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Government intervention need for social security improvement in the Democratic Republic of the Congo

A theoretical analysis using the principal–agent model

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Abstract: African populations need better support through social protection mechanisms. Among those who need social security are millions of older people who, having worked all their lives in the formal sector, are in precarious situations with lower benefits. This study aims to appreciate theoretically, using the principal–agent model, the need for government intervention as a way to improve social security in Democratic Republic of the Congo. The study reveals that the Congolese government as a principal can motivate the Institut National de Sécurité Sociale (National Social Security Institute, public company) as an agent by offering two types of contracts (optimal and sub-optimal) in order to increase Congolese pension income.

Keywords: social security, pensions, contracts, principal–agent model, Institut National de Sécurité Sociale
JEL classification: H55, C61, D82, D86

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1 Introduction

African people in several countries like having good assistance through social security mechanisms. Among those are many retirees who live in poverty with lower benefits. This implies that social security plays a key role in improving life conditions of people in a country by preventing substantial loss in consumption that comes from risks people face in life, namely: old age, disability, and death. Indeed, various ways can be used for organizing social security, following the goals of authorities and the members concerned with the organization. In Africa, usually the family and arrangements of the community play a big role in providing the support that most elders need. These arrangements constitute informal social security systems, but they cannot be a substitute for formal social security (Olivier et al. 2008). In fact, Sub-Saharan African countries have institutionalized social security schemes: contributory and non-contributory pension schemes. Whatever the type of programs considered, two key indicators of social security are highlighted: social security coverage and benefit received by the retirees. In contributory pension systems, coverage and benefit imply having sufficient time and remuneration to accumulate enough in order to generate adequate pension income. This is a condition for having adequate benefits. However, in non-contributory pension programs coverage does not depend on previous contributions and benefit is not related to the time and the amount accumulated. Africa is a continent where the first types of schemes dominate even though few workers contribute and are covered by social security (Forteza et al. 2009). Africa is also a continent where benefits paid to the retirees are at their lowest (Dorfman and Palacios 2012).

In most of the world, especially in Sub-Saharan Africa countries, after operating for decades and despite many attempts to expand formal systems, coverage rates have remained stubbornly low and benefit levels provided are also too low (Bailey 2004; Palacios and Sluchynskyy 2006; World Bank 2012). Social assistance through general safety net programs or categorical targeting is an increasingly popular response to the coverage gap (Palacios and Sluchynskyy 2006). In other words, social assistance that is based on a non-contributory pension scheme, also called "social pension," is proposed for solving the low coverage rate problem (Durán-Valverde 2002; Palacios and Sluchynskyy 2006; Pelham 2007; Knox-Vydmanov 2011). However, the issue of financing the social pension scheme gives rise to the debate on financial sustainability because of limited budgetary resources and the priorities of several countries (Guhan 1994; Töstensen 2004; Townsend 2007). Thus, many countries in Africa continue to maintain only social insurance systems whereas southern Africa and Mauritius experiment with universal systems. Table 1 illustrates some indicators of pension systems.[1]

[1] Proportions of elders receiving a retirement and workers' contribution to a pension scheme are determined from the World Social Security Report 2010/11 (International Labour Organization, 2010). Both proportions correspond to a latest available year for each country between 2002 and 2008. For the Democratic Republic of the Congo, the latest available year is 2008. Other indicators are obtained from International Social Security Association (2013). In Table 1, old-age benefits are calculated by a percentage of the insured's average earnings in some best years multiplied by the number of years of contributions. Some countries pay an additional percentage of the insured's average monthly earnings for each 12-month period of contributions exceeding the minimum contribution period for a pension. These benefits have to be found between the minimum and maximum pension. About old-age pension, certain countries have different classifications of "old age" for men and women, for different types of jobs. In this case, we consider old age for men for the first and use averages for the second.

Table 1: Social insurance system indicators

Countries	Vesting period (minimum contribution period)	Coverage			Contribution rate (%)	Old-age benefits (%)
		Old-age pension	Proportion of elders receiving a retirement (%)	Workers' contribution to a pension scheme (%)		
Algeria	15	60	31.7	37.3	17.25	2.5
Benin	15	60	2.6	4.2	10	2
Burkina Faso	15	59	1.6	2.4	11	2
Burundi	15	60	3.8	3.3	10	2
Cameroon	15	60	9.1	11.5	7	2
Cape Verde	15	65	90	21.7	10	2
Chad	15	60	1.6	1.6	8.5	2
Congo, Republic of	25	60	17	7.5	12	2.5
Congo, Democratic Republic of	5	65	17.7	10.5	7	1.67
Côte d'Ivoire	15	60	9.5	9.1	14	1.33
Gambia	10	60	3	2.9	15	7.5
Ghana	15	60	3.8	9.2	18.5	2.5
Guinea	15	60	3.1	10.8	12.5	2
Mauritania	15	60	9.3	9.4	9	1.33
Morocco	8	60	16	16.8	11.89	6.25
Niger	15	60	5.2	1.2	10.5	2
Rwanda	15	55	12.1	4.1	6	2
Sierra Leone	15	60	0.2	3.8	15	2
Sudan	20	60	3.8	2.9	25	0.24
Tanzania	15	60	3.2	3.3	20	2
Togo	15	60	3.1	5.7	16.5	1.33
Tunisia	10	60	55.1	34.5	12.5	4
Zambia	15	55	7.7	8.8	10	1.33
Zimbabwe	10	60	6.2	14.5	7	1.33

Source: International Social Security Association (2013) and ILO (2010).

