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Abstract

We analyse in a firm the possible choice between two systems of corporate governance: the one-tier board, a structure commonly used in the Anglo-American world, and the system of Codetermination, a two-tier board with the presence of workers' representatives in the supervisory board, a model commonly adopted by firms in Germany. The aim is to fill a gap present in the current literature, the absence of a mathematical model that explains how works the governance's system of Codetermination presents not only in the German world, but expanding in many other European countries, as a result of the recent EU directives, which emphasize the need to involve workers in company decisions.

Keywords: Corporate Governance, Codetermination, Labor Representation, Workers, Human Capital, Single Board, One-Tier Board, Monitoring, Welfare.
Jel classification: G34, L22

1.Introduction

Corporate governance has become a major concern in recent years, probably due to meltdown scandals of several major companies around the world like Enron and Parmalat. In fact, the board in a system of governance performs different and complex functions and it is easy to understand how the effectiveness of its actions is fundamental to the growth and development of a firm. It should be noted also that the tasks of a board in a company represent the livelihood of its workers and their families (Stiglitz 1985, Hansmann 1990).

Also for the above scandals, following which thousands of people lost their jobs without having any direct responsibility, it seems essential that an additional agent in the firm, the worker, can take decisions on the development of the same firm through the expression of vote in the board because he/she brings human capital. Due to previous studies on the separation of ownership and control (see e.g. Shleifer and Vishny, 1997) this could have a double benefit for the company and the shareholders. On one hand, there is a stakeholder inside the company that can rarely get the chance to appropriate for private benefits (unlike the manager), for both the role it has and because his family livelihood depends on his salary, as we have already mentioned. On the other hand, "an important remark made by Holmström (1999) and by Roberts and Van den Steen (2000) is that when employees cannot participate in corporate decision making a likely response may be unionisation and/or strikes. There are many examples in corporate history where this form of employee protection has proved to be highly inefficient, often resulting in extremely costly conflict resolutions for the firm. Thus, in practice an important effect of employees representation on boards may be that employees' human capital investments are better protected and that shareholders' excessive urge to dismiss employees is dampened" (Polinsky and Shavell, 2007).

In the United States the law puts shareholders' interests first as well as the common use in the United Kingdom. The board has a fiduciary duty to shareholders and firms tend to adopt a one-tier structure. Germany instead has a system of codetermination where larger firms have two boards: the supervisory and the management board. Half of the supervisory board's members are elected primarily by workers and partly by labour unions. The other half represents shareholders. There is also a chairman who can cast tie-breaking votes if necessary, so his/her vote is very important. Although the shareholders have the option to vote down the workers, the vast majority of decisions are unanimous (Gorton and Schmid, 2004). So, the supervisory board represents the interests of the company as a whole. It elects, monitors and dismisses the management board, which operates the company. Supervisory boards typically have about 17 members, more than standard US and UK boards with an average respectively of 10.8 (Block and Gerstner, 2016) and 11.93 (Jungmann, 2006). The focus of the chapter is on how the German codetermination system works[1] and the comparison with the most common system of governance, the single board. In this case the interests of workers are protected mainly through strikes and/or through trade union membership. However, the unions themselves may have conflicts of interest. Just think that in Italy a worker who wants to join a union must pay a registration fee deducted from the salary. This registration fee pays the wage of those who are supposed to guarantee the wellbeing of the workers. Often these fees are not adequately regulated by a national legislation, like in the case of the general secretaries of labour unions in Italy, where a person can get around five times more than what

[1] For an extensive and update literature review about the theme of Codetermination see Forcillo (2017a).

is earned by an ordinary worker[2]. We could question if those people really do have an incentive to stop the possibility of more strikes or layoffs. If so, a worker would no longer need to pay a union fee. Given that, we have a potential conflict of interest among labour unions, firms and workers. So, the idea is that the presence of workers on the board could not only improve the quantity and quality of monitoring, but also at the same time, protect themselves through a direct democracy, without necessarily enrolling in a union and thus alleviate another potential conflict of interest. From a mathematical point of view, the chapter focuses on the size of the expected gains and consequently on different private benefits that large shareholder and manager could obtain depending on the investment project chosen. In the codetermination system, the large shareholder with the help of the workers, are involved in monitoring the management board, which has the option to choose the investment project. In the single board, the large shareholder does both functions. The basic framework in our model is from Graziano and Luporini (2012). They analyse if a system of governance with two distinct boards, one for selection of investment projects and one for monitoring, can reduce the conflict of interests between the large shareholder and the manager. The primary conclusion is that the large shareholder, despite his loss in private benefits, continues to maintain the incentives to monitor the manager, expecting higher return compared to the one-tier structure. However, Graziano and Luporini consider a dual board without the presence of workers inside, where the salary is normalized to zero. What we want to do then is to add the workers and their salary inside the model and check if their presence would differently affect the behaviour and choices of the large shareholder and manager, analysing how these could impact the firm's system.

