THE COST OF COVID-19 IN MANUFACTURING COMPANIES IN TOGO

New technical proposal

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Abstract
CORONAVIRUS has the effect of lastingly affecting the economic activity of countries worldwide. The study conducted from a representative sample of manufacturing companies in Togo will allow us to observe the immediate consequences of the pandemic on the companies that we have evaluated in terms of cost. The long-term cumulative effect of the disruption of social relationships and dysfunctions linked to the organization of work could have consequences for the sustainability of vulnerable enterprises. In order to identify the impact of the covid-19 pandemic on business productivity, logistic modeling will be done.

This part will be supplemented by the simulation results and the main recommendations

Keywords: Coronavirus, manufacturing companies, costs, productivity, logistic modeling.

Introduction
The first diagnosis of coronavirus infection was made in Wuhan, an industrial megalopolis in central China, and is spreading around the world. This unknown virus responsible for acute and fatal respiratory disorders (several thousand deaths worldwide). It can be said to date that between January and April 2020, the response to the Pandemic, both national and international, was much the size that would have been necessary to stem the rapid spread of outbreaks of infection by containment measures of the world population pending an adequate clinical solution. However, this change of scale was not taken into account early enough in certain countries of the world and the late reaction of the authorities allowed the outbreak of the pandemic in Italy, France, Spain and the USA.

The crisis erupted as the horizon cleared: truce in the Sino-American trade war, lower tensions between Washington and Tehran, forecast of more optimistic growth of the International Monetary Fund (IMF) in 2020 (+3.3 %), renewed confidence, too, for European manufacturers.

The main economic impact of the pandemic is not only due to direct and indirect health costs (mortality, reduction in the workforce, public health expenditure) but also costs induced by behavioral changes dictated by fear of contagion. Indeed, more than the health cost of covid-19, it is the inappropriate reactions of irrational fears and anxieties that could constitute the main channel through which the pandemic can affect economies via the closing of borders, travel restrictions on the territory, the abandonment of cultures, etc.

As a reminder, in 2003, the epidemic of severe acute respiratory syndrome (SARS), although ultimately limited (8,500 cases identified and 800 dead), had cost the world economy $ 40 billion, or 4.7 million dollars per case. Between 80 and 90% of this cost was due to changes in actors' behavior.

In developing countries in general the prevalence of the disease would be worrying, in this case on the African continent where the problem would be better extended to the threat posed by the COVID-19 pandemic on the functioning and production of businesses.

Goals

The general objective of this study is to assess the socio-economic consequences of the COVID-19 pandemic in Togo

Specifically it is a question of measuring:

• costs incurred by COVID-19 for manufacturing companies in Togo

• the impact of the costs induced by COVID-19 on the productivity of businesses in Togo.

Hypotheses

H1: COVID-19 involves significant direct and indirect costs in companies in Togo;

H2: the costs induced by COVID-19 negatively impact business productivity.

The rest of our proposal is as follows: the first section presents the literature review on the impact of a pandemic on the economy; the second section presents the study methodology and the data source, the third part will present the expected results.

1-Literature review

On the economic level, health is a pillar of human capital which constitutes the foundation of economic productivity. As well as the economic well-being of households, good health of the population is an essential condition for the reduction of poverty, economic growth and long-term economic development on the scale of an entire society.

Health capital includes a duration component which is measured at time t either by the probability of dying in T or by life expectancy at age T. And a quality component which is measured by a relative index between 0 for the dead and 1 for perfect health, called QALY (Quality Adjusted Life Years). Each individual is born with a life and health potential which decreases with age until death. This capital is part of the utility function of each: it determines both the quality of his life and his possibilities of work, therefore of gain and consumption.

Several methods are used to build a measure of quality of life that reflects a person's state of health (Drummond 1998, Methods of economic evaluation of health programs): the state of health scale, the questioning explicit of the person on how he feels his handicaps and sufferings, the lottery method and finally that of the surveys aiming at the estimation of the willingness to pay to change state of health.

