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A Specification of the General Theory of the Firm:
Employment and Profit, Investment and Interest rates

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Abstract:

Adopting a Cobb-Douglas specification, this paper clarifies and confirms the results of the general theory of the firm. First, it shows that wage rigidity in the short run is linked to the fact that it depends, on the one hand, on average labor productivity, which is not very flexible in the short run, and, on the other hand, the state of the labor market in terms of primary income distribution, which generally only changes after lengthy wage negotiations. Second, the article confirms, on the one hand, that gross profit is the determinant of labor demand in the short run while the level of real wages is one of its determinants in the medium and long run and, on the other hand, that the security of labor is favorable to employment, while its flexibility is favorable to gross profit. Third, the article confirms that (i) the corporate investment strategy depends on the financing structure of companies; (ii) the relationship between investment and interest rate is complex and not monotonous; the sign of this relationship depends in particular on the nature and level of financing constraints, the degree of interest rate elasticity of the credit supply and the level of capital profitability. Fourth, the article shows that the interest rate and the depreciation rate affect investment level in different ways and that each of these rates is a determinant of investment in its own right. Therefore, considering the sum of the interest rate and the depreciation rate ($r + \delta$) as a determinant of investment would not be relevant.

Résumé : **Une spécification de la Théorie générale de la firme :** *Emploi et profit, Investissement et taux d'intérêt*

Adoptant une spécification de Cobb-Douglas, cet article vient préciser et confirmer les résultats de la théorie générale de la firme. Premièrement, il montre que la rigidité des salaires dans le court terme serait liée au fait qu'ils dépendent, d'une part, de la productivité moyenne du travail qui elle est peu variable dans le court terme et, d'autre part, de l'état de fonctionnement du marché du travail en matière de répartition primaire de revenu qui généralement ne change qu'après de longues négociations salariales. Deuxièmement, l'article confirme, d'une part, que le profit brut est la variable déterminante de la demande de travail dans le court terme, tandis que le niveau des salaires réels est l'un de ses déterminants à moyen et long terme et, d'autre part, que la sécurité du marché du travail est favorable à l'emploi, tandis que sa flexibilité est favorable au profit brut. Troisièmement, l'article confirme que (i) la stratégie d'investissement dépend de la structure de financement des entreprises ; (ii) la relation entre l'investissement et le taux d'intérêt est complexe et n'est pas monotone ; le signe de cette relation dépend notamment de la nature et du niveau des contraintes de financement, du degré d'élasticité de l'offre de crédit par rapport au taux d'intérêt et du niveau de profitabilité du capital. Quatrièmement, l'article montre que le taux d'intérêt et le taux d'amortissement influent de façon différente sur le niveau de l'investissement et que chacun de ces taux est un déterminant à part entière de l'investissement. Par conséquent, considérer la somme du taux d'intérêt et du taux d'amortissement ($r + \delta$) comme une variable déterminante de l'investissement ne serait pas pertinent.

Keywords: Firm, profit, investment, employment.
Mots clés : Firme, profit, investissement, emploi.

JEL classification: D21, E22, J23

Sommary

1. Introduction

The firm is the main player in the market economy. Therefore, better apprehending the firm is essential for understanding the functioning of the economy as a whole in order to make better economic policy recommendations. However, the critical review of contemporary developments made by Coriat and Weinstein (2010) concluded that economic theory offers a vision of fragmented firm. Also, because of the overly simplistic assumptions relating to the firm, a significant gap is observed between the facts and the dominant economic theories results, in particular concerning the labor and capital markets. So, these markets are the subject of several controversies in macroeconomic analysis. According to Gregory Mankiw (1999), these controversies have often led to contradictories economic policies recommendations proposed by economists to decision-makers.

This is why the General Theory of the Firm seeks to better understand the behavior of companies on the basis of more realistic hypotheses (Zerbo, A. 2016, 2018a and 2018b, Zerbo A. and Hien, L. 2019, 2020). Taking into account all of the company's stakeholders, market imperfections and, thus, transaction costs and funding constraints, the General Theory of the Firm established several new results. It demonstrates, among other things, that (i) real gross profit is the main determinant of employment in the short-run, while real wages and the capital stock are determinants of employment in the medium and long run, (ii) labor flexibility is favorable to gross profit while security in the labor market is favorable to employment; hence the importance of flexisecurity in the labor market, (iii) investment is not a monotonous function with respect to the interest rate: the relationship between investment and interest rate can be positive or negative.

In addition, the General Theory of the Firm has highlighted general calculation formulas of (i) marginal transaction costs in the labor market, (ii) marginal transaction costs in capital markets, as well as (iii) marginal opportunity costs of funding constraints in the capital markets.

The purpose of this article is to specify the General Theory of the Firm in order to further specify its general lessons and to present it in a more accessible form for empirical tests and economic modeling. To do this, the most common functional form in the economic literature, namely the Cobb-Douglas function, is used to define the corporate production technology, the compromise functions and the funding supply functions. On this basis, this article aims (i) to point out the expressions of the marginal transaction costs in the markets, as well as those of the marginal opportunity costs of funding constraints in the capital markets, (ii) to determine the conditions of the optimal investment strategy, as well as the relationship between investment and interest rates.

Therefore, this paper is structured in four sections. The first section is devoted to a brief reminder of the General Theory of the Firm. The second section provides a specification of this theory and, on this basis, provides the expressions of the marginal costs borne by firms in the labor and capital markets. Thus, based on this specification, the last two sections respectively analyze the labor market equilibrium and the corporate investment decision.

2. Brief reminder of the General Theory of the Firm

The basic idea of the General Theory of the Firm is that economic players negotiate compromises among themselves (they make deals) in the markets. They negotiate, sign contracts, agreements or conventions, and execute them in an environment characterized, among other things, by imperfect markets, asymmetric information and privileged relationships. So companies' labor demand behavior is dictated by the labor market compromise process, while their investment decision is determined by the capital market compromise process.

1. *The basic premise of the General Theory of the Firm*

The General Theory of the Firm is based on the idea that the company is an entity, composed of the employer (or managers), employees and possibly shareholders. This entity owns assets, contracts, develops and manages specific know-how, promotes compromise between stakeholders, produces goods and/or services to generate income which is distributed to said stakeholders. Also, the company may maintain privileged relationships with suppliers and especially with banking and/or financial institutions, in particular for the management of its cash and the financing of its investment projects.

Contrary to neoclassical concept, the company does not only serve the employer interests, namely the maximization of profit. The company aims to satisfy all stakeholders so that it performs sustainably in its value creation function. Although conflicting, the stakeholders' interests are interdependent. Indeed, as much as the employer wishes to make more profit, it is in his interest (i) that his employees are relatively satisfied so that the labor productivity would be high and (ii) that the shareholders and the lenders are also satisfied so that they would continue to support the company's investment projects. Conversely, in order to keep their jobs and have high wages, the employees have an interest, on the one hand, in the employer making high profits and, on the other hand, in the shareholders and lenders being suitably paid so that they continue to support the company. Likewise, as much as the shareholders wish to have high dividends, they also have an interest (i) in the company having capacity to invest again, (ii) in the managers and the employees being in satisfactory working conditions and (iii) in the lenders being suitably paid so that they continue to support the company's investment projects. As for the lenders, the more they want to get high interest rates, the more they have an interest in the company being sustainably efficient so that it can honor its commitments over time.

Therefore, the interests of stakeholders are conflicting and interdependent. So the company has to operate on the compromise basis between its stakeholders. Operating on the compromise basis does not exclude the adoption of opportunistic behaviors by stakeholders. The asymmetric information and the bargaining power imbalance between the stakeholders encourage such behavior, not only during negotiations, but also during the compromise execution. Also, because of the changes that can occur in the relationships between stakeholders, especially on the informational and institutional level, the compromise is not static; it is dynamic. For example, the updating of information on the opportunistic behaviors of a stakeholder can cause the state of compromise in force by the other stakeholders to be called into question and, thus, lead to new negotiations to establish a new compromise state.

Thus, the corporate compromise state at a given time depends not only on the institutional, legal and information environment, but also on the economic, social and relational environment in which it operates. For example, the position of each stakeholder in the negotiations will depend in particular on the fact that the economic environment offers him more or less other alternatives to achieve his goals. Also, the state of trust relationships between stakeholders, the rationality level or altruism level of stakeholders, as well as the social relationships between them influence the compromise.

In view of these elements, the General Theory of the Firm considers that the company is characterized by an implicit compromise function, namely a subjective utility function. The company seeks to optimize this function so that each stakeholder feels satisfied. This corresponds to limited rationality principle of Williamson (1975) according to which economic players make choices intentionally rational, but inevitably limited, because of the limits in their capacities to access and process information, as well as the limits imposed by the institutional, legal, relational and social environment. Obviously, just like a compromise state, the compromise function is characterized by the state of the institutional and legal, informational, economic and social environment in which the company operates. Therefore, the compromise function changes structurally with these elements. The measurable objectives of the stakeholders are the arguments of the compromise function. These include profit, wage, employment, investment, return rate on capital and bank guarantees.