There are in literature mathematical models that explain how the single board works (see e.g. Hermalin and Weisbach, 1998), but the same does not happen to the German system. Therefore, the aim is to fill a gap present in the current literature, building first a mathematical model of corporate governance that explains the operations of the German system of codetermination and at the same time, check whether it is preferable to adopt this model or the classic Anglo-American model, i.e. a system without the presence of workers that can make decisions and carry out controls on the firm's management. The main finding is that codetermination could be beneficial for all agents in the firm, large shareholder included.

The rest of the chapter is organized as follows. Section 2 presents the model. The choice of monitoring intensity, by the large shareholder in the one-tier system and by the large shareholder and workers in the codetermination system, is analysed in section 3. Section 4 illustrates the choice of effort in these structures of governance. Sections 5, 6 and 7 compare the two structures and present the main results. Finally, section 8 concludes.

2. The model

A large shareholder owns a large part α of shares that giving him full control in a firm. The minority shareholders hold a portion of shares equal to $(1-\alpha)$ and they are not represented

[2] "Cisl, scoppia il caso dei mega-stipendi. Dirigente li denuncia ma verrà espulso", *La Repubblica,* August 10, 2015. "Cisl, Raffaele Bonanni un segretario sindacale da 336mila euro l'anno", *Il Fatto Quotidiano,* October 30, 2014.

on the board[3]. The law gives to the large shareholder the right to choose between two models of governance, the sole board and the codetermination system. There are two main activities: selection of investment projects and monitoring. In the sole board both activities are implemented by a single board controlled by the large shareholder. In the codetermination system the two activities are separated: a management board is in charge to choose investment projects, monitoring activity instead is attributed to a supervisory board, half controlled by the large shareholder and half controlled by the representatives of the firm's workers. In the codetermination system, as the German law prescriptions, the same member cannot be present on both boards. The protection of workers is thus guaranteed by the direct representation on the board in the company rather than by the only presence of labour unions.

There are only two projects that can be chosen because they yield a non-negative return. In particular, projects 1 and 2 yield profit $\pi > 0$, in the case of success, and $\pi = 0$ in the case of failure. If a project is chosen, workers are hired. From the workers' perspective is fundamental that the project does not fail. In fact, if the project yields a positive return they receive a salary w (where $w < \pi$), otherwise they do not receive it and they are all fired (Faleye et al., 2005). So, for the worker is not important which of the two projects is chosen, but it is important that the firm has an adequate system of governance and that the project is managed by a capable manager. The fraction of capable (H) and bad (L) manager is λ and $(1 - \lambda)$ respectively. With probability p^H, the project is profitable if the manager is H and with probability p^L if the manager is L, where $p^H > p^L > 0$. Large shareholder and manager have different preferences due to the possibility of obtaining personal private benefits (Principal Agent Problem, see e.g. Jensen and Meckling, 1976), depending on the investment project undertaken. Private benefits are obtained even with $\pi = 0$. There is no possibility to obtain private benefits for workers or minority shareholders. Project 1 produces private benefits $B > 0$ to the large shareholder and b_1 to the manager. Project 2 gives private benefits b_2 to the manager and zero to the large shareholder (remember: the large shareholder chooses the board structure). Since $b_2 > b_1 > 0$ the manager always prefers project 2. An important difference between the two systems of governance is that only in the sole board the large shareholder is able to force his favourite investment decision (project 1), but at the end of section 6 we show that the large shareholder could prefer, as well as the manager, project 2 depending on the size of his expected gains.

The model develops over four periods and it is resolved by backward induction. At

[3] We think that this represents the capital structure in Germany and in the UK and US. In fact Jungmann (2006) claims that "the latest statistics clearly show a recent trend that the ownership structure in the UK is no longer as dispersed as it once was. Consequently, whilst a couple of years ago the differences in the shareholder structures might have been a valid explanation for the results of comparative studies on the effectiveness corporate control, with respect to recent data for the UK and Germany, this is no longer the case".

$t = 0$, the large shareholder chooses the type of governance. If he chooses a single board, he is the only one sitting on the board. If he chooses a codetermination system, the workers nominate their representatives, so both large shareholder and workers sit on the supervisory board. The large shareholder in the one-tier structure, the large shareholder and the workers in codetermination, hire a manager in the job market. We assume that at the time of recruitment the type of manager is unobservable by large shareholder and workers giving them the right motivation to engage monitoring.

At $t = 1$, manager and large shareholder exert their effort to become informed about investment projects. Information requires a cost. For the manager, it is $e^2/2$ and he has probability e to become informed. For the large shareholder, it costs $\varepsilon^2/2$ and he has probability εe to become informed; so this probability is conditioned to the manager's activity. As in the German system, the only task for the workers is to perform monitoring activity.

At $t = 2$, if a project is undertaken, the large shareholder in the single board, the large shareholder and workers in the codetermination system, start their monitoring activity on the manager. This activity is successful with probability M, at cost $M^2/2$ for each agent. Obviously monitoring objective is to find out a low-ability manager in order to replace him, raising expected profit and expected salary.

