a scenario of the pension system into a general equilibrium analysis: A France caught between three constraints

2.1 The issue of pensions from the COR’s perspective, a partial equilibrium analysis

The COR’s assessment report prepared for the last pension reform of Fillon’s government (COR, 2010) gives three forecasting scenarios of the financial needs of the pension system. In the scenario A, the French economy is rapidly catching up the production losses caused by the crisis. On average, over the 2011-2020 period, labor productivity is growing by 2.1% per year - which is
significantly above its long-term trend (1.8%) - but unemployment remains high, although it finally declines at the end of the period (6.4% in 2020). These assumptions correspond to an optimistic view according to which the crisis has no long term effect on potential growth. The two less optimistic scenarios (B and C) put the country on lower growth paths (with weaker labor productivity and higher unemployment).

For each scenario, the resources of the pension system are simply deduced from a projection of the employed labor force and two simplifying assumptions: a constant value-added sharing between operating surpluses and compensations of employees¹, and a constant rate of social security contributions on those compensations². The financial needs of the system are then given by difference with the forecasted expenditures. The forecasts of future pension benefits are made by the main pension schemes and are extrapolated to the whole system by the DRESS³.

Into this purely accounting framework, the issue of pensions is framed only in redistributive terms. A reform - or a business-as-usual scenario - has no effect on production costs, wages, household demand, etc. In the end, those policy choices are almost neutral for activity and employment. This is particularly important since the public debate focuses exactly on those macroeconomic consequences. Besides, it must also be noted that only a postponement of retirement ages mechanically benefits growth by increasing the labour force. Production increases in proportion to this new supply of labour accordingly to a simple calculation: the new number of hours worked is multiplied by a constant total labour productivity parameter. In other words, it is assumed that wages are unaffected and the entire additional labour supply matches a corresponding demand.

Thus, the COR’s scenario helps to assess one of the main macroeconomic constraints the French economy will be facing in the future: a growing financial burden of pensions. But this assessment is made independently from the climate policy constraint (the French “Facteur 4” target which requires dividing by four greenhouse gas emissions by 2050⁴), and also independently from two other important macroeconomic constraints that will develop within the same time horizon:

- An external constraint that combines, on the one hand, the competitive pressure on the goods and services made in France, and on the other hand, the financial pressure on households and firms of higher imported prices of hydrocarbons.

- An internal constraint: a decreasing trend in savings available for investment due to a relative increase of the “dependent” population (the number of people aged over 75 and below 20). Savings and investments compatible with scenario A are not specified neither by the COR nor the Treasury.

Our objective is to show that some diagnosis errors may occur if the mutual interactions between all those constraints and growth are neglected. Omitting those interactions is equivalent to assuming that the economy will continue to rely on external debt to finance pensions and energy

¹ Total gross labour costs, including social contributions of employers and employees.
² In scenario A, compensations of employees amount for to 57.6% of GDP; the rate of social security contributions is 22.0%; the employed labor force is obtained by applying to the active population an unemployment rate of 6.4% in 2020; the number of retired and the levels of retirement benefits are assessed under the hypothesis of constants returns in the main French pensions schemes (“AGIRC” and “ARRCO”).
³ Direction Recherche, Etudes, Evaluation et Statistiques (assessment board of the Ministère des affaires sociales et de la santé).
imports (if fossil energy consumptions remain important). We can introduce this key point independently from any modelling with a simple accounting reasoning.

Let us consider an open economy with balanced external trade (X). Domestic consumption (C) and investment (I) exhaust the gross domestic product (GDP):

\[ \text{GDP} - C - I = X = 0 \]

For stake of simplification, let us also admit that all final energy consumptions are imported (no refining and electric production). This imported energy (Xe) is consumed by households (Ce) and industries (Ci). The previous accounting identity may thus be detailed, with (Cq) standing for non-energy consumptions and (Xq) non-energy exportations:

\[ \text{GDP} - Cq - Ce - I = Xq - Xe \]

Because we assume a balanced trade, exports of goods and services (Xq) must equal imports of energy (Xe). In addition, demand for domestic products and services (Cq + I + Xq) must exceed disposable revenue (GDP) in order to finance the energy bills of industries (Ci):

\[ Cq + I + Xq = \text{GDP} + Ci \]

Now, if we consider an increase in energy prices and if we assume that the “fundamentals of the economy” are the same (volumes of energy consumption, non-energy consumption, investment and exports), then we have two implied consequences. On the one hand, national disposable income decreases (\( \Delta \text{GDP} = -\Delta Ci \)): with a same production the higher energy costs of industries must be financed. On the other hand, the heavier energy bill reduces the available savings (\( \Delta [\text{GDP} - C - Ce] = -\Delta Xe \)) and the deterioration of the current account balance leads to higher external deficit and debt.

Of course, this simple reasoning says nothing about the mechanisms through which the two constraints of energy dependence and social security and pensions funding interact. But it shows the importance to deepen the analysis of those macroeconomic interactions.

### 2.2 Towards a comprehensive macroeconomic analysis

We have used a version of the IMACLIM model that has been developed to evaluate the socioeconomic impacts of a carbon tax reform in France (Combet, 2013). This modelling depicts an open-economy with four types of agents (households disaggregated into twenty income classes, firms, public administrations, and the ‘rest-of-the-world’) and four products (crude oil, fuels for transportation, other energies for housing and a ‘composite’ of non-energy goods and services).