Also, knowing that the principle of negotiation is to converge the stakeholders' positions, intermediate solutions are preferred over extreme solutions. This implies that the compromise possibilities set is convex, that is to say, the corporate compromise function is concave.

In addition, in the process of the company, two interdependent negotiation levels can be distinguished. On the one hand, there is the primary compromise which relates to the distribution of added value between the wage bill and the gross operating surplus (gross profit) and, on the other hand, there is the capital compromise which relates to the distribution of income linked to capital: interests, dividends and retained earnings.

2. *Corporate primary compromise process*

The compromise between employers and employees (primary compromise) mainly concerns (i) the average level of real wages (w/p), (ii) the level of employment (L) and (iii) real gross profit (π), under technology constraints (Zerbo 2016). Thus, given the institutional, informational and social environment, the stakeholders seek to reach the optimal compromise, constrained by production possibilities.

Let U be the primary compromise function given by relation (1) and F the production function of companies given by relation (2). So the companies' primary compromise program is given by relation (3).

$$U = U(\pi, L, w/p) \quad (1)$$

$$Y = F(K, L) \quad (2)$$

$$\begin{cases} Max\, U(\pi, L, w/p) \\ u/c \quad \pi + (w/p)L - F(K, L) \leq 0 \end{cases} \quad (3)$$

This primary compromise program determines, on the one hand, the process of wage negotiation and, on the other hand, the corporate behavior of labor demand. In fact, wage negotiations precede the demand for labor by companies; that is to say, the stakeholders (employers and employees) agree on the remuneration of the workforce before it is used. Then, the companies program can be distinguished in two stages. The first stage concerns wage negotiations, which determines the real wage level, and the second stage concerns the determination of the demand for labor.

Given the institutional, regulatory and informational environment of the labor market characterized by the primary compromise function U, as well as the average productivity of labor (Y/L), wage negotiations relate to real wages (w/p) and gross profit per output unit (π/Y), under the wealth distribution constraint. Indeed, to determine wages, the labor productivity is considered as a given by the stakeholders, even if it is imperfectly known and it is subject of moral hazards. At this productivity level, employers want to pay a real wage level which would guarantee them both a high gross profit per output unit (π/Y) and a suitable level of work effort, while employees aim for a relatively high real wage level. Their interests being conflicting (short run) and interdependent (medium and long run), employers and employees have to negotiate to determine the real wage level.

Thus, the process of wage negotiation is deuced from the companies' primary compromise program (relation 3), such as given by relation (4).

$$\begin{cases} \underset{\pi/Y,\, w/p}{Max}\ U(\frac{\pi}{Y}, \frac{w}{p}, \frac{L}{Y}) \\ s/c \quad \frac{\pi}{Y} + (w/p)\frac{L}{Y} \leq 1 \end{cases} \tag{4}$$

The first-order conditions give the system of equations (22) which indicates that the real compromise wage is such as the marginal rate of substitution (*$MSR_{w\pi}$*) of real wage for profit per output unit is equal to the average productivity of labor. The compromise point ((w/p)*; (π/Y)*), solution of the system of equations (5), is such as the desire to earn an extra penny on real gross profit per output unit is equal to an employee's desire to earn an extra penny from the real wage (Zerbo 2016).

$$\begin{cases} MRS_{w\pi} = \frac{Y}{L} \\ \frac{\pi}{L} + (w/p) = \frac{Y}{L} \end{cases} \tag{5}$$

Furthermore, the system of equations (5) allows to determine the compromise point of wage negotiation as the intersection of, on the one hand, the conventional curve of wage negotiation (CCWN) which is given by first equation and, on the other hand, the technical curve of wage negotiation (TCWN) which is given by second equation. Making the total differential of the first equation of the system (5) shows that the conventional curve is increasing.

Solving the first-order conditions (system of equations 22) gives the expression of real wage as a function of average labor productivity (Y/L). Solving the total differential of this system points out that real wage is increasing with average labor productivity. Thus, it can be write the relation (6) which expresses the real wage as a function of average labor productivity (Y/L).

$$(w/p)^* = w_r\left(\frac{Y}{L}\right) \tag{6}$$

Once the real wage is determined through the wage negotiation process, the company maximizes the compromise function in relation to the levels of labor demand and real gross profit, under the wealth distribution constraint (program 7). In fact, for a given real wage level (w/p), employers aim for a high real gross profit level while minimizing, as far as possible, the total cost of labor; while employees aim for a high level of employment which would in particular avoid layoffs and, at best, reduce the workload per person. Their interests being conflicting and interdependent, the stakeholders have to negotiation to determine the level of employment and, thus, the level of real gross profit.

$$\begin{cases} \underset{\pi,\, L}{Max}\, U(\pi, L, w/p) \\ u/c \quad \pi + (w/p)L - F(K, L) \leq 0 \end{cases} \tag{7}$$

The maximization of the compromise program (7) gives the results of the system (8) below. Thus, given the imperfection of information, asymmetric information, the stakeholders' respective bargaining powers, labor legislation, contracts between the stakeholders and social relationships, the optimal compromise (L*; π*) in the labor market is solution of the system of equations (8).

$$\begin{cases} \dfrac{\partial F}{\partial L} + MRS_{L\pi} = w/p \\ \\ \pi + (w/p)L = F(K, L) \end{cases} \qquad (8)$$

The first equation of the system (8) gives the conventional curve of labor demand (CCLD), while the second equation expresses the technical curve of labor demand (TCLD). The optimal compromise (L*; π*) represents the intersection of these two curves. That is to say the optimal compromise situation in the labor market is acceptable both technically and conventionally. Under the assumptions of the convexity of the compromise possibilities set and the concavity of the production function, the optimal compromise situation exists and is unique. Also, the labor demand is increasing with the real gross profit. Furthermore, econometric tests carried out on OECD countries confirm that the labor demand increases with gross profit (Zerbo 2018a).

In the first equation of system (8), the marginal rate of substitution of labor demand for real gross profit ($MRS_{L\pi}$) represents, on the one hand, the marginal transaction costs of the labor demand borne by the employer due to imperfections in the labor market. On the other hand, the $MRS_{L\pi}$ reflects the labor market flexibility. The more the labor flexibility increases, the more the $MRS_{L\pi}$ tends towards 0 and, thus, the system of equations (8) tends towards the neoclassical optimum conditions (profit maximization) and the labor demand becomes less sensitive to changes in real gross profit. Conversely, the more rigid or imperfect the labor market becomes, the more the $MRS_{L\pi}$ increases and, as a result, companies' labor demand becomes more sensitive to changes in real gross profit.

Solving the system of equations (8) gives the level of optimal compromise employment (L*) as a function of real gross profit (π*) in the short run (relation 9) and as a function of real wages and the capital stock in the medium and long term (relation 10).

$$L^* = L(\pi^*) \qquad (9)$$

$$L^* = L(w/p\,;K) \qquad (10)$$

Real gross profit is therefore the determining factor of employment in short-run. Under the assumption of the convexity of the compromise possibilities set and the concavity of the production technology, it is shown that the level of employment increases with real gross profit.

3. *Corporate capital compromise process* [1]

To invest, the company can use equity or loans. Thus, the corporate investment decision involves three types of economic players: the managers' team, the shareholders, the lenders. This decision is the result of a compromise between these three economic players concerning the distribution of the income generated by the investment project (retained earnings (net profit), dividends and interests) and the investment amounts by funding source.

In the capital compromise process, (i) the managers' team expects a high retained earnings (net profit) in order to allow the company to get a high financial capacity, (ii) the shareholders expect more return on their shares and (iii) the lenders wish to benefit from high interest rates and substantial collaterals from the managers' team in relation to their commitments.

[1] This presentation is a synthesis of Zerbo, A. & Hien, L. (2020). For a more detailed presentation of the capital process, refer Zerbo. A and Hien, L. (2020).

So, the companies have an implicit compromise function, called "capital compromise function", whom arguments are: the expected retained earnings (G), the net return rate expected by the shareholders (r_{nE}), the net interest rate required by lenders (r_{nD}), the equity-financed investment (I_E), the debt-financed investment (I_D), the collaterals required by lenders (B). Noted V, the capital compromise function is given by the relation (11).

$$V = V(G\,;r_{nE}\,;I_E\,;r_{nD}\,;I_D\,;B) \qquad (11)$$

Thus, this capital compromise function takes into account (i) the objectives of the managers' team, namely the investment amount ($I_E + I_D$) and expected retained earnings (G), (ii) those of the lenders which consist in granting to the company a credit characterized by a net interest rate r_{nD}, an amount I_D and collaterals B, as well as (iii) the objective of the company shareholders which consists in placing funds I_E at a net return rate r_{nE}. Note that, on the one hand, net interest rate (r_{nD}) is equal to tax rate on interests (t_D) multiplied by debit interest rate (r_D), on the other hand, net return rate (r_{nE}) is equal to tax rate on dividends (t_E) multiplied by equity return rate (r_E).

