Unemployment, Public Spending and International Trade: Challenges for an Optimal Tax Design Appendix

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A Complements on the analytical model

A.1 Trade flows: Some microfoundations

We detail here a rationale for the specifications of home trade flows vis-à-vis the rest of the world. Precisely, we relate the flows of foreign imports and exports (Z^* and X^*) to optimal demand for goods from abroad, according to the following program.

Let us thus assume that the rest of the world is endowed with a quantity Y^* of a tradable good, none of the home good. The equilibrium market condition for the foreign good is such that foreign private consumption is given by $C_F^* = Y^* - X^*$ where X^* refer to exports from the foreign country to the home country.[1] The foreign country also imports Z^* of the home good, which she consumes totally. The foreign household's maximization program is then such that:

$$\begin{aligned} \max_{C_F^*, Z^*} U^*(C_F^*, Z^*) &= \max_{X^*, Z^*} \left\{ Y^* - X^* + \frac{(Z^*)^{\frac{\sigma^*-1}{\sigma^*}}}{(\sigma^*-1)/\sigma^*} \right\} \\ \text{s.t.} \qquad & \phi X^* = Z^* \end{aligned} \tag{1}$$

with $\sigma^* > 1$, the price elasticity of foreign imports. Given our assumption of fixed production, there is no leisure choice hence the foreign households derive utility from the consumption of national good (C_F^*) and the imports of goods from abroad (Z^*). Given the absence of international trading of financial assets, both countries are characterized by a zero trade balance (Equation (1)). The FOCs with respect to X^*, Z^* therefore lead to $Z^* = \phi^{\sigma^*}$, $X^* = \phi^{\sigma^*-1}$.

A.2 The decentralized economy

A.2.1 The zero-profit condition

We demonstrate here that the free-entry condition also leads to zero profits in the decentralized economy. Given the relation between the job filling rate $q = M/V$ and the probability of job finding $p = M/U$, the free-entry condition indeed rewrites as

$$\varpi \frac{V}{U} = p(Ah^\alpha - (1+\tau_f)wh)$$

Given that $p = N$ and that $U = 1$, this amounts having $\varpi V = N(Ah^\alpha - (1+\tau_f)wh)$. This implies that:

$$wNh = \frac{ANh^\alpha - \varpi V}{1+\tau_f} \;\Leftrightarrow\; 0 = ANh^\alpha - \varpi V - (1+\tau_f)wNh \equiv \pi$$

which we recognize as the zero-profit condition. Also note that this result demonstrates that the share of wages in GDP wNh/Y is smaller than 1 in the presence of non zero vacancy cost, even with a linear production function in N.

[1] One could add public expenditures G^* without altering the results.

A.2.2 The Nash-bargaining problem

The marginal value of employment for workers It is assumed that the household is a "big family" where employed workers ensure the unemployed ones. The family's problem is to maximize the utility function subject to the budget constraint. By analogy with a dynamic matching problem, and defining $\widetilde{\Gamma}(h) = \sigma_L \frac{h^{1+\eta}}{1+\eta}$, one can derive the enveloppe condition with respect to employment:

$$\begin{aligned}
\frac{\partial V^e(L)}{\partial N} &= -\widetilde{\Gamma}(h) + \lambda[(1-\tau_w)wh - \widetilde{b}] \\
\frac{\partial V^e(L)}{\partial N} &= -\widetilde{\Gamma}(h) + \frac{(1-\tau_w)wh - \widetilde{b}}{(1+\tau_c)(C_H + \phi C_F)} \\
\Rightarrow \mathcal{V}^e &= \frac{(1-\tau_w)wh - \widetilde{b}}{1+\tau_c} - \underbrace{\widetilde{\Gamma}(h)(C_H + \phi C_F)}_{\equiv \Gamma(h)}
\end{aligned}$$

where $\mathcal{V}^e$ represents the marginal value of employment for an agent within the family.

