Workers behavior and labor contract : an evolutionary approach*

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Abstract

This article investigates the co-evolution of labor relationships and workers preferences. According to recent experimental economics findings on *social preferences*, the workforce is assumed to be heterogeneous. It is composed by both *cooperative* and *non-cooperative* workers. In addition, firms differ by the type of contract they offer (*explicit* or *implicit*). Finally, both the distribution of preferences and the nature of labor contract are endogeneized. On the one hand, firms can invest in *corporate culture* in order to change workers preferences. On the other hand, the relative proportion of each type of contract is driven by an evolutionary process. The complementarity between the transmission of cooperation and the implementation of *implicit contracts* leads to multiple equilibria which allow for path-dependence. This property is illustrated by evolutions of American and Japanese labor contracts during the twentieth century.

JEL Codes: D64, D86, Z10.

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1 Introduction

The international comparisons of employment relationships and contractual practices in large manufacturing firms lead to the emergence of two major and antagonistic models. On the one hand, the liberal one, which is based on explicit and legally enforceable agreements between employees and employers. On the other hand, the coordinated one where implicit and ambiguous employment contracts dominate. Japan and United States are regarded as distinctive representant of respectively the coordinated model and the liberal one.[1] This co-existence of different types of contract deviates from the traditional economic explanations. Indeed, the standard principal-agent theory predicts that an *explicit contract* provides more incentives to workers than an *implicit contract*. Consequently, this latter should have vanished over time.

The aim of this article is to provide an explanation for the persistent implementation of *implicit contracts* and to the international differences in the nature of the labor relationships. I consider that two types of workers co-exist: *cooperative* ones and *non-cooperative* ones. Firms are also heterogenous, they offer either an *implicit* (IC) or an *explicit contract* (EC). Moreover, both the distribution of preferences and the proportion of each type of contract evolve over time. Firms can invest in *corporate culture* in order to change workers preferences. Whereas, evolutions of the contractual structure is driven by an evolutionary process. The complementarity between the transmission of cooperation and the implementation of *implicit contracts* leads to the existence of multiple equilibria. This property could be at the origin of the international differences empirically pointed out.

The existence of *cooperative* agents is highlighted by an extensive experimental literature on social preferences. These agents do not behave in a selfish way, *i.e.* their own actions are not only driven by extrinsic motivation (as the reward/punishment scheme) but rather by intrinsic motivations (as trust or possibilities of involvement). Fehr and co-authors show that a significant proportion of subjects behaves reciprocally and provides a positive effort even if an *implicit contract* is proposed (see Fehr & Gätcher (2000) for a survey).[2] Then, *implicit contracts* seem to provide intrinsic work mo-

[1] See, for instance, Hall and Soskice (2001) on the institutional diversity across major industrial countries.

[2] These experimental results are obtained even in one-shot interaction. In this framework, the possibility of subsequent gains do not constitute motivations for cooperation.

tivation to agents who exhibit preferences for reciprocity. Moreover, Fehr & Gätcher (2000) and Frey (1997) show that extrinsic motivation crowd out these intrinsic motivations. As a result, if the proportion of reciprocator workers (workers who exhibit preferences for reciprocity) is large enough, the implementation of *implicit contracts* induces more incentives than *explicit contract*. Then, it could be the optimal choice of a firm.[3]

A direct implication of these findings is that cultural differences between countries can lead to international differences in the nature of labor contracts. This argument reintroduces older views on the distinction between American and Japanese style of management. According to these perspectives, the origin of this discrepancy comes from cultural differences between the two societies (see Morigushi (2000) for further discussions). The more cooperative nature of the Japanese workforce would explain the adoption of the *implicit contract*. However, taking the culture (in our framework, the distribution of preferences) as given, exogenous and invariant over time, it fails to explain the evolution of labor relationships within the two countries. Morigushi (2000, 2003) highlights that evolutions of American and Japanese labor relationships, during the twentieth century, were accurately similar until 1930's and diverged since the Great Depression. According to these facts, preferences of American and Japanese workers were relatively close at the begining of the twentieth century but evolved in different ways since the Great Depression. To comply with these facts, the culture has to be considered as an endogenous variable.

The literature on the cultural transmission of preferences, originated by works of Cavalli-Sforza & Feldman (1981) and Boyd & Richerson (1985), provides the tools to endogenize the distribution of preference for *reciprocity*. It highlights the role of the vertical transmission of preferences, that is the transmission from parents to children. Bisin & Verdier (2001) go beyond by considering this vertical transmission as endogenous. Indeed, parents can make socialization efforts in order to transmit their own preferences to their children. In this framework, Bisin *et al.* (2004) and Olcina & Peñarrubia (2004) analyze the evolution of cooperation. I depart from this framework assuming that firms, as parents in Bisin and Verdier model, invest in *corporate culture* in order to shape preferences of their workers. In addition, I show

[3]Alternative explanations for the implementation of *implicit contracts* exist but the existence of social preferences seem to provide the most relevant explanation (see Bowles (2000)).

that the main results of Bisin & Verdier (2001) (*cultural substitution* property and heterogeneity of preferences at the equilibrium) still hold. The idea that firms spend ressources to influence workers preferences is introduced by Lazear (1995) in a genetic model. Rob and Zemski (2002) also consider that firms are able to affect the process of preferences formation through the incentive scheme they chosen. The present article is a first attempt to build bridges between litterature on *corporate culture* and models of preferences transmission.

Since decisions of *non-cooperative* workers are only ruled by material payoffs while *cooperative* ones react to intrinsic motivations, *cooperative* (respectively *non-cooperative*) workers make more effort if the contract is *implicit* (respectively *explicit*). It results in a complementarity between the transmission of cooperation and the implementation of *implicit contracts*. Indeed, on the one hand, firms which offer an *implicit contract* spend resources to instill *cooperative* preferences to their workers. On the other hand, if the proportion of *cooperative* workers is high, the relative profit of an *IC* firm is important. It induces a spread of the *implicit contract*.

The property of complementarity implies that two countries having close initial conditions can follow distinct trajectories and converge to different long-run situations. Two long-run equilibria are stable, the *IC-equilibrium* (where firms adopt the *implicit contract* and the workforce is *cooperative*) and the *EC-equilibrium* (where *explicit contract* dominates and workers are *non-cooperative*). It also induces the possibility of path dependence since exogenous shocks have a lasting impact on the contract evolution. As an illustration, consider an economy which converges towards the *IC-equilibrium*. During the convergence, both the proportion of *implicit contracts* and the proportion of *cooperative* workers increase. Consider now an exogenous shock in favor of the *explicit contract*. The model predicts that the effects of this shock depend on the structure of preferences (*i.e.* the proportion of each type of workers) in the economy where it occurs. Indeed, the gain of adopting the *explicit contract* is positively related to the proportion of *non-cooperative* workers. Along the path of convergence towards the *IC-equilibrium*, an early shock occurs when the proportion of *non-cooperative* workers is still sufficiently important. Then, it enhances the probability of bifurcation towards the *EC-equilibrium*.

These results comply with the evolution of American and Japanese style of management during the twentieth century. Indeed, Jacoby (1985) and Moriguchi (2000, 2003) highlight that U.S. and Japan were on the same path

until 1930's. It is characterized by the transition from an *explicit contract* to a more *implicit contract*.[4] The Great Depression appears to constitute a change in the trajectory associated with the return of the *explicit contract* in the large American manufactures. According to these facts, the American workers were sufficiently *cooperative* at the beginning of the twentieth century to allow for the adoption of the *implicit contracts*. However, economic shocks, as the Great Depression, seem to be able to break out the cooperation. In the model, the periods of economic recessions can be interpreted as exogenous shocks in support of the *explicit contract*. The Great Depression deeply affected the U.S. economy at a moment where the implementation of the *implicit contracting* was limited and consequently the level of cooperation of the workforce still low. Then, it could explain why the *implicit contract* has been phased out. A comparable shock occurred in Japan almost two decades later (the Japanese post-war depression). At this time, the *implicit contract* was a generalized practice and the level of *cooperation* was sufficiently high to avoid the spread of the *explicit contracts*. Hence, differences in the timing of the shocks may have induced long-term divergences in the type of labor relationships and the distribution of preferences between the two countries.

