SAFIRE 2.0: Connecting Regional Socio-Demographic Dynamics to Budgetary Outcomes

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Abstract

This memo outlines the approach implemented in SAFIRE 2.0 to endogenize the regional growth rate of personal income tax receipts present in the existing SAFIRE 1.0 simulator, including the simulation of revenues generated by the Special Financial Law (SFL) for the Regions. Our objective is to make that growth rate a function not just of demographic trends but also of the socio-economic profile of the regional population, as reflected by employment rates and the proportion of highly educated individuals. Additionally, we propose linking the region's socio-economic profile to its *i)* other non-SFL direct tax revenues and *ii)* overall public spending levels. This allows us to assess the sensitivity of Brussels' long-term budget balance or imbalance to various scenarios related to the region's socio-economic profile evolution.

Keywords: Regional Finance, Special Financing Law, Immigrants, Fertility, Education

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1 SAFIRE with socio-economic profile endogeneised

At its core, the current version of SAFIRE[1] (Decoster and Sas, 2011) (i.e. SAFIRE 1.0) assumes that regions experience some GDP growth rate as predicted by the BNB-NBB. It then connects this growth rate to the regional growth rate of income tax receipts as follows:

Assumption 1 is that the growth rate of tax basis (B) is equal to the growth rate of GDP

$$g_B = g_Y \tag{1}$$

In elasticity terms, we have that the income tax receipts (T) to GDP (Y) relationship is

$$\epsilon_{T,Y} = \epsilon_{T,B}\,\epsilon_{B,Y} = \epsilon_{T,B} = g_T/g_B > 1 \tag{2}$$

due to the progressivity of the income tax.

Also, the taxable income (B) can be seen as driven by the evolution of the taxable income per taxpayer ($b = B/N$) and the number of taxpayers (N)

$$1 + g_B = (1 + g_b)(1 + g_N) \tag{3}$$

Similarly, for income tax paid, we have two components: tax per payer ($t = T/N$) and the number of payers (N)

$$1 + g_T = (1 + g_t)(1 + g_N) \tag{4}$$

Considering that

$$\epsilon_{t,b} = g_t/g_b \tag{5}$$

we finally have that

$$\begin{aligned} g_T &= (1 + \epsilon_{t,b}\,g_b)(1 + g_N) - 1 \\ g_T &= g_N + \epsilon_{t,b}\,g_b(1 + g_N) \end{aligned} \tag{6}$$

[1] Simulatie en Analyse van de Financiering van de Regio

And assuming that $g_B = g_Y$ we have that $g_b = g_y$ thus that the growth rate of the per tax-payer income is equal to the growth rate of labour productivity. The latter can be computed as

$$\begin{aligned} g_b = g_y &= (1 + g_Y)/(1 + g_N) - 1 \\ g_b(1 + g_N) &= g_Y - g_N \end{aligned} \tag{7}$$

This ultimately leads to

$$g_T = g_N + \epsilon_{t,b}(g_Y - g_N) \tag{8}$$

If we consider nominal growth (thus with CPI indexation), we get what is currently implemented in SAFIRE.

$$\begin{aligned} \widehat{g_T} &= (1 + g_{CPI})(1 + g_N + \epsilon_{t,b}(g_Y - g_N)) - 1 \\ &= (1 + g_{CPI})(1 + g_N + \epsilon_{t,b} g_b(1 + g_N) - 1 \\ &= (1 + g_{CPI})(1 + g_N)(1 + \epsilon_{t,b} g_b) - 1 \end{aligned} \tag{9}$$

We point out that $\widehat{g_T}$ could be further endogenized. We posit that a large part of the evolution $\widehat{g_T}$ in Brussels (relative to what happens in the other regions of the country) will depend on the future behaviour of non-EU background (who happen to be significantly more numerous in Brussels). As to the latter, two dimensions are key. The first is a change (most likely a rise) in their employment rate (and thus labour force participation), particularly among females, that may translate into a faster growth rate of the number of taxpayers. That change could impact the growth rate of the taxable average income in the short- to medium-run. Second, their educational attainment gap might gradually reduce in the long run, affecting productivity growth ($g_b = g_y$). So far, citizens with a non-EU background have displayed a handicap on both fronts. Our first extension thus enhances SAFIRE 1.0 to account for these two sources of dynamic change in the regional taxable income.