In the light of Table 1, the minimum years (15) of contribution that qualifies one for benefit is almost the same for African countries, except a few countries with a lower vesting period; Democratic Republic of the Congo (DRC) has the lowest vesting period of 5 years. Concerning coverage, all countries have a social insurance system that covers wage and salary workers against loss of income due to old age. In general, old-age pension starts at 60 years; in DRC and Cape Verde, the age required is 65 years. Sub-Saharan Africa remains the region with the lowest coverage rates in the world. For the whole of Sub-Saharan Africa the average coverage rate, by using the "share of population above legal retirement age in receipt of a pension," is just 15.6% compared with the global average of 40.2% (ILO 2010). Cape Verde has the highest rate with 90%, followed by two North African countries having 55% (Tunisia) and 38% (Algeria). All other countries have coverage below 20%, with the majority falling below 10% of the elder population receiving a retirement. In DRC, 17.7% of retirees get the benefit and this rate is superior to the one of Sub-Saharan countries of this sample except for Cape Verde. Moreover, when we use "active contributors to a pension scheme in the working-age population" for expressing coverage rate, Sub-Saharan Africa keeps its position (5.4% against 26.4% for world average). Nevertheless, DRC with 10.5% comes after four Sub-Saharan countries (Cameroon, Cape Verde, Guinea, and Zimbabwe). All pension programs under social insurance are financed at least in part by employer and employee contributions. With that in mind, countries in Africa have different contribution rates. Rwanda has the lowest contribution rate at 6% of wages, whereas Sudan (25%), Tanzania (20%), and Ghana (18.5%) have higher contribution rates as a percentage of wages. DRC has a weak contribution rate at 7% of wages. Concerning old-age benefits, for each country Table 1 gives a percentage of the insured's average earnings, which is multiplied by the number of contribution years in order to obtain retirement income. Gambia has the highest percentage in Africa with 7.5%, followed by Morocco with 6.25%. Sudan has the lowest percentage at 0.24%.

For DRC, 1.67% means that for the same earnings and years of contributions, a Congolese retiree receives less income than a person of another country (with a higher percentage). Even though DRC's percentage of retirement benefits is superior to those of six countries (Côte d'Ivoire, Mauritania, Sudan, Togo, Zambia, and Zimbabwe), this is lower than that of 18 other countries. According to a report of the Institut National de Sécurité Sociale (National Social Security Institute, INSS) (2014), the minimum monthly pension is US$36.

According to Table 2, the highest coverage rates (>75%) are observed in countries that have introduced universal pension systems (Botswana, Lesotho, Mauritius, and Namibia) or means-tested old-age pensions (South Africa) in association with contributory systems. Nevertheless, some countries (Namibia and South Africa) pay a retirement benefit more than US$100 whereas others pay an amount less than US$100.

Table 2: Universal pension system indicators

Countries	Coverage		Old-age benefit (a lump sum per month: US$)
	Old-age pension	Rate (%)	
Botswana	65	100	29
Lesotho	70	81.6	53
Mauritius	60	100	67
Namibia	60	86.6	668
South Africa	60	76.4	141

Source: International Social Security Association (2013) and ILO (2010).

DRC is located in central Africa and extends on a surface area of 2,345,410 km^2 with nine direct neighbors. In this country, the social security is ensured by INSS, a public enterprise. Social security history in DRC is marked by two periods: colonial period and period after independence. During the colonial period, two types of social security have existed: one is for expatriate employees (European and Asian) and the other for native workers (Congo or the close colonies). The period after independence is dominated by the promulgation of the organic decree law of social security on June 29, 1961. This legal instrument created the INSS by the fusion of three pension funds: workers' pension fund, central pension fund for family benefit and compensation, and pension fund for workers' disabilities. The INSS aims at organizing and managing the Congolese general scheme of social security. It manages five possibilities out of nine provided for by the Convention 102 of the International Labour Organization (ILO), which are gathered in three branches: pension branches (disability, retirement, and survivor), occupational risks branches (industrial accidents and occupational diseases), and family benefits branches (family loads). Placed under the guarantee of the State, the INSS is supervised by the Ministry of Labor and Social Welfare and by the Ministry for the Wallet.[2] The INSS covers employed persons, including household and casual workers, sailors, and public-sector employees not covered by a special system. Likewise, it deals with voluntary coverage for non-employed persons who were previously insured for at least 5 years and who request coverage in the 6-month period after insured employment ceases. However, self-employed persons are excluded and civil servants get a special system. It is important to note that the retirement benefits are adjusted by presidential decree.