At $t = 3$, all the previous results are realized. Assumptions in the model are that $p^H - p^L < 1/(\alpha\pi + w)\lambda(1-\lambda)$, $B < B_{max}$, $b_2 < 1$ and $b_2 K_L^w > b_1 K_L$.

3. Monitoring

There are two levels of monitoring intensity, the first one in the sole board and the second one in the codetermination system. With probability M, monitoring gives to the large shareholder/supervisory board the possibility to find out the manager's ability. A H manager is confirmed while an L manager is fired. With probability $(1-M)$, monitoring is unsuccessful. In this case the manager is retained because the probability to hire a H manager is the same as that of the incumbent being high ability. So, in the one-tier system the optimal level of monitoring derives from the maximization of the large shareholder's share of expected profit, net of the monitoring cost $M^2/2$

$$\max_M \alpha\pi\{\lambda p^H + (1-\lambda)[\lambda p^H M + (1-\lambda)p^L M + (1-M)p^L)]\} - M^2/2$$

where $M^2/2$ is the monitoring cost. The large shareholder obtains a profit equal to $\alpha\pi$ with probability p^H when the manager is H, independently from monitoring. After positive monitoring, when a L manager is substituted with a good one, $(1-\lambda)\lambda p^H M$. With probability p^L, when an L manager is replaced with a L one, $(1-\lambda)(1-\lambda)p^L M$. Finally, after unsuccessful monitoring when the manager is L, $(1-\lambda)(1-M)p^L$. From the FOC, we obtain the optimal level of monitoring equal to:

$$M^* = \alpha\pi\,(1-\lambda)\lambda\,(p^H - p^L) \tag{1}$$

In the codetermination system instead, monitoring intensity results from the sum of the large shareholder's expected profit net his monitoring cost, plus workers' expected salary net their monitoring cost. In particular, the maximization problem for the large shareholder, conditional on the workers' monitoring level, is equal to:

$$\max_{M_{LS}} \alpha\pi\{\lambda p^H + (1-\lambda)[\lambda p^H \min(M_{LS} + M_w, 1) + (1-\lambda)p^L \min(M_{LS} + M_w, 1) + \min[1 - (M_{LS} + M_w), 1]p^L)]\} - (M_{LS})^2/2$$

From the FOC, we obtain:

$$M_{LS}^* = \alpha\pi\,(1-\lambda)\lambda\,(p^H - p^L)$$

The maximization problem for the workers, conditional on the large shareholder's monitoring level, is equal to:

$$\max_{M_w} w\{\lambda p^H + (1-\lambda)[\lambda p^H \min(M_{w+}M_{LS}, 1) + (1-\lambda)p^L \min(M_w + M_{LS}, 1) + \min[1 - (M_w + M_{LS}), 1]p^L)]\} - (M_w)^2/2$$

From the FOC, we obtain:

$$M_w^* = w\,(1-\lambda)\lambda\,(p^H - p^L)$$

Then, the total level of monitoring on manager from the supervisory board is:

$$M^{**} = M_{LS}^* + M_w^* = (\alpha\pi + w)\,(1-\lambda)\lambda\,(p^H - p^L) \tag{2}$$

So, the presence of the workers in the supervisory board allows a higher level of monitoring on the manager than the one-tier system. The reason is that workers, due to their tasks in the company and their daily working relationship with the manager, may have access to different types of information that the large shareholder alone may not have. Thus, in the codetermination system, a double level of control is created for the manager regarding different levels of information and it is easier to find out a bad manager. The presence of workers in the codetermination system acts as a strong signal for the less capable manager, who perceives the presence of another agent monitoring his tasks and consequently he changes his behaviour and level of effort. This result follows what we said before: the workers have a great interest that the project has positive returns and that therefore is managed by a good manager. Even more when compared to the large shareholder. In fact, he may obtain private benefits, while the only source of income for the workers is the wage received, only if the project is successful; if not, they are fired. However, workers have the same monitoring cost of large shareholder because while there is usually no problem for him in finding adequate representatives with advanced qualifications, such standards would be a problem for workers representatives that are unqualified to deal with matters such as accounting, finance and corporate strategy (Huse et al., 2009).

