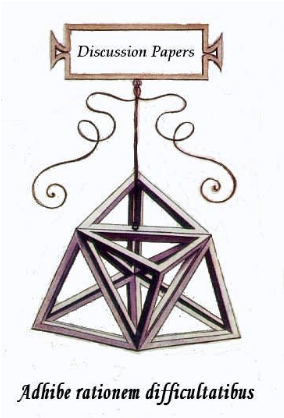
Discussion Papers
Collana di
E-papers del Dipartimento di Scienze Economiche – Università di Pisa



Maurizio Lisciandra

The Role of Reciprocating Behaviour in Contract Choice

Discussion Paper n. 65

2007

Discussion Paper n. 65, presentato: **febbraio 2007**

Author's Address:
Dipartimento di Studi su Politica, Diritto e Società G. Mosca,
Università di Palermo, Piazza Bologni 8, 90134 Palermo – Italy

Email: lisciandra@cantab.net

Acknowledgement

This paper draws on Chapter 4 of my Ph.D. dissertation, which is still unpublished. I would like to thank Prof. David Perez-Castrillo (Universitat Autònoma de Barcelona), Prof. William Brown (University of Cambridge), and especially Prof. Marco Casari (Purdue University) for their helpful comments and suggestions. The usual disclaimer applies.

Please quote as follows:
Maurizio Lisciandra (2007), "The Role of Reciprocating Behaviour in Contract Choice", Discussion Papers del Dipartimento di Scienze Economiche – Università di Pisa, n. 63 (http://www-dse.ec.unipi.it/ricerca/discussion-papers.htm).

Discussion Paper
n. 00

Maurizio Lisciandra

The Role of Reciprocating Behaviour in Contract Choice

Abstract
The Role of Reciprocating Behaviour in Contract Choice

This paper will use some deviations from the standard homo ïconomicus paradigm in order to offer further insights into the contractual choice in labour interactions. This introduces several facets of incentive enforcement, co-operative behaviour, and contractual (in)completeness. The theoretical modelling draws on an original definition of reciprocity and makes use of important parameters that are missing from the previous analyses of this type, such as technology, cost of contract enforcement, maximum willingness to reciprocate. The paper will assess whether signalling is an optimal and practicable strategy and investigate whether reputation, through repeated interactions, induces different equilibria compared to the one-shot game. Finally, further micro-foundation will be provided for those studies that experimentally show that trust and reciprocity might represent efficiency-enhancing variables.

JEL: C7, D86, K12
Keywords: Incentives, Reciprocity, Labour Contracts, Incompleteness

Contents

1. Introduction

The standard homo œconomicus paradigm assumes that individuals respond exclusively to economic drives. This paper will use some deviations from this main proposition in order to offer further insights into the contractual choice in labour interactions. Drawing from the incremental knowledge brought about by modern behavioural and experimental economics, labour economics can expand and improve its investigations for a better understanding of its main research areas. Theoretical investigations on labour contracting suffer very much from the restrictive paradigms imposed by standard competitive theory and new approaches based on additional motivational drives appear promising or, in many regards, already academically established.

The experimental investigations carried out by several economists during the last years drew attention to the role of emotional and reciprocal behaviour as well as social norms as important driving forces that lead agents to deal with the complexity of labour contracts. References would be the analyses of Fehr, Klein, and Schmidt (2001), Falk and Gachter (1999), Fehr, Gachter, and Kirchsteiger (1997), to cite only a few authors.[1] This recent literature has been concerned with the specification of preferences that could incorporate psychological effects. At the same time, it has been focused on producing evidence that could support the Pareto superiority of certain contract settings, wherein reciprocal behaviour plays a major role. In particular, Fehr, Klein, and Schmidt (*ibid.*) investigated the contractual choice of principals with different inequity aversions in order to explain why incomplete contracts, which do not rely on effort enforcement and verification by third parties, were often superior to complete contracts, in which reciprocity had less importance.