On the other hand, collective health capital, that of a society or a nation is first of all the sum of the individual capitals which compose them, but not only. Two factors are added to this, external economies and collective ethical concerns. We find the effects with contagion and uncertainty. My individual health indeed depends on that of my neighbor. First by risk of contagion of the disease. Then of the level of risk tolerated in society, in a situation of uncertainty, it is in my interest, because of the "veil of ignorance", that all of society protects itself from risks in order to protect myself from them, therefore may my neighbor also be protected.

Piatecki and Ulmann (1996) have shown how the aggregation process transforms the nature of the utility function in a particular way for health.

Indeed, in individual utility functions, health and other consumptions are complementary, more health confers more time for education and work, therefore more income and more consumption of other goods and services. Once the individual functions have been aggregated, the collective utility function integrates health and other consumption as substitutable elements, see Geoffard and Verdier (1996).

Grossman (1998) presented health as a durable good and integrated it into a general model of household consumption and investment. All economic agents inherit human capital, which tends to depreciate at an increasing rate with age. But Grossman sees the individual in part as a producer of his own health. He optimizes his income and his consumption during his life by fighting against this depreciation by his preventive attitudes, by devoting time to it and by using care. This optimization is done under time and income constraints. There are two sub-models.

One considers health as an investment to increase production and earning capacity. The demand for health is then a demand derived from the general demand for well-being. This reasoning applies well to adolescents and the active population from an individual perspective. At the collective level, it escapes it in the zones affected by unemployment where a part of the working age population can remain at the same time unoccupied and in bad health without effect on the economy. The second sub-model considers health as pure consumption: it improves the utility derived from life and from other consumption. This analysis applies in a general model where individual and collective consumption are at the same time other durable goods, current consumption, but also personal life. The pure consumption optic applies to the inactive and in particular to the retired. Grossman's approach makes health an endogenous factor in all economic behavior.

Improved health contributes to economic growth, and this different ways: it limits the shortfall due to the incidence of morbidity on the workforce, it makes it possible to exploit natural resources which, located in areas infested with pathogen vectors, were totally or largely inaccessible; it increases the school attendance rate and allows children to better assimilate what they are taught, finally it frees up for other purposes the resources that would have served, if not to treat the sick.

The most obvious effects of improved health on the workforce are the reduction in the number of days lost due to illness, increased productivity, improved chances of accessing better-paid jobs and extending the working life.

1-1 Health and productivity

The first use of a global model of the economy to examine the consequences of a serious illness dates back to studies by Barlow (1967). He used a macroeconomic long-term simulation model to measure the impact of the eradication of malaria from real per capita income in Sri Lanka.

It is on this basis that J. Behram (1988) sought to analyze how growth economic and health interacted theoretically; health being a component essential to human capital, investments in health have direct and indirect on productivity and consequently on economic growth.

Meyers and Henn (1988) tried to develop a methodology similar to that of Barlow to measure the economic impact of HIV / AIDS in Africa.

It was in the early 1990s that the question of the economic impact caused by a high morbidity and mortality has arisen vis-à-vis countries where the spread of the pandemic was worrying (from 1% in Senegal to around 40% in southern African countries). The problem has widened to the threat that the epidemic poses to functioning and state production.

On the sectoral and microeconomic level Bamett, and Hals wimmer (1991) have worked on agricultural and livestock systems in Tanzania and Zambia. The results made it possible to establish the links between the disease, the questioning of food security, the impoverishment of certain regions and the family and social problems caused by the high mortality and morbidity of the active population. Another study on the commercial sector in Kenya made it possible to assess categories of costs identified by others (Forsythe et al 1994) such as those induced by medical absenteeism, premature deaths, recruitment of new employees.