Our objective was to build a comprehensive macroeconomic picture of France for 2020 that is compatible with the COR’s scenario A. Starting from a consistent dataset for a given base year (in what follows, 2004), such a projection may be built if one have sufficient information to describe all the accounting identities of a general equilibrium\(^5\). The COR’s scenario gives us the future levels of

\(^5\) Details about the projection method, the IMACLIM version, data, and results are available in technical appendices: [http://www.imaclim.centre-cired.fr/spip.php?article=316](http://www.imaclim.centre-cired.fr/spip.php?article=316).
gross domestic product, wages, social security contributions, and retirement benefits. But we have to specify final demand (domestic savings, investment, external trade), foreign capital required to realize the COR’s GDP, and the future levels of households and firms’ energy consumptions.

A comprehensive macroeconomic table is completed by importing data from other studies. Those data and the corresponding sources are summarized in table Tableau 1. This table displays a vision of the future constraints the French economy will be facing in 2020. Even if those data come from quality studies they have been arbitrarily chosen among various possible scenarios (other quantitative visions of the future could thus be defended as well). In what follows, we will neglect uncertainties about the future, for our goal in this paper is essentially heuristic: to discuss the methodology for and the usefulness of linking various issues of public finance reform. But those uncertainties are important and must be the objective of future applied exercises. What matters here is 1) to get a quantitative picture for 2020 that is consistent with explicit assumptions, and 2) to shed light on the mutual interactions between demand, energy and demographic constraints.

<table>
<thead>
<tr>
<th>Financial tensions heightened by the demographic transition</th>
<th>2004 to 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old-age dependency ratio	extsuperscript{a} (COR, 2012)</td>
<td>+29%</td>
</tr>
<tr>
<td>Retirement benefits (COR, 2012)</td>
<td>+215%</td>
</tr>
<tr>
<td>Household saving rate	extsuperscript{b}</td>
<td>-37%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tensions on international markets and energy resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil import price</td>
</tr>
<tr>
<td>Price-competitiveness of domestic productions</td>
</tr>
</tbody>
</table>

Limited energy saving opportunities and technical change possibilities\textsuperscript{e}

\textbf{Note:} This table displays only the main assumptions. More details are given in technical appendices: [http://www.imaclim.centre-cired.fr/spip.php?article=316](http://www.imaclim.centre-cired.fr/spip.php?article=316).

\textsuperscript{a} Old-age dependency ratio is the ratio of the number of retirees to the number of active people.

\textsuperscript{b} This trend in saving rate come from a simulation made by Aglietta et Borgy (2008, page 25-26) in the case of a business-as-usual scenario without pension reform.

\textsuperscript{c} Which is equivalent to an oil import price of 60€ per barrel (scenario from Bibas et al., 2012).

\textsuperscript{d} Ratio of the price of production of the French composite good to the price of the foreign composite good: simulation drawn from the IMACLIM-R World model used for the Energy Modeling Forum.

\textsuperscript{e} Scenario simulated with the IMACLIM-R-France model that represent explicitly technical inertia. This scenario gives the energy consumption levels and the CO\textsubscript{2} emission coefficients for households and firms in 2020. No ambitious climate policy is assumed at global level, and no large infrastructure policy is assumed at national level (building renovation, collective transportation, rail and river freight).

**Tableau 1 Key assumptions about the future French context (2020)**

Three parameters are determinant for the calculation of the trade balance and the needs for foreign capital. The first two are coming from scenarios built for the Energy Modeling Forum (Bibas et al., 2012): a 95% increase in the import price of oil relative to its 2004 level and a 0.5% increase in the ratio between the French and foreign non-energy production prices (the progression of labour costs is higher in France than in the rest-of-the-world due to the higher burden of dependent populations). The third parameter – a 37% decrease in the household saving rate – comes from Aglietta et Borgy (2008).
Under those assumptions, the national agents’ incomes and expenditures are almost given. An additional hypothesis about the level of investment is made to complete the 2020 national accounts. We assume this level being proportional to the capital intensity and the level of production (we keep the 1.5 proportional coefficient observed in 2004). Then, the calculation of the trade balance for non-energy goods and services balances the domestic supply of composite products. Given the level of domestic savings, foreign capital flows balance the financial needs of the investment. Lastly, the financial positions of agents display the net accounting counterpart of their loans/borrowings assuming that all assets/liabilities are accrued linearly over the 2004-2020 period.

The corresponding projected national accounts are given in table Tableau 2.

<table>
<thead>
<tr>
<th>Billions euros</th>
<th>Private agents</th>
<th>Administrations</th>
<th>Rest-of-the-world</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade balance</td>
<td></td>
<td></td>
<td>78</td>
</tr>
<tr>
<td>Energy</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Other goods and services</td>
<td>-</td>
<td>-</td>
<td>227</td>
</tr>
<tr>
<td>Gross operating surpluses</td>
<td>632</td>
<td>62</td>
<td>-</td>
</tr>
<tr>
<td>Compensations of employees</td>
<td>1 100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Taxes minus subventions on production and indirect taxation</td>
<td>-</td>
<td>364</td>
<td>-</td>
</tr>
<tr>
<td>Social contributions</td>
<td>-</td>
<td>311</td>
<td>-</td>
</tr>
<tr>
<td>Primary incomes</td>
<td>1 732</td>
<td>737</td>
<td>305</td>
</tr>
<tr>
<td>Property incomes</td>
<td>57</td>
<td>-336</td>
<td>279</td>
</tr>
<tr>
<td>Social transfers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td>36</td>
<td>-36</td>
<td>-</td>
</tr>
<tr>
<td>Retirement</td>
<td>352</td>
<td>-352</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>174</td>
<td>-174</td>
<td>-</td>
</tr>
<tr>
<td>Other transfers</td>
<td>6</td>
<td>-22</td>
<td>16</td>
</tr>
<tr>
<td>Direct taxation</td>
<td>-292</td>
<td>292</td>
<td>-</td>
</tr>
<tr>
<td>Gross disposable income</td>
<td>2 064</td>
<td>110</td>
<td>600</td>
</tr>
<tr>
<td>Consumption</td>
<td>1 646</td>
<td>620</td>
<td>-</td>
</tr>
<tr>
<td>Gross fixed capital formation</td>
<td>431</td>
<td>77</td>
<td>-</td>
</tr>
<tr>
<td>Expenditures on final use</td>
<td>2 077</td>
<td>696</td>
<td>-</td>
</tr>
<tr>
<td>Self-financing capacity</td>
<td>-13</td>
<td>-587</td>
<td>600</td>
</tr>
<tr>
<td>Net financial position</td>
<td>1 166</td>
<td>-6 251</td>
<td>5 085</td>
</tr>
</tbody>
</table>

