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# BE HEALTHY, BE EMPLOYED: A COMPARISON BETWEEN THE US AND FRANCE BASED ON A GENERAL EQUILIBRIUM MODEL

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# Be healthy, be employed: A comparison between the US and France based on a general equilibrium model

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**Abstract**

Does health differences between the US and France come from unemployment risk gaps? A general equilibrium model *à la* Aiyagari (1994) augmented by investments in health *à la* Grossman (1972) is used to analyze the market allocations of two particular economies: the US and France. The US are characterized by low unemployment risk, associated to low unemployment insurance. The turnover in the US is larger than in France. We show that expenditures in health are strongly related to the labor market turnover leading the American to perceived their employment spells as a more risky events, therefore reducing their incentives to invest in health. This contributes to explain the poorer health of the Americans than French.

**Keywords:** Unemployment risk, Health inequalities, heterogenous agent model

**JEL Classification:** E24, I12, I14

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# 1 Introduction

During recent years, the health inequalities have become more and more a severe issue around the globe. In developed countries, one dimension of these inequality is the difference of health status between employees and unemployed workers. In the US, the percentage of poor health agents among workers is about 8.2%, but it's basically doubled among agents who experience less than one year unemployed duration but even tripped among agents who experience longer than one year unemployed duration (see Meyer et al. (2013) [13]). Despite its generous social security system, France must also deal with health inequalities. At a 35 years old, the life expectancy of unemployed male is 28.5 years, while it rises to 40 years for an employee (see Potvin et al. (2010)[14]). In this paper, we explain these health inequalities using a general equilibrium model *à la* Aiyagari (1994)[1] augmented by investments in health *à la* Grossman (1972)[9]. Our goal is to understand the interactions between choices of health expenditures and unemployment risk, in a framework rich enough to account for the major differences between the United States and France to explain health status differences.

We develop an original extension of the Aiyagari's model where, besides the labor income risk, an uncertainty on the health status is introduced. The health choices are discrete as in search models of the labor market where multiple offers are available[1]: agents decide to consume or not a fix amount in health services. This leads only individuals in bad health to invest in health. The investment in health only gives a better chance to restore the health status: it is a risky project. In this risky environment, agents can save to insure themselves against these bad shocks (unemployment and disease). Hence, our approach accounts for the interaction between assets accumulation and investment in health. In this dynamic and stochastic framework, the complete history of the agents on the labor market determines wealth distribution and thus the heterogenous financial capacities to invest in health: the health inequalities are an endogenous output of the model solution. This is a crucial point because survey reports that 15.8% of individuals declare that they give

[1] These discrete choices are closed to those of a search models of the labor market where multiple offers are available; see e.g. Algan, Hairault, Langot and Chéron (2003) [2].

up spending on health for financial reasons (see Dourgnon et al (2012)[5] based on ESPS survey). Additional empirical evidences show that health inequalities is not only caused by labor market status or dangerous habits (alcohol addictive, heavy smoker,etc.), but also by several barriers such as information barriers, or culture barriers, and most importantly, financial barriers (see Jusot (2010)[11]).[2] In order to examine contrasting experiences and thereby check the robustness of our model, we use it to study two countries: the US where the unemployment insurance is limited in the context of low unemployment risk and high turnover, but where the cost of health expenditures is large, and France where the unemployment benefit system is more generous in the context of high unemployment risk and low turnover, but where the price of the health services are low.[3]

In general equilibrium model, the health risk leads to health expenditures that can reduce through a crowding-out effect the amount of saving. But the health risk is also a motive of precautionary saving. These two opposites effects drive the changes in saving and thus the capital available for the production, and thus the output. Moreover, the risks on the labor market have a direct impact on the output via the employment level, but also provide incentives for self-insurance, and thus affect the output via the capital stock. Our general equilibrium model accounts for these complex interactions. Numeral resolutions based on calibration of both countries allow us to determine which are the dominant forces at work. Our first result come from the calibration restrictions: if we want to match a larger share of health expenditures in GDP in the US than in France but, at the same time, a smaller percentage of individuals in good health in the US than in France, we must introduce heterogenous parameters for the health sector, in addition to heterogenous labor market characteristics. Hence, as in Fonseca, Langot, Michaud and Sopraseuth (2018)[6], it is necessary to introduce a higher price of the health services in the US as well as a lower value of a healthy life (More frequent health risky behaviors in the US). We also show that the productivity of the health sector must be higher in the