We know, for example, that the involvement and participation of companies in employee health varies (Aventin et al, 1999), which implies long variations in management of the disease by the employer. A study carried out by Dr Eholie S. (2000) on the Ivorian Electricity Company (CIE), showed the socio-economic impact of mortality and disease-related morbidity. The impact of the disease in this company represented 70% of the overall mortality. Absenteeism linked to this illness represented an average of 56 to 70 days per year. The cost of opportunistic infections was estimated at between 10 to 15 million FCFA on average, which represented 5 times the cost of triple anti-viro therapy. At the macroeconomic level, the World Bank has developed an approach to the pandemic.

A World Bank study in Tanzania established a team to analyze the effects of AIDS on economic growth. This study was by John Cuddington (1991). This study uses a simple model that incorporates increased morbidity and mortality due to the disease. The model examines the lost productivity per case of illness and the effect of the cost of illness in a reduction in savings. According to this study, the disease will reduce the average growth rate of the GDP in Tanzania in the period 1985-2010 from 3.3% to 2.8%.

According to Jonhn Cuddington (1991), Global production (Yt) is supposed to depend positively on the one hand on labor (Lt) and on the other hand on the stock of capital (Kt). He adds to the Solow model the prevalence rate of PANDEMIA (at) because of its impact on the two production factors mentioned above. Yt = F (Kt, Lt, at); at = the prevalence rate of the pandemic at time t.

On the assumption of constant returns to scale, the writing of the Cobb-Douglas function is simplified and becomes $Q = AK^{a}L^{1-a}$ with $0 < a < 1$

The effect of the prevalence of the pandemic on the increase in production is linked to its opposite effect on health status and on the workforce. These considerations are incorporated into the unit of labor force efficiency (E_t).

J. Cuddington uses this assumption of constant returns to scale to define the next production function $Y^t = \alpha\gamma^t E_t^{\beta} K_t^{1-\beta}$ (β = a)

l-β = (dy / y) / (dk / k), it is the elasticity of the production compared to the variation of the capital factor.

γ : technological innovation in terms of rate

α: this is the adjustment coefficient: it is constant

E_t: is the unit of efficiency of the labor force

K_t: is the capital stock

The pandemic can have a profoundly negative effect on the quality and ultimately on the entire size of the workforce. The above two factors depend both the health of the worker and the accumulation of work experience. A simple constraint that can reduce the good health of the population is the prevalence rate of the disease. The individual productivity of the worker is according to the model of Cuddington assumed to depend on years of professional experience.

Starting from the above constraints, the impact of the pandemic on the workforce can be introduced into its relationship with the unit of work efficiency (E_t).

$$E_t = (1 - za_t)\rho(a_t)L_t$$

z: is the unit of work lost by a sick worker in terms of absence or reduction of productivity in work

ρ : is the unit of work efficiency

a_t: pandemic prevalence rate

L_t: the active workforce.

This loss of productivity in the workplace affects both the victim of the disease and those around him (members of his family). The parameter z does not necessarily have to be between 0 and 1. For example if a person who has the disease stops working and those around him (the members of his family) must also resign himself to work to bring him assistance then z = 2 (depending on the model, the scale of productivity loss is between [0.2]).

In addition to its negative impact on labor productivity, the disease reduces the size of the labor force (in comparison with the "disease-free" scenario) when we have an increase in the specific mortality rate. The pandemic therefore has a negative impact on the rate of population growth. This is checked in the following equation:

$n_t = n_t(a_t)$ ou $\delta_n / \delta_a \prec 0$

n_t: the "disease-free" population growth rate

$n_t(a_t)$: the rate of population growth "with illness"

The first derivative of equation confirms well the empirical assertion of the negative effect of the pandemic on the rate of population growth.