We use SILC-EU data to estimate *i)* the share of people with a non-EU background *ii)* their employment and tertiary educational attainment gap [two of the parameters we would like to "manipulate"] to assess how they may impact labour productivity (growth).

Consider that the share of people with a non-EU background is α and that EU and non-EU citizens forming the working-age population do not display the same employment rate μ: these people suffer and employment gap $\mu^G \equiv \mu^{NEU} - \mu^{EU}$. The overall regional employment rate writes :

$$\begin{aligned} \mu = (1-\alpha)\mu^{EU} + \alpha\mu^N EU) \\ \mu = \mu^{EU} + \alpha\, \mu^G \end{aligned} \tag{10}$$

We propose connecting this with SAFIRE by rewriting the tax receipts equation as a function of tax per employed person ($t = T/\tilde{N}$), the number of employed persons aged 20-65 ($\tilde{N}$)

$$1 + g_T = (1 + g_t)(1 + g_{\tilde{N}}) \tag{11}$$

where $\tilde{N} = \mu\eta N$ with μ the employment rate as defined by eq. (10), and η the share of working age individuals in the population. Compared to the current version of SAFIRE, population growth no longer automatically translates into tax receipts growth as we make the latter conditional on a (at least) proportional increase in the number of people in employment. Simultaneously, we allow for the possibility of these two factors being combined to boost tax receipts further.

Turning to education, we may consider β the share of people (in employment) with tertiary education attainment in the region; the labour productivity (index) could be written (normalizing on non-tertiary wage) as

$$w = (1-\beta) + \beta(1+\theta) = 1 + \theta\beta \tag{12}$$

where θ is the wage premium associated with tertiary education attainment. If we consider that people with a non-EU background display an educational attainment gap $\beta^G \equiv \beta^{NEU} - \beta^{EU}$, we can write

$$\begin{aligned} \beta = (1-\alpha) + \alpha(\beta_{EU} + \beta^G) \\ \beta = \beta_{EU} + \alpha\, \beta^G \end{aligned} \tag{13}$$

Putting eq.(13), (12) together, we get

$$w = 1 + \theta(\beta_{EU} + \alpha\, \beta^{G}) \tag{14}$$

The connexion with the SAFIRE is done by assuming that $g_b \equiv g_{tfp} + g_w$ where g_{tfp} is the TFP growth rate unrelated to educational attainment/labour productivity/wage w (e.g. 1%), and g_w is the growth rate of our productivity/wage index w in eq.(17). For scenario s, the growth rate of the tax receipts becomes

$$\begin{aligned}
\widehat{g_{s,T}} &= (1 + g_{CPI})(1 + g_{\tilde{N}})(1 + \epsilon_{t,b} g_b) - 1 \\
&= (1 + g_{CPI}) \\
&\quad\ (1 + g_{\tilde{N}}(\rho, \mu_s^G) \\
&\quad\ (1 + \epsilon_{t,b}(g_{tfp} + g_w(\theta, \alpha, \beta_s^G))) - 1 \\
s &= 0 \dots S
\end{aligned} \tag{15}$$

where $\tilde{N}_s = \mu_s \rho N$, $\mu_s = \mu^{EU} + \alpha\, \mu_s^G$ and $w_s = 1 + \theta(\beta^{EU} + \alpha\, \beta_s^G)$

Using EU-SILC, we observe that α is .38 in Brussels in 2022 and grows at an annual rate of .44% point, implying that it could reach .52 in 2050. The corresponding α is .08 in Flanders in 2022 and is expected to reach .148 in 2020, whereas it was .076 in 2022 in Wallonia and is expected to be .13 in 2025. In what follows, we take these projections as given. Similarly, we block the wage premium θ at their 2022 regional level, namely .60 in Brussels, .38 in Flanders and .38 in Wallonia.