* Without reform, the mean tax rates remain at their 2004 levels.

** The gross domestic product is equal to the sum of primary incomes of private agents and administrations.

* The property income transfers reflect the trends in agents’ net financial position. For public administrations, this encompasses payment of debt service.

* Social transfers evolve proportionally to the numbers of unemployed, retired and the total population (accordingly to the COR’s assumptions). The mean level of retirement benefits is available in COR’s data. The other levels of social benefits follow the progression of wages.


Tableau 2  Comprehensive macroeconomic accounts for France in 2020
2.3 A long-term trend towards higher debt: the role of energy and savings deficit

The projected macroeconomic accounts resulting from this exercise display higher public deficits and social transfers (respectively 24% and 23% of GDP). Due to the optimistic assumptions of the COR’s scenario A, unemployment benefits weight only 1.5% of GDP. Nevertheless, this is more than offset by the rise of retirement benefits (reaching 14% of GDP).

The key element in this scenario is the great national debt increase (it reaches twice the level of GDP)\(^6\). The important inflow of foreign capital results from two contextual elements. On the one hand, export surpluses of non-energy goods and services are not sufficient to finance the higher energy bill (3.2% of GDP). On the other hand, available domestic savings do not meet the needs of productive investment. But this high level of debt does not constrain the economy to growth at a slower pace than the one assumed in the COR’s scenario A. In this calculation the country can further rely on debt to pay his debt (creditors do not impose an absolute limit on the level of national debt).

Of course, this last assumption seems unrealistic\(^7\). But it is a convenient one to make in order to identify the orders of magnitude of the imbalances that could result from a “do-nothing” scenario.

In fact, compared to this do-nothing scenario, each of the simulated reform schemes will trigger three mechanisms according to equations that describe the behaviours of productive systems, domestic agents, the labour market and the globalised product and financial markets (Figure 1).

\[^6\text{Recall that we are talking about an extreme case (and unrealistic) where no reform at all is implemented. It is assumed also that the debt of private and public institutions do not alter their behaviours at the time horizon considered. In other words, we assume that those players are “myopic”: the levels of their debts impact neither the household saving rates nor the firms’ investment decisions. Those two variables (saving and investment) only depend on growth and demographic assumptions.}\]

\[^7\text{Typically, econometric studies shows that economic growth is significantly reduced when the ratio of public debt to GDP exceeds 90\% (Reinhart and Rogoff, 2010).}\]
1. Changes in production costs will affect the trade balance and the level of domestic demand if those changes result from an adjustment of wages. Therefore, the composite price of non-energy products and services will be impacted by any change in the share of taxation bearing on production costs, but also by any policies that will impact the level of investment (assumption of "induced technical change"), the level of production (assumption of "static decreasing returns"), and the level of employment (assumption of a sensitivity of wages to the level of the unemployment).

2. Changes in the oil bill to GDP ratio will impact the purchasing power of households and will affect the capacity of the country to control its trade balance and debt. The introduction of energy-carbon taxation will incite energy efficiency and the penetration of renewable energies according to an estimation of technical change possibilities coming from the IMACLIM-R model. This model represents explicitly energy production techniques and equipments, cf. Bibas et al. (2012). By 2020, the prices-elasticities of the household consumption of fuel and housing energy are -0.57 and -1.03, and the corresponding income-elasticities +0.29 and +0.52. But these elasticities decrease when the level of energy consumptions became close to some levels of “basic energy needs”.

3. A structural change will modify the labour and energy intensities in production accordingly to changes in the relative cost of labour and the other relative costs of inputs. We are talking about structural change because, at this level of aggregation, substitution between labour and energy encompass both technical change within industries and the relative weights of industries within the whole production structure of the economy. We use here an aggregated substitution elasticity of +1.2. But again, technical inertia is modelled by the existence of constant minimum levels of inputs consumption (not responsive at all to relative prices or any other economic signals).

3 Funding plans without tax reform: some hopes partially disappointed

Two solutions are put forward in order to avoid both the deadlocks of a do-nothing scenario and the difficulties of a process of tax reform: an increase in retirement ages (IRA) and a decrease in public spendings (DPS). The former has been favoured in the previous French reforms, while the latter is more and more advocated in order to reduce deficits, and to offset the rise in other public expenditures, including social and retirement benefits.

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9 The link between labour costs and competitiveness is sometimes challenged. It is argued that there are many other important determinants of competitiveness: product quality, organization of production and supply chains, workers’ training, management etc. This is an argument against the idea that any improvement of competitiveness requires wage moderation, while such moderation has a recessionary impact on final demand. This argument is of course valid. Nevertheless, it does not change the fact that competitiveness will be affected by higher labour costs under any set of assumptions about those determinants of productivity.