Among the social security indicators highlighted, coverage rate and retirement benefit can be considered as important variables for improving life conditions of the elderly population in DRC. First, according to data in Table 1, 17.7% of retirees receive benefit for having participated in a social insurance system when they were workers and 82.3% live without social security support. To make an effort to raise this rate will contribute to improving the situation for other older people

[2] The Ministry of Labor and Social Welfare takes an interest in technical and administrative management of the INSS and the Ministry of Wallet supervise its financial management.

but not for those receiving a pension if the benefit does not change. However, increasing coverage rate will imply resorting to the universal system that is difficult to realize by a post-conflict country like DRC where priorities exist without much financial means to meet them. Second, social security systems can be strengthened by increasing old-age income without increasing coverage rate. Thus, only elders who evolved in the formal sector and previously contributed would see their situation improve. Even though this method neglects a large proportion of elders, it will not be expensive for the government and it would stimulate many workers to participate in the contributory pension scheme. To that end, a reasonable question that the present study raises is: what mechanisms can the Congolese government envisage to incentivize the INSS to increase old-age income?

This study aims at appreciating theoretically, using the principal–agent model, the necessity for government intervention as a way to ameliorate elderly population income in DRC. The study shows that the Congolese government as a principal can motivate the INSS as an agent by offering two types of contracts (optimal and sub-optimal) in order to increase retirement benefits in DRC. Both contracts correspond to two equilibrium conditions in the form of a game matrix. These equilibrium conditions constitute two strategies that the principal and the agent can play: equilibrium based on the strategy "absence of compromise," which represents the optimal contract, and equilibrium based on the strategy "compromise," symbolizing the sub-optimal contract. With reference to the risk imbedded in asymmetric information, the Congolese government and the INSS are going to choose a sub-optimal contract like that of a prisoner's dilemma. Nevertheless, it is up to this contract to improve life conditions of older people.

This study is structured as follows. Section 2 presents the literature review. Section 3 examines the methodology of the study. In section 4, the results are presented, and Section 5 focuses on conclusion and recommendation.

2 Literature review

Many studies exploring the literature on social security highlight some problems or limitations of formal social security systems based on contributory programs in Sub-Saharan Africa. First, they are mainly limited to the formal employment sector with disparities by gender and by place of residence (Townsend 2007; Adésina 2008; Golaz et al. 2012). Second, few contributors participate in the contributory pension scheme, implying low coverage rate (Palacios and Sluchynskyy 2006; World Bank 2012). Third, the levels of old-age benefit are too low (Bailey 2004). Fourth, the share of social security expenditure in a country's GDP is relatively lower than in other regions of the world (Bonnet 2005). Fifth, pensions systems administered by governments in Africa have little credibility because of high administrative costs, unreliable services for beneficiaries, and the mismanagement of pension reserves (World Bank 2012).

To solve those problems, a non-contributory pension program has been proposed. This universal system or social pension has permitted the reduction of disparities between urban and rural residents, the taking into account of older adults who work in formal and informal sectors, and the increase of coverage rate because it is high in countries where social pension has been set up (Durán-Valverde 2002; Palacios and Sluchynskyy 2006; Pelham 2007; Knox-Vydmanov 2011). Even though most Latin American countries, with the exception of Haiti, Honduras, and Nicaragua, have expanded their pension systems or established non-contributory pensions or cash transfer programs targeted at older persons, few countries in Africa (especially southern Africa) have set up universal pension (Forteza et al. 2009). In spite of its positive effect, many African countries are still waiting to put in place social pension. This can be explained by a debate the studies raise about financing a universal system in the context of weak financial means that many

African countries find themselves in. Setting up a basic universal pension depends on the cost, the political will, and policy priorities (Pelham 2007; Knox-Vydmanov 2011). The number of people getting income pension and the amount of money paid are variables on which cost depends. Knox-Vydmanov (2011) shows that social pension systems can be set up in several African countries by spending 1% of GDP or less. Likewise, Holmqvist (2010) finds that some countries such as Burkina Faso may be able to finance a non-contributory scheme if it increases the tax revenue by 1% . However, certain studies have revealed financial problems that Sub-Saharan African countries face, such as insufficient funds in their budget and preferential allocation of financial means (Gruat 1990; Guhan 1994; Töstensen 2004). In this respect, two problems can be brought up. First, many countries have difficulties in increasing revenue from taxes because of the mismanagement of pension reserves. Second, the budget of a country prioritizes other sectors such as education, infrastructure, economy, and health care instead of the social security sector.

If social pension gives rise to a solution for the issue of low coverage rate, studies do not agree about its capacity to lead to high levels of retirement benefits because some countries (Botswana and Lesotho) using universal pension have low old-age income (see Table 2). Low levels of universal pension and weak elderly revenue in the social insurance system due to insufficient contribution years are two factors leading to African elders working in advanced age if their physical condition allows. In fact, according to Molmy et al. (2011), more than a third of older people are still in employment in Senegal whereas the proportion is over a half in DRC. Likewise in Botswana, aged persons who receive a pension income represent a high percentage of the population, but the level of pension overall is very low. Moreover, at least 30% of people beyond 'pension age' continue to have a paid job (ILO 2010). Golaz et al. (2012) argue that when benefits are insufficient, the family intervenes to help retirees who are not physically strong enough to continue doing a remunerative activity. However, in the future, because of the increase in life expectancy and the reduction in fertility in Africa, families may not be able to support the burden represented by an ageing population. In this case, better measures of public policy seem compulsory.