The experience of the worker can be obtained by the difference between the age of the worker noted i and 15 years of age (the age from which one is productive). Studies that have attempted to establish a relationship between work experience and wages suggest that there is a positive but non-linear relationship between these two variables. Consequently, the simulation model assumes that the efficiency of work in the absence of illness for a worker at age i is approximately equal to:

$$\rho_i = 0,8 + 0,02(i-15) - 0,0002(i-15)^2$$

ρ : Work efficiency

i: age of worker

This labor factor efficiency is a representation of Boyer's salary function which has been tested in companies in Kenya.

1-2 Savings behavior

The Pandemic affects savings through several mechanisms: by the direct effect, an increase in medical expenditure which presupposes both a reduction in savings and a reduction in expenditure in sectors other than health, or by the indirect effect , an effect on the mortality rate, life expectancy, age structure and good health of the population.

The model assumes that the annual health care expenditure of sick patients (H) is equal to the annual health care cost per patient (m) multiplied by the number of patients affected by the disease ($L_t a_t$) So we have $H = m L_t a_t$

In addition, the model assumes that a fraction x of the annual cost of health care comes from savings while the remainder in a proportion of (l-x) comes from a reduction in other current expenditure. John Cuddington then defines national domestic savings as equal:

$S_t = soY_t - xma_tL_t$

St: national domestic savings percentage of GDP

Y_t: overall production (GDP)

x: the fraction of the annual cost of health care from savings

m: is the annual cost of health care per patient

a_t L_t: proportion of the population affected by the disease

This specification of savings implies that the ratio of domestic savings to GDP decreases when the prevalence of the disease or the costs of care per patient increases.

The savings ratio is equal to: $s_t = S_t / Y_t = s_0 \frac{xmaL}{Y} t$

To simplify the notation in the analytical model, the savings ratio in the previous equation is written: St = S (at)

S (at): domestic savings to GDP ratio in the presence of disease

The derivative of the equation clearly shows that there is a negative relationship between the increase in the prevalence or costs of health care linked to illness and the savings ratio.

1-3 Capital accumulation

The accumulation of the domestic capital rate depends positively on the sum of domestic savings and external savings, and negatively the depreciation rate noted θ

According to Solow's model (1956), the exchange rate in the capital / labor ratio (k = K / L)

can be written k = [s (a) + s *] f (k, a) - n (a) k - k

f (k, a): is the product per head

s (a): is the national savings rate in the presence of the disease

s *: is the external savings rate

θk: depreciation of capital at the rate

From this capital accumulation equation, we deduce the negative effects of the increase in the prevalence of the disease on the rate of capital formation. This results in a reduction in the capital-labor ratio. This drop in the ratio can be offset in the long term by the demographic impact of the disease on the number of workers.

All in all, there is a negative relationship between savings, productivity, GDP and the increase in the pandemic. The exogenous reduction in labor affects economic activity.

Devarajan, Kambou and Mead (1993) used to measure the macro-economic impact of AIDS the Computable General Equilibrium (CGE) model to conduct a study in Cameroon. This model suggests that in the worst-case scenario, the average GDP growth rate for the 1991-1997 period could drop dramatically from 4.3% to 2.4%.

This correlation between better health and stronger economic growth remains even when other economic variables are introduced in an attempt to take into account inter-country growth patterns (as in the work of Barro and Sala Martin 1995 et al). A conventional statistical estimate indicates that each improvement in 10% of life expectancy at birth (EVN) corresponds to an increase in economic growth of at least 0.3 to 0.4 percentage points the other factors were considered constant.

Therefore, the difference in annual growth due to life expectancy between a country typical high income (EVN = 77) and one of the least developed countries type (EVN = 49) is about 1.6 percentage points per year which over time produces huge effects.

The model of Piatecki and Ulmann (1995) illustrates the way in which one formalizes the relationships between health and economic growth. The utility function of the representative household is written in the form $U = \int_0^{\infty} e^{\rho t}\left(\frac{C^{1-\sigma}}{1-\sigma} + \frac{S^{1-w}}{1-w}\right)dt$

C: represents consumption

S: health status of the representative household

σ: degree of risk aversion linked to consumption

ω : degree of aversion to health risk

ρ : discount rate

The degrees of aversion and the discount rate are positive.