For the managers' team, the objective is to increase the production capacity (the capital stock) in order to generate some high retained earnings which gives more possibilities for internal funding of investment in the future. Let δ be the yearly depreciation rate of the capital stock, τ be the income tax rate and $\boldsymbol{\alpha}_0$ be the share of debt in the capital stock K_0 at initial time. The expression of the retained earnings is given by the relation (12). The relation (13) recalls the expression of gross profit which intervenes in the expression of the retained earnings. The relation (14) indicates that the capital stock is equal to the initial stock added to the total of investment.

$$G(I_E, I_D) = (1-\tau)\left[\pi(K_0 + I_D + I_E) - r_D(\alpha_0 K_0 + I_D) - (K_0 + I_D + I_E)\delta\right] - r_E((1-\alpha_0)K_0 + I_E) \qquad (12)$$

$$\pi(K) = F(K, L) - (w/p)L \qquad (13)$$

$$K = K_0 + I_D + I_E \qquad (14)$$

As for lenders, they have a funding supply function according to the project category (relation 15). The arguments of this funding supply function are, among other things, the net interest rate and the amount of collaterals. The more the managers' team is able to provide the necessary collaterals and/or to pay lenders at a high interest rate, the more willing lenders are to finance their projects.

$$S_D = \varphi(r_{nD}; B\ ) \qquad (15)$$

The amount of collaterals supplied by the managers' team to lenders depends on the amount of the investment credit (relation 16). The supply of collaterals increases with the amount of loan, namely the debt-financed investment I_D.

$$S_{Col} = B(I_D) \qquad (16)$$

As regards shareholders, their funding supply depends on the net return that they can expect from the investment (relation 17). Thus, the higher the net return rate, the more willing the shareholders are ready to provide funds for the investment project.

$$S_E = \psi(r_{nE}) \qquad (17)$$

So, the negotiation process leading to a compromise between the three economic players (managers, lenders, shareholders) about the investment project consists in optimizing the capital compromise function (relation 11) under the following constraints:

(i) the retained earnings expected by managers' team is lower than or equal to the retained earnings generated by the company;

(ii) the quantity of debt-funded investment is less than or equal to the loan supply;

(iii) the quantity of equity-funded investment is less than or equal to the equity supply;

(iv) the amount of collaterals obtained by lenders is less than or equal to the companies' collaterals supply.

Thus, the capital compromise program for one period is given by the relation (18). To understand the corporate investment behavior, the compromise function optimization is done from the corporate perspective (managers' team perspective). That is to say this optimization is done with respect to the variables that define the actual amounts of earnings, assets or expenses for company, namely G, r_E, I_E, r_D, I_D, B.

$$\begin{cases} \underset{G, r_E, I_E, r_D, I_D, B}{Max} \quad V(G\,; r_{nE}\,; I_E\,; r_{nD}\,; I_D; B) \\ u/c \\ \quad G \leq (1-\tau)\left[\pi(K_0+I)-(\alpha_0 K_0+I_D)r_D-(K_0+I)\delta\right]-((1-\alpha_0)K_0+I_E)r_E \\ \quad I_D \leq \varphi(r_{nD}; B) \\ \quad I_E \leq \psi(r_{nE}) \\ \quad B \leq B(I_D) \end{cases} \tag{18}$$

Solving this optimization program highlights the general expressions of marginal transaction costs and marginal opportunity cost of funding constraints in the capital markets.

In the equity market, the marginal transaction costs of equity-funded investment (MTCEFI) are equal to the marginal rate of substitution of equity investment for net profit ($MRS_{I_E G}$) divided by (1 -τ), as shown in relation (19). Under the assumption of convexity of the compromise possibilities set, the transaction costs of the equity-funded investment decrease with the amount of the investment and increase with net profit. Also, as shown in relation (19), they are increasing with the income tax rate.

$$MTCFE = \frac{1}{1-\tau} MRS_{I_E G} \tag{19}$$

The marginal opportunity cost of funding constraints in equity market (MOCFCE) is given by relation (20). It increases with the total equity of companies (K_E), with the income tax rate (τ). It decreases with the elasticity of the equity supply with respect to its return rate, as well as with the marginal rate of substitution of net return rate for net profit ($MRS_{r_{nE} G}$), which measures the willingness of the managers' team to pay a high return rate to the shareholders.

$$MOCFCE = \frac{K_E - (1-t_E) MRS_{r_{nE} G}}{(1-\tau)(1-t_E)\dfrac{\partial \psi}{\partial r_{nE}}} \tag{20}$$

With regard to the loan market, the expression of the marginal transaction costs of the investment is given by the relation (21). It consists of two types of marginal transaction costs: the marginal transaction costs of the investing act from a loan (without collaterals) and the marginal transaction costs attributable to the collaterals mobilization.

The marginal transaction costs of debt-funded investment (MTCDFI) decrease with the amount of the investment and the amount of collaterals. They increase with the income tax rate (τ) and the response of the collaterals supply to changes in loan amount ($\partial B/\partial I_D$).

$$MTCFD = \frac{1}{1-\tau}\left(MRS_{I_D G} + \frac{\partial B}{\partial I_D} MRS_{BG} \right) \qquad (21)$$

As for the marginal opportunity cost of funding constraints in the loan market (relation 22), it increases with the company total debt in capital stock (K_D), the interest tax rate (t_D) and the response of the loan supply to changes in the net interest rate ($\partial \varphi / r_{nD}$). It decreases with the efficiency of collaterals system, namely ($\partial \varphi/\partial B$)×($\partial B/\partial I_D$), with the income tax rate and with the willingness of the managers' team to pay a high interest rate, namely the marginal rate of substitution of net interest rate for net profit ($MRS_{r_{nD}G}$)

$$MOCFCD = \left(1 - \frac{\partial \varphi}{\partial B}\frac{\partial B}{\partial I}\right) \frac{\left(K_D - \frac{1-t_D}{1-\tau} MRS_{r_{nD}G}\right)}{(1-t_D)\frac{\partial \varphi}{\partial r_{nD}}} \qquad (22)$$

The first-order conditions of the compromise program (18) are presented by the system of equations (23). The first equation of this system relates to the equity market, while the second equation relates to the loan market. The other equations express the saturation of the constraints of the compromise program.

$$\begin{cases} \frac{\partial \pi}{\partial K} + MTCFE = (\delta + \frac{r_E}{1-\tau}) + MOCFCE \\ \frac{\partial \pi}{\partial K} + MTCFD = (\delta + r_D) + MOCFCD \\ G = (1-\tau)[\pi(K) - K_D r_D - \delta K] - K_E r_E \\ I_D = \varphi(r_{nD}; B) \\ I_E = \psi(r_{nE}) \\ B = B(I_D) \end{cases} \qquad (23)$$

Each of the two first equations states that the optimal amount of investment financed through a given capital market is such as the capital marginal profitability plus the marginal transaction costs of investment is equal to the sum of the capital user cost and the marginal opportunity cost of funding constraints in the said market.

From the first-order conditions (system 23), two theorems relating respectively to the corporate optimal investment strategy and to the relationship between investment and interest rate were stated and demonstrated (Zerbo, A. and Léon, H. 2019, 2020).

Regarding the theorem of optimal investment strategy, it is applicable under two types of hypotheses. The first hypothesis considers that the compromise possibilities set is convex; that is to say that the economic players negotiate with the aim of bringing their positions together. The second category of assumptions relates to the concavity and increasing of the company gross profit function, the funding supply functions and the collaterals supply function, with respectively the capital stock, the interest rates and the investment credit. In other words, it is considered that each of these functions is increasing with its respective argument, but with a decelerated rate of increase.

The theorem stipulates, on the one hand that, under the above-mentioned conditions, the optimal investment strategy $(I_E^* \ ; \ I_D^*)$ is such as the total marginal costs of funding minus the marginal transaction costs in the equity market on the one hand, and in the loan market on the other hand, are equal. That is to say that the optimal investment strategy $(I_E^* \ ; \ I_D^*)$ is such as the relation (24) is verified.[2]

$$\left[\frac{r_E}{(1-\tau)} + MOCFCE - MTCFE\right] = \left[r_D + MOCFCD - MTCFD\right] \tag{24}$$

On the other hand, the theorem shows that at the optimum $(I_E^* \ ; \ I_D^*)$, the marginal preference for equity over loans (measured by the $MRS_{I_D I_E}$) is equal to one (1) plus the ratio of (i) the difference between the total marginal costs of funding minus the marginal transaction costs of possible collaterals (or marginal net financing costs) on the two capital markets compared to (ii) the marginal transaction costs of the equity-funded investment. That is to say the company marginal preference for equity over loans is given by the relation (25), where the term MTCBD designates the marginal transaction costs of collaterals in loan market.

$$MRS_{I_D I_E} = 1 + \frac{\left[r_D + MOCFCD - MTCBD\right] - \left[\frac{r_E}{(1-\tau)} + MOCFCE\right]}{MTCFE} \tag{25}$$

One of the consequences of this theorem is that the funding structure influences the optimal investment strategy when the capital markets are hetero-expensive (very common case). As a reminder, capital markets are said to be hetero-expensive if their net marginal costs of funding are not equal for at least one investment strategy $(I_E \ ; \ I_D)$.[3] The optimal investment strategy is independent of the funding structure if the capital markets are iso-expensive (very exceptional case), that is to say if the net marginal costs of funding in the two markets are equal for all investment strategies $(I_E \ ; \ I_D)$.

