Is the German strategy applicable to France?

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Abstract

This article questions the consequences for France of a policy that would replicate the German experience since the mid-2000s and addresses the possibility of alternative strategies. Utilising the CGE model built by Beissinger et al. (2016), we implement a series of simulations to analyse the impacts (i) of a German-type labour market reform, and (ii) of a policy which stimulates the demand for non-tradable services. We show (i) that structural differences could make a German-type policy less efficient and more painful (in terms of inequality) in France, and (ii) that a public action which directly targets the demand for non-tradable services could provide an alternative policy.

Keywords. Hartz reforms, Inequality, Pro-non-tradables fiscal policy, Reservation wage, Unemployment.

JEL Classification. E24, E61, E64, E65, F16.

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1. Introduction

This paper questions the consequences for France of a policy that would replicate the German experience since the mid-2000s and addresses the possibility of alternative strategies. We start from the diagnosis of Beissinger, Chusseau & Hellier (2016, hereafter BCH) who explain the German economic performance by the combination of (i) the rise in competitiveness related to offshoring and (ii) the decrease in unemployment generated by the growing demand for non-tradable services linked to labour market reforms. Using a slightly modified version of the computable general equilibrium model of BCH, we implement a series of simulations which show (i) that a German-type policy could be less efficient and more inequality-enhancing in France than in Germany, and (ii) that another policy which directly targets the demand for non-tradable services could be an alternative, but it could come into conflict with EU institutional rules.

Since the mid-2000s, the German economy has exhibited economic outcomes which are substantially better than those of most European and advanced countries. Compared to other Eurozone countries, German growth has been higher, German unemployment has rapidly and continuously decreased leading to full employment, public accounts have significantly improved, and gains in external competitiveness and trade surpluses have been sizeable. However, these high performances of the German economy are rather recent. In the early 2000s, Germany was 'the sick man' in Europe, with low growth, high unemployment and high public deficit and debt. The recovery of the German economy began in 2006, i.e., just after the final setting of the large labour market reform decided from 2003 to 2005, known as the Hartz laws.

The four phases of the Hartz reforms have deeply modified the German labour market structure (Jacobi & Kluve, 2007 and Alber & Heisig, 2011, for comprehensive expositions). Hartz I (in 2003) has deregulated temporary agency employment and Hartz II (in 2003) has made the non-standard employment (the so-called 'mini-jobs') easier, less costly and more profitable for both firms and workers. Finally, Hartz IV (set in 2005) has substantially reshaped the unemployment compensation regime by reducing both the length and levels of unemployment benefits, by gathering the social and unemployment assistance schemes into a unified system, and by permitting the coincidence of low-paid part-time work with unemployment benefits.

The coincidence of the German upsurge with the implementation of the Hartz reforms has led a number of observers to explain the former by the latter. This explanation is based on the following sequence. By promoting labour flexibility and reducing labour costs, the Hartz reforms have increased German competitiveness, boosted exports and production, and lessened unemployment, public deficit and public debt. Germany could consequently escape from the restrictive fiscal policies implemented in most European countries, which has again fostered German growth compared to the rest of Europe.

Based on the observation that this diagnosis is at odds with facts (in particular, the increase in competitiveness and the related rise in exports occurred from the mid-1990s to the mid-2000s, i.e., before the setting of Hartz laws), BCH propose the following alternative explanation. The increase in German firms' competitiveness was based on the large offshoring of their low skill intensive production stages implemented from 1995 to 2005, particularly in central European countries. The offshoring-related decrease in the demand for low skilled workers firstly lessened their wage and raised inequality. But the labour cost adjustment rapidly met the reservation wage, which was rather high in Germany because of the labour market characteristics. Confronted with growing unemployment, the German government sets the Hartz reforms, inducing thereby a downward shift in the reservation wage.[1] This has increased the demand for low-skill intensive non-tradable services, which has in turn lessened unemployment.

In this explanation, competitiveness is related to offshoring and lower unemployment to the increase in the demand for (and production of) non-tradable services made possible by the decrease in the reservation wage. In consequence, higher inequality and working poverty is the price to pay for lower unemployment. In their conclusion, BCH remark (i) that the same strategy could be more difficult to implement in a number of Eurozone countries because of structural differences with Germany, and (ii) that another strategy which consists in fostering the demand for non-tradable services could bring similar results in terms of unemployment without increasing inequality and poverty.

Based on this suggestion of the potential effects of German-type policies in other Eurozone countries, we implement a series of simulations to assess (i) the impact of such a policy in France, and (ii) the impact of an alternative policy based on a public-funded increase in the demand for non-tradable services.

[1] In addition, Dustmann et al. (2014) note that several key changes in the German labour market structure occurred before the Hartz laws, and Burda & Hunt (2011) that the German firms transitorily lower the working time of their employees rather than dismissing them, which lessened unemployment.

The simulations implemented in this paper show that a German-type policy which combats offshoring-related unemployment through a decrease in the reservation wage could be more painful in terms of inequality when being implemented in France. This derives from the structure of the labour force, which is more skill-oriented in Germany. We subsequently simulate another strategy which consists in modulating the levies so as to direct demand towards the low skill intensive services without modifying the reservation wage. We find that this policy permits to reach the same goal in terms of unemployment with a significantly lower increase in inequality.

It should be emphasized that these simulations are exercises of applied theory. They must be interpreted as portraying the effects of each policy ceteris paribus, i.e., without accounting for other differences than those in skill endowment, in goods quality and in policies which are at the core of the model. In particular, divergences in the geographical orientation of external trade, in sectoral technologies, in financial structures, in cultural and political environment, in external shocks etc. are disregarded. As these differences typically interact with policies, their counting could modify the outcomes of the simulations. Finally, we do not analyse each component of the labour market reform. Our hypothesis is that the main channels through which the reform acts is the reduction of the reservation wage which lowers the cost of unskilled workers by making them accept lower pays.

Section 2 compares Germany and France in terms of the main variables considered in the model. Section 3 exposes the CGE framework and Section 4 the calibrated scenarios and the selected parameters. Section 5 presents the results. These results are discussed and we conclude in Section 6.

2. Germany and France: a comparison

In this section, the indicators which are relevant for our subject are compared for Germany and France. As France has had an average position in Eurozone since the mid-1990s for a large range of economic variables, the differences diagnosed between Germany and France are similar to those between Germany and Eurozone on average.

As regards growth and unemployment, Figures 1 and 2 clearly reveal two periods. From 1995 to 2005, Germany exhibited lower growth and a higher rise in unemployment than France (and Euro-zone countries), whereas the opposite developments have been observed since then.

The same two periods can be distinguished when considering the exports/GDP ratio and offshoring (Figures 3 and 4). From 1995 to 2005, Germany substantially increased its exports and offshoring grew much more rapidly than in France. Since 2005, the increase in the Export/GDP ratio has been slower and the difference with France has remained unchanged. Similarly, German offshoring has continued to rise but not more than in France and Eurozone from 2006. Note that the share of Central Europe in the imports of intermediate goods from emerging countries for manufacturing industries (measuring offshoring) was of 60% in Germany against between 30 and 35% in France in the 2000s.

In contrast with the previous indicators, the increase in inequality in relation to France has been permanent since the mid-1990s (Figure 5). The same continuous increase can be observed for part-time employment (Figure 6). Contrary to what is usually observed, the decrease in unemployment has not lessened part time employment in Germany, quite the opposite.