These findings are in line with Morigushi (2000, 2003, 2005). However, our theoretical framework differs broadly from Morigushi's one. She considers an employment system as an equilibrium outcome of a repeated game between workers and firms. This game presents multiple equilibria and the selection of equilibrium depends on the *institutional capital* (level of trust) accumulated by the economy. Hence, culture is assimilated to this *institutional capital* and to beliefs on the behaviors of other players. In our framework, the culture is a distribution of preferences, which evolves over time. Taking into account heterogenous preferences allows to obtain the results of Morigushi without considering repeated interactions between firms and workers. However, the proportion of *cooperative* workers in the present model could be interpreted as *institutional capital* in the Morigushi's studies. Greater is this proportion, higher is the probability to sustain cooperation between employers and workers.

[4]These transition towards the *implicit contracting* manifested by the spread of corporate welfare in both countries (Moriguchi (2000, 2003)). This phenomenon is also perceptible in Britain, France and Germany. However, Jacoby (1985) notices that, among these countries, the United State and Japan have the more in common (for instance, the spread of corporate welfare preceded the rise of welfare state in the two countries).

The next section introduces the two worker types (*cooperative* and *non-cooperative*) and the two contract types (*implicit* and *explicit*). It also sets out the main assumptions of the model. In section 3, the short-run equilibrium is analyzed. Section 4 endogenizes the distribution of preferences and the distribution of labor contracts. Section 5 presents the long-run dynamics. Section 6 offers observations on the predictions of the model. Finally, section 7 concludes.

2 The model

2.1 Basic structure

The economy is composed of a continuum of firms and a continuum of workers. Both the population of firms and the population of workers are heterogeneous. Two types of firm co-exist, the type IC offers an *implicit contract* and the type EC offers an *explicit contract*. Thus, p_t denotes the proportion of IC firms and $(1-p_t)$ is the proportion of EC firms. Changes in p_t will be driven by an evolutionary process. The population of workers is constituted by a proportion q_t of *cooperative* (or reciprocator) workers and a proportion $(1-q_t)$ of *non-cooperative* (or selfish) workers. Each worker lives one period and has one child.[5]

A date t is divided into two sub-periods. At the beginning of the first sub-period, each worker is randomly matched with a firm and executes the contract proposed by it.[6] This contract spans over the two sub-periods. It is assumed that the firm cannot observe the type of the worker, but knows the distribution of preferences (*i.e.* q_t). Moreover, firms have the possibility to invest in business culture in order to shape employees preferences. If this investment succeeds, preferences of worker may change between the first and the second sub-period. At the end of the date t, each worker perfectly transmits his preferences to his child.

[5]To simplify a non-overlapping structure has been chosen. This assumption does not influence the results of the model.

[6]It could be profitable for the worker to reject this contract and to look for another one. This possibility is ruled out assuming that a new match is costly. If this cost is sufficiently high, workers always choose to accept the contract. Such an assumption is obviously restrictive but it allows to focus on workers' effort incentives. Considering also the choices of participation would make the analysis more complex.

2.2 Nature of the contract

An *implicit contract* is specific as it is not legally enforceable. Employers and employees involve in an exchange of commitments. The employee promises to provide effort and cooperation and the employer commits to provide non-contractable benefits to him. Since the contract is not enforceable, the commitment can be unilaterally broken up without costs and with legal impunity.

Conversely, the *explicit contract* specifies precisely the worker's tasks and earnings. It allows for the supervision of employees. If a worker does not accomplish these specific tasks and is detected, he is dismissed. This threat of dismissal provides extrinsic motivations to effort for workers.

2.3 Cooperative and non-cooperative types

A *cooperative* worker (indexed by c) exhibits preferences for reciprocity. The trust granted by the principal (the firm) represents an incentive for *cooperative* agents to provide an effort. In this case, a well specified contract that enables a low degree of freedom (*explicit contract*) is considered as a sign of distrust and implies a loss of utility (Frey (1997)). Moreover, a *cooperative* worker suffers a loss whenever either himself or the company chooses to cooperate while the other does not.

A *non-cooperative* worker (indexed by nc) is assumed to be self-regarding. His decisions are independent from the potential intrinsic motivations provided by a contract and are only ruled by extrinsic motivations.

2.4 What is corporate culture?

This model is based on the definition of *corporate culture* highlighted by Lazear (1995): It implies an initial explicit investment in order to modify workers preferences.[7] This definition complies with historical studies of Jacoby (1985) and Moriguchi (2003, 2005). They highlight that many large American and Japanese firms created *corporate culture* thanks to costly per-

[7]Lazear writes:"*Corporate culture is thought to change the way that workers choose to act without using direct monitoring and compensation. It generally requires an initial investment that instills a particular set of values in its workers so that they behave in the desired fashion as a natural consequence of utility maximization.*"

sonnel programs of socialization and education which promoted a spirit of employer-employee cooperation.[8]

This investment will be introduced through the preferences transmission mechanism proposed by Bisin and Verdier (2001). They assume that parents can invest in order to increase the probability to transmit their own preferences to their children. In our context, firms spend resources so that workers adopt preferences that fits with its goals. Thus, EC (respectively IC) firms invest in *corporate culture* in order to convert a *cooperative* (*non-cooperative*) worker into a *non-cooperative* (*cooperative*) one. The probability of sucess of this conversion equals the amount invested in *corporate culture* (denoted τ^{ς}, $\varsigma \in \{IC, EC\}$). The costs of this investment has the following form: $C(\tau^{\varsigma}) = (\tau^{\varsigma})^2 / 2k$, with k a sufficiently low parameter to ensure that $\tau^{\varsigma} \in [0, 1]$.

3 Short-run equilibrium

This section focuses on the optimal choices of firms and workers at a date t. First, we consider the case where the contract is *explicit* then we study the case of an *implicit contract*.

3.1 Explicit contract

3.1.1 Timing

An *explicit contract* consists in a wage w for each sub-period and a specified set of tasks.[9] To perform these tasks, the worker has to choose his level of effort at the beginning of each sub-period. The choice set is discrete ($e_i^c \in \{\bar{e}, \underline{e}\}$ and $e_i^{nc} \in \{\bar{e}, \underline{e}\}$ respectively denote the effort choice of a *cooperative* worker and of a *non-cooperative* worker for the sub-period i, with $i \in \{1, 2\}$). Then, for each sub-period, worker has to choose between working and shirking.

Concerning the firm, the specification of the tasks allows it to check out workers effort with a positive probability s. A detected shirker is dismissed and not paid. Moreover, at the beginning of the first sub-period, the firms

[8] Those programs took the form of picnics or field days, athletic clubs, social gatherings, employee associations or magazines, corporate training...

[9] To simplify, it is assumed that the wage is the same for sub-period 1 and sub-period 2.

choose a level of *corporate culture* (τ^{EC}). Figure 1 summarizes the timing of decisions of both the worker and the firm.

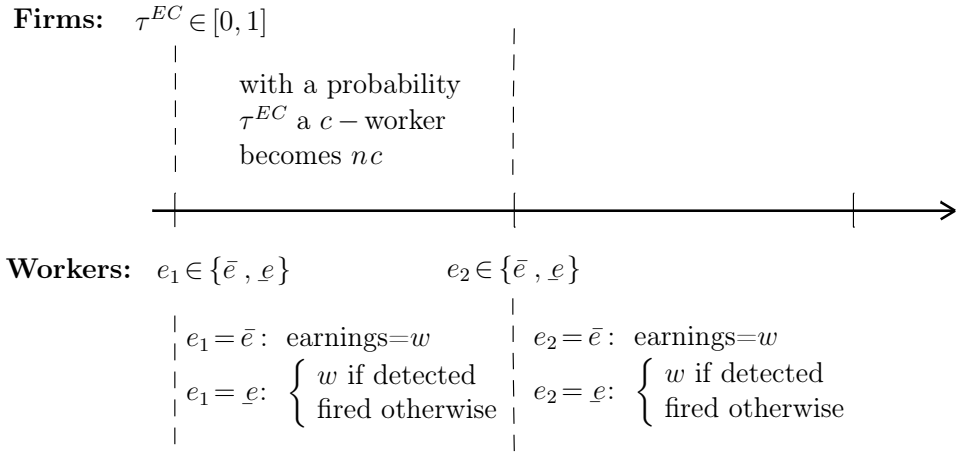


Fig. 1. *Timing of firms and workers decisions when the contract is explicit*

In the following sub-sections, I determine the optimal levels of workers effort. Then, these efforts being given, I deduce the optimal level of investment in *corporate culture*.