The Modigliani-Miler theorem (1958) on the structure of corporate finance is a corollary of this first theorem. Indeed, note that when the capital markets are perfect and without taxes (unrealistic hypotheses), the transaction costs and the opportunity costs of funding constraints are equal to zero, moreover their interest rates are equal. Then, their net marginal costs of funding are equal and, therefore, they are iso-expensive and, thus, according to the theorem, the optimal investment strategy is independent of the funding structure. So, as Modigliani-Miller (1958) stated, if markets are perfect and free of taxes, then corporate investment policy is independent of their financing structure.

The second theorem on the relationship between investment and interest rate states that under the same assumptions as the first theorem, investment is not a monotonous function of interest rate. The relationship between investment and interest rate can be negative or positive depending on the level of the capital profitability. As a reminder, empirical evidence has highlighted a positive relationship

[2] To obtain this result, you can also take the difference between the two first equations of the system (23) and make the necessary groupings.

[3] Note that if the net marginal costs of funding are equal for all investment strategies, then the numerator of the second term of relation (25) would be zero and, thus, the preference for equity over loanable funds would be therefore equal to 1. So, the preference is identical for the two sources of funding. Thus, in this case, the financing structure does not influence the optimal investment strategy. Conversely, if this numerator is different to zero, the preference for equity over loanable funds would be greater than or less than 1; which means that the optimal investment strategy favors one source of funding over the other.

between interest rate and investment (Naboulet A. and Raspiller S. 2006; Sharpe S. A. and Suarez G. A. 2014). Also, for Greenwald, Stiglitz and Weiss (1984), imperfections of information in capital market can lead to credit rationing, so that the level of credit supply, not its cost, determines the demand for investment.

3. A specification of the General Theory of the Firm

On the one hand, this section aims to specify the behavioral functions of stakeholders in the labor market and in the capital markets. On the other hand, it involves applying the general results of the General Theory of the Firm presented in the previous section to calculate and analyze (i) the marginal transaction costs and (ii) the marginal opportunity costs of funding constraints.

1. *The behavioral functions of the General Theory of the Firm*

The General Theory of the Firm considers that companies have (i) a production function which depends on the capital and labor, (ii) a compromise function leading the stakeholders, which can be distinguished into a labor compromise function and a capital compromise function. In addition, they have a collaterals supply function which is increasing with the demand for loan. In accordance with the purpose of this article, these business behavior functions are specified here in the form of Cobb-Douglas.

Thus, the production technology of companies is given by the relation (26) where the power coefficients *a* and *b* are positive (elasticity coefficients) and less than 1. Thus, the production technology is increasing and concave with each input. For given levels of inputs K and L, production technology allows to calculate the level of the output, namely the added value (Y) that companies can generate.

$$F(K,L) = qK^a L^b \quad (26)$$

The compromise function of the labor market (primary compromise) is given by the relation (27) where α_1, α_2, α_3 are positive parameters whose sum is equal to 1. Thus, the compromise function is increasing and concave with each argument, that is to say the compromise possibilities set is convex.

$$U(\pi; w/p; L) = \pi^{\alpha_1} (w/p)^{\alpha_2} L^{\alpha_3} \quad (27)$$

The capital compromise function is given by the relation (28) where θ_1, θ_2, θ_3, θ_4, θ_5 and θ_6 are positive parameters whose sum is equal to 1. Thus, the capital compromise function is increasing and concave with each argument; in other words, the compromise possibilities set in the capital markets is convex.

$$V(G; r_{nD}; I_D; B; I_F; r_{nF}) = G^{\theta_1} r_{nD}^{\theta_2} I_D^{\theta_3} B^{\theta_4} I_F^{\theta_5} r_{nF}^{\theta_6} \quad (28)$$

In these compromise functions, the coefficients α_i and θ_i measure the degree of "collective preference" for the concerned variable compared to the others. These coefficients depend in particular on the bargaining power of stakeholders, the institutional and legal framework of the markets and the economic and social environment.

In the compromise function of the labor market (relation 27), for example the coefficient α_1 measures the degree of "collective preference" for the real gross profit compared to the real wages and employment, taking into account the respective bargaining powers and the institutional, legal and social framework. The higher the employers' bargaining power and/or the more the labor law is favorable to employers, the higher the coefficient α_1 compared to α_2 and α_3 which measures respectively the degree of "collective preference" of the real wages and of the employment. Conversely, the higher the wage bargaining power of employees (insiders) and/or the more the labor law is favorable to wage compared to profit and employment, the higher the coefficient α_2 compared to α_1 and α_3.

Likewise, in the capital compromise function (relation 28), for example the coefficient θ_2 reflects the degree of "collective preference" for the interest rate in the loan market. The higher the lenders' bargaining power and/or the more the loan market regulation is favorable to lenders, the higher the coefficient θ_2 compared in particular to θ_1 and θ_6 which measure respectively the degree of "collective preference" for the retained earnings and for dividends distribution. As another example, the more expensive the investment procedures and/or the more restrictive the Investment Code, the higher the coefficients θ_3 and θ_5. Also, the more complex and expensive the procedures for pledging collateral to borrow, the higher the coefficient θ_4. Finally, for instance, the higher the illegal levies on corporate profits (bribes), the lower the coefficient θ_1.

Regarding the collaterals supply function of companies, it depends on the amount of the investment credit I_D as shown in relation (29) where B_0 is a positive constant and the coefficient σ is positive and less than 1. Thus, the collaterals supply function of companies in the loan market is increasing and concave.

$$B(I_D) = B_0 I_D^{\sigma} \tag{29}$$

In addition to these corporate behavior functions, the General Theory of the Firm considers that lenders and shareholders have funding supply functions. The supply of loanable funds depends on the net interest rate and the amount of collaterals. Thus, the loan supply function is given by the relation (30) where φ_0 is a positive constant, a_1 and a_2 are positive coefficients less than 1.

$$\varphi(r_{nD}; B) = \varphi_0 \, r_{nD}^{a_1} B^{a_2} \tag{30}$$

Regarding the equity supply function, it depends on the net return rate expected by the shareholders as shown by relation (31) where ψ_0 is a positive constant and the coefficient a_3 is positive and less than 1.

$$\psi(r_{nF}) = \psi_0 \, r_{nF}^{a_3} \tag{31}$$

Based on this specification, the following two subsections successively examine the marginal transaction costs of labor demand and investment demand, and the marginal opportunity costs of funding constraints in the capital markets.

2. *Marginal transaction costs in labor and capital markets*

In the General Theory of the Firm, three types of transaction costs are highlighted. These are the transaction costs of labor demand, the transaction costs of debt-funded investment and the transaction costs of equity-funded investment demand.

a. Labor demand marginal transaction costs

According to the General Theory of the Firm, the marginal transaction costs of labor demand (MTCL) are measured by the marginal rate of substitution of labor demand for gross profit ($MRS_{L\pi}$). This marginal rate of substitution is equal to the ratio between the marginal compromise of labor demand ($\partial U/\partial L$) compared to the marginal compromise of gross profit ($\partial U/\partial \pi$). Thus, taking into account the above specification of the labor market compromise function, the marginal transaction costs of labor demand are equal to the ratio of the gross profit compared to the labor demand multiplied by the ratio of the labor coefficient (α_3) compared to the coefficient of gross profit (α_1), as expressed by the relation (32).

$$MTCL = \frac{\alpha_3}{\alpha_1}\frac{\pi}{L} \tag{32}$$

Thus, the marginal transaction costs of labor demand are decreasing with the level of labor demand, but they are increasing with the expected gross profit. Also, the marginal transaction costs of labor demand are increasing with employment security, measured here by α_3/α_1 and, thus, they are decreasing with the labor flexibility, namely α_1/α_3. Thus, the more the labor institutions protect employment and the unions are "powerful", the higher the ratio α_3/α_1 and, therefore, the higher the marginal transaction costs of labor demand for a given average profitability of labor (π/L).

b. *Marginal transaction costs of the debt-funded investment demand*

The general expression of the marginal transaction costs of the debt-funded investment demand (MTCDFI) is given by the relation (21). These marginal transaction costs are equal to the sum of two types of transaction costs: the transaction costs of the funds raising to invest and the transaction costs of the necessary collaterals to access to loanable funds. Thus, by applying the relation (21) on the basis of the specified functions, the marginal transaction costs of the debt-funded investment demand are given by the relation (33).

$$MTCDFI = \frac{1}{1-\tau}\left(\frac{\theta_3 + \sigma\theta_4}{\theta_1}\right)\frac{G}{I_D} \qquad (33)$$

From this expression, it appears that the marginal transaction costs of debt-funded investment decrease with the amount of investment I_D and with θ_1 namely the coefficient preference for retained earnings. They are increasing with the expected retained earnings, with the income tax rate, as well as with the sum of the preference coefficient relating to the debt-funded investment and the preference coefficient relating to collaterals weighted by the elasticity coefficient of the corporate collaterals supply.