In this model, consumption and health are two substitutable goods, whereas they are generally considered to be complementary. Indeed, it is impossible to consume when the level of health is zero, representing death. Just as consuming nothing undoubtedly leads to the death of a person.

At each period, production is divided between investment and consumption

Y = C + I

The representative company ensures the production of the unique good of the economy, according to a Cobb-Douglas type production function, with S, the health factor and L, the work devoted to the production of the single good and K the capital $Y = AK^{\alpha} L^{\beta} S^{\gamma}$

Finally, the production function of health is defined according to the share of work devoted to health either (l-L) or A (human capital inspired by Lucas) and a technological parameter 8, the following equation represents the variation of health S in the time compared to the initial stock S: $S = \delta(1-L)S$

In this model, there are two decision variables, consumption C and time devoted to production L and they are determined so as to maximize the program.

On the balanced growth path, K, S and C grow at a constant rate. We define these growth rates as µK, µS, and µC respectively. So $\mu_k = \frac{\gamma}{1-\alpha}\mu_s$

We note that, in the case of constant returns to scale, i.e. $\alpha + \beta + \gamma = 1$

$\gamma \prec 1-\alpha$ implies $\mu_k < \mu_s$ and therefore the growth of the economy is lower than the health status growth.

In the case of increasing returns to scale, economic growth can as well be less, equal or greater than that of the state of health. By elsewhere, growth in health status being a function of the share of work devoted to health and a technological factor, the growth of the economy therefore depends on these two factors.

Van Zon and Muysken (1997) also start from a growth model inspired by Lucas, Complemented by the Grossman health demand model. They establish a link between health and growth, which explains the evolution of health expenditure and their consequences for growth.

The authors assume that health plays a major role in growth. On the one hand, the health sector can find itself in competition with that of education within the framework of scarce resources and thus have an influence on the growth process, in particular in an endogenous approach conferring on education a central role in the accumulation of skills. On the other hand, good health is a prerequisite for any economic growth, given its influence on labor productivity.

The model of Van Zon and Muysken (1997) leads to maximizing a utility function:

$$U = \int_0^{\infty} \ell^{\rho t}\left(\frac{(C/L)^{1-\sigma}-1}{1-\sigma}\right)Ldt$$

C: Consumption

L: All the work available in the economy (assumed here to be constant)

: Degree of risk aversion linked to consumption, also called inter elasticity substitution time,

p: Discount rate

The production function is: $Y = (A(1-h)L)^{\alpha}$

At stationary equilibrium, we obtain by solving the model: $g = \mu_a = (\delta - \rho)/\sigma$ and $h = \mu_a / \delta$

The growth rate (g) increases according to the accumulation of knowledge (productivity of the accumulation process) as well as according to the value of the inter-temporal elasticity of the agents which translates their disposition to defer their consumption to the future to invest and reap the benefits later. Lucas (1998)

Likewise, an increase in the discount rate means a decrease in the possibilities of future consumption and therefore growth. Finally an increase in the rate of growth also requires an increase in the share of work allocated to the accumulation of know (h).

$$S = \delta_s \left(\frac{VSL}{L} \right)^{\beta} - \Delta S = \delta_s (vS)^{\beta} - \Delta S \qquad \text{With } 0 < \beta < 1$$

S: the average state of health of the population

Δ S: corresponds to the rate of exogenous depreciation of health over time

v: being the share of the health sector in total employment

VSL: the total number of inputs that generate health services.

The authors assume that the production of health services is proportional to the sum of the inputs. This proportionality is represented by.