3.1.2 Effort choice of workers

On one hand, *Non-cooperative* workers suffer a disutility of effort d when they choose $\bar{e}$. On the other hand, in line with experimental findings, *cooperative* workers consider the implementation of an *explicit contract* as a sign of distrust. This feeling induces a subjective cost modelled as an additional disutility of effort. $D > d$ denotes the total disutility of effort (objective and subjective) by sub-period for *cooperative* workers.

Hence, if a *cooperative* worker chooses to work during one sub-period, his payoffs, for this sub-period, are equal to $w - D$. However, as mentioned previously, if he chooses to shirk, he receives w with a probability $(1 - s)$, otherwise, he is dismissed without wage. Notice that, if a worker who shirks during the first sub-period is detected and dismissed, he can not work during the second one. Consequently he receives no wages during the two sub-

periods (see (3) and (4)). Expressions (1)-(4) summarize these assumptions.[10]

$$
\begin{aligned}
U^c(\bar{e},\bar{e};EC) &= 2(w-D) && (1)\\
U^c(\bar{e},\underline{e};EC) &= w-D+(1-s)w && (2)\\
U^c(\underline{e},\bar{e};EC) &= (1-s)w+(1-s)(w-D) && (3)\\
U^c(\underline{e},\underline{e};EC) &= (1-s)w+(1-s)^2w && (4)
\end{aligned}
$$

The expected utilities of a *non-cooperative* worker are deduce in the same way. The only difference is the level of effort disutility (equal to D for a *cooperative* worker and to d for a *non-cooperative*):

$$
\begin{aligned}
U^{nc}(\bar{e},\bar{e};EC) &= 2(w-d) && (5)\\
U^{nc}(\bar{e},\underline{e};EC) &= w-d+(1-s)w && (6)\\
U^{nc}(\underline{e},\bar{e};EC) &= (1-s)w+(1-s)(w-d) && (7)\\
U^{nc}(\underline{e},\underline{e};EC) &= (1-s)w+(1-s)^2w && (8)
\end{aligned}
$$

The model assumes that the two types of agent have different preferences. To obtain my dynamical results, this differences have to be large enough to ensure that workers behave differently depending on their preferences. The fact that different preferences induce various behaviors in the workplace has been highlighted by many empirical studies (see Bowles *et al.* (2001) for a survey). Moreover, experimental findings show that extrinsic motivation (based on rewards and punishments, here w and s) may crowd out intrinsic motivations for agents who exhibit preferences for reciprocity, and then lead them to a lower level of effort (see Fehr and Gätcher (2000) for a survey). The following assumption results in *cooperative* and *non-cooperative* workers to behave in different ways:

$$[1-(1-s)^2]w > D > sw > d \qquad (9)$$

Lemma 1 directly follows.

Lemma 1 *Under condition (9), if an explicit contract is proposed, cooperative workers always choose to work in the first sub-period and to shirk in the second one:* $e_1^c = \bar{e}$ *and* $e_2^c = \underline{e}$*; non-cooperative workers work for the two sub-periods:* $e_1^{nc} = e_2^{nc} = \bar{e}$.

[10] $U^{\mu}(e_1^{\mu}, e_2^{\mu}; \varsigma)$ denotes the expected utility of a worker with preferences $\mu \in \{c, nc\}$ choosing the level of efforts e_1 and e_2, for a contract $\varsigma \in \{IC, EC\}$. This utility is assumed to be linear in the payoffs.

The probability to detect a shirker is sufficiently high compared to the disutility of a *non-cooperative* worker (d) to ensure that this type of worker always chooses to work. For a *cooperative* worker, the probability to be fired is obviously higher if he shirks during the two sub-periods rather than during only one. Under condition (9), the value of D is such that a *cooperative* worker has no incentive to shirk during the first sub-period ($[1-(1-s)^2]w > D$). However, since $D > sw$, he will choose the low level of effort during the second sub-period. Hence, results of Lemma 1 hold.[11]

3.1.3 Investment in corporate culture

The output per worker is stochastic and depends on the level of worker's effort. The level of effort $\bar{e}$ (respectively $\underline{e}$) induces a level of output H with probability $\bar{\pi} > 1/2$ and a level of output L with a probability $(1-\bar{\pi})$ (respectively H with probability $(1-\bar{\pi})$ and L with a probability $\bar{\pi}$), with $H > L$. Let define π^H (the expected output when the worker chooses $\bar{e}$) and π^L (the expected output when the worker chooses $\underline{e}$):

$$\pi^H \equiv \bar{\pi}H + (1-\bar{\pi})L \tag{10}$$

$$\pi^L \equiv \bar{\pi}L + (1-\bar{\pi})H \tag{11}$$

It follows that $\pi^H > \pi^L$. In addition, costs of production (ψ) are assumed to be exogenous and constant.[12] The randomness of the output implies that the firm can not deduce workers' behavior from its observation.

Since (by Lemma 1) *cooperative* workers will choose $e_2^c = \underline{e}$, a firm which proposes *explicit contract* has incentives to shape worker's preference in order to make them *non-cooperative*. At the begining of each period t, the firm has the possibility to invest in *corporate culture*. As noticed in section 2.4, this investment will determine the probability for a *cooperative* worker to become *non-cooperative* during the first sub-period (see Figure 1). The expected

[11]Notice that condition (9) can be relaxed: other conditions would ensure that *cooperative* and *non-cooperative* workers do not respond to the same incentives. For example, under the assumption that: $D > [1-(1-s)^2]w > sw > d$, *cooperative* workers always shirk and *non-cooperative* workers always work. Under this alternative assumption, the results of the model will be qualitatively unaffected but analytically more complicated.

[12]Results are unaffected if the production costs correspond to the wages paid. However, this assumption would make the analysis more complicated. Indeed, it makes necessary to take into account the fact that a shirker is not paid with a probability s.

profit of an EC firm choosing a level of investment $\tau^{EC} = \tau$ is denoted $\Pi^{EC}(\tau; q_t)$:

$$\Pi^{EC}(\tau; q_t) = (1 - q_t)2\pi^H + q_t \left[\tau 2\pi^H + (1 - \tau)(\pi^H + \pi^L)\right] - \psi - C(\tau) \quad (12)$$

Indeed, with probability $(1 - q_t)$ the firm is matched with a *non-cooperative worker* which chooses the high level of effort for the two sub-periods (see Lemma 1) and then which induce an expected profit equal to $2\pi^H$. Conversely, the firm is matched with a *cooperative* worker with a probability q_t. This type of worker chooses $\bar{e}$ for the first sub-period and $\underline{e}$ for the second. However, with a probability τ, the investment of *corporate culture* is successful and the *cooperative* worker becomes *non-cooperative* (choosing $\bar{e}$ for the second sub-period). Expression (12) directly yields:

$$\Pi^{EC}(\tau; q_t) = 2\pi^H - \psi - q_t\Delta\pi + q_t\tau\Delta\pi - C(\tau) \quad (13)$$

with $\Delta\pi = \pi^H - \pi^L$. The firm EC chooses the value of τ which maximizes the expected profit (13). This optimal value is:

$$\tau^{EC} = q_t k \Delta\pi \quad (14)$$

The level of investment in *corporate culture* is an increasing function of q_t. Indeed, benefits of this investment derive from the change in the preferences of *cooperative* workers. Then, the higher is the probability for the firm to be matched with a *cooperative* worker, the higher are these benefits.

As it will be shown in section 4.2, this result induces preferences heterogeneity at the equilibrium. A similar result is obtained by Bisin and Verdier (2001) by assuming a two-step process of socialization, the first step (the vertical socialization) and the second step (the horizontal one) being substitutes. Here, the property of *cultural subsitution* is obtained in a simple way (in a one step process), it comes from the fact that the incentives, for a firm, to instill the appropriate preferences are decreasing with the proportion of agents which exhibit these preferences.