Finally, the labour cost has increased far less rapidly in non-tradable services compared to manufacturing, and this difference has significantly increased after the Hartz reforms (Figure 7; g is the growth rate of the labour cost in manufacturing in relation to non-tradable services).

In short, the observed variations reveal the following key elements:

1) The increase in offshoring concerns both countries, but this rise has been particularly high in Germany and the difference in offshoring between Germany and France remains substantial (Figure 4). Offshoring is concomitant with the increase in competitiveness and in the upsurge of German exports from 1995 to 2005.

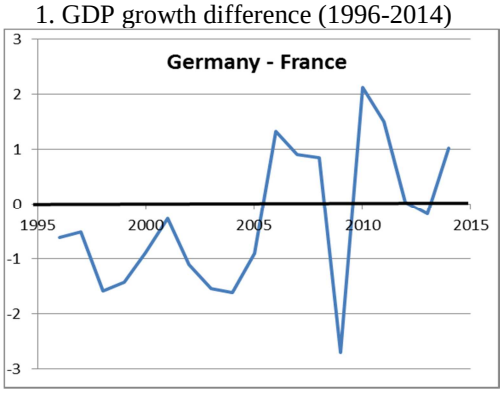
2) The decrease in the German unemployment has followed the set of labour market reforms which began before the Hartz laws (Dustmann et al., 2014) but have been magnified by these laws. Unlike Germany, France has experienced a large increase in unemployment since the 2008 financial crisis.

3) In Germany, the labour market reforms have substantially increased both part time employment (Figure 6) and the number of non-standard employment (mini-jobs). In contrast, the number of part time jobs has not increased in France (Figures 6). This could suggest that a proportion of the difference in unemployment between the two countries could be explained by the development of part-time jobs in Germany.

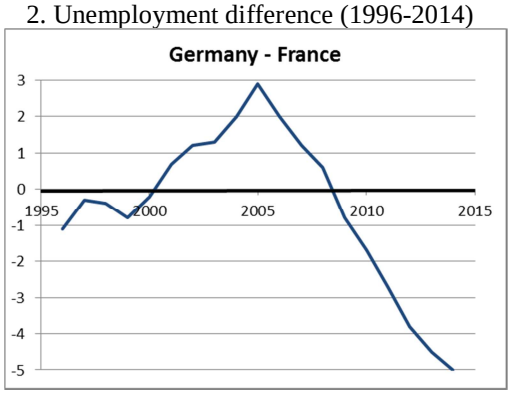
4) Finally, France appears to be relatively less endowed with skilled labour than Germany, but more that the Eurozone southern countries (Figure 8. Euro-south is a weighted average of Greece, Italy, Portugal and Spain).

Figures

1. GDP growth difference (1996-2014)

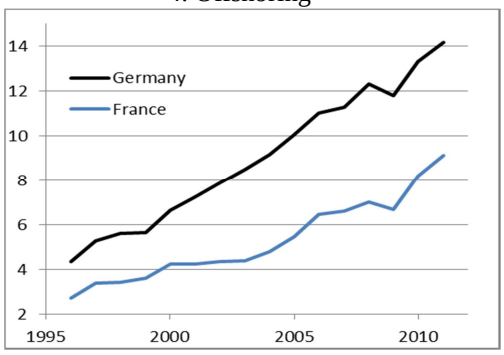


2. Unemployment difference (1996-2014)

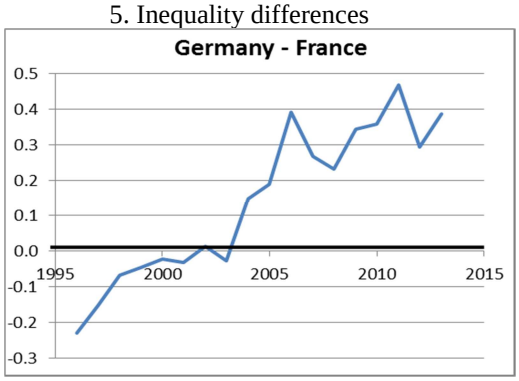


3. Ratio Exports (goods & services)/GDP

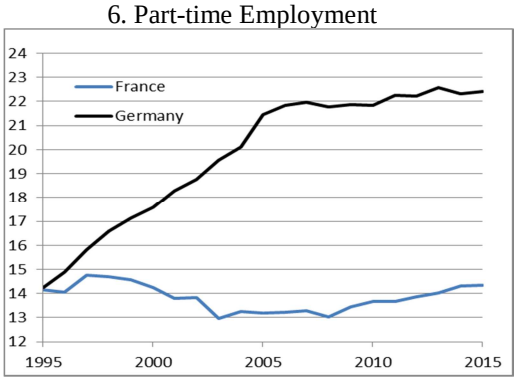
4. Offshoring



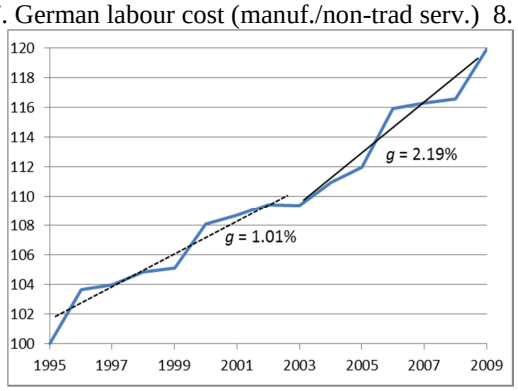
5. Inequality differences



6. Part-time Employment



7. German labour cost (manuf./non-trad serv.)



8. Share of skilled workers (labour force 2012)

Explanations: 1. *Difference (Germany – France) in real GDP growth. Source: CHELEM.* 2. *Difference in unemployment rate. OECD Stat.* 3. *Ratio: exports of goods & services on GDP. OECD Stat.* 4. *Ratio of imports of intermediate goods from emerging countries (CEEC included) to manufacturing value added. Authors' calculation from CHELEM (CIN) and OECD Stat.* 5. *Difference in gross earnings inter-decile ratio D9/D1.OECD Stat.* 6. *Incidence of part time employment (total). OECD Stat.* 7. *Ratio of hourly labour cost (HLC) in manufacturing to HLC in non-tradable services. NT services = wholesale & retail trade, restaurant & hotels. OECD Stat (STAN database).* 8. *Skilled workers (ISCED 4-6) (% of the labour force, 2012). OECD Stat.*

3. The CGE framework

The simulations and the different scenarios will be implemented from a slightly modified version of BCH (2016) CGE model, to which we add taxes and public expenditures. We summarize here the framework and main assumptions of this model. A more comprehensive discussion of the hypotheses can be found in BCH.

The simple CGE model constructed here does not intend to encompass all the changes in economic activity and economic imbalances in both countries. The model is centred on the impact of the decrease in the reservation wage (linked to a labour market reform) and of the rise in the demand for non-tradable services (linked to a so-oriented policy).

3.1. The model

There are two factors of production, low skilled labour *L* and high skilled labour *H*.

a) Countries

The World economy is comprised of three areas:

1) A country called *Home*, which can be Germany or France depending on the country which is analysed. The two countries (Germany and France) differ in size, in factor endowments and in the quality of their goods (see hereafter).

2) *North* gathers all advanced countries except Home. North values are depicted by a tilde ($\tilde{}$).

3) *South* gathers all emerging countries to which low skilled segments can be offshored. South values are depicted by a star (*).