The main ideas are therefore derived from this literature: in the principal-agent theory, contracts rely on the court of law and/or reputation as enforcement devices, but equally important enforcement mechanisms can be found in the role of fair-mindedness and reciprocity. When the former devices are not present, in order to enforce a specific effort level a share of fair-minded

[1] For an extensive overview on this topic, see Fehr and Schmidt (2001).

and reciprocal principals must exist. In fact, suppose there are only self-regarding principals. A bonus contract, which is based on a gentleman's agreement where the principal pays the agent after the latter has supplied the agreed effort, can never be realised under the standard assumptions on preferences. Selfish principals would never pay the bonus after an agent has fulfilled his commitment, since self-regarding principals would not recognise any value to the employee's action. If all principals were known to be selfish, no agent would accept such an agreement.[2] However, these very incomplete contracts are common and often realised. For instance, in some jobs, pay takes the form of performance-related bonus, which firms actually pay despite there being no legal obligation to do so. By preserving the standard economic assumptions, folk-theorem-like explanations are introduced in order to explain this regularity; however one-shot interactions, where deviations from the standard preferences are allowed, can explain co-operative behaviour, and sometimes they represent the most appropriate explanations.[3]

In the following, two different contracts will be compared: a fully incomplete one, like the bonus contract, and a fully complete one, where no deviation from a written contract is allowed. Firstly, in a one-shot game, the choice between these two contractual typologies is theoretically investigated according to different degrees of diffusion of reciprocal attitude among principals. At the same time, the theoretical model will make use of other important parameters, which are missing from the previous analyses of this kind, such as technology, cost of contract enforcement, and maximum willingness to reciprocate. Further investigations about their role in the sub-game perfect equilibria through static analyses will be carried out. In other words, those conditions in which an incomplete contract is preferable to a complete contract and vice versa will be identified. Furthermore, the model will introduce emotion-drive agents so as to understand to which extent agents with different preferences would change the contractual choices of principals. The investigation will also cover issues like signalling and reputation, so as to

[2] No threat is assumed. A threat would render less incomplete the contract. Self-regarding principals would consequently act with a strategic behaviour, and therefore according to the degree of the threat they would pay the bonus.

[3] Think trivially about tipping in those restaurants where interactions happen only once.

evaluate whether signalling is an optimal and practicable strategy and whether reputation effects, through repeated interactions, induce different equilibria compared to the one-shot game. Finally, since trust and reciprocity appear to have efficiency-enhancing features also according to other investigations applied to countries and organisations,[4] this paper will provide further micro-foundation for these studies by means of welfare analyses that will describe the best practice that would achieve the most efficient production surplus.

A clarification should be given right at the outset about which definition of reciprocity is going to be used, because this term, given its complexity, is still not supported by a well-defined paradigm. The following model introduces preferences that incorporate reciprocal behaviour by means of a psychological impact which is consequential to the outcome of an action (i.e., one's own action or the counterpart's action). No evaluation of the intentions underlying the action will be included in the model. Authors like Rabin (1993 and 1998), and Falk and Fischbacher (2000) have sustained the importance of intentions in the psychology of reciprocity. More recently, Bolton and Ockenfels (2000) and Fehr and Schmidt (1999) adopted a definition of reciprocity in terms of inequity aversion. However, social norms, to which individuals can be sometimes more responsive and which can consequently hold back the role of private intentions, are equally important, so that what eventually matters is the consequence of a specific action and the psychological impact deriving from the action-outcome sequence. In principle, the following analysis is not even interested in the main causes of the reciprocal behaviour because, in this setting, players' reciprocal response is supported by a general psychological impact on the fair/unfair behaviour of the counterpart or the party itself. This allows an immediate focus on the outcome of any interaction, and a significant simplification of the setting to be analysed.

Hence, the theoretical investigation carried out in this paper introduces individuals who experience emotions.[5] To be specific, in a principal-agent model, a fraction of principals will experience psychological costs when breaching an incomplete agreement and psychological gains from its

[4] See, for example La Porta et al. (1997), and Bohnet, Frey, and Huck (2000).
[5] On this topic, see for example Loewenstein (2000).

fulfilment. These individuals have a preference for honesty, which is missing from self-regarding principals who respond only to mere economic drives. In the same fashion, a fraction of agents can also experience a psychological impact, but this time this is caused by the principal's action, since the principal can cheat or reward the agents' trust and their consequent effort exertion.

The results of this investigation are mainly derived from complex analytical and graphical simulations. The adoption of mathematical software allowed the composition of often-complicated solutions of optimisation problems, which could not otherwise be interpreted. The paper is organised as follows. In Section 2, the general specification of the model is presented by setting out the utility functions and the timing of the game. The tree of the game will elucidate all possible outcomes in the principal-agent interaction. In Section 3 and 4, a more analytical investigation is provided, and the sub-game perfect equilibria of the one-shot interaction will be found respectively for the one-type-agent case and two-types-agent case. Section 5 investigates the opportunity for the fair-minded principals to send credible signals to the agent about their true type. Differentiating themselves from self-regarding principals could be particularly profitable for reciprocating principal, because agents would not suffer from asymmetric information and consequently would change their beliefs and implement a first best effort level. Reputation through repeated interactions is another method that could differentiate fair-minded from self-regarding principals. The effects of repeated interactions on contract choice will be analysed in Section 6. A comparison between the social optimum and the decentralised solution in terms of the total surplus produced is the topic of Section 7. We will be able to distinguish accurately those circumstances in which the introduction of fair-minded players is beneficial to the society as a whole. Finally, the last Section summarises the main results achieved and concludes the paper.