In addition, τ^{EC} is increasing in $\Delta\pi$ which measures the rise of output induced by the change of preferences of a *cooperative* worker.

Substituting (14) into (13) it follows the optimal profit of an EC firm:

$$\Pi^{EC}(\tau^{EC}; q_t) = 2\pi^H - \psi - q_t\Delta\pi + \frac{k}{2}(q_t)^2(\Delta\pi)^2 \quad (15)$$

3.2 Implicit contract

3.2.1 Timing

As the *explicit* one, the *implicit contract* spans over the two sub-periods. It consists in a fixed wage w by sub-period (assumed to be similar to the wage specified by an *explicit contract*) and the promise of an additional payment δ in exchange of workers effort and cooperation.[13] Such an exchange of commitments is by nature non enforceable. The firm can respect the contract (*Cooperate* and choose $\delta = \bar{\delta} > 0$) or not (*Renege* and choose $\delta = 0$). In the same way, the worker can cooperate ($\bar{e}$) or not ($\underline{e}$). Workers receive δ, and then observe if the firm honored its promise, at the end of first sub-period (after having chosen e_1 but before choosing e_2). In addition, since the contract is not enforceable, the firm cannot protect itself against shirking behavior of workers. This timing of decisions is represented in Figure 2.

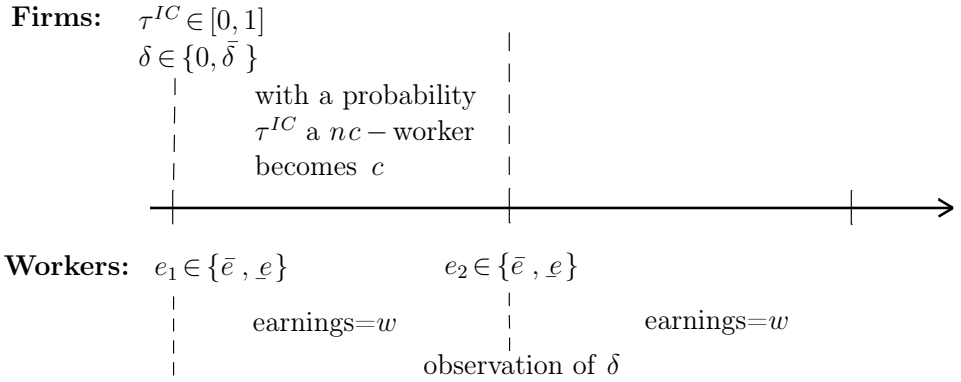


Fig. 2. *Timing of firms and workers decisions when the contract is implicit*

[13]Notice that δ may be a non-monetary reward, as the implementation of corporate welfare programs (see Moriguchi (2000) and (2003) for illustrations of corporate welfare programs set up both in Japan and in U.S.). In the same way, the effort expected from workers may be *higher* than $\bar{e}$. For instance, it may consist in an investment in specific human capital (see Moriguchi (2005)). To simplify, I assume that $\bar{e}$ is the same if the contract is *implicit* or *explicit*.

3.2.2 Effort choice of workers

If the contract is *implicit*, shirkers can not be detected and fired, then there are no extrinsic motivation for effort. However, the *implicit contract* provides intrinsic motivations to *cooperative* workers.

Since *non-cooperative* workers are not characterized by other-regarding preferences, their choices are unaffected by the behavior of the firm. Their effort disutility is the same that in the case of an *explicit contract* (d). Conversely, *cooperative* workers value the possibilities of involvement and the trust granted by the firm which do not supervise them. As a consequence, they suffer no effort disutility.[14] However, they suffer a subjective cost (denoted c) in the case of non-cooperative outcome. In the first sub-period (before the potential paiement of δ), the expected utilities of, respectively a *cooperative* and a *non-cooperative* worker, are:

$$U_1^c(e_1^c = \bar{e}; IC) = w \tag{16}$$
$$U_1^c(e_1^c = \underline{e}; IC) = w - c \tag{17}$$
$$U_1^{nc}(e_1^{nc} = \bar{e}; IC) = w - d \tag{18}$$
$$U_1^{nc}(e_1^{nc} = \underline{e}; IC) = w \tag{19}$$

Expression (17) implies that a *cooperative* worker is subject to a psychological cost c when he shirks in the first sub-period. Indeed, it is costly for him to not cooperate when the firm gives the possibility to do it. This worker suffers the same cost in the second sub-period if he chooses $\bar{e}$ while the firm has reneged on its promises (choosing $\delta = 0$). This effect is illustrated by the expected utility functions of the second sub-period:

$$U_2^c(e_2^c = \bar{e}; IC) = \begin{cases} w - c & \text{if} \quad \delta = 0 \\ w + \bar{\delta} & \text{if} \quad \delta = \bar{\delta} \end{cases} \tag{20}$$
$$U_2^c(e_2^c = \underline{e}; IC) = \begin{cases} w & \text{if} \quad \delta = 0 \\ w + \bar{\delta} - c & \text{if} \quad \delta = \bar{\delta} \end{cases} \tag{21}$$
$$U_2^{nc}(e_2^{nc} = \bar{e}; IC) = \begin{cases} w - d & \text{if} \quad \delta = 0 \\ w - d + \bar{\delta} & \text{if} \quad \delta = \bar{\delta} \end{cases} \tag{22}$$
$$U_2^{nc}(e_2^{nc} = \underline{e}; IC) = \begin{cases} w & \text{if} \quad \delta = 0 \\ w + \bar{\delta} & \text{if} \quad \delta = \bar{\delta} \end{cases} \tag{23}$$

[14]The fact that the effect of intrinsic motivations fully compensates a potential work disutility is a simplification without consequences on the conclusions of the model.

The fact that a *cooperative* agent suffers a cost when his trust is betrayed (see (20)) but also when he betrays (see (21)) is a standard assumption in the literature on social preferences (see, for instance Guttman (2003)). However, this condition is not a necessary one. Alternatively, I could assume that a *cooperative* agent suffers when the firm reneges whatever his own behavior. As pointed out in the previous subsection, a sufficient condition to obtain my results is that the two types of worker do not adopt the same behavior for, at least, one sub-period. By expressions(16)-(19)and(20)-(23), the results of the following Lemma are straightforward:

Lemma 2 *If an implicit contract is proposed, non-cooperative workers always choose to shirk:* $e_1^{nc} = e_2^{nc} = \underline{e}$. *Cooperative workers always work if the firm chooses* $\delta = \bar{\delta}$*:* $e_1^c = e_2^c = \bar{e}$*, while they only work during the first sub-period and shirk during the second:* $e_1^c = \bar{e}$ *and* $e_2^c = \underline{e}$ *if the firm chooses* $\delta = 0$.

Since workers cannot be fired, the choices of first and second sub-periods are independent. By (16)-(19), it is obvious that the lack of extrinsic motivations implies that *non-cooperative* workers shirk in first sub-period. While, intrinsic motivations are sufficiently strong for *cooperative* workers to ensure that they choose $\bar{e}$. For the second sub-period, workers observe δ before to make their choices of effort. By (20)-(23), *non-cooperative* workers choose $\underline{e}$ whatever the behavior of the firm and *cooperative* ones choose $\bar{e}$ (respectively $\underline{e}$) if $\delta = \bar{\delta}$ (respectively $\delta = 0$).

The following subsections focus on the choice of *corporate culture* investment in the case where $\delta = \bar{\delta}$. Then, I will study in which cases the firm have incentives to choose $\delta = 0$.

3.2.3 Investment in corporate culture

As for the *explicit contract*, $\bar{e}$ (respectively $\underline{e}$) induces an expected output of π^H (respectively π^L) and ψ denotes the costs of production. Furthermore, the cooperation (choice of $\bar{e}$ by the worker and of $\delta = \bar{\delta}$ by the firm) induces an additional output denoted γ in second sub-period.[15]

The investment in *corporate culture* has the same properties than in the case of an *explicit contract*: firms choose τ^{IC} in order to maximize its expected profits. The expected profit of an IC firm choosing δ and τ is denoted

[15]The fact that the cooperation between the firm and the worker increases the joint surplus is well documented (see Kandel & Pearson (2001) and Moriguchi (2000)).