The factors endowments are given, $(\bar{L}, \bar{H})$ in the Home country and $(\bar{\tilde{L}}, \bar{\tilde{H}})$ in North. In addition, *L* depicts the employed unskilled labour in Home which differs from $\bar{L}$ in case of unemployment.

b) Sectors and production

There are three sectors:

1) Sector *l* utilises unskilled labour to produce one homogeneous unskilled intensive good *l*. The production of *l* is fully located in South and imported by both Home and North.

2) The skill-intensive sector produces two sets of differentiated goods. According to Armington's hypothesis, there are Home varieties (*i* in sector *h*) and North varieties ($\tilde{i}$ in sector $\tilde{h}$). The production of both types of varieties *i* and $\tilde{i}$ combines two segments, a skill intensive *H-segment* and an unskilled intensive *L-segment*.

In both sectors h (Home) and $\tilde{h}$ (North), we assume a continuum of varieties over an interval normalised to 1, $[0,1]$, with differences in the cost of producing offshore across varieties. So as to focus on the sole Home developments, we assume that North does not outsource abroad its segments $\tilde{S}_L$.[2] We denote $S_L(i)$ and $S_H(i)$ the unskilled and skilled segments respectively in the production of variety *i* of sector *h*.

All the differentiated skill intensive goods (varieties *h* for Home and $\tilde{h}$ for North) are produced by the same Cobb-Douglas combination of two segments.

$$Y_h = A\left(S_L^h\right)^{\alpha}\left(S_H^h\right)^{1-\alpha}; \qquad \tilde{Y}_h = A\left(\tilde{S}_L^{\tilde{h}}\right)^{\alpha}\left(\tilde{S}_H^{\tilde{h}}\right)^{1-\alpha}$$

Segments $S_L(i)$ and $\tilde{S}_L(\tilde{i})$ have the same technology which utilises unskilled labour only. Symmetrically, segments $S_H(.)$ and $\tilde{S}_H(.)$ utilise skilled labour only with the same technology:

$$S_L(i) = L_i^h, \qquad \tilde{S}_L(i) = \tilde{L}_{\tilde{i}}^{\tilde{h}}$$

$$S_H(i) = H_i^h, \qquad \tilde{S}_H(\tilde{i}) = \tilde{H}_{\tilde{i}}^{\tilde{h}}$$

3) The third sector produces one non-tradable service (*nt*) which utilises unskilled labour only with the same linear technology in all advanced countries:

$$Y_{nt} = \delta L_{nt}\ , \qquad \tilde{Y}_{nt} = \delta \tilde{L}_{nt}$$

c) Demand

The utility function of households is in all countries:

$$u = \gamma_l \log c_l + \gamma_h \log\left(a\int_0^1 c_h{}^{\theta} dh + \int_0^1 c_{\tilde{h}}{}^{\theta} d\tilde{h}\right)^{1/\theta} + \gamma_{nt} \log\left(c_{nt} + g_{nt}\right) + v(g_G)\ , \quad \gamma_h + \gamma_l + \gamma_{nt} = 1$$

where c_i is the consumption of good, variety or service $i = l,h,\tilde{h},nt$, g_{nt} is the amount of private service *nt* freely provided by the State ($c_{nt} + g_{nt}$ is the total amount of service *nt* consumed by the household), and g_G the amount of public non-tradable services (different from *nt*) freely provided by the State ($\partial v / \partial g_G > 0,\ \partial^2 v / \partial g_G{}^2 < 0$). Hence, γ_i is the share of sector *i* in the households' consumption of private goods.

[2] Waiving this assumption would not modify the results (the differences between Home and North would just be reduced) but it would substantially complicate the model.

Coefficient *a* indicates the attractiveness of the home varieties in relation to the North varieties, i.e., its relative quality. A higher value of *a* induces an increase in the demand for the Home products compared to the demand for North products in sector *h*.

There is a tax on consumption (value added tax, VAT) which applies to all goods except the non-tradable service. In the simulation, we shall modulate the values of the taxes so as to analyse different scenarios (in one of them, the VAT is utilised to subsidise sector *nt* and lower thereby the price of service *nt*).

Household *m* maximises its utility subject to the usual income constraint $(1+\tau)\left(p_l c_{l,m} + \int_0^1 p_h c_{h,m} dh + \int_0^1 p_{\tilde{h}} c_{\tilde{h},m} d\tilde{h} \right) + (1-s)\, p_{nt} c_{nt,m} \leq I_m$, where τ is the VAT rate and *s* the subsidy to *nt*.

d) Offshoring and the cost of producing offshore

In the Home sector *h*, the cost of producing offshore segment $S_L(i)$, denoted ω_{it} for variety *i* at time *t*, differs across varieties.

Globalisation takes the form of a general decrease in the cost of producing offshore, which incites an increasing number of productions *i* to relocate their segment $S_L(i)$ to South.

The goods $i \in [0,1]$ are ranked in ascending order of offshore cost.

We assume that, at any time *t*, the offshore cost is linearly increasing in *i* from $\underline{\omega}_t$ to $\bar{\omega}_t = \underline{\omega}_t + \kappa$:

$$\omega_t(i) = \underline{\omega}_t + i \times \kappa, \qquad i = 0,...,1$$

Suppose that, at time *t*, the *L*-segments of the Home varieties $[0,k]$ are offshored whereas the varieties $]k,1]$ are fully produced in Home. Then, the cost of producing offshore segment $S_L(k)$ of good *k* is exactly equal to the cost of producing it in Home, i.e., to the unskilled labour wage w_L. Hence:

$$\omega_{kt} = \underline{\omega}_t + k \times \kappa = w_{Lt} \Rightarrow \underline{\omega}_t = w_{Lt} - k \times \kappa$$

And (*t* is omitted to simplify):

$$\omega(i) = w_L - (k-i)\kappa, \qquad i = 0,...,1$$

The varieties *i* with offshored segments $S_L(i)$ are those with an offshore cost $\omega(i)$ lower than the cost of producing S_L in Germany w_L ($\omega(i) = w_L - (k-i)\kappa < w_L$). Consequently, the decrease in the offshore cost $\underline{\omega}_t$ can be modelled as an increase in *k*, i.e., in the number of varieties with segment S_L being offshored. *This value then moves from k = 0 (i.e., no offshoring: all the segments S_L being produced at home) to k = 1 (i.e., all the segments S_L are offshored).*

3.2. Equilibrium

The system of equations which defines the model general equilibrium without taxes and public spending is depicted inside the frame below.

These equations are determined by assuming (i) market clearing on each market, and (ii) balanced trade between all areas. This permits to ignore the inside values of the South in the determination of the equilibrium (see the explanations in BCH, 2016).

The equilibrium is calculated for each value of *k*, i.e., for the number of varieties *k* with offshored segment $S_L(i)$ moving from none (*k* = 0 and all the *h*-varieties are fully produced in Home) to all of them (*k* = 1 and all the *L*-segments $S_L(i)$, $i \in [0,1]$, are offshored).

In all the considered scenarios (see Section 4), the skill premia (*w* in the Home country and $\tilde{w}$ in North) and the total incomes (*I*, $\tilde{I}$ and *I** for Home, North and South respectively) are endogenous variables. The unskilled labour wage w_L in the Home country is endogenous (and the unskilled labour employment $L = \bar{L}$ exogenous) as long as its full employment equilibrium value is above the reservation wage $\underline{w}$, whereas $w_L = \underline{w}$ is exogenous and employment L and the rate of unemployment $u = (\bar{L} - L)/\bar{L}$ are endogenous when the full employment unskilled labour wage is lower than the reservation wage.