Regarding the employment gap (μ_s^G), we have -.23 in 2022 in Brussels, -.15 in Flanders and -.22 in Wallonia. For the education attainment gap (β_s^G) in 2022, we have -.23 in Brussels, -.13 in Flanders and -.004 in Wallonia.

We explore the sensitivity of a change in these two parameters. We assume a relatively rapid convergence of employment rates in the three regions and posit a slower/more gradual rise in educational attainment. Our simulations (s) proceed by defining the convergence horizon (H_s) beyond 2024, in other words, the time it tasks for the above employment and education gaps to close. In addition, we assume that these adjustments do not happen linearly/at a constant rate equal to the ratio of the gap to the horizon (μ_G/H_s or β_G/H_s). We rather assume for outcome $X = \mu, \beta$

$$X_{t+1} = X_t + \lambda_t \frac{X^G}{H_s} \tag{16}$$

where λ_t

$$\lambda_t = 1 + \epsilon(H_s/2 - t) \tag{17}$$

with

- $\sum^{H_s} \lambda_t = 1$ and $\lambda_t = 0$ if $t > H_s$;
- $\lambda_t = 1$ when $t = H_s/2$;
- λ_t rises with t if $\epsilon < 0$ and λ_t goes down with t if $\epsilon > 0$;
- $\epsilon <\mid 2/H_s \mid$

In particular, for all our simulations, we assume that convergence starts slow $\lambda_t < 1; \epsilon < 0$ and then gradually picks up.

2 Beyond SFL : linking the socio-economic profile to overall budget (im)balance

Formula 17 is used to assess the impact of socioeconomic changes on special financing law (SFL- income/revenue for the regions (incl. Brussels), but we also use it to assess the impact on the overall budget, spending and deficit of the Brussels region.

As to revenues, consider inc^{SFL} the sums generated by the SFL, and inc^{tot} the total income of the Brussels region. For years 2016 to 2022, we can compute the difference between these, i.e., $inc^* = inc^{tot} - inc^{SFL}$. These revenues are not negligible, representing more than 70% of the SFL-related revenue. In other words, non-SFL revenue now represent more than 40% of the total. These primarily consist of real estate-related taxes. We assume here below that they grow at a rate equal to

$$
\begin{aligned}
\widehat{g_{s,T^*}} = &(1 + g_{CPI}) \\
&(1 + g_{\tilde{N}}(\rho, \mu_s^G)) \\
&(1 + (g_{tfp} + g_w(\theta, \alpha, \beta_s^G)) - 1 < \widehat{g_T} \\
s = &0, \dots S
\end{aligned}
\tag{18}
$$

thus where there is no supra unitaire elasticity $\epsilon_{t,b} \equiv 1$

As to overall public spending by the Brussel region SP_t, we start from the most recent value available (i.e. the year 2022) and consider that its growth rate follows that of non-SFL revenues but is slowed down pro-rata the (additional) growth generated by (rising) employment and educational attainment under scenario $s \neq 0$ compare to the reference scenario $s = 0$. Technically, this is done by assuming that only a fraction of the reference growth rate is passed on to spending growth. In other words, we assume that a higher employment rate and/or higher educational attainment should reduce the growth rate of public spending.

$$
\begin{aligned}
\widehat{g_{s,SP}} &= \widehat{g_{s,T^*}}^{\lambda_s(.)} - 1 \leq \widehat{g_{s,T^*}} < \widehat{g_T} \\
s &= 0, \dots S
\end{aligned}
\tag{19}
$$

where $\lambda_s = 1 + \max\{0, \widehat{g_{s,T^*}} - \widehat{g_{0,T^*}}\} \geq 1$, and more so if scenario $s \neq 0$ implies a higher tax revenue growth rate g_{s,T^*}. Remember mathematically that an exponent ≥ 1 applied to $\widehat{g_{s,T^*}} \leq 1$ deflates the latter.

References

Decoster, A. and W. Sas (2011). *De bijzondere financieringswet voor dummies.* Tech. rep. 4, pp. 1–27.