$\Pi^{IC}(\delta, \tau; q_t)$. By Lemma 2, for a given value of $\tau^{IC} = \tau$ and if the firm cooperates (choice of $\delta = \bar{\delta}$), its expected profit is:

$$\Pi^{IC}(\bar{\delta}, \tau; q_t) = q_t(2\pi^H + \gamma) + (1 - q_t)\left[\tau(\pi^H + \pi^L + \gamma) + (1 - \tau)2\pi^L\right] - \psi - \bar{\delta} - C(\tau) \tag{24}$$

Indeed, if the firm is matched with a *non-cooperative* worker, he becomes *cooperative* with a probability τ. If his preferences change, the worker change its behavior of second sub-period, choosing $e_2 = \bar{e}$. Such a change of behavior provides an expected output of $\pi^H + \gamma$ instead of π^L.

It follows from (24):

$$\Pi^{IC}(\bar{\delta}, \tau; q_t) = 2\pi^L - \psi - \bar{\delta} + q_t(2\Delta\pi + \gamma) + (1 - q_t)\tau(\Delta\pi + \gamma) - C(\tau) \tag{25}$$

then, the optimal value of τ is:

$$\tau^{IC} = (1 - q_t)k(\Delta\pi + \gamma) \tag{26}$$

τ^{IC} is an increasing function of the proportion of *non-cooperative* workers. Indeed, these latter increase their effort if the firm succeeds in modifying their preferences. Then, the property of *cultural substitution* also holds Moreover, τ^{IC} rises with $\Delta\pi + \gamma$, the additional output allowed by the change of *non-cooperative* workers behavior.

Finally, the profit of the firm is:

$$\Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t) = 2\pi^L - \psi - \bar{\delta} + q_t(2\Delta\pi + \gamma) + \frac{k}{2}(1 - q_t)^2(\Delta\pi + \gamma)^2 \tag{27}$$

3.2.4 When will a firm renege?

If the firm decides to renege on its promises ($\delta = 0$), both *non-cooperative* and *cooperative* workers choose the low level of effort during the second sub-period. Hence, the firm has no incentive to change workers preferences and its investment in *corporate culture* will be null. As a consequence, the profit of a firm choosing to renege is:

$$\Pi^{IC}(0, 0; q_t) = q_t(\pi^H + \pi^L) + (1 - q_t)2\pi^L - \psi = 2\pi^L + q_t\Delta\pi - \psi \tag{28}$$

The following Lemma sets in which cases an IC firm has incentives to renege on its promises and to choose $\delta = 0$.

Lemma 3 *For k low enough and if $\bar{\delta} < \Delta\pi + \gamma$, there exists a threshold $\bar{q} \in [0,1]$ such as, if $q_t < \bar{q}$ the firm prefers $\delta = 0$ and if $q_t \geq \bar{q}$ the firm chooses $\delta = \bar{\delta}$.*

Proof The firm chooses to renege ($\delta = 0$) if $\Pi^{IC}(0,0;q_t) > \Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)$. From (28): $\Pi^{IC}(0,0;0) = 2\pi^L - \psi$ and $\Pi^{IC}(0,0;1) = \pi^H + \pi^L - \psi$. From (27): $\Pi^{IC}(\bar{\delta}, \tau^{IC}; 0) = 2\pi^L - \psi - \bar{\delta} + (k/2)(\Delta\pi + \gamma)^2 < \Pi^{IC}(0,0;0)$ for k low enough, and $\Pi^{IC}(\bar{\delta}, \tau^{IC}; 1) = 2\pi^H + \gamma - \psi - \bar{\delta} > \Pi^{IC}(0,0;1)$ if $\bar{\delta} < \Delta\pi + \gamma$. Moreover, $\Pi^{IC}(0,0,q_t)$ is linearly increasing in q_t and:

$$\frac{\partial \Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)}{\partial q_t} = 2\Delta\pi + \gamma - k(1-q_t)(\Delta\pi + \gamma)^2 \tag{29}$$

which is positive for k low enough. It is straightforward that:

$$\frac{\partial^2 \Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)}{\partial q_t^2} > 0 \tag{30}$$

then, $\Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)$ is increasing and convex in q_t. Consequently, $\Pi^{IC}(0,0;q_t)$ and $\Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)$ intersect only ones and $\Pi^{IC}(0,0;q_t)$ is higher (respectively lower) than $\Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)$ if q_t is lower (respectively higher) than $\bar{q}$. □

The assumption $\bar{\delta} < \Delta\pi + \gamma$ ensures that the net gains of cooperation are positive. If it is violated, firms which implement an *implicit contract* never choose to honor it. In the case where the assumption is respected, if q_t is sufficiently low (lower than $\bar{q}$), the benefits allowed by the high level of effort of *cooperative* workers during the second sub-period are too low to compensate the cost δ. Then, firms prefer to renege.

4 The evolutionary set-up

4.1 Evolution of labor relationships

At the end of each date, firms which offer the less profitable contract have a positive probability to be replaced by firms which offer the alternative contract. This probability of change is assumed to be an increasing function of the profit differences (see Nelson & Winter (2002) for further discussions). Thus, the evolution of p_t between the date t and $t+1$ is given by the rule[16]:

$$\Delta p_t = p_{t+1} - p_t = p_t(1-p_t)\varphi(\Pi_t^{IC}(q_t) - \Pi_t^{EC}(q_t)) \tag{31}$$

[16]See the Appendix for a formal analysis.

where φ is a positive constant, low enough to ensure that $\varphi(\Pi_t^{IC}(q_t) - \Pi_t^{EC}(q_t)) \in (0,1)$. It reflects the fact that, greater is the payoff difference, higher is the probability that a firm having the less successful form of contract disappears due to the competitive pressure. The expression of $\Pi_t^{EC}(q_t)$ is given by (15) ($\Pi_t^{EC}(q_t) \equiv \Pi^{EC}(\tau^{EC}; q_t)$) and, by Lemma 3:

$$\Pi_t^{IC}(q_t) = \begin{cases} \Pi^{IC}(0,0;q_t) & \text{if} \quad q_t < \bar{q} \\ \Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t) & \text{if} \quad q_t \geq \bar{q} \end{cases} \tag{32}$$

The following Lemma describes the evolution of p_t according to the value of q_t.

Lemma 4 *For k low enough and $\bar{\delta} < \Delta\pi + \gamma$, there exists a unique $\tilde{q} \in [0,1]$ such that:*

$$\begin{cases} \Delta p_t < 0 & \text{if} \quad q_t < \tilde{q} \\ \Delta p_t = 0 & \text{if} \quad q_t = \tilde{q} \\ \Delta p_t > 0 & \text{if} \quad q_t > \tilde{q} \end{cases} \tag{33}$$

moreover $\tilde{q} > \bar{q}$.

Proof It is straightforward that $\Pi^{IC}(0,0;q_t) < \Pi^{EC}(\tau^{EC};q_t)$, then $\Pi_t^{EC}(q_t) > \Pi_t^{IC}(q_t)$ for all $q_t \in [0,\bar{q}]$. In addition:

$$\Pi^{IC}(\bar{\delta}, \tau^{IC}; \bar{q}) = \Pi^{IC}(0,0;\bar{q}) < \Pi^{EC}(\tau^{EC};\bar{q}) \tag{34}$$

and from the proof of Lemma 3, $\Pi^{IC}(\bar{\delta}, \tau^{IC}; q_t)$ is increasing and convex in q_t. $\Pi^{EC}(\tau^{EC};1) = 2\pi^H - \psi - \Delta\pi + (k/2)(\Delta\pi)^2 < \Pi^{IC}(\bar{\delta}, \tau^{IC};1)$ for k low enough and $\bar{\delta} < \Delta\pi + \gamma$. Furthermore:

$$\frac{\partial \Pi^{EC}(\tau^{EC};q_t)}{\partial q_t} = -\Delta\pi + kq_t(\Delta\pi)^2 \tag{35}$$

which is negative for k low enough. It directly comes that:

$$\frac{\partial^2 \Pi^{EC}(\tau^{EC};q_t)}{\partial q_t^2} > 0 \tag{36}$$

then $\Pi^{EC}(\tau^{EC};q_t)$ is decreasing and convex in q_t. Hence, there exists $\tilde{q} \in (\bar{q},1]$ such as, if $q_t \gtreqless \tilde{q}$ then $\Pi_t^{IC}(q_t) \gtreqless \Pi_t^{EC}(q_t)$. □

Figure 3 illustrates these results by depicting the value of Δp_t as a function of q_t for a given p_t and for k low enough.