Once the endogenous variables are determined, we can calculate the prices ($p_i, i = l, nt$; P_h, the price index of the goods produced by sectors *h* and $\tilde{h}$; *P*, the general price index) and the after-tax unskilled labour *real* wage ϖ_L (Appendix A).

Finally the above equations are subsequently modified when assuming structural policies in which the levies from a tax on the consumption of tradable goods are utilised to boost the demand and production of non-tradable services. The related systems of equations are in Appendix B.

General equilibrium

Endogenous variables: w, $\tilde{w}$, I, $\tilde{I}$, I^*, w_L or L.

Exogenous variables: $\tilde{w}_L = 1$; $L = \bar{L}$ or $w_L = \underline{w}$.

Equations

[1] $$\tilde{w} = \frac{(1-\alpha)(1-\gamma_{nt})}{\alpha + (1-\alpha)\gamma_{nt}} \frac{\bar{\tilde{L}}}{\bar{\tilde{H}}}$$

[2] $$w = \frac{(1-\gamma_{nt})\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)} + (1-k)\frac{\kappa}{w_L}\left(1-\alpha(\sigma-1)\right)\right)}{\gamma_{nt}\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}\right) + \left(\frac{1+\tau}{1-\alpha} - (1-\gamma_{nt})\right)(1-k)\frac{\kappa}{w_L}\left(1-\alpha(\sigma-1)\right)} \frac{L}{\bar{H}}$$

[3] $$I = w_L(L + w\bar{H})$$

[4] $$\tilde{I} = \frac{\tilde{w}_L}{\alpha + (1-\alpha)\gamma_{nt}} \bar{\tilde{L}}$$

[5] $$I^* = \left(\frac{1-\gamma_{nt}}{\gamma_h} \frac{w_L \dfrac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + 1 - k}{a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}} + \frac{\gamma_l}{\gamma_h} \right) \tilde{I} - I$$

[6] $$I^* = \frac{1}{\gamma_h} \frac{(\gamma_l + \alpha\gamma_h) w_L \dfrac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + \gamma_l(1-k) + \gamma_l a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}{(1-\alpha) w_L \dfrac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + (1-k) + a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}} (I + \tilde{I})$$

4. Scenarios and parameters

4.1. The scenarios

Two sets of scenarios will be simulated, one being centred on labour market reforms and the other on a sector-oriented fiscal policies.

The first set of scenarios compare the German and French economies in two situations: 1) a labour market reform in Germany (Hartz laws) which lessens the reservation wage and no reform in France, and 2) a labour market reform in France which is similar to the German reform.

The second set of simulations is centred on France, and it compares the effects of a German-type strategy (labour market reform which lessens the reservation wage) with a structural sectoral policy which boosts the demand for non-tradable services through modifications in taxes and public expenditures. Three types of policies are simulated, each of them being funded by a value added tax (VAT) which applies to all goods except the non-tradable service.

a) Labour market reforms in France and Germany

The first two scenarios are centred on labour market reforms that lower the reservation wage.

The first scenario assumes different strategies in Germany and France. Germany follows a strategy which is consistent with what has been observed since the mid-1990s and is modelled following BCH interpretation. Offshoring firstly lessens the unskilled labour full employment wage, and subsequently increases unemployment once the unskilled workers' market clearing wage has reached the reservation wage. Confronted with growing unemployment, the government sets labour market reforms, which lower the reservation wage from $\underline{w}_1$ to $\underline{w}_2$ and foster thereby the demand for non-tradables. In France, the first two phases of the same scenario apply, but this country does not respond to growing unemployment by a labour market reform, allowing thereby unemployment to increase.

In this scenario, France and Germany do not only diverge in their response to unemployment, but also in their structural characteristics (skill endowment, population, quality of the varieties produced by sector h) that make the market clearing wages, the skill premium, the reservation wage and finally the timing and speed of offshoring to differ between the two countries.

This scenario is modelled by assuming the same cost of producing offshore in both countries, this cost decreasing with time.

In the second scenario, the French government implements the same type of reforms as Germany so as to combat unemployment. This is modelled by making the reservation wage decrease (from $\underline{w}_1$ to $\underline{w}_2$, with values different in France compared to Germany). For France, we then analyse the shape of such policies that permit to reach either the same unemployment rate as in Germany, or the same skill premium (inequality). We then compare the effects of this type of policy in both countries. These effects are not identical because of structural differences, particularly in skill endowment.

In both scenarios, (i) the initial reservation wage is 15% lower than the full employment unskilled labour wage without offshoring in both France and Germany, and (ii) Germany implements a labour market reform that lowers the reservation wage by 20% when the unemployment rate attains 15% of the working population, whereas France leave its reservation wage unchanged.

In the second scenario, we calculate (i) the increase in the French skill premium (inequality) which permits to reach the German unemployment resulting from the labour market reform (20% decrease in the German reservation wage) at full offshoring, and (ii) the increase in the French unemployment which permits to replicate the German skill premium resulting from this labour market reform.

b) Sectoral policies

This second set of scenarios assesses the effects of sectoral policies which foster the demand for non-tradable services and compares these policies with a Hartz-type labour market reform.

Three policies are considered, all of them being funded by a value added tax (VAT) which applies to all tradable goods but not to the non-tradable service. By selecting public expenditures on non-tradables funded by a VAT on tradables, we generate two channels through which the demand for non-tradable services increases: (i) the decrease in their relative price due to the between-sector difference in VAT and (ii) the utilisation of the taxes to foster the demand for those services. A decrease in, e.g., the employer's payroll tax on unskilled workers' wages would be less efficient because it would lower the cost of both sectors *nt* and *h*, provided that offshoring is not total in the latter.

In the first policy, the related levies are utilised to buy the non-tradable service and to provide it freely to households. This policy is not efficient because it typically creates a crowding-out effect on private spending: as they freely receive non-tradable services, households reduce their demand for these services, which lessens the impact of the policy on their production and thereby on employment.

In the second policy, we suppose that the levies are utilised to buy non-tradable services which are different from those which are bought on the market and hence not substitutable for them. These services could be devoted to the maintenance of cities or public equipment, anti-pollution actions, supports to poor households and/or to migrants etc. Those services can be bought from the private sector or directly produced by the public sector. We also assume that the technology to produce these services is similar to that to produce the private services bought by households in the market.

In the third policy, the levies are assigned to a subsidy to lower the price of the non-tradable service on the market. The subsidy rate is *s*, and the price of service *nt* then moves from p_{nt} down to $(1-s)p_{nt}$. It can be noted that this is equivalent to the state refunding the proportion *s* of the households' purchase of service *nt*.

As in the scenario with a labour market reform, the sectoral policies are implemented when the unemployment rate attains 15% of the working population. For each policy, we calculate the amount of tax (VAT rate on tradable goods) necessary to reach the same result in terms of unemployment with full offshoring (k = 1) as determined by the former decrease in the reservation wage. We can then appraise the pro-*nt* sectoral policies by highlighting its tax cost and its benefit in terms of (lower) inequality compared to the Hartz-type policy.

4.2. The parameters

Tables 1 and 2 depict the parameters and country-specific values utilised in the simulations. The justification of the parameters is discussed in BCH (section 5.3., p.324). As regards Germany, the values selected in Table 2 have been slightly modified compared to those utilised in BCH (2016).