10 In what follows, we will not consider the impact of such a reform neither on the activity behaviours of workers nor on the date of their retirement. Those consequences are studied in micro-simulations models (in France, the COR use the DESTINI model). We will not make any distinction between effective and legal ages of retirement. Therefore, any increase in the retirement age will trigger mechanically a corresponding decrease in the proportion of retired people.

10 Under the presidency of N. Sarkozy (the 2010 Fillon’s reform), but also for the 1993 Balladur’s reform (an increase in the length of the contribution period from 150 to 160 quarters to get the full benefit rate) and the 2003 Fillon’s reform (implementation of a discount rate for missing years of contribution and a premium rate for additional years).
3.1 Increase in the retirement age

The COR estimates that balancing the budget of the pension system until 2020 by using only this lever would require “an increase of more than 3 years in the average retirement age (compared to 2008)” (COR, 2010, page 46).

Within the COR’s modelling framework, a larger active population (here, 4.8% larger) is the only way to boost economic growth: with constant unemployment rate and productivity, the additional labour supply increases mechanically production. But this implicitly assumes a comparable increase in domestic demand and exports, and therefore in labour demand (Chérèque et al., 2010).

This measure is equivalent to a 13% increase in the demographic ratio (labor force / retirees)\(^{11}\). In order to test the impact of a labour market response to this additional supply of labour (which is far from marginal), we have used a “wage curve” which formalises a certain level of sensitivity of net wages to change in unemployment rate. This formulation may be used, for instance, to represent a balance of power in wage bargaining. Here, we assume a negative elasticity of -10%. In the literature, the value of this parameter is discussed at length, particularly with regards to the long run (Blanchet, 2003). Despite the uncertainty, our particular assumption is enough to illustrate our point: it is neither certain nor mechanical that the economic system would be able to absorb this excess supply.

This specification allows us to simulate a de-indexation of wages to consumption prices, and thus it is possible that the reform impact the level of real wages. This specification is convenient for us to model easily an assumption of “wage moderation” in a context of economic crisis, with high energy prices, and increasing exposure to new industrial competitors. This assumption is quite different from the COR’s hypothesis of constant value-added sharing. Under this latter assumption, wages are never affected by any change in the economic conditions or the funding of pensions.

As compared to our do-nothing scenario (with unlimited debt), the increase in the retirement age allows a better control of deficits and debts (Table Tableau 3, « 3 years IRA »). The foreign balance deficit decreases by 9.8%, public deficits by 10.0%, and the public debt to GDP ratio by 4.9%. But this better result has a cost: GDP is 1.4% lower and the unemployment rate 1.4 percentage point higher. Indeed, the reform scheme triggers the following depressive mechanism:

- The additional labour supply pushes down wages (-3.3%).
- This erodes the purchasing power of households, but benefits to price-competitiveness
- The rise of exports (+0.9%) and the lower share of imported goods in consumption (-1.5%) are not sufficient to offset the lower household consumption (-2.4%).
- This depressive effect is not compensated by a structural change towards a higher employment path because the relative prices between labour, capital and energy do not vary much.

Therefore, the additional labour supply is only partially absorbed. The potential increase in domestic production is not released and only 79% of the social debt is funded. The increase in the retirement age must be higher to reach 100% (Tableau 3, « IRA > 3 years »). In this case, we see an improvement in the trade balance deficit (-7.2%) and in the debt repayments (-18.3%). But the

\(^{11}\) This equivalence is given by the accounting equation describing the financing of pension schemes (COR, 2006, page 49).
previous depressive mechanism is stronger. It leads to a higher contraction of wages (-4.2%) and a higher erosion of household consumption (-3.2%). Consequently, GDP is 1.9% lower and unemployment is 1.8 percentage point higher than in the case of the do-nothing scenario.

<table>
<thead>
<tr>
<th>Reform scheme</th>
<th>3 years IRA</th>
<th>IRA &gt; 3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding of pension deficits over 2011-2020</td>
<td>79%</td>
<td>100%</td>
</tr>
<tr>
<td>Demographic ratio</td>
<td>+13%</td>
<td>+17%</td>
</tr>
<tr>
<td>CO₂ emissions</td>
<td>-1.5%</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Real gross domestic product</td>
<td>-1.4%*</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Unemployment rate (% points)</td>
<td>+1.4**</td>
<td>+1.8</td>
</tr>
<tr>
<td>Labour intensity of composite production</td>
<td>+0.0%</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Oil bill to GDP ratio</td>
<td>+1.9%</td>
<td>+2.4%</td>
</tr>
<tr>
<td>Composite household consumption</td>
<td>-2.4%</td>
<td>-3.2%</td>
</tr>
<tr>
<td>Composite production price</td>
<td>-1.7%</td>
<td>-2.1%</td>
</tr>
<tr>
<td>Exported volumes of composite goods</td>
<td>+0.9%</td>
<td>+1.2%</td>
</tr>
<tr>
<td>Imported proportion of composite goods</td>
<td>-1.5%</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Trade balance deficit</td>
<td>-5.6%</td>
<td>-7.2%</td>
</tr>
<tr>
<td>Net nominal wages</td>
<td>-3.3%***</td>
<td>-4.2%</td>
</tr>
<tr>
<td>Public debt to GDP ratio</td>
<td>-4.9%</td>
<td>-6.2%</td>
</tr>
<tr>
<td>National debt to GDP ratio</td>
<td>-6.7%</td>
<td>-8.5%</td>
</tr>
<tr>
<td>National debt repayments</td>
<td>-14.6%</td>
<td>-18.3%</td>
</tr>
</tbody>
</table>

Note: results are expressed relatively to the 2020 situation resulting from the do-nothing scenario.