In relation (33), the ratio $(\theta_3 + \sigma\theta_4)/\theta_1$ reflects the complexity to complete the procedures of investing act via loan market (apart from funding constraints). The more the Investment Code is constraining for investors (θ_3 high) and/or the investing procedures are complex and expensive (θ_3 high) and/or the pledging collateral procedures are complex and expensive ((θ_4 high) and/or the illegal deductions from profits (bribes) are high (θ_1 low), the higher the ratio $(\theta_3 + \sigma\theta_4)/\theta_1$ will be, and thus, the higher the transaction costs of debt-funded investment.

c. *Marginal transaction costs of equity-funded investment demand*

With regard to the marginal transaction costs of equity-funded investment (MTCEFI), its general expression is given by the relation (19). Applying this general expression to the behavior functions specified above, the marginal transaction costs of the equity-financed investment are given by the relation (34) below.

$$MTCFE = \frac{1}{1-\tau}\left(\frac{\theta_5}{\theta_1}\right)\frac{G}{I_E} \qquad (34)$$

These marginal transaction costs are decreasing with the amount of equity-financed investment and the coefficient θ_1; they are increasing with the income tax rate, the coefficient θ_5 and the expected retained earnings.

Also, in this expression (34), the ratio θ_5/θ_1 measures the complexity to invest from equity (apart from the constraints of mobilizing this equity). Thus, the more restrictive the Investment Code in terms of investing from equity and/or the procedures of investing form equity are complex and expensive and/or the bribe are high, the higher the ratio θ_5/θ_1 and, thus, the higher the transaction costs of equity-funded investment.

3. *Marginal opportunity costs of funding constraints in the capital markets*

The General Theory of the Firm distinguishes (i) the marginal opportunity cost of funding constraints in the equity market and (ii) the marginal opportunity cost of funding constraints in the loan market.

a. *Marginal opportunity cost of equity funding constraints*

Concerning the marginal opportunity cost of funding constraints in the equity market (MOCFCE), its general expression is given by the relation (20). Applying this general expression with the functions specified above, the marginal opportunity cost of equity funding constraints is given by expression (35) below.

$$MOCFCE = \frac{r_E K_E - \left(\frac{\theta_6}{\theta_1}\right) G}{(1-\tau) a_3 \psi} \tag{35}$$

According to this relation (35), the marginal opportunity cost of equity funding constraints is equal to the ratio (i) of the difference between the total amount of expected dividends ($r_E \times K_E$) and the willingness of managers' team to pay dividends ((θ_6/θ_1)×G) compared to (ii) the equity supply multiplied by its elasticity coefficient (a_3) and by (1-τ).

Thus, the greater the difference between the total amount of expected dividends and the willingness of the managers' team to pay dividends, the greater the equity funding constraints and the higher their opportunity cost. Also, the higher the income tax rate, the higher the opportunity cost of equity funding constraints. Conversely, the higher the equity supply, the lower the equity funding constraints and the lower their opportunity cost.

b. *Marginal opportunity cost of funding constraints in loan market*

Regarding the marginal opportunity cost of funding constraints in the loan market (MOCFCD), its general expression is given by the relation (22). Applying the specified functions to this general expression, the marginal opportunity cost of funding constraints in loan market is given by expression (36) below.

$$MOCFCD = (1-\sigma a_2) \frac{r_D K_D - \left(\frac{\theta_2}{\theta_1}\right) G}{(1-\tau) a_1 \varphi} \tag{36}$$

According to this relation (36), the marginal opportunity cost of funding constraints in loan market is equal to the product between, on the one hand, 1 minus the efficiency of collaterals system (1– σa2) and, on the other hand, the ratio (i) of the difference between the total amount of expected interest ($r_D \times K_D$) by the lenders and the willingness of managers' team to pay interest ((θ_2/θ_1)×G) compared to (ii) the loan supply multiplied by its elasticity coefficient (a_1) and by (1-τ).

Thus, the more efficient the collaterals system (σa_2 is high), the lower the funding constraints in loan market and the lower their opportunity cost. Also, the greater the difference between the total amount of expected interest and the willingness of the managers' team to pay interest, the greater the funding constraints in loan market and the higher their opportunity cost. Also, the higher the income tax rate, the higher the opportunity cost of funding constraints in loan market. Conversely, the higher the loan supply, the lower the funding constraints in loan market and the lower their opportunity cost.

4. Labor market equilibrium: real wage and labor demand

According to the General Theory of the Firm, there are two of negotiation stages in the labor market: wage negotiation and negotiation relating to employment level.

1. *Salary negotiation and wage rigidity*

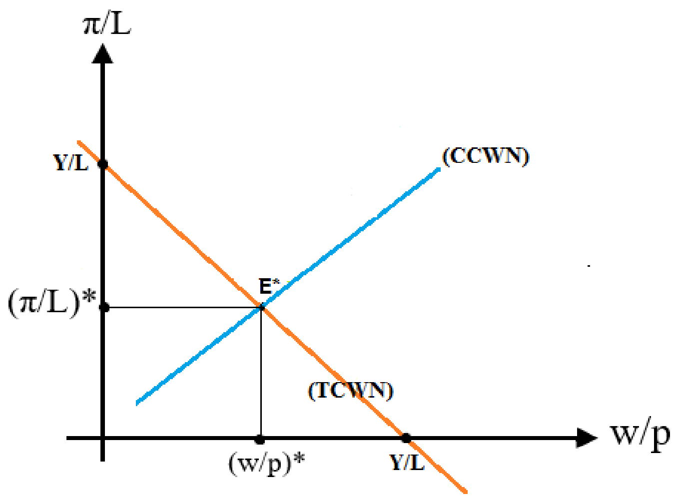
a. Determining of the real wage level

With reference to the results of the General Theory of the Firm, the situation of wage compromise is determined by the system of equation (5), namely the first-order conditions of the wage negotiation program. Applying the specified behavior functions to the system (5) gives the system of equations (37) below, where Y denotes the total output or total added value.

$$\begin{cases} \frac{\pi}{L} = \frac{\alpha_1}{\alpha_2}(w/p) & (CCWN) \\ \frac{\pi}{L} = \frac{Y}{L} - (w/p) & (TCWN) \end{cases} \qquad (37)$$

These first-order conditions of wage negotiation process give two equations corresponding to two curves: the conventional curve of wage negotiation (CCWN) and the technical curve of wage negotiation (TCWN). Thus, the real wage of compromise corresponds to the intersection of these two curves in the plane (w/p; π/L), as shown in graph 1 below.

Graph 1: Determining of real wage



Source: This Paper

On this graph 1, point E*, the intersection of the conventional curve and the technical curve of salary negotiation, corresponds to the salary compromise point (E*). At this point, the real wage level is equal to (w/p)* and the average profitability of labor is equal to (π/L)*.

Solving the system of equations (37) gives the expressions of the real compromise wage level and the average profitability of labor given respectively by relations (38) and (39).

$$(w/p)^* = \frac{\alpha_2}{\alpha_1 + \alpha_2}\frac{Y}{L} \qquad (38)$$

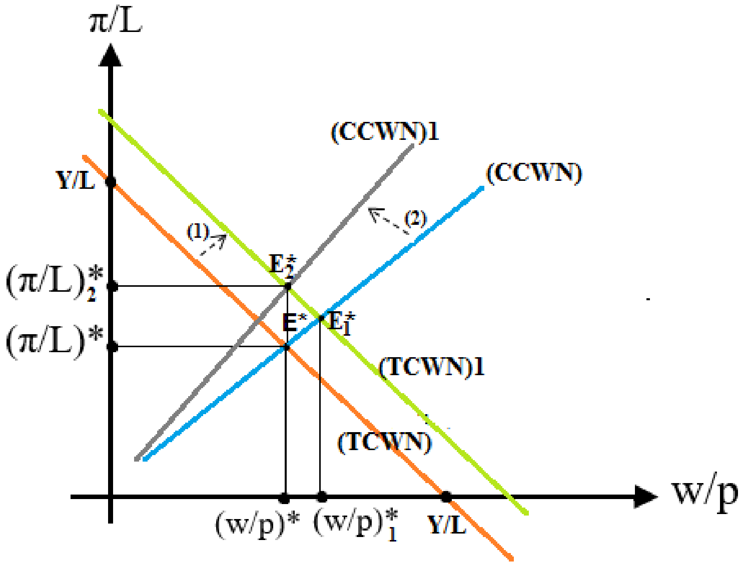
$$(\pi / L)^* = \frac{\alpha_1}{\alpha_1 + \alpha_2} \frac{Y}{L} \qquad (39)$$

According to relation (38), the real compromise wage is increasing with the average labor productivity and the coefficient α_2 which measures, in particular, the wage bargaining power of employees, the information level of employees and the state of the legislative and regulatory about salaries.

b. *Wage rigidity in the short run*

On the basis of the previous results, the real compromise wage depends on the average labor productivity and on the coefficients of the compromise function. However, the average labor productivity and the coefficients of the compromise function do not vary in the short run. This partly explains the rigidity of the average wage in the short run.