In spite of limitations of the social insurance system, studies have shown the effect of a pension program on the economy. In that respect, Ijeoma and Nwufo (2015) find a strong positive linear relationship between the contributory pension expenditure and the GDP in Nigeria, and they also find that the contributory pension scheme has significantly impacted the development of Nigeria's capital market. Adejoh (2013) highlights the positive effect of contributory pension schemes on GDP. Gunu and Tsado (2012) point out that the contributory pension system has begun to contribute to increase the growth and development of not only the Nigerian capital market but also the economy in general. Oluwatoyin and Ikechukwu (2009) show a positive effect of the contributory pension system on employee retirement benefits of Nigerian firms with quoted stocks. Concerning the universal system, its impact on poverty reduction has been observed (Schwarzer and Querino 2002; Lucia Acosta 2005; Barrientos and Hulme 2008). Likewise, its influence on the reduction of the social impact of global economic and financial crises is shown (Stiglitz 2009).

In the light of what precedes, the issue of low levels of retirement benefit does not depend on the type of pension system. Social security can be improved by increasing coverage rate or by raising old-age benefit or by increasing both. Thus, exploring social security improvement based on contributory schemes within the framework of the principal–agent model approach seems worthwhile. To the best of the author's knowledge, given that the existing literature on social security does not use the principal–agent model, the originality of the present study relies on this methodological approach.

3 Methodology: Model specification

The principal–agent model is based on the following basic assumptions:

- Relationship between a principal and an agent cannot be repeated.
- Existence of a legal framework allows one to respect the contract proposed by the principal and accepted by the agent.
- The principal is the leader according to Stackelberg model: this means the principal offers various contracts and anticipates that the agent will choose the contract that maximizes his utility (Laffont and Martimort 2002; Bolton and Dewatripont 2005).

This methodology is proposed by Laffont and Martimort (2002) and Bolton and Dewatripont (2005). The principal's objective is to develop the optimal contract for the agent. For this, he maximizes its objective function relative to incentive and participation constraints. There are two utility functions: one for the principal and another for the agent. Each one maximizes its utility function. Thus, the principal's utility (virtually linear) is:

$$V = S(q) - t, \tag{1}$$

with $S' \succ 0$, $S'' \prec 0$, $S(0) = 0$, and $t \in R$ is the transfer (payment) that the principal gives the agent.

The agent's utility (virtually linear) is:

$$U = t - C(q,\theta), \tag{2}$$

with $C(q,\theta) = \theta q + F$ representing the agent's production cost, $\theta \in R_{++}$, $F=0$. Note that q is a variable representing produced quantity, V is the principal's utility, S symbolizes the function of V, S' expresses the first-order condition for a maximum, S'' represents the sufficient condition for a maximum, U is the agent's utility, C symbolizes the function of costs generated by the agent's activity, F represents fixed costs, R is a collection of rational numbers, R_{++} constitutes a collection of positive rational numbers and θ is a parameter meaning a type (efficient or non-efficient) of agent. So, the function that the principal has to maximize is:

$$\left\{ \begin{array}{l} Max_{(t,q)} S(q) - t \\ S/C : t - C(q,\theta) \geq 0 \end{array} \right\}. \tag{3}$$

The agent's reservation utility is assumed to be independent on θ, which is normalized to 0. At the optimum, we have the first-order condition:[3]

[3] The first-order condition allows us to get maximal quantities which can be the higher value of production the agent has to product for which the principal is ready to pay him an amount. This best possible value is the condition that should permit the agent to receive remuneration. q^{aIC} means a quantity produced in a context of complete information and t^{aIC} is the payment in the same context.

$$\left\{\begin{array}{l} S\left(q^{oIC}\right)=C'\left(q^{oIC},\theta\right)=\theta \\ t^{oIC}=C\left(q^{oIC},\theta\right)=q^{oIC}\theta \end{array}\right\}. \tag{4}$$

3.1 Principal–agent in a context of complete information

The contract contains maximum quantity and transfer (q^{oIC}, t^{oIC}) that the agent can choose or not. This contract is optimal if the type of the agent is θ. Consequently,

$$S(q^{oIC})-t^{oIC}=S(q^{oIC})-C(q^{oIC},\theta)\geq 0. \tag{5}$$

We can consider two optimal contracts: $\left(\bar{t},\bar{q}\right)$ and $\left(\underline{t},\underline{q}\right)$ if $\bar{\theta}\succ\underline{\theta}$ (the value of parameter θ is low for an efficient agent and high for a non-efficient agent), where $\left(\bar{t},\bar{q}\right)$ is an optimal contract for an agent's type $\bar{\theta}$ (non-efficient agent) and $\left(\underline{t},\underline{q}\right)$ is an optimal contract for an agent's type $\underline{\theta}$ (efficient agent).[4] Thus, $\underline{q}\succ\bar{q}$ (as S' is small in the first-order condition): the maximum production of the efficient agent is greater than the one of the non-efficient agent;

$$\underline{t}-C(\underline{q},\theta)=\underline{U}=0=\overline{U}=\bar{t}-C(\bar{q},\theta); \tag{6}$$

and

$$\underline{V}=S(\underline{q})-\underline{\theta q}\equiv\max_q S(q)-\underline{\theta}q\succ S(\bar{q})-\underline{\theta}\bar{q}\succ S(\bar{q})-\bar{\theta}\bar{q}=\overline{V}, \tag{7}$$

where the profit of the principal is high if the agent is efficient.