* A 1.4% decrease in GDP in 2020 as compared to the do-nothing situation is equivalent to a 0.12 variation point of annual growth over the 2004-2020 period, which corresponds to slightly more than a five month delay in growth.

** A 1.4 point higher unemployment is equivalent to a 1.8 point reduction of employment since 2004 (from 9.6% to 7.8%), or to a mean job creation of about 22 000 jobs per year.

*** A 3.3% decrease in the purchasing power of employees is equivalent to a 0.29 point variation of the annual growth rate over the 2004-2020 period, which corresponds to about a nine month delay in wage development.

Tableau 3  Macroeconomic impacts of an increase in the retirement age (IRA) as compared to the do-nothing scenario (without reform)

We can always discuss this pessimistic conclusion arguing that an effective extension of the working period will produce some important productivity gains (higher qualifications, improved organisation of production, and better accumulation of work experience). It should nonetheless be noted that additional conditions are necessary in order to actually foster employment and to resolve the issue of pensions through an increase in the retirement age.

3.2 Decrease in public spending

The choice of decreasing public spending has something to do with the valuation of the right “weight of the state” and the assessment of the relative efficiency of public and private expenditures
with respect to social Welfare. We will debate here on the “cost of public funds”\textsuperscript{12}. A cost-beneficie analysis on this issue would have to balance the expected entrepreneurial gains arising from a reduction of the whole tax burden, against the productivity losses due to fewer public resources devoted to R&D, the development of new sectors (Bompard, 2009), education (Askénazy, 2011), health and public infrastructure (Glomm et Ravikumar, 1992). In what follows, we will simply assume that all those long term impacts offset.

Under those hypotheses, the volume of public expenditures\textsuperscript{13} must be reduced by 6.1% to fund pensions over the period (Table Tableau 4). The impacts on activity and employment are very similar to those triggered by an increase in the retirement age. As compared to the COR’s scenario A, GDP and unemployment are slightly less affected (-1.7% against -1.9%, and +1.7 against +1.8 point).

<table>
<thead>
<tr>
<th>Budgetary objective</th>
<th>Funding the pension deficit over the 2011-2020 period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reform scheme</td>
<td>IRA &gt; 3 years</td>
</tr>
<tr>
<td>Demographic ratio</td>
<td>+17%</td>
</tr>
<tr>
<td>Volume of public expenditures</td>
<td>id.</td>
</tr>
<tr>
<td>CO₂ emissions</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Real gross domestic product</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Unemployment rate (% points)</td>
<td>+1.8</td>
</tr>
<tr>
<td>Labour intensity of composite production</td>
<td>+0.0%</td>
</tr>
<tr>
<td>Oil bill to GDP ratio</td>
<td>+2.4%</td>
</tr>
<tr>
<td>Composite household consumption</td>
<td>-3.2%</td>
</tr>
<tr>
<td>Composite production price</td>
<td>-2.1%</td>
</tr>
<tr>
<td>Exported volumes of composite goods</td>
<td>+1.2%</td>
</tr>
<tr>
<td>Imported proportion of composite goods</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Trade balance deficit</td>
<td>-7.2%</td>
</tr>
<tr>
<td>Net nominal wages</td>
<td>-4.2%</td>
</tr>
<tr>
<td>Public debt to GDP ratio</td>
<td>-6.2%</td>
</tr>
<tr>
<td>National debt to GDP ratio</td>
<td>-8.5%</td>
</tr>
<tr>
<td>National debt repayments</td>
<td>-18.3%</td>
</tr>
</tbody>
</table>

Note: results are expressed relatively to the 2020 situation resulting from the do-nothing scenario.

Tableau 4 Macroeconomic impacts of a decrease in public spending (DPS) as compared to the do-nothing scenario (without reform)

A sustainable reduction of public expenditures has a depressive impact on effective demand. But this contraction of activity affects less employment than in the case of an increase in the retirement age. Here, a higher proportion of the population leaves the labour market and the

\textsuperscript{12} The ambiguity of this concept has been discussed in the context of France by Guesnerie (2007).

\textsuperscript{13} With a constant proportion between current consumption and investment in the public budget.
downward pressure on wages is lower. Consequently, the purchasing power of households and private consumption are less impacted. But higher wages means also higher production costs, and lower trade performance.

Hence, in the model, the results are slightly better with a decrease in public spending than with an increase in the retirement age. But those results are qualitatively not very different. Nevertheless, one must keep in mind that this comparison implicitly assumes the development of private structures able to produce collective services at a comparable quality/cost ratio. This is of course required to maintain global productivity and ensure social cohesion.

4 Carbon taxation as a leverage to unlock a well-established situation

We are facing true limits when we try to fund pensions without reforming the tax system. But we know as well the serious difficulties we encounter when we try to follow this path: higher social contributions may favour undeclared work, higher VAT rates may have strong distributional impacts, higher income taxation may worsen tax evasion. Those arguments are sufficiently well-know and it is not necessary to insist here any further. But surely, the fact that discussions on tax reform are locked in public debate is a major problem for collective action. Here, we aim to show that carbon taxation could help providing new room for maneuver.

4.1 A potential for economic synergy

To reach this conclusion let us compare three different options of pension system funding (all of them bridge the financial gap evaluated in the COR’s scenario A)\(^\text{14}\):

1. An increase in the retirement age (the previous “IRA > 3 years” scheme);
2. An increase in employers and employees social security contributions on labour income (SSC), which is after all the natural solution within the current system;
3. A comprehensive carbon tax reform: a carbon tax that gradually increases to reach 200€/tCO\(_2\) in 2020 and whose revenue is used as partial substitute for SSC. The remaining deficit of the pension system is filled with an increase in income tax (IT).