4. The choice of efforts

In the single board (denoted by subscript S), the manager with probability e and the large shareholder with probability $e\varepsilon$, exert efforts to have information about investment projects. With probability $e(1-\varepsilon)$ project 2 is chosen (only the manager obtains information about the project). With probability $(1-e)$ no project is selected, generating zero profit and private benefits. In the codetermination system (subscript D_w) instead, only the manager exerts effort (probability e) because the project's choice is assigned to him. We define $K_H = K_H^w \equiv 1$, the probability to be retained for a manager H in the single board and codetermination respectively. $K_L \equiv (1-M^*)$ and $K_L^w \equiv (1-M^{**})$ are the analogous probability for a manager L, with $K_L > K_L^w$ due to the fact that $M^{**} > M^*$. Then, the maximization problem for a manager of ability $i = H, L$ is different in both structures. In particular, in the single board is equal to:

$$\max_e e\,[\varepsilon_S^* b_1 K_i + (1-\varepsilon_S^*) b_2 K_i] - e^2/2,$$

From the FOC, we obtain:

$$e_S^{i*} = [b_2 - \varepsilon_S^*(b_2 - b_1)]K_i \tag{3}$$

In codetermination is equal to:

$$\max_e e[b_2 K_i^w] - e^2/2$$

From the FOC, we obtain:

$$e_{Dw}^{i*} = b_2 K_i^w \tag{4}$$

In (3) the managerial effort is negatively correlated to the effort of the large shareholder ε_S^*, because a greater value of ε_S^* reduces the probability of carry out project 2. Since $K_H = K_H^w > K_L > K_L^w$, it immediately follows that $e_S^{H*} > e_S^{L*}$ and $e_{Dw}^{H*} > e_{Dw}^{L*}$, i.e. that a H manager exerts a higher level of effort than an L one in both structures. For a H manager, the effort does not depend on monitoring and he is always confirmed. The effort of an L manager instead, negatively depends on monitoring, because K_L and K_L^w depend on M^* and M^{**}. Furthermore, since $K_L > K_L^w$, a bad manager has a bigger probability to be retained in the single board rather than codetermination due to the lower level of monitoring intensity implemented without the presence of workers that act in codetermination as added controllers. This is an important difference between the two systems of governance.

The large shareholder's effort depends on the chosen board. In codetermination, the effort is equal to zero because the project's choice is completely delegated to the manager. In the single board, however, he expects an effort from the manager $e_S^* \equiv \lambda e_S^{H*} + (1-\lambda) e_S^{L*}$ that gives to the large shareholder a probability of high profit equal to:

$$P_S = \lambda e_S^{H*} p^H \ + \ (1-\lambda) e_S^{L*} \left[p^L (1 - M^*) + \ \left(p^H \lambda \ + \ p^L (1-\lambda) \right) M^* \right] \tag{5}$$

The analogous probability in codetermination, with an expected level of effort from the manager $e_{Dw}^* \equiv \ \lambda e_{Dw}^{H*} + (1-\lambda) e_{Dw}^{L*}$, is equal to:

$$P_{Dw} = \lambda e_{Dw}^{H*} p^H \ + \ (1-\lambda) e_{Dw}^{L*} \left[p^L (1 - M^{**}) + \ \left(p^H \lambda \ + \ p^L (1-\lambda) \right) M^{**} \right] \tag{6}$$

A good manager has a p^H probability of success. An L manager has a p^L probability of success, and he can be replaced (successful monitoring) or not replaced (unsuccessful monitoring) and the new manager can either be good (with probability λ) or bad (with probability $1-\lambda$). Then, the maximization problem of the large shareholder in the single board is equal to:

$$\max_{\varepsilon} e_S^* \left[\varepsilon (B + \alpha \pi P_S) + (1-\varepsilon) \alpha \pi P_S - \ (M^*)^2/2 \right] \ - \ \varepsilon^2/2$$

where $e_S^* \varepsilon (B + \alpha \pi P_S)$ represents the probability for the large shareholder to be informed and then obtain expected profit plus private benefits from project 1; $e_S^* (1-\varepsilon) \alpha \pi P_S$ represents the probability to obtain only expected profit in case project 2 is undertaken (only the manager is informed). From the FOC, we obtain:

$$\varepsilon_S^* = \ B e_S^* \tag{7}$$

Solving the system (3) − (7) we have:

$$\varepsilon_S^* = \frac{B b_2 K}{1 + B(b_2 - b_1) K} \tag{8}$$

$$e_S^{i*} = \frac{b_2 K_i}{1 + B(b_2 - b_1) K} \qquad i = K, L \tag{9}$$

where $K \equiv \ \lambda K_H + (1-\lambda) K_L$. In particular, ε_S^* is continuously increasing in B, ranging from $\varepsilon_S^* = 0$ when $B = 0$, to $\varepsilon_S^* = 1/2$ when $B_{mid} = \frac{1}{(b_1 + b_2) K}$, to $\varepsilon_S^* \to 1$ when $B \to B_{max} \equiv 1/b_1 K$, ($\partial \varepsilon_S^* / \partial B \ > \ 0$). e_S^{i*}, $i = K, L$ instead is continuously decreasing in B, ranging from a minimum of $b_1 K_i$, to a mid value of $\left(\frac{b_1 + b_2}{2} \right) K_i$, to a maximum of $b_2 K_i$.

5. Single board versus codetermination

Considering the level of effort (4) and (9) in order to compare the codetermination and one-tier system, we have the following lemma.