Their first approach leads to writing the growth model with health in the form:

$$U = \int_0^{\infty} \ell^{\rho t} \left(\frac{(C/L)^{1-\sigma} - 1}{1-\sigma} \right) L dt$$

$$Y = (A(1-h-v)sL)^{\alpha} . K^{1-\alpha}$$

$$K = Y - C$$

$$A = \delta h s A$$

$$S = Z_0 V^{z}$$

The steady state resolution gives

$$g = \mu_A = \frac{1}{\sigma} \left(\delta_A (1-\beta) \bar{S} - \rho \right)$$

According to the program of equations defined above, average health depends positively on the efficiency of the health system and negatively on the rate of depreciation of health capital. Thus, the growth and distribution of work among sectors other than the health sector do not depend exclusively on their own productive characteristics, but intrinsically on those of the health sector.

If health is not included in the utility function directly, the health sector has an optimal size which is compatible with optimal growth. In this case, health is a pure complement to growth from the supply point of view. Therefore, any reallocation of work from the health sector to the education sector should slow growth. On the other hand, an increase in the demand for care, whether it is due to an increase in preference for health or the aging of the population, will have a negative effect on growth: health and growth are then substitutes.

This result provides an illustration of Baumol's disease in the health sector: it may happen that an increasing share of national income is spent on health services, with a negative effect on the growth rate of the economy.

An economic study (Blooms and Sachs 1998) reveals that more than half of the difference in growth between Africa and the rapidly growing East Asian countries is statistically explained by the effects of the burden of disease, demography, rather than by the classic variables of macroeconomic policy and governance.

A high prevalence of the disease is associated with significant and lasting reductions in economic growth rates. For example, a high prevalence of malaria has been shown to reduce economic growth by 1% per year or more. In healthy countries, people live on average longer than elsewhere, so their economic gains of a lifetime are much higher.

2-Methodology

This study will highlight the impacts of the COVID-19 pandemic on the functioning of businesses in Togo from a representative sample. It will be based on a mixed survey (qualitative and quantitative) carried out in these manufacturing companies and will make it possible to understand the essential mechanisms of the action of COVID-19 on the functioning of the companies studied and to establish an important nomenclature of the coronavirus on the 'economic activity

We then use the results of the survey to econometrically model the impact of the pandemic on business productivity in Togo.

Sampling and data source

We will randomize our data (manufacturing companies) from the database of the General Census of Enterprises in Togo (RGE) of INSEED.

Data collection technique

A questionnaire will be administered directly to the business manager or a service manager who understands all aspects of the business.

Choice of study variables and econometric modeling

The classification of costs linked to the coronavirus pandemic in companies will allow us not only to have an idea of the survey variables but will also allow us to design our econometric model in order to estimate the impact of COVID- 19 on business productivity.