According to the economic literature, the best way to achieve CO\(_2\) emissions reductions at the lowest possible cost is to implement a carbon tax and to use its revenue to reduce some existing distorsive tax, in the European context labour tax\(^\text{15}\). We will not discuss here the theoretical questionings about the possibility to get a “strong double dividend”: a net economic gain for activity and employment. It would be necessary to discuss the reasons why a reallocation of the tax burden away from labour has not been implemented before, independently from a climate policy. And why

\textit{In our model the impacts of higher VAT rates are very similar to the impacts of higher income tax (IT). We thus only present the impact of higher IT. To capture the specifics of higher VAT, a model must have a greater number of different goods and services. This would have taken us too far from our objective to show that the current compartmentalization of expertise has a cost.}

\textit{See the first and second IPCC reports (IPCC, 1995, 2001).}
this has not been done without resorting to energy tax\textsuperscript{16} (Guesnerie, 2010, p. 35-37). Notwithstanding this theoretical debate, two important questions remain: do we want to reduce our CO\textsubscript{2} emissions and energy dependence? And if the answer is yes, how should we introduce a carbon tax component? In which general tax and benefit system?

Figure 2 gives an overview of the results. It shows the comparison of the two usual reforms of the pension system with the comprehensive carbon tax reform. Not surprisingly, we see that the increase in social security contributions is the most costly reform scheme for activity, wages and employment. More surprisingly, we observe that the comprehensive scheme that includes a carbon tax, decreases SSC (-7 points) and increase IT (+2 points), is better, not only with regards to the environmental indicator, but also regarding the three other economic indicators.

Note: the three tax reforms fund the deficit of the pension system over the 2004-2020 period. Results are expressed relatively to the 2020 situation resulting from the do-nothing scenario. ("IRA > 3 years").

Figure 2 Carbon tax reform: potential room for a no-regret action

In view of these results, the reader may feel uncomfortable as he would need some time to assess and fully understand the numerical model from which those results are drawn. We shall detail the economic mechanisms involved in a minute. At this point, we just want to use this overview of the results to introduce our main conclusion. These results well illustrate the fact that analysing independently the design of a climate policy and the one hand, and the design of a pension reform on the other, may deprive us from identifying potential synergies or antinomies between objectives. This is true from the perspective of funding social security systems. But this true as well with regard to the objective to contribute to the mitigation of CO\textsubscript{2} emission and climate change.

Of course, only the scheme that includes a carbon tax allows the French economy to follow a path compatible with the French “Facteur 4” objective, which implies a volume of CO\textsubscript{2} emissions below 317 MtCO\textsubscript{2} en 2050 (a 19% decrease since 2008)\textsuperscript{17}. In the “IRA > 3 years” and “SSC” scenarios,

\textsuperscript{16} Theoretically, the best option would be to substitute income tax for labour tax. Given a same labour tax reduction (-7.0%), we would get a slightly higher consumption level (+0.5%) and lower employment rate (-0.2 percentage point). But this good result comes at a cost of higher trade deficit (+4.0%), as the oil bill is much heavier (+20.1%). In addition, the mean increase in IT must reach +3 points (1 point more than with a carbon tax component). The increase should be even higher at high income levels, if lower and middle classes have to be preserved.

\textsuperscript{17} This climate objective has been enshrined in the French law the 13\textsuperscript{th} of July, 2005 (Syrota report, 2008).
the deficits of CO\textsubscript{2} emissions reduction are respectively 215 and 219 MtCO\textsubscript{2}. The level of emissions would be 68\% higher than the target. But an ambitious environmental tax reform will not be implemented if it jeopardizes the attainment of other socioeconomic objectives. In other worlds, the success of an environmental transition depends on its acceptability with regard to those other public policy dimensions. For instance, we will see below that a carbon tax that is not compensated by a reduction of other tax on production costs (like SSC) would have too negative impacts for households and businesses. The higher energy bills would spread from one sector to another, leading to a general price increase. This would adversely impact both the purchasing power of households and the competitiveness of domestic productions. Implementing a carbon tax component in this way would be equivalent to achieve a CO\textsubscript{2} reduction target at a much higher economic cost\textsuperscript{18}. The risks of too costly and badly-designed climate policies constitute, in our opinion, the main obstacle to the necessary long-term rise of carbon price signals.

4.2 Understanding the mechanism of synergy

As we shall see the different components of the comprehensive tax reform contribute to reinforce the three positive mechanisms that determine the levels of activity and employment. They tend to 1) increase wages while controlling production costs, 2) decrease fossil energy imports, 3) and increase the labour intensity of domestic production.

To understand the mechanisms that generate these results, it is useful to consider the macroeconomic impacts of each tax component separately. We compare each resulting economic situations to the one produced by an increase in retirement age (Tableau 5). In each case, the same targets regarding the funding of the pension system and the national debt are achieved. The household saving rate adjusts to meet the required national debt to GDP ratio.

The result of higher social security contributions (SSC) is hardly surprising: the rate increase should reach 7.2 points to fund social benefits, the cost of production increases by 2.3\%, and the price of the composite good rises greatly. This higher domestic price induces: 1) a decline in net exports (-1.2\%), 2) a rise in the import proportion of products in domestic markets (-2.0\%)\textsuperscript{19}, and 3) a reduction in the purchasing power of households. With the assumption of stringent competitiveness constraint, the resulting contraction of demand is increased by a downward pressure on net wages (-4.7\%). This affects strongly the purchasing power of households and their consumption (even if the latter only decreases by 1.7\%). Consumption is indeed sustained both by social transfers that are indexed on prices, and non-wage incomes that are less affected. As a result, activity and especially employment deteriorate faster as compared to the retirement age scenario (-2.1\% of GDP and +2.2 points of unemployment).