Lemma: the level of effort exerted by the manager H *is higher in codetermination:* $e_{Dw}^{H*} \geq e_S^{H*}$*, with* $e_{Dw}^{H*} = e_S^{H*}$ *iff* $B = 0$ *implying* $\varepsilon_S^*|_{B=0} = 0$*. The level of effort exerted by the manager* L *could be higher or smaller in the codetermination system. In particular, if* $B = 0$ *or for low value of it, the level of effort exerted by the manager* L *in codetermination is smaller than the sole board,* $e_{Dw}^{L*} < e_S^{L*}$*. If* $B \to B_{max}$*, the level of effort exerted in codetermination is greater than the sole board,* $e_{Dw}^{L*} > e_S^{L*}$*. So, with a manager* L *the two structures cannot be equivalent,* $\mathrm{e}_{\mathrm{Dw}}^{\mathrm{L}*} \neq \mathrm{e}_{\mathrm{S}}^{\mathrm{L}*}$.

Proof: e_S^{*i} *is continuously decreasing in* B*,* $\frac{\partial \mathrm{e}_{\mathrm{S}}^{\mathrm{i}}}{\partial \mathrm{B}} = \frac{-b_2 K_i (b_2 - b_1) K}{[1 + B(b_2 - b_1)K]^2} < 0$ *and* $K_L > K_L^W$.

The effort's level for a manager H is independent of monitoring, so the presence of workers does not change his behaviour and the two structures could be equivalent. The effort of an L manager negatively depends on monitoring. Although private benefits could be equal to zero and the large shareholder has no interest to supervise, workers still have interest in monitoring the manager, so there is a higher level of control due to their presence. A manager L knows that and in the codetermination system he understands that it is easier to be picked out. So, he changes his behaviour giving a lower level of effort. Only if $B \to B_{max}$, the manager L loses the incentive to exert effort in the single board, because e_S^{i*} is continuously decreasing in B. So, enhancing the private benefits for the large shareholder, the effort of an L manager is higher in codetermination. As showed by Graziano and Luporini, we have a situation where the level of effort for a manager H is higher than a manager L, but in our case the two structures are no longer equivalent with the presence of an L manager, even if $B = 0$, due to workers' presence on the board that increases the level of monitoring. This result is significant: since the large shareholder cannot know in advance the type of manager, by adopting the codetermination system he knows that the less capable manager always exerts a smaller effort for zero or low level of B and so it is easier to find out the type of manager.

6. Expected gains of large shareholder

Comparing (5) and (6) we have a situation where the first term of (6) is greater than the first term of (5), with $\lambda e_{Dw}^{H*} p^H = \lambda e_S^{H*} p^H$ iff $B = 0$. So, in presence of a manager H, $P_{Dw} \geq P_S$. Looking at the second term, the probability of the outcome monitoring is always higher in the codetermination system, due to $\mathrm{M}^{**} > \mathrm{M}^{*}$. Then, to be sure that $\mathrm{P_{Dw}} \geq \mathrm{P_S}$, we need to look at the effort of a manager L. In particular, for zero or a low level of B, the manager L knows that the large shareholder exerts zero or a low effort, consequently $\mathrm{e}_{\mathrm{S}}^{\mathrm{L}*} > \mathrm{e}_{\mathrm{Dw}}^{\mathrm{L}*}$ and $\mathrm{P_S}$ could be bigger than $\mathrm{P_{Dw}}$. For a higher level of B, a manager L has less incentive to exert effort in the single board, because the effort is continuously decreasing in B. So, an increase of private benefits for the large shareholder, diminish the manager's effort in the single board. It follows that $\mathrm{e}_{\mathrm{Dw}}^{\mathrm{L}*} > \mathrm{e}_{\mathrm{S}}^{\mathrm{L}*}$ and $\mathrm{P_{Dw}}$ is always bigger than $\mathrm{P_S}$.

The large shareholder preference, however, depends on his expected gains. Under the codetermination structure, the large shareholder wants to maximize his fraction of shares net

of monitoring cost and workers' expected salary. So, the expected gains of the large shareholder are equal to:

$$E(G_{Dw}) = P_{Dw}\alpha(\pi - w) - e^*_{Dw}(M^*_{LS})^2/2 \quad (10)$$

In the sole board, the large shareholder exerts his effort and also obtains private benefits B. Then, in the one-tier structure his expected gains are equal to:

$$E(G_S) = P_S\,\alpha(\pi - w) - e^*_S(M^*)^2/2 + \varepsilon^*_S e^*_S B - (\varepsilon^*_S)^2/2 \quad (11)$$

where $(M^*_{LS})^2/2 = (M^*)^2/2$. In the Appendix, we prove the following proposition:

Large shareholder preferences depend on the size of his private benefit B *and we can identify two cases according to its value. If* $\bar{B} > B > \bar{\bar{B}}$ *the large shareholder always prefers the single board; if instead* $\bar{B} \leq B \leq \bar{\bar{B}}$ *he prefers the codetermination structure. Hence two values exist,* $\bar{B}$ *and* $\bar{\bar{B}}$ *between that the large shareholder always prefers the codetermination structure rather than the sole board.*