Table 1. Parameters common to both countries

γ_l	γ_h	γ_{nt}	α	A	σ	δ	κ
0.25	0.35	0.4	0.25	1	2	1	0.33

Table 2. Country-specific values

Country	a	$\bar{L}$	$\bar{H}$	$\bar{\tilde{L}}$	$\bar{\tilde{H}}$	$\bar{H} / \bar{L}$	$\bar{\tilde{H}} / \bar{\tilde{L}}$	$\bar{L}_A$	$\bar{H}_A$	$\bar{H}_A / \bar{L}_A$	$\underline{w}_1$	$\underline{w}_2$
Germany	0.4	7.7	2.3	55	15	29.87	27.27	62.7	17.3	27.59	0.94	0.75
France	0.35	6.37	1.63	56.33	15.67	25.59	27.82	62.7	17.3	27.59	0.856	0.70

The population and endowments of the advanced area (Home country + North, depicted by subscript A in Table 2) are the same in all simulations. These endowments were selected so as

to broadly represent their share in the advanced countries private employment in the 2000s. The relative skill endowment is higher in Germany than in France, in line with the stylised fact depicted in Figure 8. The ratios $\bar{H} / \bar{L}$ and $\tilde{\bar{H}} / \tilde{\bar{L}}$ have been lowered to account for the fact that public employment, which is not inserted in the model, is more skill intensive than private employment. Coefficients *a* for Germany and France are selected to obtain a before-offshoring export/GDP ratio consistent with what was observed (Figure 3).

5. Results

We firstly expose the outcomes of the scenarios centred on labour market reforms. We subsequently compare these outcomes with those of the sectoral policies.

5.1. Labour market reforms

Table 3 depicts the characteristics of France and Germany before offshoring, i.e., for $k = 0$.

The zero unemployment rate must be interpreted as a situation with frictional unemployment only (since we have no search and matching frictions in our model). The skill premium is lower in Germany, and the unskilled workers' real wage higher, which directly results from the higher skill endowment of this country compared to France.

Table 3. France and Germany before offshoring

	u *	*Skill premium w*	w_L / P **
France	0	3.20	64.6
Germany	0	2.74	68.8

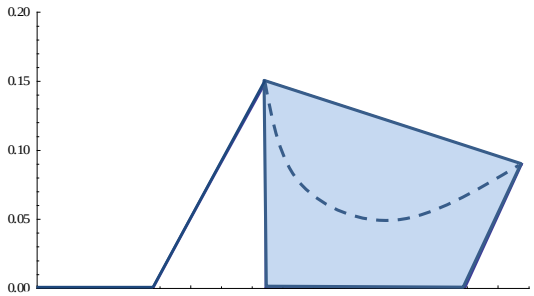
* *u* = unemployment rate; ** w_L / P = unskilled workers' real wage.

a) Labour market reform in Germany and not in France

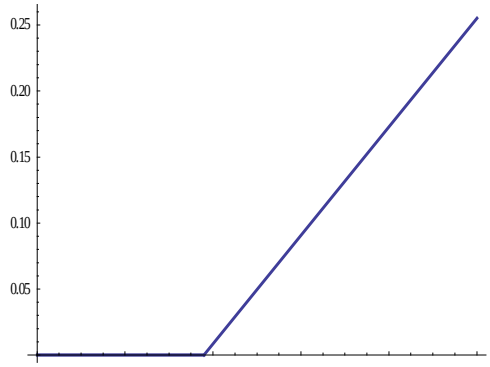
In Figures 9, we start from a situation with no-offshoring ($k = 0$) and we move to full offshoring (k = 1), each country being characterised by the reservation wage $\underline{w}_1$ depicted in Table 2. We further assume a decrease in the reservation wage in Germany (Hartz-type reform) from $\underline{w}_1$ to $\underline{w}_2$ when total unemployment reaches the rate 15% and no-reform in France. We picture the results of this scenario in terms of unemployment, skill premium (indicator of inequality between skilled and unskilled workers) and the unskilled workers' real wage (indicator of their purchasing power) in each country.

Figure 9. Labour market reform in Germany and not in France*

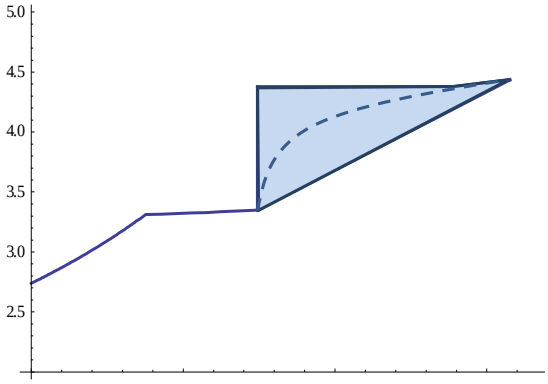
Germany

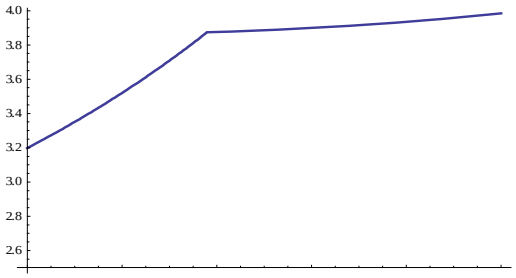


France

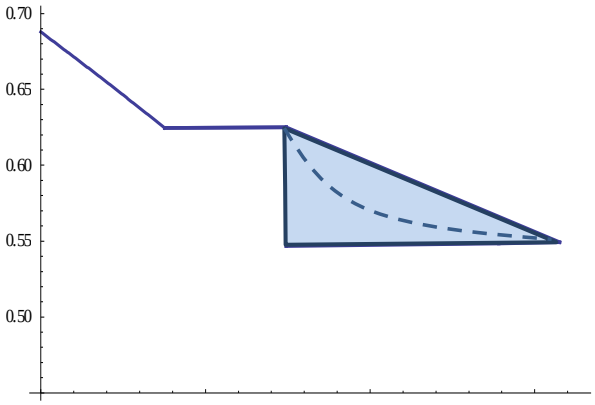


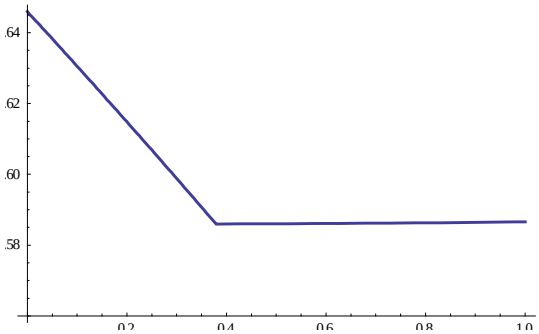
a) Unemployment rate (total)





b) Skill premium





c) Unskilled workers real wage

** The figures start at k = 0 and from the moment when the h-variety with the lowest offshore cost begins to be offshored, and they end for k = 1 (full offshoring). As the before-offshoring unskilled labour wage is lower in France than in Germany, the variations pictured in Figures 9 begin later in France than in Germany. In particular, there is a time period during which the French skill premium remains unchanged at 3.2 whereas the German skill premium increases.*

As the before-offshoring unskilled labour wage is higher in Germany than in France (Table 3), offshoring typically starts earlier in Germany. In this country, it leads to a rise in inequality as long as the decreasing unskilled labour wage does not attain the reservation wage. From then, unemployment continuously increases until the moment when the labour market reform (decrease in the reservation wage) is implemented. The setting of the labour market reform results in a decrease in unemployment and an increase in inequality. These variations take place inside the dimmed surfaces in Figures 9. The bottom side of this surface corresponds to a one-shot decrease in the reservation wage and to the return to Germany of all the segments the production of which becomes less costly in Germany because of the reform, even those which will soon be relocated to the South as the cost of producing offshore continues to decrease. This situation is obviously unrealistic. The top side of the dimmed surface corresponds to a smooth decrease in unemployment and a smooth increase in the skill premium, until the values corresponding to a situation of full offshoring ($k = 1$). The dashed curves picture variations which are between these two situations. In France, as no reform is implemented, inequality increases until the moment when the unskilled labour wage attains the reservation wage, and unemployment continuously increases afterwards.