However, $\underline{t}=\underline{\theta q}$ may be smaller or larger than $\bar{t}=\bar{\theta}\bar{q}$ according to the form of S.[5]

From the above, the agent cannot refuse any contract because the utility that he will have by choosing any contract proposed by the principal will be at least equal his reservation utility. In the context of complete information, the delegation is not expensive for the principal because he reaches the same level of utility that he would get if he had produced by himself with the same agent's cost function. It is important to note that the principal can observe the type of agent in the context of complete information, but he cannot do that when information is asymmetric. This way, the agent can hide his type. So, how can the principal incite the agent to reveal his true type?

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[4] $\underline{q}$, $\underline{t}$, $\underline{U}$, and $\underline{V}$ represent quantity obtained, transfer given, the function value of the agent's utility, and the function value of the principal's utility, respectively, if the agent is efficient $\left(\underline{\theta}\right)$. $\bar{q}$, $\bar{t}$, $\overline{U}$, and $\overline{V}$ are quantity obtained, transfer given, the function value of the agent's utility, and the function value of the principal's utility, respectively, if the agent is non-efficient $\left(\bar{\theta}\right)$.

[5] For more detail, refer to Laffont and Martimort (2002), who, like Bolton and Dewatripont (2005), lengthily extend on the various approaches of the inciting mechanisms within the framework of the principal–agent model.

3.2 Principal–agent in a context of asymmetric information

Assuming

$$\Theta = \left\{\underline{\theta}, \overline{\theta}\right\}, \overline{\theta} \succ \underline{\theta}, \ \Pr(\underline{\theta}) = \alpha, \tag{8}$$

we wonder what will happen if the principal proposes two contracts $\left\{\left(\underline{t}, \underline{q}\right), \left(\overline{t}, \overline{q}\right)\right\}$ obtained in the context of complete information. Given the difficulty that the principal has to distinguish between two types of agents when information is asymmetric, the efficient agent $\left(\underline{\theta}\right)$ can choose the contract for the non-efficient agent $\left(\overline{\theta}\right)$ because his utility will be higher than zero instead of zero:

$$\left(\underline{t}, \underline{q}\right) \rightarrow \underline{t} - C\left(\underline{q}, \underline{\theta}\right) = 0 \tag{9}$$

and

$$(\overline{t}, \overline{q}) \rightarrow \overline{t} - C(\overline{q}, \underline{\theta}) = \overline{q}\,\overline{\theta} - \overline{q}\,\underline{\theta} \succ 0\,. \tag{10}$$

Consequently, the best contract in the context of complete information cannot be implemented in the context of asymmetric information because one type of agent imitates another type. Then, what kind of contracts can the principal propose for the agent in this latter context?

We consider a packet of two contracts as earlier: $\left\{\left(\underline{t}, \underline{q}\right), \left(\overline{t}, \overline{q}\right)\right\}$. This packet is incentivized if it satisfies the following incentive[6] (IC1, IC2) and participation (PC1, PC2) constraints:

$$\underline{U} \equiv \underline{t} - C(\underline{q}, \underline{\theta}) \geq \overline{t} - C(\overline{q}, \underline{\theta}), \tag{IC1}$$

$$\overline{U} \equiv \overline{t} - C(\overline{q}, \overline{\theta}) \geq \underline{t} - C(\underline{q}, \overline{\theta}), \tag{IC2}$$

$$\underline{t} - C(\underline{q}, \underline{\theta}) \geq 0, \tag{PC1}$$

$$\overline{t} - C(\overline{q}, \overline{\theta}) \geq 0. \tag{PC2}$$

In the context of complete information, the agent has an exact reservation utility whatever his type $\left(\underline{U} = \overline{U} = 0\right)$; however, this is not possible in the context of asymmetric information if $\overline{q} \neq 0$ (i.e., if the principal wants to use two types of agents for the production) like a packet of incentive contracts. Thus, (IC1) implies:

$$\underline{U} \geq \overline{t} - \underline{\theta}\overline{q} = \overline{U} + \overline{q}\Delta\theta \succ \overline{U} \geq 0 \tag{11}$$

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[6] The constraints of IC1 and IC2 imply a constraint of monotony: $\overline{t} \leq \underline{t}$ and $\overline{q} \leq \underline{q}$.