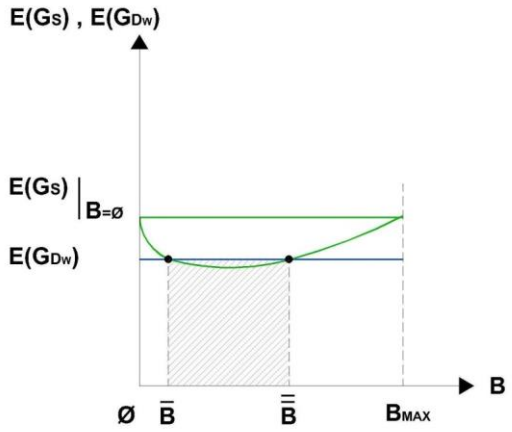

Figure 1. Expected gains of the large shareholder.

Figure 1 shows the presence of a U-shaped between the choice in the hand of large shareholder between a system of codetermination and a single board when the dimension of private benefits is increasing. In particular, the large shareholder chooses the codetermination system if B is not "too small", having the right motivation to monitor, without adopting opportunistic behaviour towards workers, and if it is not "too large" that he can appropriate for a large quantity of private benefits in the single board. If these conditions are respected, the large shareholder chooses the codetermination structure, giving to the workers the possibility to be represented on the board, protecting through a kind of direct democracy their rights and their place of work and safeguarding their life and that of their family.

7. Expected Gains fof other agents

Let us focus on the expected gains of other agents in the model. In particular, for the minority shareholders in the sole board and codetermination system, they are respectively equal to:

$$P_{Dw}[(1-\alpha)(\pi - w)] \tag{12}$$

$$P_S[(1-\alpha)(\pi - w)] \tag{13}$$

If the conditions in section 6 are respected, $P_{Dw} > P_S$ and the expected gains are higher in the codetermination system. In this situation, there is also a greater protection of the minority shareholders' interests as claimed by Fauver and Fuers (2006) and it may also reduce the conflict of interests between large and minority shareholders (Villalonga and Amit, 2006).

The manager can choose among two possible investment projects, getting private benefits b_1 from project 1 (with probability $\varepsilon_S^* e_S^*$), and b_2 from project 2, with probability $e_S^*(1-\varepsilon_S^*)$. Given these conditions the manager's expected gains in the single board are equal to:

$$e_S^*[\varepsilon_S^* b_1 + (1-\varepsilon_S^*)b_2] - (e_S^*)^2/2 \tag{14}$$

where:

$(e_S^*)^2/2 =$ effort's cost for the manager in the single board

In codetermination, the expected gains are equal to:

$$e_{Dw}^* b_2 - (e_{Dw}^*)^2/2 \tag{15}$$

where:

$(e_{Dw}^*)^2/2 =$ effort's cost for the manager in codetermination

If we compare (14) and (15) we note that the manager prefers a governance's system of codetermination, because the choice of the project is entirely delegated to him, who then always chooses project 2 when informed, obtaining private benefits equal to b_2 greater than b_1. As shown in section 4, in the case of sole board the manager's effort is negatively correlated to the large shareholder's effort; therefore, in the sole board there is uncertainty on the amount of private benefits that the manager can appropriate. In codetermination, however, he gets for sure private benefits equal to b_2 when informed.

Finally, the workers' expected gains in codetermination and in the one-tier system are respectively equal to $wP_{Dw} - e_{Dw}^*(M_w^*)^2/2$ and wP_S. In the first case, the workers incur in the monitoring cost. It is the cost to be paid to have the possibility to make decisions in the firm, a cost that they do not support in the sole board. So, for the workers is important that the probability of generating gains in the codetermination system, P_{Dw}, is large enough compared to P_S, to offset this cost, and/or to be able to do it, the benefits that workers (e.g. a

smaller likelihood of layoffs, strikes, unions power) enjoy in this role inside the board in the firm. So, as hypothesized by Fauver and Fuers, there is like an inverted U-shaped (figure 2) linked to the benefits that the workers obtain with a codetermination system. In the initial part of the curve not only the benefits for the company increase, but also those for the workers in terms of more involvement in the company operations and less probability of layoffs and strikes. Nevertheless, the workers have a monitoring cost to pay in order to have such benefits, a cost that is not supported in the single board. As long as this cost is not so high, the workers prefer the codetermination system because the benefits exceed the disadvantages. When the cost is too high, the workers prefer the sole board, because the cost can offset any advantages obtained. For this reason in the second part of the curve there may be also a decrease of benefits for the company because the workers could acquire too much power and thinking more about their salary than the value of the firm at the shareholders' expense. Furthermore in this part of the curve are also increasing the private benefits of the large shareholder, so he could be incentivised to activate only a low level of monitoring acting as free-rider with the intent of taking excessive advantage from the workers.