[2]For simplicity and as in De Nardi, French and Jones (2016)[4] or in Fonseca, Langot, Michaud and Sopraseuth (2018)[6], we assume that the benefice of being healthy is directly added in the utility function. We do not introduce bonus in wage when individual are in the good health state, because the impact of this channel is negligible. See Eric French (2005)[7].

[3]Given that the health investment is a fixed cost, the generosity of the health insurance system is simply revealed by the gap between the values of these fix costs among countries.

US than in France in order to match our set targeted moments. Secondly, counterfactual experiments shows that all the characteristic of the US labor market (low unemployment benefit and high turnover) contributes significantly to the poor heath of the Americans. Nevertheless, we also show that the indirect impact of the labor market status on health status have a lower impact on crosscountry differences than the structure of the health market (price, productivity and risky behaviors).

There already exists a literature that analyze the health choices using general equilibrium model with heterogenous agents. French(2003)[8] reveal a significant catastrophic health costs risk: in any given year, 0.1% of households suffer a shock that costs at least 125,000 dollars over their lifetime. De Nardi(2009)[3] build a model that aims to explores the different saving behaviors upon retirement of different Social-Economic Status when facing various health risks. This paper shows that *(i)* the risk of living beyond the expected life span, explains the very slow assets de-cumulation rate of the elderly after retirement, and *(ii)* the medical costs is another important determinant to the assets de-cumulation rate of the elderly. But these works mainly focus on the elderly. One exception is Fonseca, Langot, Michaud and Sopraseuth (2018)[6] that focus on the health risks for all individuals and also compare the market allocations for a large set of OECD countries. Fonseca, Langot, Michaud and Sopraseuth (2018)[6] show that the cross-country differences in the price of health services are the main explaining factor allowing them to explain simultaneously the gaps in health status and in health expenditures as a percentage of GDP in the OECD countries of their sample. Nevertheless these authors deals with the labor market risk as an income risk without distinguishing between employment and unemployment. In this paper, we propose a parsimonious model that allows us to analyze the health risks for all the population, with a particular focus on its interaction with the unemployment risk on the labor market.

The organization of this paper is as follows: in section 2 we present the theoretical model and the algorithm, in section 3 we discuss the method we use to calibrate different parameters, especially the ones related to the health risk. Then we present the results, alongside with their interpretations and intuitions.

# 2 The theoretical model

**Individual agents.** The economy is populated by a continuum of infinitely lived households and the total population is normalized to 1. At the beginning of the current period, a household earns an amount of wealth denoted by $a$. The household is characterized by an employment status and an health status. Let denote by $j$ the employment status. The household may be employed ($j = e$) or unemployed ($j = u$). The health status is denoted by $h$. The household may be in good health ($h = g$) or in bad health ($h = b$). To sum up, at the present time, an agent is characterized by a vector of three state variables $(a, j, h)$.

Job and health status evolve following Markov processes. The process describing the evolution of the job status is exogenous and is characterized by the following transition matrix:

$$\begin{pmatrix} \pi_{e,e} & \pi_{e,u} \\ \pi_{u,e} & \pi_{u,u} \end{pmatrix}$$

where $\pi_{j,j'}$ is the probability of transition from state $j$ and to state $j'$ (for $j = e, u$ and $j' = e, u$). One obviously has $\pi_{j,e} + \pi_{j,u} = 1$, with $j = e, u$. The process describing the evolution of the health status will be described latter.

The instantaneous utility function of an individual agent includes two additive terms. The first term is the standard CRRA utility function depending on the individual consumption level. The second term corresponds to an additional utility of being in good health. One has:

$$u(c) = \frac{c^{1-\mu} - 1}{1 - \mu} + \mathbb{1}(h = g) \times \overline{u} \tag{1}$$

where $\mu$ is the risk aversion coefficient and $\overline{u}$ denotes the additional amount of utility of being in good health. Finally, $\mathbb{1}()$ is an indicator function satisfying $\mathbb{1}(h = g) = 1$.