There are rents resulting from the information provided for each type: $\underline{U} \equiv \underline{t} - \underline{\theta}\underline{q}$ and $\overline{U} \equiv \overline{t} - \overline{\theta}\overline{q}$. Thus, the program of the principal can be written as follows:

$$\begin{array}{l} Max_{\{(\underline{t},\underline{q}),(\overline{t},\overline{q})\}} \alpha\left(S(\underline{q}) - \underline{t}\right) + (1-\alpha)\left(S(\overline{q}) - \overline{t}\right) \\ S/C : (\text{IC1}), (\text{IC2}), (\text{PC1}), \text{and } (\text{PC2}) \end{array}. \qquad (12)$$

Using the rents resulting from the information provided, the program becomes:

$$Max_{\{(\underline{U},\underline{q}),(\overline{U},\overline{q})\}} \underbrace{\alpha\left(S(\underline{q}) - \underline{\theta}\underline{q}\right) + (1-\alpha)\left(S(\overline{q}) - \overline{\theta}\overline{q}\right)}_{\textit{effectiveness-allowance hoped}} - \underbrace{\left(\alpha\underline{U} + (1+\alpha)\overline{U}\right)}_{\textit{rents resulting from information hoped}}, \qquad (13)$$

with incentive (IC3, IC4) and participation (PC3, PC4) constraints:

$$\underline{U} \geq \overline{U} + \overline{q}\Delta\theta, \qquad (\text{IC3})$$

$$\overline{U} \geq \underline{U} - \underline{q}\Delta\theta, \qquad (\text{IC4})$$

$$\underline{U} \geq 0, \qquad (\text{PC3})$$

$$\overline{U} \geq 0. \qquad (\text{PC4})$$

To solve this program, it is important to assess these rents ($\underline{U}$ and $\overline{U}$) using constraints. For this, we have to resort to examining the constraints that could be saturated at the optimum (Kuhn and Tucker 1951). Two cases are examined: with inclusive contracts and without inclusive contracts.

With inclusive contracts: $\overline{q} \succ 0$

Starting from PC3, IC3, and IC4, if $\underline{U} = 0$, then $-\underline{q}\Delta\theta \leq \overline{U} \leq -\overline{q}\Delta\theta$; this violates PC4. Consequently, $\underline{U} \succ 0$. From PC4, IC3, and IC4, if $\overline{U} = 0$, then $\overline{q}\Delta\theta \leq \underline{U} \leq \underline{q}\Delta\theta$, which respects PC3. Only the efficient agent has a positive rent resulting from information. Given the rationality of the non-efficient agent, only $\overline{U} = 0$ is possible. This implies $\underline{U} = \overline{q}\Delta\theta$ (as the agent's type $\underline{\theta}$ wants to imitate the agent's type $\overline{\theta}$ but not vice versa). So at the optimum, constraints IC3 and PC4 should be saturated.[7] Substituting in the program the rents resulting from the information above, we have:

[7] The saturation of the constraint implies equality of the two members (i.e., right-hand side and left-hand side). As above, from PC4, IC3, and IC4, if $\overline{U} = 0$ in PC4, $\overline{q}\Delta\theta \leq \underline{U} \leq \underline{q}\Delta\theta$; $\underline{U} = \overline{q}\Delta\theta$ in IC3. Thus, IC3 and PC4 are saturated. However, the replacement of their values in the two other constraints (IC4 and PC3) gives: $\overline{U} \geq \underbrace{\overline{q}\Delta\theta - \underline{q}\Delta\theta}_{\prec 0}, \Rightarrow \overline{U} \prec 0$ in IC4. This violates the condition requiring that $\overline{U} = 0$ in PC4. From PC3, $\underline{U} \geq 0$

$$Max_{\{\underline{q},\overline{q}\}}\alpha\left(S(\underline{q})-\underline{\theta}\underline{q}\right)+(1-\alpha)\left(S(\overline{q})-\overline{\theta}\overline{q}\right)-\alpha\overline{q}\Delta\theta. \quad (14)$$

Deriving this function, we obtain at the optimum the elements of inclusive contracts in the context of asymmetric information:

$$\frac{\partial -}{\partial \underline{q}}=\alpha\left(S'(\underline{q})-\underline{\theta}\right)=0\Rightarrow S'\left(\underline{q}^{oAI}\right)=\underline{\theta}, \quad (15)$$

$$\frac{\partial -}{\partial \overline{q}}=(1-\alpha)\left(S'(\overline{q})-\overline{\theta}\right)-\alpha\Delta\theta=0\Rightarrow S'\left(\overline{q}^{oAI}\right)=\overline{\theta}+\frac{\alpha}{1-\alpha}\Delta\theta. \quad (16)$$

Comparatively, in the context of complete information, we obtain $\underline{q}^{oAI}=\underline{q}^{oCI}$ and $\overline{q}^{oAI}$ □ $\overline{q}^{oCI}$, and maximum payments:

$$\underline{t}^{oAI}=\underline{U}+\underline{\theta}\underline{q}^{oAI}=\overline{q}^{oAI}\Delta\theta+\underline{\theta}\underline{q}^{oAI}=\overline{q}^{oAI}\Delta\theta+\underbrace{\underline{\theta}\underline{q}^{oCI}}_{\underline{t}^{oIC}}\succ\underline{t}^{oCI}, \quad (17)$$

$$\overline{t}^{oAI}=\overline{U}+\overline{\theta}\overline{q}^{oAI}=\overline{\theta}\overline{q}^{oAI}\prec\overline{\theta}\overline{q}^{oAI}=\overline{t}^{oCI}. \quad (18)$$