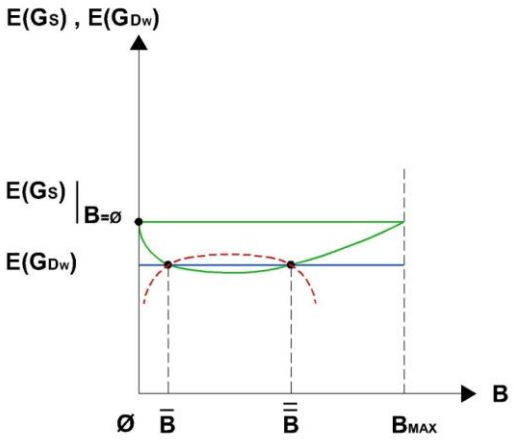

Figure 2. Inverted U-shaped

8. Conclusions

The codetermination system, like a standard dual board, has the benefit of valuing the role of managers, but at the same time, there is also a higher intensity of monitoring. The prices to be paid for the large shareholder are two: the exclusion from the management board and therefore from the investment decisions and the presence of workers on the supervisory board. However, the large shareholder could choose a codetermination system due to a greater return in expected gains. Graziano and Luporini (2012) show a similar conclusion in a dual board case without workers, analysing only the large shareholder's expected gains. The total welfare of the firm's system without workers is analyzed by Forcillo (2017b).

This chapter shows that by adopting the codetermination system, which provides the inclusion of workers with the large shareholder on the board, and by analysing not only his expected gains, but those of all agents in the model, everyone has the opportunity to obtain higher expected gains, without this affecting the well-being of others, in a situation closer to an allocation Pareto optimal. This result is significant: it means that the same large shareholder could decide to implement such structure. Or, if he may get a very large quantity of private benefits by choosing the one-tier structure, an external controller (such as the Government) may decide to intervene, correcting any distortion of the governance system and impose by law, the board's structure and the conditions which guarantee a higher social welfare in the firm system. Furthermore, if we refer to European policy, at the same time, the adoption of a system of codetermination follows the guidelines set out by the European Union (Simons and Kluge, 2004). In addition, considering an analysis on a larger scale and taking into account other major world economic, such as Italy, the US and UK, this gives to the workers the possibility to be directly involved in the important business decisions, in a kind of direct democracy in the company. This may ensure a better quality of work for the workers and for the firm itself, in terms of reduction of layoffs, more involvement for the workers and thus the possibility to have wages for their family livelihood, and in terms of a decrease in collective strikes and production block for the company.

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Appendix.

To prove the part on expected gains, we can rewrite $E(G_S)$ and $E(G_{Dw})$ as follows:

$$E(G_S) = \alpha[\lambda \mathrm{J_H} \mathrm{e_S^{H*}} + (1-\lambda)\mathrm{J_L}\mathrm{e_S^{L*}}] + (\varepsilon_S^*)^2/2 \tag{16}$$

where $\mathrm{J_H} \equiv (\pi - w)\mathrm{p^H} - (M^*)^2/2\alpha$

$\mathrm{J_L} \equiv (\pi - w)[\mathrm{p^L}(1-M^*) + \left(\mathrm{p^H}\lambda + \mathrm{p^L}(1-\lambda)\right)M^*] - (M^*)^2/2\alpha$

$$E(G_{Dw}) = \alpha[\lambda \mathrm{Y_H} \mathrm{e_{Dw}^{H*}} + (1-\lambda)\mathrm{Y_L}\mathrm{e_{Dw}^{L*}}] \tag{17}$$

where $\mathrm{Y_H} \equiv (\pi - w)\mathrm{p^H} - (M_{LS}^*)^2/2\alpha$

$\mathrm{Y_L} \equiv (\pi - w)[\mathrm{p^L}(1-M^{**}) + \left(\mathrm{p^H}\lambda + \mathrm{p^L}(1-\lambda)\right)M^{**}] - (M_{LS}^*)^2/2\alpha$

Note that:
$(M_{LS}^*)^2/2\alpha = (M^*)^2/2\alpha$, so $J_H = Y_H$ and we call both J_H. $Y_L > J_L$ because $M^{**} > M^*$.

Taking the derivative of (16) with respect to B we obtain:

$$\frac{\partial E(G_S)}{\partial B} = \alpha\left[\mathrm{J_H}\lambda\frac{-\mathrm{b_2}\mathrm{K_H}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}}{[1+\mathrm{B}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}]^2} + \mathrm{J_L}(1-\lambda)\frac{-\mathrm{b_2}\mathrm{K_L}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}}{[1+\mathrm{B}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}]^2} + \varepsilon_S^*\frac{-\mathrm{b_2}\mathrm{K}}{[1+\mathrm{B}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}]^2}\right] =$$

$$\frac{\mathrm{b_2}\mathrm{K}}{[1+\mathrm{B}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}]^2}\{-\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1}) + \varepsilon_S^*\}$$

$\frac{\mathrm{b_2}\mathrm{K}}{[1+\mathrm{B}(\mathrm{b_2}-\mathrm{b_1})\mathrm{K}]^2}$ is always positive. So the sign depends on $\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1})$.