\textsuperscript{18} For instance, in our model, a same emission reduction target can also be reached with a non-recycled 200\$/tCO\textsubscript{2} carbon tax in 2020. But in this case the resulting GDP is 1.0\% lower, unemployment 1.3 point higher, net wages and household consumption 3.2\% and 0.2\% lower, and the public and national debts to GDP ratios 2.4\% and 4.2\% higher.

\textsuperscript{19} The moderate deterioration of the trade balance we observe in table 5 may surprise the reader. Indeed, the country exports a composite production at higher price compared to the retirement age scenario (IRA > 3 years).
Budgetary objective | Funding the pension deficit over the 2011-2020 period
--- | --- | --- | --- | ---
Reform scheme | SSC | CT | IT | CT/DSSC & IT
--- | --- | --- | --- | ---
Rates adjustments | +7.2 pts | 709 €/tCO$_2$ | +1.4 pts | 200 €/tCO$_2$ -7.0 pts (SC) +2.0 pts (IT)
Household saving rate | -0.0 pts | +0.3 pts | +0.0 pts | 0.2 pts
CO$_2$ emissions | -0.8% | -54.7% | +0.1% | -27.7%
Real gross domestic product | -2.1% | -4.4%* | +0.1% | +0.4%
Unemployment rate (% points) | +2.2 pts | +1.3 pts | -0.1 pts | -1.9 pts
Labour intensity of composite production | -0.3% | +1.2% | -0.0% | +0.9%
Oil bill to GDP ratio | -1.1% | -28.9% | -0.0% | -17.2%
Composite household consumption | -1.7% | -2.5% | +0.1% | +1.3%
Composite production price | +2.3% | +3.7% | +0.1% | +0.1%
Exported volumes of composite goods | -1.2% | -1.9% | -0.0% | -0.1%
Imported proportion of composite goods | +2.0% | +3.3% | +0.1% | +0.1%
Trade balance deficit | -1.0% | -9.0% | 0.2% | -2.6%
Net nominal wages | -4.7% | -2.8% | +0.1% | +4.8%
Public debt to GDP ratio | id. | id. | id. | id.
National debt to GDP ratio | id. | id. | id. | id.

CT: implementation of a carbon tax; SSC: increase in the rate of social security contribution; IT: increase in income tax.
Note: results are expressed relatively to the 2020 situation resulting from the increase in the retirement age scenario (more than three years increase required to fund the pension system over the period. "IRA > 3 years" scheme).

Tableau 5  
Macroeconomic impacts of four different tax reform schemes as compared to the increase in the retirement age scenario (IRA > 3 years)

A carbon tax not compensated by lower labour tax (CT scheme) weights even more heavily on activity (-4.4% of GDP). This highly negative impact results from a strong increase in production costs (+3.7%), which is primarily due to the high level of carbon tax that is required to fund social benefits (709€/tCO$_2$). The resulting depressive consequences on demand and production are neither offset by the significant reduction of the oil bill (-28.9%) nor by the slight increase in labour intensity (+1.2%).

Nevertheless, in comparison with the SSC scheme, the constancy of social security contributions favours a better control of labour costs (they increase less than capital and energy costs). As a result, the CT scheme benefits more labour-intensive sectors and employment (+1.3 point of unemployment, against +2.2 with the SSC scheme). The constancy of social security contributions also allows a smaller contraction of net wages (-2.4% against -4.7%). But those two positive effects do not offset the negative impacts of higher fuel prices (187%) and other energy prices (108%)$^{21}$:

$^{20}$ The profitability of high labour intensive sectors increases in comparison to the profitability of high energy intensive sectors.

$^{21}$ The ex ante impact of the carbon tax on fuel prices is higher because the energy aggregate used in buildings (for residential and tertiary uses) includes a share of electricity that is not taxed.
- The purchasing power of households decreases. The budget share of energy is multiplied by 1.5 and the household saving rate must increase by 0.3 point to achieve the same level of national debt to GDP ratio (as compared to the increase in the retirement age scenario).

- The trade balance of non-energy goods and services is deteriorated. The burden of energy bills on the production cost of composite good doubles. Exports decrease by 1.9% and the share of imported products in final demand by 3.3%.

The high level the carbon tax must reach exacerbates those negative impacts (709€/tCO₂). This high rate is required to bridge the financial gap of the pension system solely with carbon tax revenue. But at such a high rate, we enter an area where the “decarbonisation potentials” of the economy are saturated²² (Figure 3). The negative impacts of higher prices are therefore magnified.

![Figure 3](image-url)

**Figure 3** Changes in the CO₂ content of growth, as compared to 2004, by level of non-recycled carbon tax reached in 2020 (0 to 1000€/tCO₂)

Compared to the two previous options, the macroeconomic impacts of an increase in income tax (IT) are superior. Those impacts are rather similar to the ones resulting from the “IRA > 3 years” scheme (+0.1% of GDP, -0.1 point of unemployment)²³. But in this case, we have a smaller variation of the composite price (+0.1%) because the tax burden on production costs is alleviated. Consequently, exports and imports are almost the same as in the “IRA > 3 years” scenario, while the whole demand for domestic products is slightly higher. This results from the fact that the negative impact of higher IT on disposable incomes and household consumption is more than offset by the positive consequence of higher net wages (+0.1%). The balance of power in wage bargaining benefits workers because the number of job seekers is smaller compared to the scenario where the age of retirement is higher (“IRA > 3 years”). At last, household consumption and GDP are greater (+0.1%).