Note that $\underline{q}^{oAI}$ and $\underline{t}^{oAI}$ are, respectively, maximum quantity produced and transfer made if the type of agent is efficient in the context of asymmetric information. Likewise, $\overline{q}^{oAI}$ and $\overline{t}^{oAI}$ are, respectively, maximum quantity obtained and transfer carried out if the type of agent is non-efficient in the context of asymmetric information. The high level of production in the context of complete information is $\underline{q}^{oCI}$ if the type of agent is efficient and $\overline{q}^{oCI}$ if the agent type is non-efficient; $\underline{t}^{oCI}$ and $\overline{t}^{oCI}$ represent transfer in the context of complete information if the agent is efficient and non-efficient, respectively.

Without inclusive contract: $\overline{q}^{oAI}=0$

This contract is the best whether the principal provides a contract that cannot give any agent a chance to cheat. Thus, $\underline{U}=\overline{U}=0$ and $\left(\underline{t}^{oAI},\underline{q}^{oAI}\right)=\left(\underline{t}^{oCI},\underline{q}^{oCI}\right)$. In the context of asymmetric information, the firm does not maximize its profit: allowance (social value of exchange) is not efficient but it is optimal given the constraints of information.

After presenting the principal–agent model whose resolution has led to two possible types of contracts, the Congolese context can offer a reflection on the use of this methodology in order to improve social security through government intervention.

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and IC3, $\overline{U}=\underbrace{\overline{q}\Delta\theta}_{\succ 0}$; $\underline{U}$ must be superior to zero but not equal to zero. Thus, IC4 and PC3 are unsaturated constraints.

4 Theoretical results

Before presenting the results of the present study we need to clarify the framework in which the methodology is used.

4.1 Framework

On the basis of the discussion so far, the principal is represented by the Congolese government and the agent by the INSS. The principal determines the objective that must be reached by the agent. Indeed, the government expects that the INSS reaches a certain result consigned in a document. This result consists of an increase in the benefit paid to the pensioners for a given period. The INSS has more information on management or operation of the company than the government. To reach this result, it is necessary that the resources of the agent (INSS) are sufficient. These resources are made up of pension fund contributions, payment of building rents, and dividends and interests of financial investments. Pension fund contributions and payment of building rents being almost invariable, dividends and interests generated by financial investments seem to be the source suitable for increasing essential resources in order to raise retirement benefits. However, financial investments constitute a risk activity in which profitability depends on agent behavior by selecting and monitoring borrowers.

To analyze theoretically mechanisms that the government can put in place, we are going to depend on the model previously presented in Section 3. The amount of dividends and interests generated by financial investments corresponds to q, minimum benefit is similar to y, and payment made by the principal to the agent t. So, the minimum benefit if $y=S(q)$, which is an increasing function of the amount of dividends and interests generated by financial investments. Some hypotheses for understanding this study properly are:

- The first two components of resources (pension fund contributions and payment of building rents) do not vary; only the third component (dividends and interests of financial investments) can vary and consequently modify the total resources.[8]
- The supplement of the dividends and interests is used for financing the increasing minimum benefit, until reaching for example US$60 (a monthly average).[9]
- The amount of dividends and interests (q) must at least be equal to a minimum amount fixed beforehand.

4.2 Presentation of results and their interpretation

Three cases representing incentive contracts can be considered before a contract is signed:

- With inclusive contract: The difficulty to distinguish types of agents before a contract is signed (efficient agent: $\underline{\theta}$ and non-efficient agent: $\overline{\theta}$) by the principal, and especially the

[8] In the last three years, the share of financial investments in the resources of INSS represents <5%, according to financial management agents of INSS. The near total of resources is made up of pension fund contributions. If pension fund contributions and payment of building rents vary, their change must be very weak in order to not modify the total resources substantially.

[9] We consider this amount as the poverty line because US$2 multiplied by 30 equals US$60.

tendency for the efficient agent to cheat by choosing the contract reserved versus a non-efficient agent makes it very difficult to envisage this contract as an inciting mechanism.