The marginal value of employment for the firms Using a similar reasoning, one can derive the marginal value of employment for firms from the profits expression $\pi = ANh^\alpha - \overline{\omega}V - (1+\tau_f)wNh$ as:

$$\frac{\partial \pi}{\partial N} = \mathcal{V}^f = Ah^\alpha - (1+\tau_f)wh$$

Sharing the rent With $0 < \epsilon < 1$ denoting the firms' bargaining power, the Nash-bargaining problem is then:

$$\max_{w,h} \overline{\Omega} = (\mathcal{V}^f)^\epsilon (\mathcal{V}^e)^{1-\epsilon} \Leftrightarrow \max_{w,h} \left(\frac{1-\tau_w}{1+\tau_c}(wh - \widetilde{b}) - \Gamma(h) \right)^{1-\epsilon} (Ah^\alpha - (1+\tau_f)wh)^\epsilon$$

A.2.3 Solving the model

In this section, we detail the solving of the static matching model in the decentralized case.

Using the household' s budget constraint, the FOCs on home and foreign consumptions can be written: as:

$$\begin{aligned}
C_H &= \xi \frac{(1-\tau_w)[wNh + \widetilde{b}(1-N)] - T}{1+\tau_c} \\
C_F &= (1-\xi) \frac{(1-\tau_w)[wNh + \widetilde{b}(1-N)] - T}{\phi(1+\tau_c)}
\end{aligned}$$

The trade balance equilibrium implies:

$$C_F = \phi^{\sigma^* - 1} \Rightarrow \phi = [(1-\xi)(1-\rho_g)(Y - \overline{\omega}V)]^{\frac{1}{\sigma^*}}$$

Manipulating equations, we obtain the following equations summarizing the model:

$$\begin{aligned}
C_H &= \xi(1-\rho_g)(Y-\varpi V) \\
C_F &= [(1-\xi)(1-\rho_g)(Y-\varpi V)]^{\frac{\sigma^*-1}{\sigma^*}} \\
Y &= Ah^\alpha N \\
N &= \chi V^\psi \\
h &= \left[\frac{1-\tau_w}{(1+\tau_c)(1+\tau_f)}\frac{\alpha}{\sigma_L}\frac{A}{(1-\rho_g)(Y-\varpi V)}\right]^{\frac{1}{1+\eta-\alpha}} \\
\frac{\varpi}{\chi}V^{1-\psi} &= \epsilon\left[Ah^\alpha - b - \frac{(1+\tau_c)(1+\tau_f)}{1-\tau_w}\sigma_L\frac{h^{1+\eta}}{1+\eta}(1-\rho_g)(Y-\varpi V)\right]
\end{aligned}$$

Remark that the condition on the hours worked can be rewritten as follows:

$$\sigma_L\frac{h^{1+\eta}}{1+\eta}(1-\rho_g)(Y-\varpi V) = \frac{1-\tau_w}{(1+\tau_c)(1+\tau_f)}\frac{\alpha}{1+\eta}Ah^\alpha$$

implying that the free entry condition becomes:

$$\frac{\varpi}{\chi}V^{1-\psi} = \epsilon\left[\frac{1+\eta-\alpha}{1+\eta}Ah^\alpha - b\right]$$

This defines an implicit function linking V to h:

$$V = \left[\frac{\epsilon\chi}{\varpi}\left(\frac{1+\eta-\alpha}{1+\eta}Ah^\alpha - b\right)\right]^{\frac{1}{1-\psi}}$$

Given that $N=\chi V^\psi$, one can rewrite the production function as:

$$Y = (A\chi)^{\frac{1}{1-\psi}}\left[\frac{\epsilon}{\varpi}\left(\frac{1+\eta-\alpha}{1+\eta}h^\alpha - \frac{b}{A}\right)\right]^{\frac{\psi}{1-\psi}} h^\alpha$$

and the net output:

$$\begin{aligned}
Y-\varpi V &= (A\chi)^{\frac{1}{1-\psi}}\left[\frac{\epsilon}{\varpi}\left(\frac{1+\eta-\alpha}{1+\eta}h^\alpha - \frac{b}{A}\right)\right]^{\frac{\psi}{1-\psi}} h^\alpha - \varpi(A\chi)^{\frac{1}{1-\psi}}\left[\frac{\epsilon}{\varpi}\left(\frac{1+\eta-\alpha}{1+\eta}h^\alpha - \frac{b}{A}\right)\right]^{\frac{1}{1-\psi}} \\
&= (A\chi)^{\frac{1}{1-\psi}}h^{\frac{\alpha}{1-\psi}}\left[\frac{\epsilon}{\varpi}\left(\frac{1+\eta-\alpha}{1+\eta} - \frac{b}{Ah^\alpha}\right)\right]^{\frac{\psi}{1-\psi}}\left[\left(\frac{(1+\eta)(1-\epsilon)+\epsilon\alpha}{1+\eta} + \epsilon\frac{b}{Ah^\alpha}\right)\right]
\end{aligned}$$

Assume that $\widetilde{b}=\rho_b wh$, the wage curve leads to:

$$\begin{aligned}
(1+\tau_f)wh &= \frac{1}{1-\rho_b\epsilon}Ah^\alpha\frac{(1-\epsilon)(1+\eta)+\epsilon\alpha}{1+\eta} \\
\Rightarrow b &= (1+\tau_f)\widetilde{b} = \rho_b(1+\tau_f)wh = \frac{\rho_b}{1-\rho_b\epsilon}Ah^\alpha\frac{(1-\epsilon)(1+\eta)+\epsilon\alpha}{1+\eta} \\
(1+\tau_f)\frac{whN}{Y} &= \frac{(1-\epsilon)(1+\eta)+\epsilon\alpha}{(1-\rho_b\epsilon)(1+\eta)}
\end{aligned}$$

The net output becomes:

$$\begin{aligned} Y-\overline{\omega}V &= h^{\frac{\alpha}{1-\psi}}\left(\frac{A\chi}{(1+\eta)(1-\rho_b\epsilon)}\right)^{\frac{1}{1-\psi}}\left[\frac{\epsilon}{\overline{\omega}}((1-\rho_b)(1+\eta)-\alpha)\right]^{\frac{\psi}{1-\psi}}[(1+\eta)(1-\epsilon)+\epsilon\alpha] \\ &\equiv \Theta h^{\frac{\alpha}{1-\psi}} \end{aligned}$$

Introducing this result in the FOC on hours worked, we obtain

$$h=\left[\frac{\alpha A}{\sigma_L}\left(\frac{1-\tau_w}{(1+\tau_c)(1+\tau_f)}\frac{1}{1-\rho_g}\right)\frac{1}{\Theta}\right]^{\frac{1-\psi}{(1-\psi)(1+\eta)+\psi\alpha}} \tag{2}$$

$$\text{with} \quad \Theta=\left(\frac{A\chi}{(1+\eta)(1-\rho_b\epsilon)}\right)^{\frac{1}{1-\psi}}\left[\frac{\epsilon}{\overline{\omega}}((1-\rho_b)(1+\eta)-\alpha)\right]^{\frac{\psi}{1-\psi}}[(1-\epsilon)(1+\eta)+\epsilon\alpha]$$

A.3 The centralized economy

In what follows, we detail the solving of the planner's allocation. Using the functional forms, the first-order conditions G, h, ϕ and V can be rewritten as:

$$\begin{aligned} \frac{\xi}{C_H} &= \frac{1}{C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F} \\ G &= \Phi\left(C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F\right) \\ \alpha\frac{Y}{Nh} &= \sigma_L h^{\eta}\left(C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F\right) \\ \frac{\overline{\omega}}{\chi}V^{1-\psi} &= \psi\left[Ah^{\alpha}-\sigma_L\frac{h^{1+\eta}}{1+\eta}\left(C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F\right)\right] \end{aligned}$$

The trade balance leads to $C_F=X^*(\phi)=\phi^{\sigma^*-1}$. The equilibrium on the home good market leads to $Y-\overline{\omega}V=C_H+X(\phi)+G=C_H+\phi^{\sigma^*}+G$. We deduce

$$\frac{\xi}{C_H}\sigma^*\phi^{\sigma^*-1} = \frac{1-\xi}{C_F}(\sigma^*-1)\phi^{\sigma^*-2}\Rightarrow\frac{\xi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi C_F=C_H$$