²² The possibility of describing those saturation levels is one of the main feature of ‘hybrid’ models (Ghersi and Hourcade, 2006).

²³ As noted before, we get very similar results with an increase of VAT or IT in our model. In particular, the impacts of higher IT on labour supply are not modelled, neither are the impacts of higher VAT on the relative competitiveness of sectors. An increase in VAT gives a slightly better result, because it benefits more household consumption (+0.4% against +0.1%). This favorable effect is not outweighed by lower trade performances (+1.0% against +0.6%).
The superior performance of the comprehensive tax reform («CT/DSSC & IT ») results from a combination of the three positive mechanisms we have seen before:

1. The implementation of the recycled carbon tax allows a 7 points reduction in the rate of social security contributions. The tax burden on production costs is alleviated as a whole. Indeed, part of the carbon tax is ultimately paid by non-wage incomes\textsuperscript{24}. Thus, the production cost of composite good is hardly higher compared to the retirement age scenario (+0.1% more). In fact, this increase is due to the faster wage progression (+4.8\%)\textsuperscript{25} which has positive impact.

2. The control of production costs and the progression of net wages benefit the demand for domestic production. The external trade balance of composite products is hardly impacted, while the purchasing power and the consumption of households are greater. The positive consequences of jobs creation and wage progression exceed the negative consequences of energy bills and higher IT.

3. The lower relative price of labour compared to energy gives a stronger incentive to induce a structural change towards a higher employment path. The labour intensity of the production of non-energy goods and services rises (+0.9\%) and the overall burden of oil bills is alleviated (-17.2\%).

From this combination of mechanisms, a virtuous cycle is released. As compared to the “IRA > 3 years” scheme, this comprehensive tax reform allows a conciliation of CO\textsubscript{2} emission reductions (-27.7\%) with lower unemployment (-1.9 point), and higher GDP and consumption (+0.4\% and +1.3\%). The key point here is that decarbonisation potentials are not saturated at this rate of 200€/tCO\textsubscript{2} and higher energy prices are compensated. The benefits of lighter tax burden thus outweigh the costs of heavier energy bills.

5 Conclusion

The objective of this paper was to raise attention to the prevailing intellectual compartmentalization between analyses of the “funding of pensions” on the one hand, and the “energy transition” on the other. Our aim was to show that disregarding the mutual interactions between those policy issues may lead to important diagnostic errors. This has been done by introducing a forecasting scenario of the pension system into a broader general equilibrium picture that includes a description of future constraints on energy and demand. This methodological innovation has allowed us to compare the impacts of various reform schemes of public finance with respect to multiple objectives. On the one hand, this investigation shows that using a “partial equilibrium” setting leads to under-estimate the limitations of the proposed solutions. On the other hand, it shows that we also neglect some room for manoeuvre that are available for responding to the future challenges many industrial countries are facing.

\textsuperscript{24} Part of the carbon tax falls on transfers, property and financial incomes. Of course, some specific sectors, like energy intensive industries, may bear heavier tax burdens. Nevertheless, a majority will gain and the administration may compensate those vulnerable sectors without entailing the whole performance of the tax reform (Bovenberg et al., 2008).

\textsuperscript{25} This faster wage progression makes the higher income taxation more acceptable (+2.0 points against +1.4 in the case of the increase in IT scheme). Overall, the purchasing power and the consumption of households are higher (+1.3\% against +0.1\%).
The result that the solutions proposed to finance social expenditures do not allow the French economy to meet its “Facteur 4” climate target will not disappoint those who are sceptical about the fact that ambitious climate policies are feasible in this time of economic crisis. But those sceptics will notice that all the other non-environmental measures we have considered have significant economic limitations as well (negative impacts on production costs, the purchasing power of wages, domestic demand or international trade). This is true for an increase in retirement age, social security contributions, income tax, and for a decrease in public spendings. This is equally true for a carbon tax whose revenue is directly affected to a deficit reduction, or entirely redistributed through lump sum transfers to consumers (Combet et al., 2010). This last measure is often proposed for the sake of equity, to deal with the adverse distributive consequences of a carbon tax. But the lump sum redistribution of carbon tax revenue will not compensate the negative impacts of higher energy costs for producers, and the general increase in prices will harm competitiveness and employment. Higher social security contributions will nevertheless be the worst solution. It will increase labour and production costs, while restraining energy savings. The profitability of labour-intensive sectors and their expansion will be negatively impacted and hydrocarbon imports will continue to constrain future economic developments.

Those mechanisms explain why a tax reform that includes a carbon-energy component and uses its revenue to reduce the tax burden on labour is desirable. Such a reform has the advantage of limiting the negative impacts of higher energy bills on the whole economy. It taxes non-labour incomes and therefore lightens the overall tax burden bearing on production costs, it limits the contribution of national incomes to the payment of oil bills, it increases the incentive for inducing a structural change towards a job-intensive economy, and it allows a diversification of tax bases (which is required to limit tax evasion and the rise of parallel economies).

Overall, this warning has two implications for public policy. On the one hand, the carbon tax component must be included into a reform that contributes more generally to a socioeconomic progress. If not, the required long-term rise of carbon price signals will not be achieved. It is important to work on a consistent and comprehensive reform scheme can limit the number of “loosers” and will provide economic surpluses for helping the most vulnerable industries and households (Combet et al., 2010). On the other hand, it is worth dealing with the issue of ageing and social protection without neglecting the resources that a carbon tax may bring. This line of reasoning shows that a carbon tax should not therefore being perceived as ‘green fancy’, but rather as a policy that may be adapted to the challenges to come.
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