- Without inclusive contract (contract based on absence of compromise): This optimal contract is easy to envisage, implying that only the agent indirectly bears the risk. If the agent does not realize the objective involuntarily, he will receive nothing as payment. Likewise, for a value such as q, very close to $q^*(q^{\rho AI})$, the agent will receive no payment. Thus, in the year t+1 (i.e., in future) the agent would be less incited knowing that the risk borne in the year t (i.e., at present) deprived him of payment. In this contract, the payment depends on the amount of dividends and interests corresponding to q^*.
- Contract based on compromise: Given the risks related to financial investments, if the agent discovers that he has to bear the risks alone, he will be less incited to increase financial investments. In fact, an increase in financial investments could raise the risk incurred by the agent to recover the funds, which could exert a negative effect on the amount of dividends and interests recovered and consequently discourage the agent. In this contract, the principal and the agent share the risk related to the variations of the sum of dividends and interests. This implies that the payment carried out by the principal for the agent's account depends partly on this amount. In other words, even if this sum is not equal to the one awaited (q^*) but is slightly higher than the amount obtained at the previous period, the agent will receive the payment (i.e., any increase in this amount is rewarded). That incites the agent more to increase the financial investments in the hope of high dividends and interests. This contract, which appears more motivating, is nevertheless sub-optimal.

To illustrate the sub-optimal nature of the third contract, we suppose that the share of the agent takes the following form (Varian 2006): $t(q)=\alpha S(q)+F$, with F representing any constancy and $0 \prec \alpha \prec 1$. The maximization program of the agent is as follows:

$$Max_{(q)} \alpha S(q) + F - C(q). \tag{19}$$

This implies that the agent chooses a given amount $\hat{q}$ for which

$$\alpha S'(\hat{q}) = C'(\hat{q}). \tag{20}$$

This amount does not respect the condition of effectiveness; that is: $S'(q^{\rho AI})=C'(q^{\rho AI},\theta)$.

Thus, two equilibrium conditions can be identified from analysis of the principal–agent model. They can be presented in the form of a game matrix, as shown in Table 3:

Table 3: Matrix representing the two possible equilibrium conditions of the principal–agent

Agent↓\Principal→	Absence of compromise (indisputable: $q = q*$)	Compromise $(q \le \hat{q} \ne q*)$
Absence of compromise (indisputable $q = q*$)	$(t*, y*)$	$(\hat{t}, y*)$
Compromise $(q \le \hat{q} \ne q*)$	$(0, y \le \hat{y})$	$(t \le \hat{t}, y \le \hat{y})$

Source: Author's interpretation from the preceding analyses.

Two outcomes can be highlighted on the basis of the matrix in Table 3.

Equilibrium based on the strategy "absence of compromise": optimal contract

When the government plays with the "absence of compromise" the INSS cannot play with a "compromise" because it receives nothing as payment even in the event of a small rise in the amount of dividends and interests. So, the INSS too has to play with "absence of compromise." In other words, optimal contract means that the INSS commits itself to increasing old-age benefits, symbolized by y^* (the best possible level, namely: US$60 as the minimum monthly pension), and the government promises to pay it the bonus expressed by t^* if it reaches the aim assigned by the government. Given the bonus $\hat{t}$ is inferior to the one represented by t^*, the INSS must choose the contract proposed by the government in which minimum retirement pension and transfer are at their maximum level.

Equilibrium based on the strategy "compromise": less optimal contract

When the government plays with "compromise" the INSS can only play with "compromise"; otherwise it will receive a salary lower than if it played without. Knowing that it is possible that $q \neq q^*$ (sum of dividends and interests received by the INSS can be different from the one assigned by the government), the government and the INSS will be tempted to reach an equilibrium condition and agree to a less optimal solution (like that of a prisoner's dilemma). This takes into consideration the risk imbedded in asymmetric information that makes this choice possible. Hence, this contract would incite the INSS to increase its financial investments while taking care not to allow wage decrease by letting the amount of dividends and interests to decrease. This contract is less optimal because the increase in minimum monthly pension could be less than the one expected (if the minimum retirement benefit rises without reaching US$60).

5 Conclusion and recommendation

This paper has examined the need for public intervention to improve social security. In DRC, the existence of a public company dealing with social security may be something the Congolese government can use for increasing the minimum retirement benefits that are very low. For that purpose, this study adopted a methodology that relies on the principal–agent model. This model helps us to highlight the relationship between the Congolese government and the INSS. The first is considered as a principal and the second as an agent. The principal can envisage the mechanisms that can have the form of contracts for motivating the agent. Two types of contracts can be proposed by the Congolese government to the INSS and constitute the theoretical results of this study. The first contract is optimal and represents an equilibrium based on the strategy of "absence of compromise." The second contract is less optimal and gives equilibrium that relies on the strategy qualifying the "compromise." With reference to the risk imbedded in asymmetric information, the Congolese government and the INSS will be in favor of a less optimal contract. Nevertheless, this contract is able to allow a rise in retirement benefits. This approach is the originality of this paper because existing studies on social security do not seem to use this methodology.

A recommendation deserves to be proposed by this study. The Congolese government should condition the renewal of the mandate of the INSS managers to the realization of the objective assigned to them. This renewal of the mandate would constitute a form of payment referred to in this study.

Ensuring adequate funding for older people and extending coverage to a larger share of the elderly population are the real challenges DRC faces in its search for improving its social security system. In this paper, we focused our attention on the first challenge. Given that social security is constituted by three kinds of benefits (old age, disability, survivors), the benefit of elders allows us to have a partial overview of improving social security systems. This is a limitation of the study. Another limitation is found in the second challenge that is not analyzed in this paper and could be a future area of research.

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