We then deduce that

$$\frac{\xi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi C_F=\frac{\xi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi^{\sigma^*}=C_H$$

and

$$G=\frac{\Phi}{\xi}C_H=\frac{\Phi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi^{\sigma^*}$$

Using the resource constraint, we obtain:

$$
\begin{aligned}
Y-\overline{\omega}V &= \frac{\xi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi^{\sigma^*}+\phi^{\sigma^*}+\frac{\Phi}{1-\xi}\frac{\sigma^*}{\sigma^*-1}\phi^{\sigma^*} \\
&= \frac{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}{(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\phi^{\sigma^*} \\
\Rightarrow \phi &= \left(\frac{(1-\xi)\frac{\sigma^*-1}{\sigma^*}}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}(Y-\overline{\omega}V)\right)^{\frac{1}{\sigma^*}}
\end{aligned}
$$

Thus, we deduce that

$$
\begin{aligned}
C_H &= \frac{\xi}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right) \\
C_F &= \left[\frac{(1-\xi)\frac{\sigma^*-1}{\sigma^*}}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right)\right]^{\frac{\sigma^*-1}{\sigma^*}} \\
G &= \frac{\Phi}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right)
\end{aligned}
$$

As a result, we get that

$$
C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F=\frac{1}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right)
$$

Integrating this result in the FOC on V, we obtain:

$$
\begin{aligned}
&\frac{\overline{\omega}}{\chi}V^{1-\psi}=\psi\left[Ah^{\alpha}-\sigma_L\frac{h^{1+\eta}}{1+\eta}\frac{1}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right)\right] \\
\Leftrightarrow\quad &\overline{\omega}V=\psi\left[ANh^{\alpha}-N\sigma_L\frac{h^{1+\eta}}{1+\eta}\frac{1}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\left(Y-\overline{\omega}V\right)\right]
\end{aligned}
$$

Given that the FOC on h leads to:

$$
\frac{\alpha}{1+\eta}Y=N\sigma_L\frac{h^{1+\eta}}{1+\eta}\left(C_H+\frac{\sigma^*}{\sigma^*-1}\phi C_F\right)
$$

The FOC on V becomes:

$$
\overline{\omega}V=\psi\frac{1+\eta-\alpha}{1+\eta}Y\Rightarrow Y-\overline{\omega}V=Y\frac{(1-\psi)(1+\eta)+\psi\alpha}{1+\eta}
$$

Integrating this result in the FOC on h, we obtain:

$$
\frac{\alpha}{1+\eta}=N\sigma_L\frac{h^{1+\eta}}{1+\eta}\frac{1}{\xi+\Phi+(1-\xi)\frac{\sigma^*-1}{\sigma^*}}\frac{(1-\psi)(1+\eta)+\psi\alpha}{1+\eta}
$$

The relation $\overline{\omega} V = \psi \frac{1+\eta-\alpha}{1+\eta} Y$ leads to:

$$V = \left(\psi \frac{\chi}{\overline{\omega}} \frac{1+\eta-\alpha}{1+\eta} A h^{\alpha} \right)^{\frac{1}{1-\psi}}$$

Using $N = \chi V^{\psi}$, we deduce the solution for h_{sp}:

$$h_{sp} = \left[\frac{\alpha A}{\sigma_L} \left(\xi + \Phi + (1-\xi) \frac{\sigma^* - 1}{\sigma^*} \right) \frac{1}{\Psi} \right]^{\frac{1-\psi}{(1-\psi)(1+\eta)+\alpha\psi}}$$

with

$$\Psi = \left(\frac{\chi A}{1+\eta} \right)^{\frac{1}{1-\psi}} \left(\frac{\psi}{\overline{\omega}} (1+\eta-\alpha) \right)^{\frac{\psi}{1-\psi}} [(1-\psi)(1+\eta) + \psi\alpha]$$