We now describe the budget constraint. At each period, an agent receives an income $y(j)$ depending on his job status. One has $y(e) = (1 - \tau)w$ and $y(u) = b$, with $w$ the wage rate and $b$ the unemployment benefit. The working time of an employed agent is normalized to 1, in other words, labor supply is inelastic. $\tau$ denotes the tax rate or payroll tax financing the unemployment insurance.

An agent will take the following decisions. He must choose his consumption $c$ and his asset level $a'$, and he must decide whether or not to do a fixed health spending $d$. This is a discrete choice, the decision variable is denoted by $m$. The variable $m$ takes the value of 1 if the agent invests in health and 0 if he chooses to do nothing. If the agent is in bad health, the health investment will increase the probability of transition to good health. We will discuss this point latter.

Capital is accumulated by the households. One unit of capital is rented by the representative firm at the rate $R$. Furthermore, capital depreciates at rate $\delta$. We denote by $a$ the present wealth of the agent and by $a'$ his wealth next period. The state variables characterizing the present situation of the agent are $(a, j, h)$.

The budget constraint of a state $(a, j, h)$ agent writes:

$$a' = y(j) + (1 + R - \delta)a - c - \mathbb{1}(m = 1) \times d$$

We also assume that agents face a liquidity constraint in such a way that $a' \geq 0$.

The problem of an individual agent at state $(a, j, h)$ can be written recursively. The agent has to choose its consumption level $c(a, j, h)$, its asset level $a'(a, j, h)$ and to take its care decision $m(a, j, h)$. Given the prices $w$ and $R$, the household decisions are solution of the following Bellman equation:

$$V(a, j, h) = \max_{a',c,m} \left\{ \frac{c^{1-\mu} - 1}{1 - \mu} + \mathbb{1}(h = g)\overline{u} + \beta \sum_{j'} \sum_{h'} \pi_{j,j'} \pi^{m}_{h,h'} V(a', j', h') \right\} \tag{2}$$

$$\begin{cases} -a' + y(j) + (1 + R - \delta)a - c - \mathbb{1}(m = 1)d \geq 0 \\ a' \geq 0 \end{cases}$$

$\beta < 1$ is the discount factor.

**Representative firm.** Let denote by $K$ the aggregate capital and $N$ the aggregate employment. There is a representative firm producing a single good, using a constant return-to-scale technology represented by a Cobb-Douglas production function $Y = F(K, N) = AK^{\alpha}N^{1-\alpha}$, with $A > 0$ and $\alpha \in ]0, 1[$. Assume that markets are perfectly competitive, the firm is price-taker and chooses the amount of factors that maximizes its profits. One has the following optimality conditions:

$$\frac{\partial F(K,N)}{\partial K} = \alpha A K^{\alpha-1}N^{1-\alpha} = R \tag{3}$$

$$\frac{\partial F(K,N)}{\partial N} = (1-\alpha)AK^{\alpha}N^{-\alpha} = w \tag{4}$$

**Stationary equilibrium.** We only focus on the stationary equilibrium. We suppose the replacement rate $\rho$ is given and the payroll tax $\tau$ is adjusted each period in order to balance the insurance fund. $N$ denotes the aggregate employment and $U = 1 - N$ is the number of unemployed workers. It is easy to show that the stationary level of employment is $N = \frac{1-\pi_{u,u}}{1-\pi_{e,e}+1-\pi_{u,u}}$. With $\rho$ the replacement rate, one has $b = \rho w$. For a given replacement rate, the payroll tax $\tau$ adjusts to ensure the balance of the insurance system, that is $\tau w N = b(1 - N)$ which reduces to:

$$\tau = \rho \frac{1-N}{N} \tag{5}$$

As we previously underlined, agents may decide to do or not the health spending $d$. The superscripts 1 and 0 respectively point out agents doing and not doing the health spending. One has:

$$N = N^1 + N^0 \qquad U = U^1 + U^0$$

Solving the household program (2), one gets the policy rules $c = c(a, j, h)$, $a' = a'(a, j, h)$ and $m = m(a, j, h)$. Using these policy rules, it is possible to compute the density function $\lambda(a, j, h)$ giving the number of agents at state $(a, j, h)$. We thus suppose the state variable $a$ takes its value in a grid $\mathcal{A} = \left\{0, a_1, ..., a_n\right\}$. Therefore, $\lambda(a, j, h)$ is given by the following expression:

$$\lambda(a', j', h') = \sum_{j\in\{e,u\}} \sum_{h\in\{g,b\}} \sum_{a\in\{a|a'=a'(a,j,h)\}} \pi_{j,j'} \left\{ \begin{array}{ll} & \pi^1_{h,h'} \mathbb{1}[1 = m(a,j,h)] \\ + & \pi^0_{h,h'}(1 - \mathbb{1}[1 = m(a,j,h)]) \end{array} \right\} \lambda(a,j,h)$$

**Aggregate variables.** Using this density function $\lambda(a, j, h)$, we can define the economic aggregates:

$$K = \sum_j \sum_h \int \lambda(a,j,h) a da \qquad C = \sum_j \sum_h \int \lambda(a,j,h) c(a,j,h) da$$
$$D = \sum_j \sum_h \int \lambda(a,j,h) \mathbb{1}(m = 1) d da$$

which are respectively the capital, the consumption and the medical expenditures. We can also define the population aggregates:

$$N = \sum_h \int \lambda(a,e,h) a da \qquad U = \sum_h \int \lambda(a,u,h) a da$$
$$N^1 = \sum_h \int \mathbb{1}[1 = m(a,e,h)] \lambda(a,e,h) a da \qquad N^0 = \sum_h \int (1 - \mathbb{1}[1 = m(a,e,h)]) \lambda(a,e,h) a da$$
$$U^1 = \sum_h \int \mathbb{1}[1 = m(a,u,h)] \lambda(a,u,h) a da \qquad U^0 = \sum_h \int (1 - \mathbb{1}[1 = m(a,u,h)]) \lambda(a,u,h) a da$$

which are respectively the number of employees, of unemployed workers, of employees in good health or in bad health, of unemployed workers in good health or in bad health.

The aggregation of the individual budget constraints gives:

$$K' = (1-\tau) w N + bU + (1 + R - \delta) K - (N^1 + U^1) d - C$$

Using the balanced budget constraint of the insurance fund and the firm's optimality conditions, one gets:

$$K' = (1-\delta) K + Y - (N^1 + U^1) d - C$$

**Numerical algorithm.** The model is solved using standard numerical methods. The solution method is based on the discretization of the state space variables. To begin, we guess a level aggregate capital $K_0$. Given the exogenous level of employment $N$, we use equations (3), (4) and (5) to deduce the rental rate of capital $R$, the wage rate $w$ and the unemployment benefit $b$, and thus the income process $y(j)$. This allows to solve the household program and thus to find the decision rules.[4] We use them to update the value of the aggregate capital $K_1$. The process is continued until convergence.

# 3 Calibration and results

The model is calibrated to match a set of first order moments estimated using historical data. Using this calibration, we propose to measure the contributions of both health and labor market specificities in the explanation on the contrasting equilibria that summarizes the French and the US data.

## 3.1 Calibration strategy

The vector of the model's parameter is $\Phi = \{\Phi_1, \Phi_2\}$ with $dim(\Phi) = 21$. All parameters calibrated using external information are:

$$\Phi_1 = \left\{\beta, \mu, \delta, \alpha, \{\pi^j_{e,u}, \pi^j_{u,e}, \rho^j\}_{j=US,FR}\right\} \quad dim(\Phi_1) = 10$$

The discount factor $\beta$ is calibrated to match a monthly discount factor consistent with an annual interest rate of 4%. We set $\mu$ that governs the relative risk aversion equals to 2. The depreciation rate of capital ($\delta$) is set such that 8% per year of the used capital is depreciated. The parameter of the Cobb Douglas production function is equal to 0.3. The worker flows $\{\pi^j_{eu}, \pi^j_{ue}\}_{j=US,FR}$ are provided by Shimer (2012)[15] for the US and by

[4]The household program is solved using value function iterations. Value function iteration algorithm applies the contraction mapping theorem. The algorithm is guaranteed to converge by this theorem and it stops when the gap between the value functions of two successive iterations becomes negligible. See Ljungqvist and Sargent (2004)[12] for more details on this method.