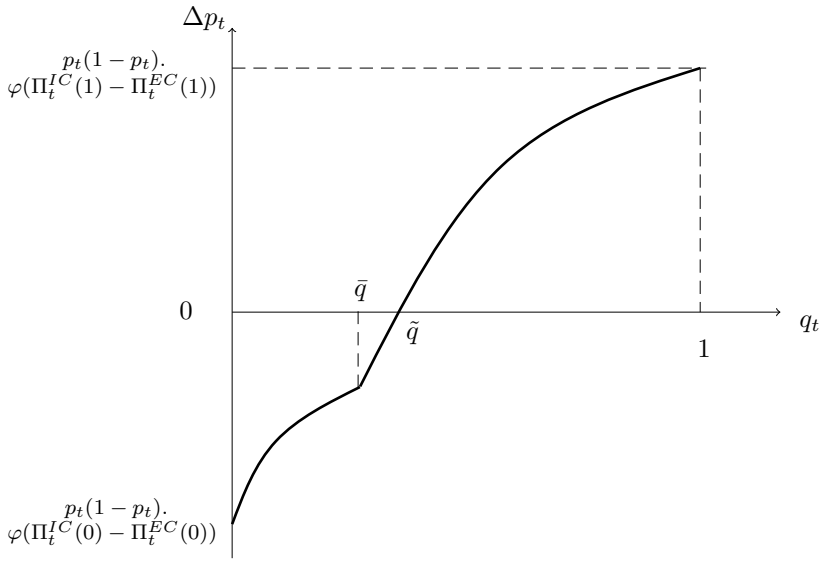


Fig. 3. *Variation of p_t function of q_t*

Cooperative (respectively *non-cooperative*) workers display higher effort if the contract is *implicit* (respectively *explicit*). Hence, the proportion of *cooperative* workers has to be high enough ($q_t > \tilde{q}$) to ensure that $\Pi_t^{IC}(q_t) > \Pi_t^{EC}(q_t)$, and then to induce an increase of p_t. Notice that, if the IC firms renege on their promises (in the case where $q_t < \bar{q}$), the *explicit contract* always allows to get a higher profit, then the proportion of *implicit contract* decreases.

4.2 Evolution of preferences

In order to analyze the process of evolution of preferences, it is necessary to study the probability for a worker to change his preferences during his life. A *cooperative* worker has a probability p_t to be matched with an IC firm, in this case his preferences does not vary. With a probability $(1 - p_t)$, he is matched with an EC firm and changes of preferences with a probability τ^{EC}. In the same way, a *non-cooperative* worker converts his preferences only if he is matched with an IC firm, which occurs with probability p_t, and if the *corporate culture* investment of the firm succeeds, which happens with probability τ^{IC}.

$P_t^{i,j}$ denotes the probability for a worker born in t with preference i to finish his life with preference j. I deduce the probability for each type of worker to keep his preferences unchanged:

$$P_t^{c,c} = p_t + (1-p_t)(1-\tau^{EC}) = p_t + (1-p_t)(1-q_t k\Delta\pi) \tag{37}$$

$$\begin{aligned} P_t^{nc,nc} &= (1-p_t) + p_t(1-\tau^{IC}) \\ &= \begin{cases} 1 & \text{if} \quad q_t < \bar{q} \\ 1 - p_t + p_t(1-(1-q_t)k(\Delta\pi+\gamma)) & \text{if} \quad q_t \geq \bar{q} \end{cases} \end{aligned} \tag{38}$$

If $q_t < \bar{q}$, the IC firms do not invest in *corporate culture*, thus *non-cooperative* workers preserve their preferences with probability one. Since, at the end of their life, parents perfectly transmit their preferences to their children:

$$q_{t+1} = P_t^{c,c} q_t + (1 - P_t^{nc,nc})(1-q_t) \tag{39}$$

by substitution of (37) and (38) in (39):

$$\Delta q_t = q_{t+1} - q_t = \begin{cases} -(q_t)^2(1-p_t)k\Delta\pi & \text{if} \quad q_t < \bar{q} \\ (1-q_t)^2 p_t k(\Delta\pi+\gamma) - (q_t)^2(1-p_t)k\Delta\pi & \text{if} \quad q_t \geq \bar{q} \end{cases} \tag{40}$$

The following Lemma describes the dynamics of q_t for a given p_t:

Lemma 5 *For a given value of p_t, there exists an unique $\hat{q}(p_t) \in [0,1]$ such that:*

i if $q_t < \bar{q}$: $\Delta q_t < 0$

ii if $q_t \geq \bar{q}$:

$$\begin{cases} \Delta q_t < 0 & \text{if} \quad q_t > \hat{q}(p_t) \\ \Delta q_t = 0 & \text{if} \quad q_t = \hat{q}(p_t) \\ \Delta q_t > 0 & \text{if} \quad q_t < \hat{q}(p_t) \end{cases} \tag{41}$$

Proof From expression (40), it is straightforward that $\Delta q_t < 0$ when $q_t < \bar{q}$. Define the function $\eta(q_t) \equiv (1-q_t)^2 p_t k(\Delta\pi+\gamma) - (q_t)^2(1-p_t)k\Delta\pi$: $\eta(0) = p_t k(\Delta\pi+\gamma) > 0$, $\eta(1) = -(1-p_t)k\Delta\pi < 0$ and

$$\frac{\eta(q_t)}{\partial q_t} = -2[(1-q_t)p_t k(\Delta\pi+\gamma) + q_t(1-p_t)k\Delta\pi] < 0$$

Then there exists a function of p_t, denoted $\hat{q}(p_t) \in [0,1]$ such that, if $q_t \gtreqless \hat{q}(p_t)$ then $\eta(q_t) \lesseqgtr 0$. Since $\eta(q_t)$ equals Δq_t for $q_t \geq \bar{q}$, the Lemma's results directly follow. □

Figure 4 illustrates the results of Lemma 5 by describing the dynamics of q_t for a given value of p_t. If $q_t < \bar{q}$, IC firms renege and have no incentives to invest in corporate culture, since the effort of EC firms to instill *non-cooperative* behavior is positive, the proportion of *cooperative* workers decreases. Moreover, Figure 4 shows the stability of the interior equilibrium $\hat{q}(p_t)$. This stability comes from the properties of *corporate culture* invest-

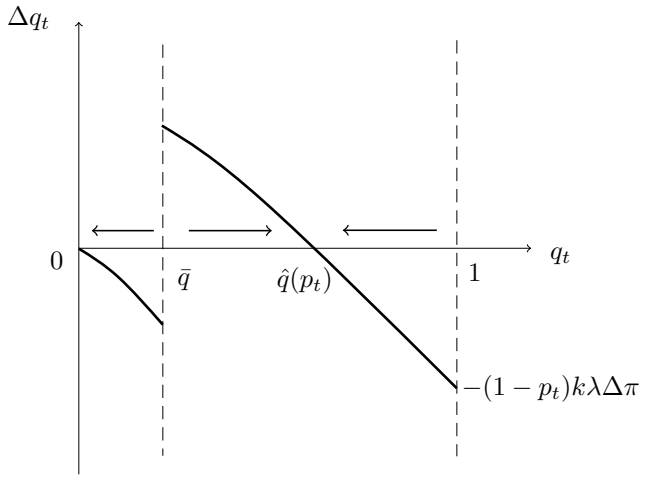


Fig. 4. *Dynamics of q_t for a given value of p_t such that $\hat{q}(p_t) > \bar{q}$*

ment (see expressions (14) and (26)). Indeed, greater is the proportion q_t, higher (respectively lower) are the incentives for an EC firm (respectively an IC firm) to instill *non-cooperative* behaviors (respectively *cooperative* behaviors). Then, if q_t is great, the efforts to instill *non-cooperative* preferences will be higher than the efforts to instill *cooperative* preferences. As a consequence, q_t will decrease.