These figures provide an interpretation of the differences in economic developments between the two countries since the mid-1990s. Offshoring has been more intense in Germany because the unskilled workers' wage was higher, leading to both growing inequality and higher unemployment (compared to France) before the labour market reform. From the setting of the reform, unemployment has decreased in Germany (whereas it increased in France) and inequality has increased whereas the reservation wage has prevented this increase in France.

b) Hartz-type labour market reform in both Germany and France

We now analyse the effects of a Hartz-type labour market reform in France and we compare these effects with those determined for Germany.

According to our model, the implementation of a labour market reform which lowers the reservation wage by 20% leads to a skill premium of 4.44 and an unemployment rate of 9% when Germany attains full-offshoring. This could be considered as a rather high unemployment rate given that the German unemployment rate is now of about 5%. It must however be noted that (i) our calculations are made by assuming full-time employment of all workers, whereas part-time jobs represent 23% of German employment, and (ii) this rate assumes full offshoring, which can be considered as a rather extreme situation, even for

tradable goods. The following analyses are based on these two results (u = 9% and w = 4.435) characterising Germany being at full offshoring.

In Table 4, we consider the moment when k attains the value 1,[3] and we analyse two cases. We firstly assume a similar rate of unemployment in both France and Germany, and we compare their related skill premia and unskilled workers' real wage. We subsequently assume identical skill premia within both countries and we compare their related unemployment and unskilled workers' real wage.

Table 4. Hartz-type reform: comparison France-Germany

	u *	*Skill premium* w	w_L / P **
Germany	9	4.435	54.92
France	9	5.20	51.36
Germany	9	4.435	54.92
France	19.38	4.435	55.59

* u = unemployment rate; ** w_L / P = unskilled workers' real wage.

Table 4 clearly shows that a German-type labour market reform would be less efficient in France than in Germany. To reach the same unemployment rate, France should accept a significantly higher inequality (and lower unskilled labour real wage). Likewise, France should accept a substantially higher unemployment to have the same skill premium (inequality) as Germany.

According to our model, it is clear that offshoring generates an inequality versus unemployment trade-off which is more intense and painful in France compared to Germany. This derives from the difference in skill endowments which forces France to lower its reservation wage more that Germany to create more unskilled jobs and lessen unemployment.

5.2. Sectoral policies

In the preceding section, we diagnosed an inequality-unemployment trade-off which is significantly more intense (and thereby more painful) in France than in Germany. So as to compare the sectoral policies with the labour market reform, we need to select an objective (u,w) of the social planner in terms of unemployment rate and inequality (skill premium). For each policy, one value of the VAT rate τ and one value of k determine one couple of values (u,w). In each case, we select here the VAT rate which is consistent with u = 12% (and $w \simeq 4$

[3] I.e., the moment when the decreasing cost of producing offshore reaches the level which makes all the L-segments $S_L(i)$, $i \in [0,1]$, to be outsourced to the South.

as shown hereafter) for $k = 1$. This choice, which is between the highly unequal situation corresponding to the 9% unemployment rate and the very high unemployment corresponding to the skill premium $w = 4.435$ (see Table 4), is clearly subjective. Another choice would just modify the related VAT rate without modifying the diagnosis (the results for other choices are available from the authors upon request).[4]

Table 5. Characteristics of the sectoral policies for $u = 12\%$ at $k = 1$

Policy	VAT rate (%)	Skill premium (w)	w_L / P
1. VAT + Provision of service *nt*	25.0	3.98	51.32
2. VAT + Provision of public *nt* services	10.0	3.98	55.40
3. VAT + Subsidies to sector *nt*	9.3	3.96	58.60
Labour market reform*	-	4.98	52.48
Situation before offshoring	-	3.20	64.60

*with a decrease in the reservation wage which generates $u = 12\%$ for $k = 1$.

Table 5 depicts the VAT rates which permit to obtain the 12% rate of unemployment when offshoring attains its highest level ($k = 1$, i.e., all the L-segments of the h-varieties are offshored), as well as the related skill premium and unskilled workers' real wage. The latter two values are also depicted (i) in the case of a labour market reform (decrease in the reservation wage) which permits to attain the same goal ($u = 12\%$ for $k = 1$), and (ii) in the before-offshoring situation depicted in Table 3.

When the VAT is utilised for the direct provision of service *nt*, the impact is minor. The VAT rate necessary for generating the 12% unemployment rate at full offshoring ($k = 1$) is exorbitant,[5] which shows the inefficiency of such a policy. The reason for this is the crowding out effect: as they freely receive service *nt* from the state, households ask more of the tradable goods l, h and $\tilde{h}$. In addition, this high VAT reduces the unskilled workers' purchasing power, which is even lower than that resulting from a Hartz-type labour market reform.

The other two policies appear significantly more efficient. To obtain a 12% rate of unemployment when the country reaches full offshoring ($k = 1$), the VAT rate is 10% in the case of provision of public goods, and 9.3% in the case of subsidies to sector *nt*. In addition, these policies result in a significant reduction in inequality compared to the labour market reform, even if inequality is higher than before outsourcing. Finally, the real wage of unskilled workers is also higher than with a Hartz-type labour market reform. Both the

[4] The values of u, w and w_L / P from the start of the policies to the time when $k = 1$ are available upon request.

[5] Remember that this rate is the one which generates the levies necessary to implement the policy.

reduction in inequality and the real wage of unskilled worker are greater in the policy scheme which combines the VAT with subsidies to sector *nt*. This policy appears to be the most efficient to reduce the inequality-unemployment trade-off.

6. Discussion and conclusion

Two major outcomes can be derived from our simple CGE model and the associated simulations.

Firstly, when implementing a Hartz-type labour market reform, the increase in inequality (the skill premium) necessary to obtain a similar decrease in unemployment is higher in France than in Germany, and the unemployment rate necessary to reach the same inequality as in Germany is much higher. These findings logically stem from the difference in skill relative endowments between the two countries. This typically shows that the inequality-unemployment trade-off is more intense and painful in France. Since the German experience has come with a significant increase in inequality, an even higher inequality should be accepted in France to reduce unemployment by the same amount as in Germany if France wanted to apply the same policy.[6]

Secondly, alternative policies which consist in supporting the demand for non-tradable services are conceivable. Three types of policy funded by a VAT on tradable goods have been considered and simulated. The first consists in a direct public purchasing and providing of the non-tradable services bought by consumers in the market. The second in the providing of non-tradables which are not bought by households and which are not substitutable for the private *nt* services. The third consists in utilising the VAT on tradables to subsidise and lower the price of non-tradables. Our simulations reveal two major outcomes:

- The direct providing of non-tradable services bought by consumers in the market is inefficient because of the crowding out effect linked to this policy. Its implementing would generate an unbearable increase in the VAT burden.