Le Barbanchon, Hairault and Sopraseuth (2015)[10] for France. These worker flows lead to a unemployment rate equal to 7.22% in the US and 10.26% in France. Finally, we estimate the replacement rates $\{\rho^j\}_{j=US,FR}$ as the gross unemployment replacement rate in OECD database and follow the results reported by CESifo Groupe (Unemployment Benefit Replacement Rates,1961-2011, 2012).

| | $\beta$ | $\mu$ | $\delta$ | $\alpha$ | $\pi_{e,u}$ | $\pi_{u,e}$ | $\rho$ |
|---|---|---|---|---|---|---|---|
| France | 0.9975 | 2 | 8% | 0.3 | 0.016 | 0.14 | 0.32 |
| US | | | | | 0.035 | 0.45 | 0.15 |

Table 1: Parameters for France and the US

For the other parameters, we need some restrictions in order to identify them using a set of moments computed using French and US data. We take as a reference the GDP of the US economy, and thus normalize $Y^{US}$ to unity (this implies a restriction for $A^{US}$). Hence, 11 parameters are calibrated:

$$\Phi_2 = \left\{A^{FR}, \left\{\bar{u}^j, d^j, \pi^j_{g,g}, \pi^{j,1}_{b,b}, \pi^{j,0}_{b,b}\right\}_{j=US,FR}\right\} \quad dim(\Phi_2) = 11$$

The calibrated parameters are the solution to $\min_{\Phi_2} ||\Psi^{theo}(\Phi_2) - \Psi||$, where the numerical solution for $\Psi^{theo}(\cdot)$ is provided by the algorithm based on value function iterations and general equilibrium convergence. The 11 free parameters are the elements of $\Phi_2$, whereas the 11 first-order moments provided by the data are:

$$\Psi = \left\{\frac{Y^{FR}}{Y^{US}}, \left\{\frac{M^j}{Y^j}, p^j(H=0), \frac{p^j(H=1|I\in Q2)}{p^j(H=1|I\in Q1)}, \frac{p^j(H=1|I\in Q3)}{p^j(H=1|I\in Q1)}, \frac{p^j(H=1|I\in Q4)}{p^j(H=1|I\in Q1)}\right\}_{j=US,FR}\right\}$$

with $dim(\Psi) = 11$.

## 3.2 Results

The solution for the calibrated parameters are reported in table 2.

**What do we learn on country-specific health market?** First of all, good health is more valuated in France than in the US. This result is in accordance with the less risky behaviors of the French people, in particular in terms of obesity. This is already underlined by Fonseca, Langot, Michaud and Sopraseuth (2018)[6]. Concerning the efficiency of the health sector, the transition matrices provide the probability gaps to be cured conditionally to spend money in health. If the agent don't buy health services, the risks are characterized by $\pi_{g,g}^{FR} > \pi_{g,g}^{US}$ and $\pi_{b,b}^{FR,0} < \pi_{b,b}^{US,0}$. This suggests that for agents who are already in good health, it's better for them to be in France than in the US, but if they are in bad health the probability to cure is lower in France. In average, without health expenditures, the probabilities to be in good health are 58.46% and 48.72% respectively in France and in the US. If the agent spend money in health services, we have $\pi_{b,b}^{FR,1} > \pi_{b,b}^{US,1}$, showing that the probability to cure is higher in the US. This suggests that the efficiency of the health sector is higher in the US than in France. Nevertheless, this efficiency gap is very small: for these agents spending money in health services, the expectations to be in good health are 80% and 79.44% respectively in France and in the US. Our results also show that the costs of health services are larger in the US than in France: we have $d^{US} > d^{FR}$. This is consistent with previous study of Fonseca, Langot, Michaud and Sopraseuth (2018)[6]. Last but not least, we calibrate $A$ in order to have the ratio between US salary and French salary at about 1.44, which is close enough to the real ratio 1.46 in OECD database.