Graph 2: Wage rigidity in the short run



Source: This Paper

Furthermore, even if labor productivity increases, its effect is not immediate on wages. Indeed, as illustrated in the graph 2, an increase in labor productivity shifts the technical curve of wage negotiation upwards, for instance, from the curve (TCWN) to the curve (TCWN)1 as shown in the graph 2. At this level of labor productivity, if the conventional curve of wage negotiation does not shift, the new wage compromise point would be at point E_1* which corresponds to a higher level of real wage $(w/p)_1$*. However, because (i) of the asymmetric information between employer and employees about labor productivity, (ii) of the non-indexing of real wage to the average labor productivity and (iii) of the long delays and procedures necessary to effect changes in the salaries, an increase in labor productivity does not systematically lead to an increase in wage level. Thus, the increase in labor productivity will be in favor of employers until new wage negotiations are started for a possibly increase in wage. Thus, before these wage negotiations, the conventional curve of wage negotiations pivots anticlockwise (around origin point of the graph)[4] so that the new wage compromise point is established at a point E_2*, where the real wage remains unchanged while the average profitability of labor $(\pi/L)_2$* becomes higher.

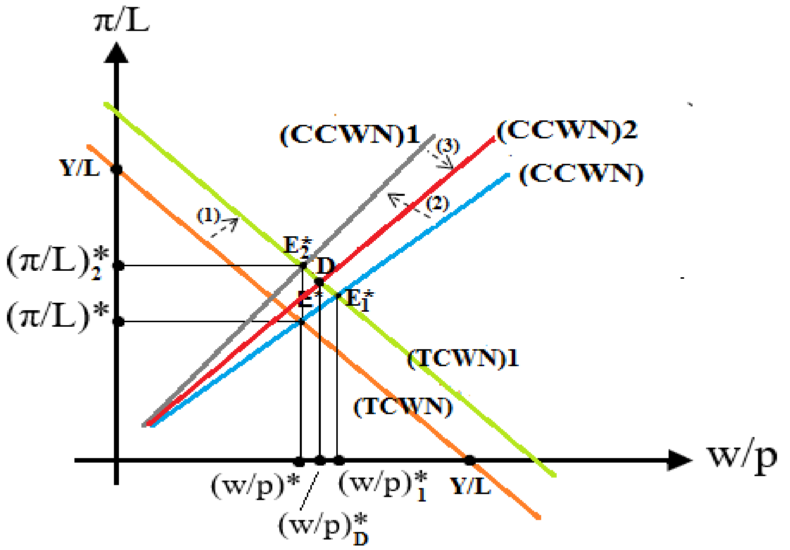
Such a change in the distribution of income generated by companies could lead to wage negotiations (more or less long) between employees and employers. On the one hand, these wage negotiations can be fruitful or unsuccessful for employees, depending on the bargaining power balance and/or the willingness of employers to accede to their grievances. On the other hand, when these wage negotiations

[4] Given its equation, the conventional curve of wage negotiation always passes though the origin point of the plan (w/p ; π/L).

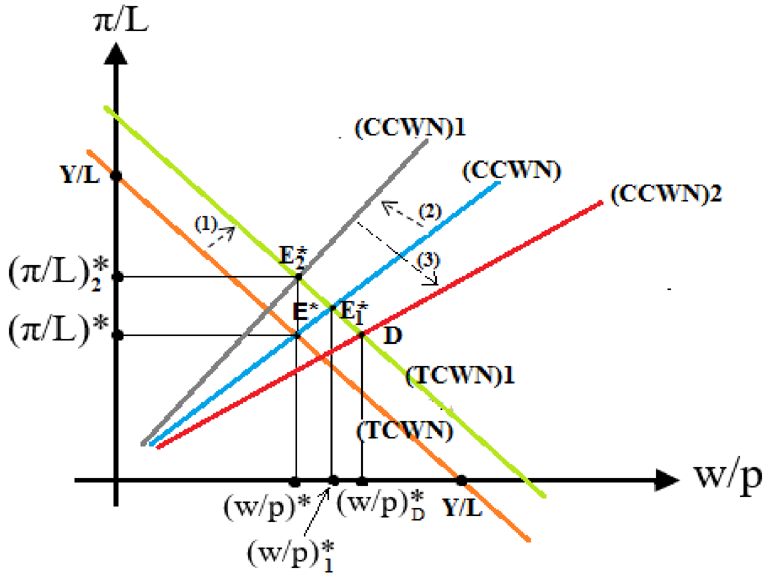
result in a wage increase, they may be relatively less successful or relatively more successful compared to the original structure of income distribution.

Graph 3: Effect of a successful wage negotiation following an increase in labor productivity

Graph 3a: Less successful wage negotiations



Graph 3b: More successful wage negotiations



Source: This Paper

When the negotiations result in wage increase, the conventional curve of wage negotiation (CCWN) pivots clockwise, from the curve (CCWN)1 to the curve (CCWN)2 as illustrated in the graphs 3. The swivel angle can be greater or less depending on whether the results of wage negotiations are more or less successful for employees. Thus, the conventional curve can pivot to maintain itself above or below the original curve (CCWN).

The graph 3a illustrates a case where the conventional curve of wage negotiation pivots and remains above the original curve. This means that the negotiations have been relatively less fruitful for the employees. In fact, when wage negotiations lead to an income distribution structure less favorable to employees compared to the distribution structure before the increase in labor productivity, the conventional curve of wage negotiations pivots clockwise but remains above the initial curve. In graph 3a, the conventional curve pivots from (CCWN)1 to (CCWN)2; thus, the new compromise point corresponds to the point D having the abscissa $(w/p)_D$* which is lower than the wage level in E_1*, namely

$(w/p)_1$*. So, the new income distribution structure established after the wage negotiations remain a priori more favorable to employers.

Conversely, graph 3b illustrates a case where the conventional curve of wage negotiations pivots clockwise to stay below the initial curve. This means that the negotiations have been relatively more successful to employees. In fact, when wage negotiations result in an income distribution structure more favorable to employees compared to the distribution structure before the increase in labor productivity, the conventional curve of wage negotiation pivots to position itself below the initial curve. On graph 3b, the conventional curve pivots from (CCWN)1 to (CCWN)2; thus, the new compromise point corresponds to the point D, giving wage level equal to $(w/p)_D$* which is higher than the wage level in E_1*, namely $(w/p)_1$*. So the new income distribution structure established after wage negotiations remains a priori more favorable to employees.

2. *Labor market equilibrium, labor demand and real gross profit*

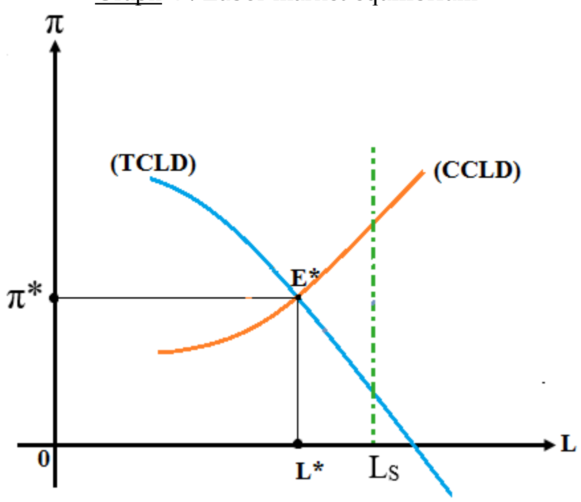
a. *Labor market equilibrium*

In the General Theory of the Firm, the labor market equilibrium results from the compromise between the stakeholders. Thus, this equilibrium is determined by the general expression of first-order conditions given by the relation (8). Applying these first-order conditions to the behavior functions specified above shows that labor market equilibrium is characterized by the system of equation (40) below.

$$\begin{cases} \pi = -\dfrac{\alpha_1}{\alpha_3}\left(bqK^aL^b - (w/p)L\right) & (CCLD) \\ \pi = qK^aL^b - (w/p)L & (TCLD) \end{cases} \qquad (40)$$

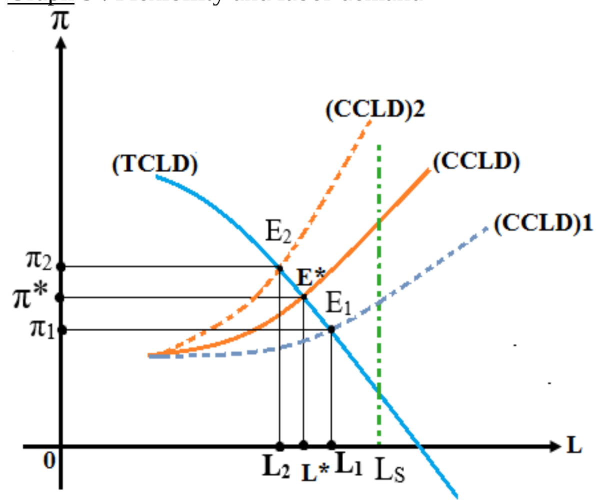
The first equation of the system (40) gives the expression of the conventional curve of labor demand (CCLD) and the second equation corresponds to the expression of the technical curve labor demand (TCLD). The conventional curve of labor demand is increasing in the plane (L; π) while the technical curve is decreasing in this plane (near the compromise point of labor demand). The equilibrium point in the labor market corresponds to the intersection of these two curves as shown in graph 4.