Moreover, notice that the steady state $\hat{q}(p_t)$ is an increasing function of p_t. The greater is the proportion of firms which propose the *implicit contract*, the higher is the probability to be matched with a firm which aims at instilling *cooperative* behaviors. When $p_t = 1$, $\hat{q}(1) = 1$, then q_t converges towards 1. Indeed, $p_t = 1$ means that a worker cannot be matched with a EC firm, then

non-cooperative behaviors cannot expand. In the same way, when $p_t = 0$, $\hat{q}(0) = 0$.

5 Long-run dynamics

5.1 Co-evolution between preferences and labor relationships

Figure 3 and 4 show that the dynamics of q_t depends on the value of p_t and the dynamics of p_t depends on the value of q_t. To study the dynamical process $(p_t, q_t)_{t\geq 0}$, I first characterize the locus of stationarity of p_t and q_t (pp locus and qq locus), then I focus on the phase diagram describing the co-evolution of p_t and q_t.

5.1.1 The pp locus

Let pp be the locus of all pairs (p_t, q_t) such that the proportion of IC firms, p_t, is in a steady state: $pp \equiv \{(p_t, q_t) : p_{t+1} = p_t\}$. From (31), $\Delta p_t = 0$ when $p_t = 0$ and $p_t = 1$. It comes from the evolutionary process: when p_t is equal to 0 or 1, the population of firms is homogenous, hence no observation and adoption of an alternative way to contracting can happen. Moreover, by Lemma 4, $\Delta p_t = 0$ when $q_t = \tilde{q}$. Then, the pp locus consists of two horizontal lines: $p = 0$, $p = 1$ and one vertical line $q = \tilde{q}$.

5.1.2 The qq locus

Let qq be the locus of all pairs (p_t, q_t) such that the proportion of *cooperative* workers, q_t, is in a steady state: $qq \equiv \{(p_t, q_t) : q_{t+1} = q_t\}$. From (40), the qq locus consists of the vertical line $q_t = 0$ and the function $p^{qq}(q_t)$ defines as:

$$p^{qq}(q_t) = \frac{(q_t)^2 \Delta\pi}{(1-q_t)^2(\Delta\pi + \gamma) + (q_t)^2 \Delta\pi} \tag{42}$$

Notice that, $p^{qq}(0) = 0$, $p^{qq}(1) = 1$ and:

$$\frac{\partial p^{qq}(q_t)}{\partial q_t} = \frac{q_t(1-q_t)2\Delta\pi(\Delta\pi + \gamma)}{[(1-q_t)^2(\Delta\pi + \gamma) + (q_t)^2\Delta\pi]^2} > 0 \tag{43}$$

then:

$$\frac{\partial p^{qq}(0)}{\partial q_t} = \frac{\partial p^{qq}(1)}{\partial q_t} = 0 \tag{44}$$

Then $p^{qq}(q_t)$ is represented in the plan (p_t, q_t) as an increasing function with a slope equals to zero in $q_t = 0$ and $q_t = 1$.

5.1.3 The phase diagram

From Lemma 4, the proportion of firms which propose the *implicit contract* increases (respectively decreases) when q_t is higher (respectively) lower than $\tilde{q}$. Moreover, from Lemma 5 the proportion of *cooperative* workers decreases when $q_t < \bar{q}$, while when $q_t \geq \bar{q}$, this proportion rises (respectively diminishes) when q_t is on the left side (respectively the right side) of $p^{qq}(q_t)$. It follows the phase diagram represented in Figure 5.

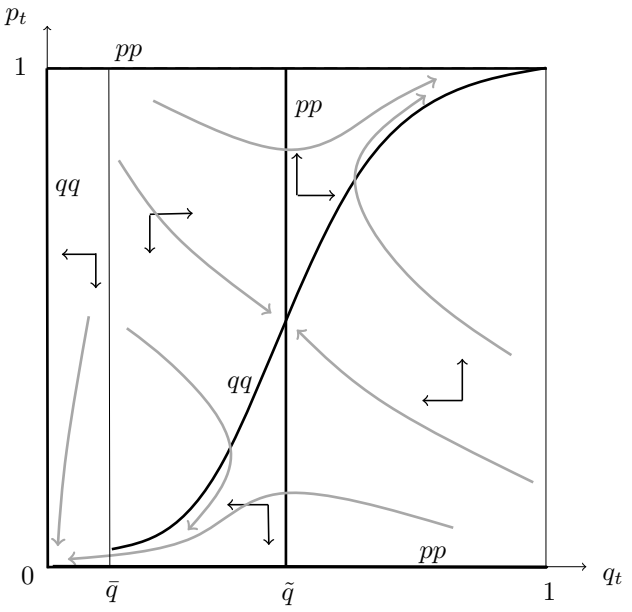


Fig. 5. *Co-evolution of* q_t *and* p_t

It shows that both equilibria $(0, 0)$, named the *EC-equilibrium*, and (1,1), named the *IC-equilibrium* are stable and that the dynamics admits a saddle point at the intersection of the qq locus and the pp locus. The presence of

multiple equilibria induces that, the long run steady state reached by one economy depends on the initial conditions. When q_0 is lower than $\bar{q}$, the economy converges towards $(0,0)$. When q_0 is higher than $\bar{q}$, two cases are possible: if (p_0, q_0) is under the saddle path, the economy converges towards $(0,0)$; if (p_0, q_0) is above the saddle path, the economy converges towards $(1,1)$.

The existence of a saddle path which share the plan (p_t, q_t) between the basin of attraction of $(0,0)$ and the basin of attraction of $(1,1)$ comes from the complementarity between *cooperative* behavior and the proportion of *implicit contracts*. On the one hand, when q_t is low, the relative profit of the IC firms is low and, through the evolutionary process, p_t decreases. On the other hand, a reduction of p_t constitutes a fall in the proportion of firms which attempt to instill preference for reciprocity and thus induces a decrease of q_t.

5.2 Effects of an economic slowdown

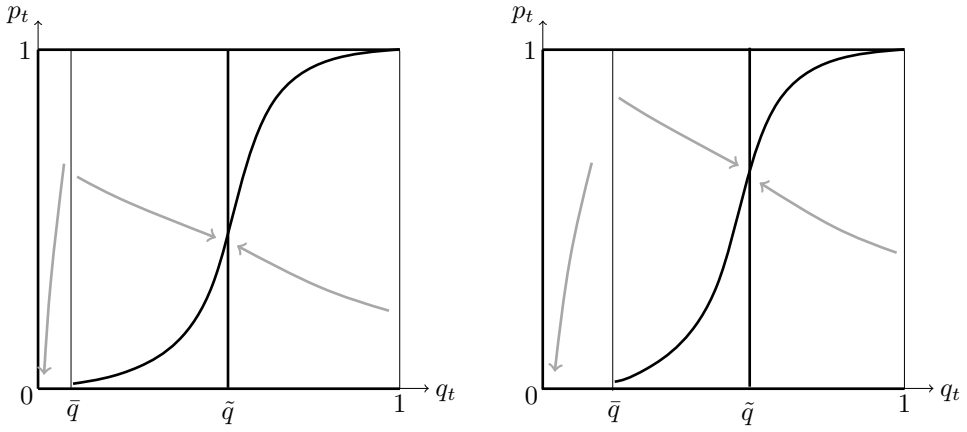
Economic depressions generate unemployment, labor force reallocations and then reduction of the average length of the employment relationship. Yet, gains of cooperation between a firm and a worker arise through a mutual trust, a sharing of information, implying a long-term contract and stability of labor relationship. Consequently, these gains, stemming from greater commitment of firm towards its employees, decrease during economic slowdowns (see Kandel & Pearson (2001) and Moriguchi (2000, 2003, 2005)). Hence, in our framework, a period of recession can be modelled as a fall of γ.