| | $A$ | $\bar{u}$ | $d$ | $\pi_{g,g}$ | $\pi_{b,b}^1$ | $\pi_{b,b}^0$ |
|---|---|---|---|---|---|---|
| France | 0.0803 | 2.295 | 0.01482 | 0.801 | 0.19 | 0.72 |
| US | 0.104 | 2.1 | 0.0347 | 0.78 | 0.15 | 0.791 |

Table 2: Calibrated parameters for France and the US

**The model's fit.** The fit of the model is reported in the table 3. We find that almost all moments we pick match the data, all except one (the percentage of healthy agents in the third revenue quartile versus the ones in the first revenue quartile), but it's because the discrete nature of the decision that agents make. In a discrete choice model, there exists a wealth threshold for each type of agent (employed and unemployed workers) above which the optimal decision is to consume health services because they are in bad health. Given that this expenditure in health services is a fix cost, all the agents above the threshold have access to the same health services and thus have the same chance to become healthy agents. Hence, in the model, the population is divided into 2 groups: those who have a low health risk and those who have a high health risk.[5] At the equilibrium, there are 2

| | France | | US | |
|---|---|---|---|---|
| | model | data | model | data |
| $Y^{FR}/Y^{US}$ | 0.6769 | 0.666 | 1 | 1 |
| $M^j/Y^j$ | 9.82% | 10% | 14.59% | 14.6% |
| $p^j(H=0)$ | 26.48% | 28% | 30.6 % | 30% |
| $p^j(H=1\|I\in Q2)/p^j(H=1\|I\in Q1)$ | 1.1012 | 1.06 | 1.1728 | 1.196 |
| $p^j(H=1\|I\in Q3)/p^j(H=1\|I\in Q1)$ | 1.2673 | 1.17 | 1.4631 | 1.337 |
| $p^j(H=1\|I\in Q4)/p^j(H=1\|I\in Q1)$ | 1.2688 | 1.245 | 1.4741 | 1.475 |

Table 3: Simulation results for France and the US

groups of agents in these economies: those we have access to the health services, and those who have not. Hence, the model generates two health groups. The first one has a low risk to be in bad health and in this case the probability to cure is high. Hence, whether these agents are in good or bad heath, with a job or not, are mainly characterized by a amount of assets larger than the threshold above which they pay the access to the health services. This feature of the equilibrium distribution also explains why the percentage of healthy agents in the third revenue quartile does not match the data: in the top two revenue quartiles, all agents are rich enough to choose to invest in health. Thus the percentage of healthy agents in the third revenue quartile is rather close to the one in the last revenue quartile but relatively far from the data showing that our two-states model is too simple to account for this heterogeneity.

# 4 Counterfactual experiments

Given these characteristics of the benchmark equilibria, we can now proceed to counterfactual simulations in order to evaluate the relative contributions of each country-specific calibration. In a first section, we focus on the impact of cross-country differences on the labor market. In a second section, we compare the impact of these labor market

[5] See the appendix A for more detailed statistics on the health gradient.

gaps to the cross-country differences observed on the health services market.

## 4.1 The impact of the cross-country differences on the labor market

Starting from the US case (case (0)), we propose two different scenarios:

(1) The employment risk (the transition matrix $\Pi_e$) is the same as in France

(2) The replacement rate $\rho$ is the same as the replacement rate in France

The results are in the table 4.

| | (1) | (2) | (0) |
|---|---|---|---|
| Scenario | $\Pi_e^{FR}$ | $\rho^{FR}$ | US bench. |
| $p(H=1)$ | 75.5 % | 77.5% | 69.1 % |
| $p(m=1)$ | 86.55% | 92.96% | 64.26% |
| $r$ | 0.2296% | 0.2474% | 0.2459% |
| Welfare* | -3.65% | 0.42% | 0 |
| Cons. losses | 3.79% | -0.4% | — |