Graph 4 : Labor market equilibrium



Source : This Paper

Graph 5 : Flexibility and labor demand



Source : This Paper

In graph 4, the equilibrium point is represented by point E* with a level of labor demand equal to L* and a level of real gross profit equal to π*. As the labor supply (L_S) does not depend on real gross profit, it is represented by the vertical dotted line in graph 4. It can therefore be greater (common case as illustrated by graph 4) or lower (rare case) than the level of the labor demand at equilibrium L*. If the labor demand is lower than the labor supply, the unemployment is equal to $L_S - L^*$.

The slope of the conventional curve of labor demand (CCLD) in the plane (L; π), given by the derivative of the conventional curve equation with respect to labor demand, reflects the degree of labor flexibility. The steeper the slope, the more flexible the labor.

$$\frac{\partial \pi}{\partial L} = (\alpha_1 / \alpha_3)\left(w / p - b^2 Y / L\right) \qquad (41)$$

The relation (41) shows that the degree of labor flexibility depends on the ratio α_1/α_3, on the real wage (w/p), on the technical coefficient of labor (b) and on the average labor productivity (Y/L) which are likely to vary only in the medium and long run. Thus, because the institutional changes in the labor market are slow, the real wages are rigid in the short run, and the average labor productivity do not vary in the short run, the degree of labor flexibility remains generally stable in the short run; it changes in the medium and long run.

As illustrated in graph 5, the degree of labor flexibility affects the level of labor demand. Indeed, when the labor flexibility decreases (i.e. the slope of CCLD decreases), the conventional curve of labor demand pivots clockwise. For instance, it shifts from the curve (CCLD) to the curve (CCLD)1; the equilibrium point now corresponds to point E_1 with a level of employment L_1 greater than L* and a real gross profit π_1 less than π*. So, a decrease in labor flexibility or a strengthening of employment security is favorable to employment, but unfavorable to profit.

Conversely, when the labor flexibility increases, the conventional curve of labor demand pivots anticlockwise (to the left). It shifts, for instance, from the curve (CCLD) to the curve (CCLD)2; the equilibrium point now corresponds to point E_2 with a level of employment L_2 which is lower than L* and a real gross profit π_2 which is higher than π*. So an increase in labor flexibility or a decrease in employment security is unfavorable to employment, but favorable to profit.

Ultimately, if labor flexibility is favorable for profit (pro-employer), employment security is favorable for employment (pro-worker). This justifies the idea of promoting flexisecurity in the labor market to boost both wealth and employment. However, as shown in relation (41), actions in favor of flexisecurity can only have significant results in the medium and long run.

b. Labor demand at equilibrium

Solving the system of equations (40) gives the expression of the labor demand at equilibrium given by the relation (42). According to this relation, the labor demand is a function of the real gross profit which varies in the short run and of the real wage which varies only in the medium and long run. So, corporate labor demand increases with real gross profit in the short run. It also increases with the technical coefficient of labor and with employment security measured by the ratio α_3/α_1. However, it decreases with real wages in the medium and long run.

$$L^* = \frac{\left(b + (\alpha_3 / \alpha_1)\right)\pi}{(1-b)\,(w/p)} \qquad (42)$$

Through this relation (42), it can be seen that any increase in real wages does not lead to a decrease in the labor demand or any decrease in wages does not lead to an increase in labor demand. When the increase in the real wage is associated with a relatively higher increase in real gross profit, the demand for labor increases. Also, when the decrease in the real wage is associated with a relatively higher decrease in real gross profit, the demand for labor decreases. Ultimately, the variation in labor demand is determined by the changes in the ratio of real gross profit compared to real wages, whose short-run changes are linked to real gross profit.

The relation (42) can be written as the sum of two positive terms as shown by the relation (42bis). The first term of this sum corresponds to the level of labor demand when it is considered that labor is perfectly flexible, namely $\alpha_3 = 0$. In other words, it is the level of neoclassical labor demand.[5]

$$L^* = \frac{b\pi}{(1-b)(w/p)} + \frac{(\alpha_3/\alpha_1)\pi}{(1-b)(w/p)} \qquad \text{(42bis)}$$

The second term of the relation (42bis) corresponds to the surplus of labor demand linked to imperfections in the labor market (imperfect information and existence of labor market institutions). It represents the gap between the labor demand of the neoclassical theory and the reality. Obviously, this surplus labor demand increases with employment security in the labor market (α_3/α_1), but also with real gross profit (π) which, in turn, increases with labor flexibility. This once again highlights the importance of a good balance between security and flexibility in labor market.

c. Real gross profit function in medium and long run

With regard to the system of equations (23) relating to the investment decision, determining the real gross profit as a function of the capital stock is important for the following section. The expression of real gross profit is obtained by continuing to solve the system of equations (40) relating to the first-order conditions of compromise in the labor market. This resolution gives the relation (43) below which expresses real gross profit as a Cobb-Douglas function depending on the capital stock (K) and real wages.

$$\pi(K) = \pi_0 K^{\lambda_1} (w/p)^{-\lambda_2} \qquad (43)$$

Where : $\lambda_1 = a/(1-b)$; $\lambda_2 = b/(1-b)$ et $\pi_0 = (1-b)\left[\frac{(b+\alpha_3/\alpha_1)^b}{1+\alpha_3/\alpha_1} q\right]^{1/(1-b)}$

5. Corporate investment decision

This section aims to analyze the corporate investment decision based on the behavior functions relating to the capital markets which have been specified in section 3 of this article. It is about examining the corporate investment optimal strategy and the relationship between investment and interest rates.

1. *Investment optimal strategy: the preference for a type of funding source*

According to the General Theory of the Firm, the corporate investment decision results from the compromise between the stakeholders of the capital markets. It is therefore the result of the maximization of the capital compromise function, under the set of constraints that companies face, whose first-order general conditions are given by the system of equations (23). Applying these first-order general conditions to the specified behavior functions gives the system of equations (44) below.

[5] It can be verify that the labor demand of neoclassical is equal to this term by applying the neoclassical model of profit maximization with the production function specified above or by simply considering $\alpha_1 = 1$, $\alpha_2 = \alpha_3 = 0$ in the primary compromise function (relation 27).

$$\begin{cases} \lambda_1 \dfrac{\pi}{K} + \dfrac{\theta_5}{(1-\tau)\theta_1} \dfrac{G}{I_E} = (\delta + \dfrac{r_E}{1-\tau}) + \dfrac{r_E K_E - (\theta_6/\theta_1)G}{(1-\tau)a_3\psi} \\ \lambda_1 \dfrac{\pi}{K} + \dfrac{(\theta_3 + \sigma\theta_4)}{(1-\tau)\theta_1} \dfrac{G}{I_D} = (\delta + r_D) + (1-\sigma a_2) \dfrac{(1-\tau) r_D K_D - (\theta_2/\theta_1)G}{(1-\tau)a_1\varphi} \\ G = (1-\tau)[\pi - r_D K_D - \delta K] - r_E K_E \\ I_D = \varphi(r_{nD};\, B_0 I_D^{\sigma}) \\ I_F = \psi(r_{nE}) \end{cases} \quad (44)$$

The corporate optimal investment strategy $(I_F^*\,;\, I_D^*)$ is a solution to the system of equations (44). Applying the theorem of optimal investment strategy shows that the corporate optimal investment strategy verifies the relation (45).[6] Thus, the corporate investment strategy is such as the final capital structure (K_E; K_D) ensures the equality of the total marginal costs of the two capital markets.

$$r_E + \frac{r_E K_E - \eta a_3 G}{a_3 \psi} \;=\; (1-\tau) r_D + \frac{(1-\tau) r_D K_D - \mu\beta G}{\beta\varphi} \quad (45)$$

Where : $\beta = \dfrac{a_1}{(1-\sigma a_2)}$; $\eta = \dfrac{(\theta_5 + \theta_6/a_3)}{\theta_1}$; $\mu = \dfrac{(\theta_2/\beta + \theta_3 + \sigma\theta_4)}{\theta_1}$

Also, according to the theorem, the indicator of preference ($P_{E/D}$) for equity over loan at the corporate optimal investment strategy is given by the relation (46). As shown in relation (46), this preference indicator can be less than or greater than 1. This means that the corporate optimal investment strategy depends on the capital structure. In other words, since capital markets are generally imperfect and have different funding imperfections and constraints, their marginal costs of mobilizing resources are not equal and, therefore, the optimal investment strategy depends on the funding structure ($P_{E/D} \neq 1$).

$$P_{F/D} = 1 + \frac{\theta_1}{\theta_5}\frac{\psi}{G}\left[\left((1-\tau)r_D + \frac{(1-\tau)r_D K_D - \rho_D G}{\beta\varphi}\right) - \left(r_F + \frac{r_F K_F - \rho_F G}{a_3\psi}\right)\right] \quad (46)$$

Avec : $\rho_D = \dfrac{\theta_2 + (\sigma/\beta)\theta_4}{\theta_1}$ et $\rho_F = \dfrac{\theta_6}{\theta_1}$

2. *Investment and interest rate relationship*

The purpose of this subsection is to analyze the investment and interest rate relationship. It is about of calculating the total differential of the first-order conditions equations of the capital compromise process (relation 44) in order to express the variation in the investment level with respect to the variations in interest rates, in the net profit and in the depreciation rate. To do this, a rearrangement of the system of equations (44) is carried out to reduce it to two main equations (system of equations (47)).[7]

[6] The relation (45) can be obtained by making the difference of the first two equations of the system (44) and by carrying out the necessary groupings.