Using the optimal size of the government, ρ_g^{sp}, we obtain:

$$h_{sp} = \left[\frac{\alpha A}{\sigma_L} \frac{\xi + (1-\xi)\frac{\sigma^*-1}{\sigma^*}}{1-\rho_g^{sp}} \frac{1}{\Psi} \right]^{\frac{1-\psi}{(1-\psi)(1+\eta)+\alpha\psi}}$$

A.4 Labor market frictions and the intensive margin of labor

To determine the role of labor market frictions on worked hours, it is sufficient to study how they affect $\Theta \neq \Psi$, as h is a decreasing function of Θ (Equation (2)). It can be shown that:

$$\text{Under } \epsilon = \psi, \qquad \frac{\partial \Theta}{\partial \rho_b} < 0 \quad \forall \rho_b > 0$$
$$\text{Under } \rho_b = 0, \qquad \frac{\partial \Theta}{\partial \epsilon} < 0 \quad \text{if } \epsilon < \frac{1+\eta}{1+\eta-\alpha} \psi$$

From the above result, it comes that $\epsilon < \psi$ is a sufficient condition for $\frac{\partial \Theta}{\partial \epsilon} < 0$. Providing that everything else equal, h is a decreasing function of Θ and recalling that $\Theta = \Psi$ in the absence of labor market frictions, this establishes that labor market frictions, either through unemployment benefits ($\rho_b > 0$) or a too large workers' bargaining power ($\epsilon < \psi$), increase the equilibrium value of worked hours relative to their first-best level (ie, $h^{dec} > h^{sp}$).

B The DGE model: A detailed view

B.1 Labor market modeling

Let e_i be the search effort of an individual worker i. Worker i's probability of finding a job is equal to $\widetilde{p}_i = \frac{e_i}{e} \frac{M(V,N)}{(1-N)}$. Since all workers are identical, the symmetric equilibrium leads to $e_i = e \; \forall i$, which implies $\widetilde{p}_i = \widetilde{p}$, with $\widetilde{p}$ the aggregate job finding rate. Defining labor market tightness θ as $\theta_t = \frac{V_t}{e_t(1-N_t)}$, the average job finding rate can be rewritten as: $\widetilde{p}_t = e_t\chi\theta_t^{\psi} = e_t p_t$, with $p_t \equiv \frac{M(V_t,N_t)}{e_t(1-N_t)}$. Alternatively, we have $\theta_t = p_t/q_t$. At the level of the firm, the vacancy filling rate q_t is $\frac{M_t}{V_t}$ or $q_t = \chi\theta_t^{\psi-1}$. The job finding rate $\widetilde{p}_t$ (the probability of filling a vacant job q_t) is an increasing (decreasing) function of labor market tightness.

B.2 The household

Preferences The economy is populated by a large number of identical households whose measure is normalized to one. Employed agents (N) work h hours. Due to search frictions, there are unemployed workers ($1-N$) who spend e hours searching for a job. Unemployed agents are randomly matched with job vacancies. Individual idiosyncratic risks faced by each agent in his job match are smoothed by using employment lotteries. Hence, the preferences of the representative household can be described according to:

$$\sum_{t=0}^{\infty} \beta^t \left[N_t U(C_t^n, h_t) + (1-N_t)U(C_t^u, e_t) + \Phi \log G_t\right]$$

with $0 < \beta < 1$ the discount factor. C_t^n and C_t^u stand for the consumption of employed and unemployed agents respectively. We assume separability between consumption and leisure, i.e. for employed and unemployed workers respectively:

$$U(C_t^n, h_t) = \log C_t^n + \Gamma_t^n \qquad \text{with} \quad \Gamma_t^n = -\sigma_L \frac{h_t^{1+\eta_L}}{1+\eta}$$

$$U(C_t^u, e_t) = \log C_t^u + \Gamma_t^u \qquad \text{with} \quad \Gamma_t^u = -\sigma_u \frac{e_t^{1+\eta}}{1+\eta}$$

with $\eta_L > 0$, $\sigma_L > 0$ and $\sigma_u > 0$. The assumption of complete insurance markets combined with separability between consumption and leisure in the instantaneous utility function implies identical optimal consumption levels between family members, whatever their employment status: $C_t^n = C_t^u = C_t,\ \forall t$.