* Variations of the welfare relative to the benchmark: ((Welfare(0)-Welfare(x))/Welfare(0))×100

Table 4: US with French-style labor market

There are two risks in the economy. The first is the job loss leading to low labor incomes and the second is the bad health leading to low welfare. Larger income risks lead the households to save more in order to smooth their consumption. At general equilibrium, this precautionary saving can reduce the interest rate. But it is not always the case because the low employment rate reduces the marginal return of the capital. Obviously these income risks (governed by the matrix $\Pi_e$) can also be reduced by the unemployment benefits ($\rho$). If France is characterized by an higher unemployment risk, this country is also more generous than the US for the unemployed workers.

**Income risks (1).** If the French labor market risks are "exported" in the US (column (1)), there will be more precautionary saving in the US: the US workers must insure themselves against a higher unemployment risk. Hence, there is more capital supply in the economy. But, at the same time, the level of employment declines (the unemployment rate is multiplied by two), leading to a decline in the demand of capital. This last effect dominates: the interest rate increases and the aggregate production declines. Hence, the higher unemployment risk is not overcompensated by the increase of the precautionary saving of the household. There is less wealth in average in this economy than in the benchmark calibration of the US economy. The surprising result comes from the share of individuals in good health: it increases. This is explained by the longer employment spells when the labor market transitions of the French economy replace those of the US economy. In this counterfactual experiment, these long employment spells allow the individuals to reach the wealth threshold from which the agents choose to buy health services. But, this rise of the proportion of agent in good health cannot compensate the losses in consumption induced by the decline in production induced by the employment loses: the welfare is reduced with respect to the benchmark. This welfare loss corresponds to a consumption reduction of 3.79% each year.

**Unemployment benefits (2).** An increase of the unemployment benefits reduces the incentives to save and thus the capital amount in the economy because the unemployment risk being more generously insured by inter-agent transfers. This increases the interest rate because the capital demand is not affected by the change in unemployment benefits. This lower level in capital can reduce the welfare. But, this is not the case because the consumption of health services increases. Indeed, less saving is needed to insurance labor market risks, then more resources are available for health expenditures. This is the case and thus more agents are in good health because a larger part of them choose to buy health services. Thus, the average welfare increases: in this case the "consumption losses" are "gains" of 0.4% each year.

**What do we learn?** These experiments reveal a surprising result: a more rigid labor market help workers, employed and unemployed, to be healthy. Nevertheless, the employment losses induced by labor market rigidities overcompensate this positive effect on health and thus reduce the welfare. In the experiment where the rise in the replacement rate leads to a welfare improvement, we reach the limits of our model. Indeed, this result can be discussed because a large number of studies underline that when the replacement rate increases, then the employment rate is reducing. If we take into account this employment elasticity to the replacement rate, we then obtain a welfare reduction.

## 4.2 The impact of the cross-country differences on the health services market

If a French-style labor market does not seem to be the good way to improve both the health and the welfare, perhaps that a French-style health services market can reach this goal. To test this idea, we propose four different scenarios:

(3) The cost of health investment $d$ in the US is the same as the cost in France

(4) The benefit of being healthy $\bar{u}$ in the US is the same as the benefit in France

(5) The health risk (the transition matrix $\Pi_H$) in the US is the same as in France

(6) The health risk $\Pi_H$, the $d$ and the $\bar{u}$ in the US are all the same as in France

The results are in the table 5.

| | (3) | (4) | (5) | (6) | (0) |
|---|---|---|---|---|---|
| Scenario | $d^{FR}$ | $\bar{u}^{FR}$ | $\Pi_H^{FR}$ | $d^{FR}$ & $\bar{u}^{FR}$ & $\Pi_H^{FR}$ | US bench. |
| $p(H=1)$ | 79.44% | 79.27% | 60.12% | 80.28% | 69.1 % |
| $p(m=1)$ | 99.99% | 99.36% | 6.84 % | 99.98% | 64.26% |
| $r$ | 0.2395% | 0.2458% | 0.2449% | 0.2373% | 0.2459% |
| Welfare* | 4.48% | 2.92% | 2.20% | 7.22% | 0 |
| Cons. losses | -4.3% | -2.9% | -2.15% | -6.8% | — |