Proposition 1 describes the consequences of a fall of γ on the dynamics properties of the economy:

Proposition 1 *A decrease of γ rises the basin of attraction of the EC-equilibrium.*

Proof From (42), it is straightforward that a decrease of γ translates the qq locus upward. Moreover, since γ has no influence on $\Pi^{EC}(q_t)$ while it increases $\Pi^{IC}(\bar{\delta}, \tau^{IC}, q_t)$ (see expression (27)), a decrease of γ induces a rise of $\tilde{q}$. Then, a fall of γ induces a move of the saddle point up to the right. Finally, from the proof of Lemma 3 and for k low enough, it is straightforward that $\bar{q}$ is negatively related to γ. Thus, a decrease in γ shifts $\bar{q}$ to the right. □

Figure 6 illustrates the consequence of a negative shock on γ on the basin of attraction of the equilibrium (0,0).



(a) Saddle path before the fall (b) Saddle path after the fall

Fig. 6. *Impact of a fall of γ on the dynamical system*

Consider an initial situation (before the shock) where (p_0, q_0) is above the saddle path and $q_0 > \bar{q}$, then the economy converges towards (1,1). The consequences of a fall of γ depends on the date of such a shock. If it is early when it occurs, the proportions p_t and q_t are relatively low. Especially, if (p_t, q_t) is under the new saddle path, q_t decreases, becomes lower than $\tilde{q}$ and consequently p_t decreases too. In this case, the long run situation will be the *EC-equilibrium*. Notice that, during the process of convergence towards the *EC-equilibrium*, q_t becomes lower than $\bar{q}$. Hence (by Lemma 3), the *implicit contract* does not allow anymore for a commitment between the firm and the workforce. Such a widespread failure to meet their promises precipitates the fall of the *implicit contracting*.

Conversely, if the shock is late, at a moment where both the proportion of *cooperative* workers and *implicit contracts* are sufficiently large, the economy will pursue its path towards the *IC-equilibrium*.

6 Discussion

The previous section highlights the existence of multiple equilibria. As a result, the consequences of a shock depend in a crucial way on the distribution

of preferences when it occurs. These properties provide a possible explanation of the international differences in the type of contract. This discussion focuses on the comparison between the Japan and the U.S.

As mentioned previously, both in Japan and U.S., the *implicit contract* spread over at the beginning of the twentieth century. How explain that the American Great Depression induced a return to the *explicit contract* while a comparable shock in Japan (the post-war depression) did not affect the generalization of the *implicit contract*[17]? According to my analysis, earlier shock in U.S. played a central role. Indeed, this shock in favor of the *explicit contract* (see section 5.2) occurred in an economy where cooperative behaviors of both workers and firms were relatively low. Due to this lack of cooperation, the expected profit of a firm which had implemented an *implicit contract* fell and the *implicit contracts* rapidly disappeared. In the present model, the disappearance of the *implicit contract* comes with the reduction of the proportion of *cooperative* workers, which lead to a new increase of the relative profit of *explicit contracts* and to the end of the possibilities of commitments betweens firms and workers if the contract is *implicit*.[18] Conversely, the Japanese post-war depression happened as both the proportion of *implicit contracts* and *cooperative* workers had already raised. Consequently, when this shock occurred (even if its magnitude was similar to the American Great Depression) the expected profits of *implicit contracts* were sustained by the cooperative behavior of the workforce. Hence, the *explicit* form of contract failed to supplant the *implicit* form of contract.

When the proportion of *cooperative* workers becoms too low (q_t lower than $\bar{q}$), the cooperation is no more sustainable in the case of an *implicit contract*: this generates an irreversibility in the process of convergence towards the *EC-equilibrium*. Indeed, a wide increase in the proportion of IC firms or a rise in the gains of cooperation, in an economy which has reached the *EC-equilibrium*, will fail to spread cooperation. Then, the economy progressively gets back to its initial equilibrium. This irreversibility effect complies with the analysis of Moriguchi (2000, 2003, 2005). According to her, the fact that firms which proposed an *implicit contract* reneged on their promises fol-

[17]Obviously, the nature of these two shocks was different. However, the length and the extent of the Japanese depression should have induced similar negative consequences on the gain of cooperation.

[18]Moriguchi (2000, 2003, 2005) highlights the consequences of the Great Depression on the fall of *implicit contracting* in U.S.

lowing the Great Depression breaks down the mutual trust between workers and employers within the U.S. economy. She concludes, that this lack of trust prevented the return of cooperation and induced the emergence of new institutional forms (as the state welfare or industrial unionism).

7 Conclusion

Several studies point out the major role played by cultural factors in the international differences in labor relationships. However, few works explored the origins and evolution of such differences. The present paper aims at filling that gap, using experimental results on *social preferences* and theoretical mechanisms on the cultural transmission of these preferences. By doing this, it provides an example of the co-evolution between institutions (types of labor relationship) and culture (levels of cooperation).[19] In this framework, the level of cooperation of the workforce and the proportion of *implicit contracts* are complements. Indeed, the more cooperative are workers, the more profitable is the implementation of *implicit contracts*. Hence, this type of contract spread rapidly. In the same way, the increasing usage of the *implicit contract* implies more possibilities of diffusion for the *cooperative* behaviors. This complementarity induces the possibility of multiple long run equilibria. As a consequence, an exogenous shock may have long lasting impact both on the distribution of preferences and the way of contracting. As an illustration, the consequences of the timing of the Great Depression on the divergence between American and Japanese ways to contract on the labor market is highlighted. In this analysis, the cause of the emergence of two models (the American and the Japanese one) is not the character intrinsically more cooperative of the Japanese workers. Here, this feature is a product of the economic history and is co-determined with the nature of the labor relationship.

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[19]See Bowles (1998) for a motivation of such a line of research.

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Appendix

Formal analysis of the dynamics of p_t

Assume that at the end of each date t each firm observes both the contract and the profit of another firm randomly chosen. Consider x the firm which observes (its profits in t are denoted Π_t^x) and y the firm which is observed (its profits in t are denoted Π_t^y). If x and y have the same contract, x retained its contract. In the same way, if x and y have different contracts and $\Pi_t^x > \Pi_t^y$, x retains its contract. Finally, if x and y have different contracts and if $\Pi_t^y > \Pi_t^x$, x adopts the contract of y with a probability $\varphi(\Pi_t^y - \Pi_t^x)$.

$Q_t^{i,j}$ denotes the probability for a firm which has the contract i at date t to have the contract j at date $t+1$. I deduce from this evolutionary process the following probability of transition:

$$Q_t^{IC,IC} = p_t + (1 - p_t) \min\{1, 1 - \varphi(\Pi_t^{EC}(q_t) - \Pi^{IC}(q_t))\}$$

Indeed, with a probability p_t, a firm IC observes a firm of same type and does not change its contract. With a probability $(1-p_t)$ it observes a firm EC and changes its contract with a probability $\varphi(\Pi_t^{EC}(q_t) - \Pi^{IC}(q_t))$ only if $\Pi_t^{EC}(q_t) > \Pi^{IC}(q_t)$. In the same way, it yields:

$$Q_t^{EC,IC} = p_t \max\{0, \varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))\}$$

The dynamics of p_t is deduced from these probabilities of transition:

$$p_{t+1} = p_t Q_t^{IC,IC} + (1-p_t) Q_t^{EC,IC}$$

In the case where the expected profit of the EC firms is higher than the expected profit of the IC firms ($\Pi_t^{EC}(q_t) > \Pi^{IC}(q_t)$), I obtain :

$$\min\{1, 1 - \varphi(\Pi_t^{EC}(q_t) - \Pi^{IC}(q_t))\} = 1 - \varphi(\Pi_t^{EC}(q_t) - \Pi^{IC}(q_t))$$

$$\max\{0, \varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))\} = 0$$

and

$$p_{t+1} = p_t + p_t(1-p_t)\varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))$$

If $\Pi_t^{EC}(q_t) < \Pi^{IC}(q_t)$:

$$\min\{1, 1 - \varphi(\Pi_t^{EC}(q_t) - \Pi^{IC}(q_t))\} = 1$$

$$\max\{0, \varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))\} = \varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))$$

and it follows:

$$p_{t+1} = p_t + p_t(1-p_t)\varphi(\Pi_t^{IC}(q_t) - \Pi^{EC}(q_t))$$