In an economy with labor market frictions, the representative household expects that the employment lotteries evolve according to: $N_{t+1} = (1-s)N_t + e_t p_t(1-N_t)$, with $p_t \equiv M_t/(e_t(1-N_t)$. The household's budget constraint is given by

$$P_t(1+\tau_t^c)C_t \leq (1-\tau_t^w)\left[N_t w_t h_t + (1-N_t)b_t\right] + P_t T_t + \pi_t$$

where C_t and P_t denote respectively the aggregate consumption and the consumption price index.

Each period, the household optimizes the consumption bundle subject to the intratemporal constraint $P_t C_t = P_{Ht}C_{Ht} + P_{Ft}C_{Ft}$, with P_{Ht} and P_{Ft} the prices of the domestic and foreign goods respectively, and P_t the associated consumer price index. Solving the intratemporal program leads to the standard optimal demand functions for each domestic and foreign varieties respectively:

$$C_{Ht} = \xi \left[\frac{1}{P_t} \right]^{-\eta} C_t \quad \text{and} \quad C_{Ft} = (1-\xi) \left[\frac{\phi_t}{P_t} \right]^{-\eta} C_t$$

with the consumption price index (CPI) a function of national goods prices:

$$P_t = \left[\xi + (1-\xi)\, \phi_t^{1-\eta} \right]^{\frac{1}{1-\eta}}$$

Firms A firm's labor employment evolves as $N_{t+1} = (1-s)N_t + q_t V_t$. Firms are subject to direct labor taxation, with τ_t^f denoting the payroll tax rate ($0 < \tau^f < 1$). Each firm chooses $\mathcal{C}_m = \{V_t, N_{t+1}, K_{t+1}, I_t | t \geq 0\}$, to maximize the discounted value of the dividend flow:

$$\max \sum_{t=0}^{\infty} \beta^t \frac{\lambda_{t+1}}{\lambda_t} \pi_t \quad \text{with} \quad \pi_t = Y_t - (1+\tau_t^f) w_t N_t h_t - P_t \left[I_t + \overline{\omega} V_t \right]$$

with λ_t the multiplier associated to the household's budget constraint.

Government budget constraint and market equilibria The government's budget constraint is written as:

$$P_t G_t + (1-N_t)(1-\tau_t^w) b_t = \tau_t^c P_t C_t + (\tau_t^f + \tau^w) w_t h_t N_t + P_t T_t$$

Equilibria on the home and foreign good market are respectively

$$\begin{aligned} C_{Ht} + I_{Ht} + G_{Ht} &= Y_t - \phi_t^{\sigma^*} \\ C_{Ft} + I_{Ft} + G_{Ft} &= \phi_t^{\sigma^* - 1} \end{aligned}$$

Thus, the equilibrium condition on the home good is given by:

$$Y_t = D_{Ht} + X_t$$

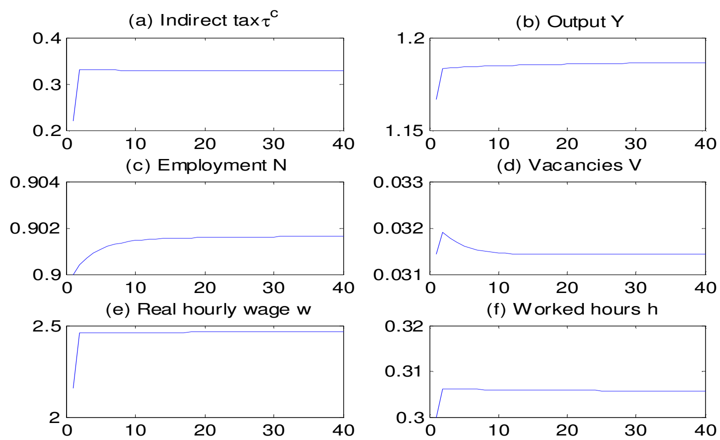
with $D_{Ht} = \xi P_t^{\eta} D_t$, $D_t = C_t + I_t + \overline{\omega} V_t + G_t$ and $X_t = \phi_t^{\sigma^*}$. Finally, the zero trade balance implies $D_{Ft} = \phi_t^{\sigma^* - 1}$ with $D_{Ft} = (1-\xi) \left[\frac{\phi_t}{P_t} \right]^{-\eta} D_t$.