* Variations of the welfare relative to the benchmark: ((Welfare(0)-Welfare(x))/Welfare(0))×100

Table 5: US with French-style health services market

**Cost of the health services (3).** The decrease of $d$ leads a larger set of agents to invest in health: the risk to be in bad health declines. Numerical results show that the percentage of healthy agents rise up to the limit. At the same time, more resources are available to insure agents against the unemployment risk. Hence, there is more capital in the economy and thus more production. This allows household to reach a higher welfare.

**Welfare benefits induced by good health status (4).** In a society where the good health is more valued (the risky behaviors as obesity more penalized), the incentives to buy health services increase. Hence, more agents spend in health services and as a result more people are in good health. The counterpart of these choices is a reduction of the saving leading to a rise in the interest rate. The impact on the welfare is a priori undetermined: the direct impact of the rise value of the good health can be compensated by the decline in the aggregate capital. Numerical results show that the former effect dominates.

**Efficiency of the health sector (5).** When the French matrix of the health risks is implemented in the US economy, the average chance to be in bad health declines. This largely reduces the incentive to spend money in health services (only 6.84% of people buy health services). Given the high costs of the health services, agents prefer to play with the "health lottery" where the medical sector do not take part. Hence, more resources can be devoted to the saving (the insurance of the income risks) leading the capital stock to increase (the interest rate declines). At the end, the agents welfare is improved

**Cost, welfare benefits and efficiency of the health sector (6).** This last scenario shows that even if the risk to be in bad health is reduced to value for the French economy, a lower cost of the health services is crucial to provide incentives to spend in health services. Moreover, the larger utility value of the good health status magnifies this incentive. Hence, the combination of these three changes in the US economy would allow American people to have a higher welfare than the French citizens.

# 5 Conclusion

This paper shows how a general equilibrium model of Aiyagari (1994)[1] augmented by health care choices in the spirit of the Grossman (1972)[9] can match the US and France differences, namely the facts that the US the health expenditures are larger than in France but the percentage of individuals in good health is smaller. Using counter-factual experiments, it is shown that the risks associated to the labor market interact with the health status of the individuals. We show that the large turnover observed in the US induces low investment in health, even if these turnovers are associated to short periods of unemployment (low unemployment risk). Indeed, what matters for the health decision seems to be the stability of the jobs. These costs in term of health linked to turnover are partially compensated by the higher employment level allowing to reach a higher production level at the general equilibrium. We also show that an increase of the unemployment benefits can improve significantly the health of the American but not their welfare. Therefore, a French-style labor market can not improve simultaneously the health and the welfare of the Americans. At the opposite, a French-style health services market can improve both the health and the welfare of the American. Indeed, larger costs of health services as well as higher risky behavior in the US are the main channels that explain these results. More precisely, the welfare gain induced by the a reduction of price of health service in the US such that it would be equal to the French one, is equivalent to a permanent increase in consumption of 4.3%. A reduction of the risky behaviors with respect to health, such that they would be equal to the French ones, will induce a rise by 2.9% permanent increase in consumption.

In future researches, more detailed risks on the labor market must be introduced. It will be also necessary to to distinguish between health care expenditures that have direct impact on the life expectancy and those that necessary during periods of dependency.

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# A The Health Gradient

| | France | | US | |
|---|---|---|---|---|
| | model | data | model | data |
| $p^j(H=1 \mid I \in Q1)$ | 63.34% | 65 % | 54.31% | 55.95% |
| $p^j(H=1 \mid I \in Q2)$ | 69.59% | 68.9 % | 63.69% | 66.9 % |
| $p^j(H=1 \mid I \in Q3)$ | 80.28% | 76.05 % | 79.46% | 74.8 % |
| $p^j(H=1 \mid I \in Q4)$ | 80.45% | 80.925% | 80.06% | 82.5 % |

Table 6: Percentage of agents in good health by income quartiles - France and US

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