We can have four cases:

1) if $\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1}) \geq 1$, the function is continuously decreasing from $E(G_S)_{B=0}$, touching once $E(G_{Dw})$. Red curve in figure 3;

2) if $\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1}) < 1$, the function is first decreasing for low values of B when $\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1}) > \varepsilon_S^*$ and increasing for higher values of B when $\alpha[\lambda \mathrm{J_H}\mathrm{K_H} + (1-\lambda)\mathrm{J_L}\mathrm{K_L}](\mathrm{b_2}-\mathrm{b_1}) < \varepsilon_S^*$, never touching $E(G_{Dw})$. Yellow curve in figure 3;

3) if $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) < 1$, the function is first decreasing for low values of B when $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) > \varepsilon_S^*$ and increasing for higher values of B when $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) < \varepsilon_S^*$, touching once $E(G_{Dw})$. Orange curve in figure 3;

4) if $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) < 1$ the function is first decreasing for low values of B when $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) > \varepsilon_S^*$ and increasing for higher values of B when $\alpha[\lambda J_H K_H + (1-\lambda)J_L K_L](b_2 - b_1) < \varepsilon_S^*$, touching twice $E(G_{Dw})$. Green curve in figure 3.

In the fourth case to be sure that two values of B exist, we need two conditions. We know that $E(G_S)_{B=0} > E(G_{Dw})$ because $J_L > Y_L \frac{(1-M^{**})}{(1-M^*)}$. $e_{Dw}^i = b_2 K_i^w \;\; i = H, L$ where $K_H^w = K_H = 1$,so we call both K_H. $\varepsilon_S^* = 0$ when $B = 0$; if $B \to B_{max}$ for $\varepsilon_S^* \to 1$, e_S^i asymptotically tends to $b_1 K_i$. For a mid value of private benefits, $B_{mid} = \frac{1}{(b_1+b_2)K}$, $\varepsilon_S^* = 1/2$ and $e_S^i = \left(\frac{b_1+b_2}{2}\right) K_i, i = H, L$. So, we can rewrite $E(G_S)_{Bmid}$, $E(G_S)_{B\to Bmax}$ and $E(G_{Dw})$ as:

$$E(G_S)_{Bmid} = \alpha\left(\frac{b_1+b_2}{2}\right)[\lambda J_H K_H + (1-\lambda)J_L K_L] + 1/8$$

$$E(G_S)_{B\to Bmax} = \alpha b_1[\lambda J_H K_H + (1-\lambda)J_L K_L] + 1/2$$

$$E(G_{Dw}) = \alpha b_2[\lambda J_H K_H + (1-\lambda)Y_L K_L^w]$$

For $B = B_{mid}$, $E(G_{Dw}) > E(G_S)_{B=Bmid}$, or $E(G_{Dw}) - E(G_S)_{B=Bmid} > 0$:

$$\alpha b_2[\lambda J_H K_H + (1-\lambda)Y_L K_L^w] - \alpha\left(\frac{b_1+b_2}{2}\right)[\lambda J_H K_H + (1-\lambda)J_L K_L] - 1/8 > 0$$

For $B \to B_{max}$, $E(G_S)_{B\to Bmax} \geq E(G_{Dw})$, or $E(G_S)_{B\to Bmax} - E(G_{Dw}) \geq 0$:

$$\alpha b_1[\lambda J_H K_H + (1-\lambda)J_L K_L] + 1/2 - \alpha b_2[\lambda J_H K_H + (1-\lambda)Y_L K_L^w] \geq 0$$

So, when $\alpha[\lambda J_H K_H(b_2 - b_1) + (1-\lambda)(2b_2 Y_L K_L^w - (b_2 + b_1)J_L K_L)] > 1/4$, and $\alpha[\lambda J_H K_H(b_2 - b_1) + (1-\lambda)(b_2 Y_L K_L^w - b_1 J_L K_L)] \leq 1/2$, $\bar{B}$ and $\bar{\bar{B}}$ both exist.

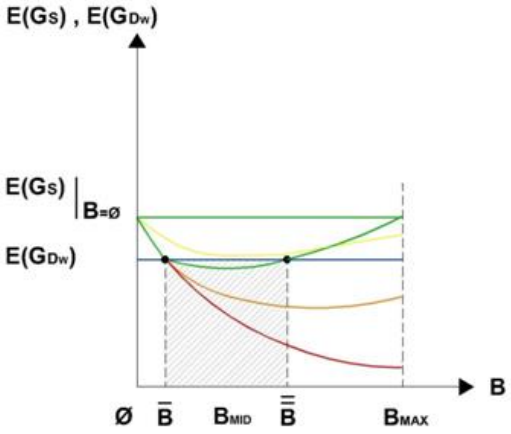

Figure 3. Trend of $E(G_S)$.