C IRFs when implementing the optimal tax reform

In this section, we present the IRFs of the main macroeconomic variables when the payroll tax rate is reduced from its benchmark value (0.34) to its optimal one ($\tau^{F*} = 0.0275$).

As reported in Figure 1, panel (c), the employment level indeed increases following the optimal tax reform. Indeed, the reduction in payroll taxes τ_f entices firms to increase labor input. On impact, the employment level N being predetermined, this is achieved through an increase in worked hours h (Figure 1, panel (f)). In parallel, firms start opening vacant jobs, so as to adjust at the extensive margin through the employment level the periods after the fiscal shock (Figure 1, panel (d)). Then, employment monotonically increases with the tax reform in the second period onward. The improvement of labor market conditions also entices unemployed workers to search more intensively, as reported in Figure 2, panel (a).

Figure 1: IRFs to the optimal tax reform (1)

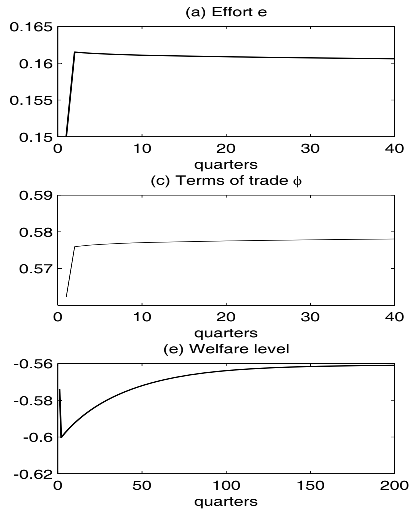


The quantitative results indicate a non negligible gain in terms of employment: The tax reform indeed leads to a 0.55 percentage point increase in the employment rate, which corresponds to a gain of around + 160,000 employed workers.[2] However, one can notice that most of the effects of the tax reform is channeled on labor input through the intensive margin adjustment: Worked hours increase by 5.31%.

Firms are enticed to invest in physical capital as the marginal productivity of capital increases with the rise in labor input. The rise in individual worked hours accounts for the immediate increase in production (Figure 1, panel (b)). In subsequent periods, the gradual increases in employment and capital contribute to further raise output, which monotonically increases until reaching its new higher steady-state level. Again, the effects are quantitatively modest, as the tax reform induces a 5.45% increase in GDP. Figure 2, panel (b) indicates that aggregate consumption goes up with the tax reform. This can be understood as the result of two opposite effects: A negative relative price effect attributable to the open-economy dimension and a positive wealth effect, notably attributable to an improvement of labor market conditions. On the one hand, households suffer from a purchasing power parity loss due to the rise in the home CPI (Figure 2, panel (d)) driven by a higher relative price of foreign goods (Figure 2, panel (c)). On the other hand, as reported in Figure 1, panels (e)

[2]This is based the employed workforce in France, which amounts to 26,337,759 persons in 2008 (INSEE data).

Figure 2: IRFs to the optimal tax reform (2)



and (f), worked hours and the real wage increase with the tax reform. Households indeed accept to bargain an increase in worked hours h as long it is accompanied by an increase in the real wage w. Despite the rise in the indirect tax rate τ_c, the magnitude of the wage increase causes the net real wage to go up. This contributes to the positive wealth effect of the tax reform, and ultimately drives aggregate consumption upwards. Figure 2, panel (e) displays the dynamics of welfare. The inverted V shape suggests that the transition is costly.