- Both other policies are feasible. However, within the synthetic framework utilised here, the levies allocated to the sectoral policy remain rather high (a VAT rate of 9.3% in the scenario with subsidies to sector *nt* and 10% in the case of public providing of non-tradable

[6] As already noted in BCH (2016), the simulated decrease in the reservation wage still induces a non-negligible unemployment rate (9% in Germany) when offshoring attains all the unskilled intensive varieties of sector *h*. These rates are however overestimated because of the low elasticity of substitution between goods and the constant skill endowments assumed in the model (see the discussion below).

services which are not substitutable for those bought by households in the market). This weakness should however be tempered for three reasons.

First, the elasticity of substitution between non-tradables and other goods is one in our utility function, which indicates no substitution between them. An elasticity of substitution higher than one would boost the employment of less skilled workers by reinforcing the demand for non-tradables linked to the change in relative prices. In addition, if we assume different non-tradables with different price-elasticities of demand, this could raise the efficiency of the policy based on a modulation of the VAT rates and subsidies. This is because the social planner can now select to lower the VAT (and increase the subsidy) on the most price-elastic services, which permits to amplify the demand effect of this policy.

Second, the levies allocated to each sectoral policy are chosen to attain the same unemployment rate as that determined by the labour market reform *when offshoring reaches its highest level,* i.e., all the *L*-segments of the *h*-varieties are offshored. This choice makes unemployment to decrease sharply (down to zero) when the sectoral policy is implemented (at this time, offshoring does not concern all the *L*-segments), and to regularly increase afterwards. This means that the rise in VAT can be lower at the beginning of its implementation to generate a decrease in unemployment.

Third, the endowments in skilled and unskilled labour are unchanged throughout the process. If we assume that the relative endowment of skilled labour tends to increase with time, then unemployment decreases as well.

All these remarks show that several simplifying assumptions of our synthetic model tend to lessen the policy efficiency. The VAT rates consistent with the social planner's objective could reveal to be significantly less intense within a broader and more realistic approach.

It must finally be emphasized that the model and simulations described here can in no way portray the whole set of factors and interactions which determine the unemployment dynamics in European countries, particularly in France and Germany. Recent analyses have suggested that a major explanation for divergence in unemployment since 2008 across EU economies can be found in the differences in intensity of the financial and real shocks experienced in each country (Boeri & Jimeno, 2016). In addition, Boeri & Jimeno (2016) suggest that the interplays between these uneven shocks and country-specific institutions (particularly on the labour markets) could explain a large part of the divergences observed across EU countries.

The model developed in this paper focuses on the sole influence of the growing demand for non-tradable services upon unskilled employment. BCH showed that this channel could be

considered as a major driver of the decrease in German unemployment which has followed the labour market reforms. This is not really surprising given that (i) offshoring to emerging countries typically destroy low and middle skilled employment in advanced economies and (ii) a decrease in the reservation wage, which derives from institutional changes in the labour market, essentially impacts the employment in non-tradables because the difference in labour costs between emerging and advanced countries is huge. The same mechanisms apply in the case of France, but the decrease in unemployment linked to the labour market reform is now lessened because of the higher endowment of unskilled labour.

We now discuss (i) the similarities between the simulated sectoral policies and certain policies decided in France in the last decades, and (ii) the institutional feasibility of the considered policies.

As regards the sectoral policies, it should be recalled that a number of policies centred on a modification of the VAT in favour of non-tradable services have been implemented in France and that their ex-post evaluations provide rather mixed results. Reduced VAT rates have been established in France since the sixties. As regards non-tradable services, several major decisions have been taken since the 1990s with the setting of reduced VAT rates in social housing, house renovation and maintenance (a series of reforms since 1991, with extensions of the scope of reductions between 1998 and 2013, and modifications from 2009 to 2014), domestic services and services to individuals and households (since 1991) and catering business (2009, modified in 2012 and 2014). Hérody & Tirot (2015) provide a description and an assessment of all these policies.

The effects of those policies depend to a large extent on the sector which is concerned and on the size of the firms, and their evaluations sometimes diverge according to the method and the selected years. In most cases, even when their impact is effective, it seems that the cost of these policies for public funds is significant and that direct expenditures could have provided higher effects, at least in the short term (Carbonnier, 2009, for domestic services[7]).

A well-known shortcoming of such policies is the existence of deadweight effects (the so-called ‘effets d’aubaine’): the beneficiaries take advantage of the reduction in price without increasing much their demand for the targeted service, or by reducing this demand in the case of a public provision of the service. So the efficiency of the policy depends (i) on the price elasticity of demand and (ii) on the crowding-out effect upon the demand for the publicly

[7] Even if the effect is positive (Flipo et al., 2007; Carbonnier, 2009 ; Marbot, 2011).

provided service. The existence of crowding-out is the main reason why we have simulated three scenarios of sectoral policies in favour of non-tradable services.

In Scenario 1, crowding out is very large and the only channel through which the consumption of *nt* increases is a limited decrease in its relative price. Then, most of the extra demand for *nt* due to public spending vanishes because of the reduction in the households' consumption of this service. This strategy can be seen as inefficient since, to obtain a non-negligible impact, it compels an unrealistic increase in the VAT rate. Scenario 2 allows the erasing of crowding-out by assuming that the publicly provided non-tradable services do not substitute for those bought in the market. Then, (i) the levies are utilised to purchase the publicly provided non-tradables, and (ii) the proportion γ_{nt} of the income is spent in the consumption of private non-tradables. Finally, Scenario 3 assumes that the policy is fully devoted to the decrease in the price of *nt*, both through the lack of VAT and the subsidy to this sector. The last two policies appear to be significantly more efficient than the former, and their impact is quite similar, with however a slightly larger impact of the subsidy policy. This higher efficiency is in line with several evaluations and studies which conclude that a direct public hiring could be more efficient than a modification of the VAT (Carbonnier, 2009; Kergueris, 2010). Note that our second strategy does not mean that the publicly-provided services should be publicly produced. They can be bought from private firms, provided that they are not substitutable for the non-tradable services bought in the market.

Finally, the implementation of a fiscal policy which boosts non-tradable services could reveal to be contradictory with certain rules of the European Union legislation. First, we have assumed a policy in which the VAT rate is 0% for non tradables. Zero VAT rates are typically not allowed in the EU, except for certain countries (the UK, Ireland) where they existed prior to the EU legislation. This is not really a problem since what is typically modelled here is the difference between the VAT on sector *nt* and on tradable goods, with the related levies being utilised to boost sector *nt*. Another concern is the possibility to subsidise service *nt* so as to lower its price and boost its production. The European Union prohibits sectoral subsidies when they tend to limit competition between firms and member states. This could restrict the scope of the subsidy policy depending on the interpretation of this limitation.

In conclusion, our model suggests that there could be a way to moderate unemployment without increasing inequality, i.e., without boosting the demand for non tradables through a decrease in the wage of less skilled workers. The implementation of such a strategy requires the prior study of price-elasticities in the different non-tradable sectors and the subsequent

definition of the sectors to be supported. It also necessitates a clear determination of the measures which are not contradictory with the European regulation and, if necessary, some propositions to relax certain rules and conditions. Finally, a precise determination of the macro-impacts of these policies requires the utilisation of a significantly more detailed macro-model of the French economy, in which the major between-variable interplays could be inserted. The simulations implemented here are indicative since they are built ceteris paribus and rest on parameters which are plausible 'on average'. Their outcomes call for a broader evaluation of the different policies.