[7] To obtain the system (47): (i) replace the 2nd equation of system (44) by equation (45) which was obtained by making the difference of the first two equations of system (44), (ii) replace the gross profit π by its expression given by the third equation of system (44), (iii) calculate the loan supply function by integrating the expression of the collaterals supply function.

$$\begin{cases} \lambda_1 \dfrac{G + r_E K_E}{K} + (1-\tau)\lambda_1 \dfrac{r_D K_D}{K} = (1-\lambda_1)(1-\tau)\delta + r_E + \dfrac{r_E K_E - \eta a_3 G}{a_3 \psi} \\ r_E + \dfrac{r_E K_E - \eta a_3 G}{a_3 \psi} = (1-\tau) r_D + \dfrac{(1-\tau) r_D K_D - \mu \beta G}{\beta \varphi} \\ \varphi = \phi_0 r_{nD}^{\beta} \\ I_E = \psi_0 r_{nE}^{a_3} \end{cases} \tag{47}$$

Making the total differential of the equations system (47) and solving the new system give the relations (48) and (49) which express respectively the variation in debt-funded investment (dI_D) and the variation in equity-funded investment (dI_E) with respect to the variation in interest rate (dr_D), to the variation in return rate (dr_E), to the variation in depreciation rate ($d\delta$) and to the variation in net profit (dG).

$$dI_D = \left(\frac{\lambda_1 \alpha (1-\tau) - A_E H_D}{T_D + \frac{(1-\tau) r_D}{\beta \varphi} A_E} \right) dr_D + \left(\frac{\lambda_1 (1-\alpha) + (A_E - 1) H_E}{T_D + \frac{(1-\tau) r_D}{\beta \varphi} A_E} \right) dr_E + \left(\frac{\frac{\lambda_1}{K} + \frac{\mu}{\varphi} + (A_E - 1)(\frac{\mu}{\varphi} - \frac{\eta}{\psi})}{T_D + \frac{(1-\tau) r_D}{\beta \varphi} A_E} \right) dG - \left(\frac{(1-\lambda_1)(1-\tau)}{T_D + \frac{(1-\tau) r_D}{\beta \varphi} A_E} \right) d\delta \tag{48}$$

$$dI_E = \left(\frac{\lambda_1 \alpha (1-\tau) + (A_D - 1) H_D}{T_E + \frac{r_E}{a_3 \psi} A_D} \right) dr_D + \left(\frac{\lambda_1 (1-\alpha) - A_D H_E}{T_E + \frac{r_E}{a_3 \psi} A_D} \right) dr_F + \left(\frac{\frac{\lambda_1}{K} + \frac{\eta}{\psi} + (A_D - 1)(\frac{\eta}{\psi} - \frac{\mu}{\varphi})}{T_E + \frac{r_F}{a_3 \psi} A_D} \right) dG - \left(\frac{(1-\lambda_1)(1-\tau)}{T_E + \frac{r_E}{a_3 \psi} A_D} \right) d\delta \tag{49}$$

Where:

$$\alpha = \frac{K_D}{K}$$

$$A_D = 1 + \frac{\lambda_1 \beta \varphi}{(1-\tau) r_D K_D} \left(\frac{G}{K} + (1-\alpha)[r_E - (1-\tau) r_D] \right) \quad ; \quad A_E = 1 + \frac{\lambda_1 a_3 \psi}{r_E K_E} \left(\frac{G}{K} + \alpha [(1-\tau) r_D - r_E] \right)$$

$$H_D = \frac{\mu \beta G}{r_D \varphi} + \frac{(1-\beta)}{\beta} \frac{(1-\tau) K_D}{\varphi} + (1-\tau) \quad ; \quad H_E = \frac{\eta a_3 G}{r_E \psi} + \frac{(1-a_3)}{a_3} \frac{K_E}{\psi} + 1$$

$$T_D = \frac{\lambda_1}{K} \left(\frac{G}{K} + (1-\alpha)[r_E - (1-\tau) r_D] \right) \quad ; \quad T_E = \frac{\lambda_1}{K} \left(\frac{G}{K} + \alpha [(1-\tau) r_D - r_E] \right)$$

The expressions (48) and (49) show that the relationship between investment and the interest rates is actually more complex than those that usually used in econometric estimates and macroeconomic modeling.

First, each multiplying factor of the variation in interest rates (dr_D and dr_E) is a function, in particular, of the interest rates r_D and r_E, the ratio of net profit compared to the capital stock (G/K), the coefficient of capital profitability (λ_1) and of the ratio of funds supply compared to capital stock of each funding source (φ/K_D and ψ/K_E). This means that the relationship between investment and the interest rates depends on (i) the levels of interest rate and return rate, (ii) the capital profitability and (iii) the level of funding supply.

Second, in each of the relations (48) and (49), the multiplying factors of the variations in the interest rates and in the depreciation rate are not only different, but they can also be of opposite sign. This indicates that the interest rate (r) and the depreciation rate (δ) have a different influence on the amount of investment. So, each of interest rate and depreciation rate is a determinant of investment in its own right. Thus, it would not be relevant to consider the sum of the interest rate and the depreciation rate ($r + \delta$) as a determining variable of investment, as is customary in the economic literature.

Third, the relations (48) and (49) point out that the multiplying factors of the changes in interest rates can be positive or negative. This means that the relationship between investment and the interest rate can be negative or positive. In other words, investment is not a monotonous function with respect to the interest rate as stated in the theorem about investment and interest rate relationship (Zerbo, A. & Hien, L. 2019, 2020).

In the loan market (relation 48), for instance, when (i) the funding constraints (excluding the effect of collaterals) are very strong, the funding supply is relatively much elastic with respect to the interest rate and the collateral system is relatively efficient (so that $\beta>1$ and $H_D<0$) and (ii) the ratio of net profit compared to capital stock (G/K) is greater than the difference between interest rates (after-tax) (i.e. $|r_E - (1-\tau) r_D|$), then the multiplying factor of the variation in the interest rate would be positive; as a result, the debt-financed investment is increasing, in this case, with the interest rate in the loan market.

This results is in line with a certain reality. In fact, when the profitability of investment is high, but the borrowing interest rate remains at a low level which does not allow lenders to mobilize sufficient funds to lend because of their high costs, the investment would stagnate. But, an increase in the borrowing interest rate would lead to an increase in the loan supply as long as the spread of interest rate would allow the lenders to mobilize sufficient funds. With the increase in loan supply due to increase in the interest rate, as the investment profitability is high and the collateral system is efficient, the companies would borrow to invest as long as the investment profitability is higher than the interest rate. So, in this case, the increase in the interest rate lead to an increase in the level of investment.

Conversely, in the same loan market (relation 48), for instance, when (i) the loan supply is not much elastic with the interest rate and the collaterals system is less effective (so that $\beta<1$) and (ii) the ratio of net profit compared to the capital stock (G/K) is greater than the difference between interest rates (after tax) (i.e. $|r_E - (1-\tau) r_D|$), but the profitability coefficient λ_1 is quite low compared to 1; then the multiplying factor of the variation in interest rate would be negative. Consequently, the debt-funded investment is decreasing, in this case, with the interest rate.

6. Conclusion

Considering that the production technology of companies and the compromise function of stakeholders, as well as the funding and collaterals supply functions in the capital markets can take the form of a Cobb-Douglas function, this article specifies and confirms the results of the General Theory of the Firm.

First, this article has shed light on the wage inertia mechanisms. The wage rigidity in the short run is linked to the fact that they depend, on the one hand, on the average labor productivity which does not vary in the short run and, on the other hand, on the state labor market functioning in terms of income distribution, which generally only changes after lengthy wage negotiations.

Second, the article confirms that gross profit is the determining variable of labor demand in the short run, while the real wages are one of its determinants in the medium and long run. Also, it is confirmed that security of the labor market is favorable for employment, but unfavorable for gross profit; while flexibility of labor is favorable for gross profit, but unfavorable for employment. This justifies the relevance of promoting flexisecurity in the labor market in order to get a sustained economic dynamic which is more favorable for employment.

Third, the article confirms that the investment strategy depends on the funding structure. Corporate preference for one funding type depends on the difference of the total marginal costs of funds mobilization between the two capital markets.

Fourth, the article confirms that investment and interest rate relationship is complex and not monotonous. It can be negative or positive. This relationship depends on the nature and the level of funding constraints, on the degree of elasticity of the loan supply with respect to the interest rate and on the profitability of capital. For instance, when (i) the funding constraints (excluding the effect of collaterals) are very strong, the loan supply is relatively elastic with respect to the interest rate, and the collaterals system is relatively effective and (ii) the ratio of net profit compared to capital stock (G/K) is greater than the difference between interest rates, so debt-funded investment is increasing with the interest rate.

Fifth, the article shows that the interest rate and the depreciation rate affect investment level differently, and that each of these rates is a determinant of investment in its own right. Therefore, it would not be relevant to consider the sum of the interest rate and the depreciation rate $(r + \delta)$ as a determining variable of investment.

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