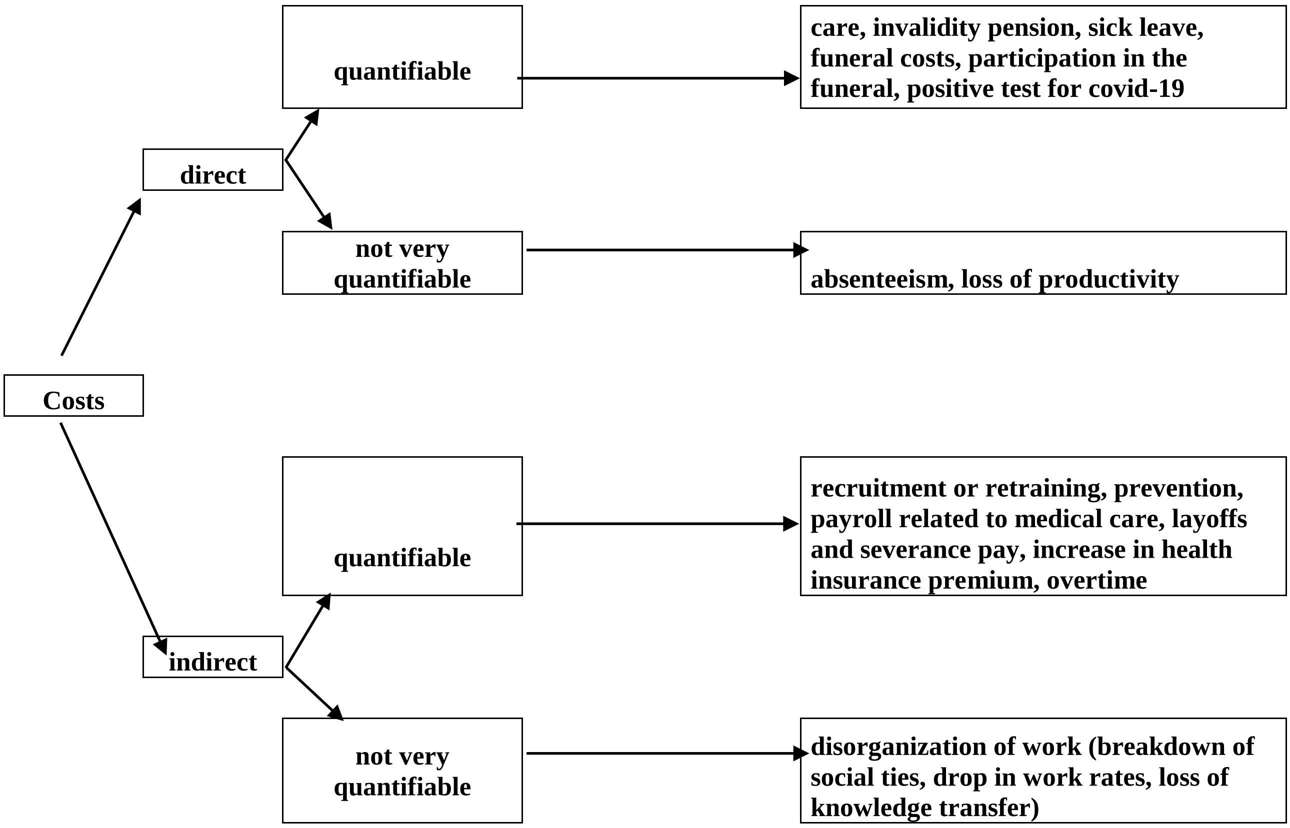

Figure 1: Classification of costs related to the COVID-19 pandemic

The functional form of the logit model used for the regression is as follows:

$$P\left(y_i = {}^{1}/_{x_i}\right) = \frac{1}{1+e^{-x_i\beta}} \qquad (1)$$

Where y is a categorical variable defined by $y_i = 1\ if\ \epsilon\ C_1$ and $y_i = 0\ if\ \epsilon\ C_0$; C_1 "event" and C_0 "no event", Loss of productivity in the context of this study. y is the binary variable "Loss of productivity"; $(X_{1,\dots,}X_p)$ a set of P explanatory variables (matrices of direct and indirect costs).

The multiple logistic regression of model (1) is formalized as follows:

$$logit\left({}^{\pi}/_{X\,=\,[1,x_{1,\dots,}x_p]}\right) = \beta_0 + \beta_1 x_1 + \cdots + \beta_p x_p \quad (2)$$

$$= \sum_{i=0}^{p} \beta_i x_i \quad \text{with } (x_{0=1})$$

with $(x_{0=1})$ = x′β (Linear predictor)

Our model is written in the following form:

$$P(\text{lost of productivity}_i = 1/x_i) = \frac{1}{1+e^{-x_i\beta}} = \text{logit}\left(\pi/X = [1, \text{direct costs}, \text{indirect costs}]\right) = \beta_0 + \beta_1 \text{direct costs} + \beta_2 \text{indirect costs} \quad (3)$$

The direct and indirect costs of the model mentioned above in Figure 1

3-Expected results

At the end of this study:

• the direct and indirect costs induced by COVID-19 for manufacturing companies in Togo are assessed

• the impact of these costs induced by COVID-19 on business productivity is estimated.

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