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Appendix A. Prices and real wages of unskilled workers

Prices

$$P_h = \left(a^{\sigma} {p_h}^{1-\sigma} \left(\frac{1-\left(1-k\kappa / w_L\right)^{1-\alpha(\sigma-1)}}{(\kappa / w_L)(1-\alpha(\sigma-1))} + (1-k) \right) + {\tilde{p}_h}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

$$p_h = A^{-1} \left(\frac{w_H}{1-\alpha} \right)^{1-\alpha} \left(\frac{w_L}{\alpha} \right)^{\alpha}; \qquad \tilde{p}_h = A^{-1} \left(\frac{\tilde{w}_H}{1-\alpha} \right)^{1-\alpha} \left(\frac{\tilde{w}_L}{\alpha} \right)^{\alpha}$$

$$p_{nt} = w_L / \delta \qquad p_l = \bar{p}_l$$

$$P = (1+\tau)^{1-\gamma_{nt}} (1-s)^{\gamma_{nt}} \, {p_{nt}}^{\gamma_{nt}} \, {p_l}^{\gamma_l} \, {P_h}^{\gamma_h}$$

where τ is the VAT rate and *s* the rate of subsidy to service *nt*.

Real wage of unskilled workers

$$\varpi_L = \frac{w_L}{P}$$

Appendix B.

Endogenous variables: w, $\tilde{w}$, I, $\tilde{I}$, I^*, w_L or L.

Exogenous variables: $\tilde{w}_L = 1$; $L = \bar{L}$ or $w_L = \underline{w}$.

In all cases, the levies from the VAT are fully utilised to increase the demand for non-tradable services (purchase of service *nt*, purchase of a public non-tradable service which is not substitutable for *nt*; subsidy to decrease the price of *nt*).

1. Model with a VAT funding the public purchase and providing of service *nt*

$$\tilde{w} = \frac{1-\gamma_{nt}}{\frac{\alpha}{1-\alpha} + \gamma_{nt}} \frac{\bar{\tilde{L}}}{\bar{\tilde{H}}}; \qquad I = w_L(\bar{L} + w\bar{H}); \qquad \tilde{I} = \frac{\tilde{w}_L}{\alpha + (1-\alpha)\gamma_{nt}} \bar{\tilde{L}}$$

$$w = \frac{(1-\gamma_{nt})\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)} + (1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))\right)}{\gamma_{nt}(1+\tau)\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}\right) + \left(\frac{\alpha}{1-\alpha}(1+\gamma_{nt}\tau) + \gamma_{nt}(1+\tau)\right)(1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))} \frac{L}{\bar{H}}$$

$$I^* = \frac{1}{\gamma_h}\left((\gamma_l + \gamma_h) \frac{w_L \frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}}{\kappa(1-\alpha(\sigma-1))} + 1 - k}{a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}} + \gamma_l \right) \tilde{I} - \frac{I}{1+\gamma_{nt}\tau}$$

$$I^* = \frac{1}{\gamma_h} \frac{(\gamma_l + \alpha\gamma_h) w_L \frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa(1-\alpha(\sigma-1))} + \gamma_l(1-k) + \gamma_l a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}{(1-\alpha) w_L \frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa(1-\alpha(\sigma-1))} + (1-k) + a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}} \left(\frac{I}{1+\gamma_{nt}\tau} + \tilde{I}\right)$$

2. Model with a VAT funding the providing of a public non-tradable service

$$\tilde{w} = \frac{1-\gamma_{nt}}{\frac{\alpha}{1-\alpha}+\gamma_{nt}}\frac{\bar{\tilde{L}}}{\bar{\tilde{H}}}; \qquad I = w_L(\bar{L}+w\bar{H}); \qquad \tilde{I} = \frac{\tilde{w}_L}{\alpha+(1-\alpha)\gamma_{nt}}\bar{\tilde{L}}$$

$$w(k) = \frac{(1-\gamma_{nt})\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}+(1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))\right)}{(\tau+\gamma_{nt})\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}\right)+\left(\frac{1+\tau}{1-\alpha}-(1-\gamma_{nt})\right)(1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))}\frac{\bar{L}}{\bar{H}}$$

$$I^* = \frac{1}{\gamma_h}\left((\gamma_l+\gamma_h)\frac{w_L\frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}}{\kappa(1-\alpha(\sigma-1))}+1-k}{a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}+\gamma_l\right)\tilde{I}-\frac{I}{1+\tau}$$

$$I^* = \frac{1}{\gamma_h}\frac{(\gamma_l+\alpha\gamma_h)w_L\frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa(1-\alpha(\sigma-1))}+\gamma_l(1-k)+\gamma_l a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}{(1-\alpha)w_L\frac{1-\left(1-\frac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa(1-\alpha(\sigma-1))}+(1-k)+a^{-\sigma}\left(\frac{w_L}{\tilde{w}_L}\left(\frac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}\left(\frac{I}{1+\tau}+\tilde{I}\right)$$

3. Model with a VAT funding subsidies to lower the price of service *nt*

$$\tilde{w} = \frac{1-\gamma_{nt}}{\frac{\alpha}{1-\alpha}+\gamma_{nt}}\frac{\bar{\tilde{L}}}{\bar{\tilde{H}}}; \qquad I = w_L(\bar{L}+w\bar{H}); \qquad \tilde{I} = \frac{\tilde{w}_L}{\alpha+(1-\alpha)\gamma_{nt}}\bar{\tilde{L}}$$

$$s = \frac{\tau(1-\gamma_{nt})}{\gamma_{nt}+\tau(1-\gamma_{nt})}$$

$$w(k) = \frac{(1-s-\gamma_{nt})(1-\alpha)\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}+(1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))\right)}{\gamma_{nt}(1-\alpha)\left(1-\left(1-\frac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}\right)+(\alpha(1-s-\gamma_{nt})+\gamma_{nt})(1-k)\frac{\kappa}{w_L}(1-\alpha(\sigma-1))}\frac{\bar{L}}{\bar{H}}$$

$$I^* = \frac{1}{\gamma_h}\left((\gamma_l + \gamma_h)\frac{w_L \dfrac{1-\left(1-\dfrac{\kappa}{w_L}k\right)^{1-\alpha(\sigma-1)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + 1 - k}{a^{-\sigma}\left(\dfrac{w_L}{\tilde{w}_L}\left(\dfrac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}} + \gamma_l \right)\tilde{I} - \frac{I}{1+\tau}$$

$$I^* = \frac{1}{\gamma_h}\frac{(\gamma_l + \alpha\gamma_h) w_L \dfrac{1-\left(1-\dfrac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + \gamma_l(1-k) + \gamma_l a^{-\sigma}\left(\dfrac{w_L}{\tilde{w}_L}\left(\dfrac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}{(1-\alpha) w_L \dfrac{1-\left(1-\dfrac{\kappa}{w_L}k\right)^{1+\alpha(1-\sigma)}}{\kappa\left(1-\alpha(\sigma-1)\right)} + (1-k) + a^{-\sigma}\left(\dfrac{w_L}{\tilde{w}_L}\left(\dfrac{w}{\tilde{w}}\right)^{1-\alpha}\right)^{\sigma-1}}\left(\frac{I}{1+\tau} + \tilde{I}\right)$$