2. The General Specification of the Model

The following setting consists of two types of contracts. One contract is **incomplete**, which means that it represents a gentlemen's agreement that cannot be enforced by any party before a court of law. The Principal (P) makes a promise in terms of a bonus B^* to be paid to the agent (A) in exchange of a specific effort *e*. If the agent accepts the agreement, once he delivers his effort he has to trust the principal to return B^*. This means that the agent cannot impose the payment and the principal may not fulfil his promise to give B^*. The second contractual form is fully **complete**. The principal pays a fee *C* in order to write the contract and make it enforceable. If the agent accepts the contract and delivers the required effort, he can enforce the payment of a fixed salary *w*. In both contracts, workers' effort is observable at no cost. Additionally, both the principal and the agent are assumed to be risk-neutral.

In the incomplete contract, **players** are of two types: the emotional/reciprocating player (**E-type**) and the self-regarding player (**S-type**). The **E-player** has in his utility function a psychological impact stemming from the counterpart's action and/or deriving from the fulfilment of a moral/social norm. Conversely, the **S-player** does not show any emotion and responds exclusively to mere economic drives, as normally assumed in the standard economic theory. Under a complete contract, there is no psychological impact both for the principal and the agent; therefore the two types of players become just the one standard homo œconomicus or S-type.[6]

Under an incomplete contract, if **principal**, the E-type has a psychological impact *I*, which depends on the action he is going to take after the worker has delivered his effort. This variable can be regarded as the utility of promise keeping. If the promise he makes is eventually fulfilled, the principal will experience a positive psychological impact, whose magnitude in terms of *utils* is equal to the value of the bonus granted *B*, up to a certain

$$I \rightarrow \begin{cases} B\ (\leq F) & \text{if } B \geq B^* \text{ and } e_A \geq e^* \\ 0 & \text{if } e_A < e^* \\ -\varepsilon & \text{if } B < B^* \text{ and } e_A \geq e^* \end{cases}$$

[6] The event of breaching the law is not considered.

amount *F*.[7] Thus, F may be regarded as the E-principal's maximum willingness to reciprocate. Alternatively, if he does not eventually fulfil his promise he will experience a negative psychological impact, say $-\varepsilon$.[8] Finally, if the agent delivers an effort e_A, which is lower with respect to what has been agreed e^*, the psychological impact is going to be equal to zero. By introducing the function *I*, promise-keeping behaviour becomes relevant in terms of utility.

Contrary to the E-principal, the S-principal is not fair-minded, thus he does not find any benefit from promise-keeping. However, I will address two cases: the one-shot game and the finitely repeated game. In the former, reputation from promise fulfilment does not play any role; consequently S-principals will not pay the bonus. In a repeated game, S-principals may be induced to pay the bonus so to profit from the reputation acquired in the long term.

Similarly, in an incomplete contract **agents** can be of two types. The E-type agents suffer from an emotional distress from being cheated equal to $-\chi$ or experience a positive psychological impact if rewarded equal to $+\chi$.[9] On the other hand, the S-type agents will not experience any psychological impact.

The **utility functions** are as follows:

$$U_P^E = y(e) + I - B \qquad U_A^E = B - \frac{1}{2}e^2 + (-1)^K \chi$$

K=1 for $e_A<e^*$ or $B<B^*$
K=2 for $e_A \geq e^*$ and $B \geq B^*$

$$U_P^S = y(e) - B \qquad U_A^S = B - \frac{1}{2}e^2$$

For the sake of simplicity, no base-wage is paid in advance to the agents. The cost-of-effort function is increasing at an increasing rate. Its second derivative is set to one to reduce the complexity of calculations. The

---

[7] The hypothesis over the size of the psychological impact appears sustainable and reasonable. One hardly experiences a strong psychological impact for tiny amounts of money and vice versa. Thus, it is reasonable to assume that the psychological impact can be proportional to the size of the bonus. For the sake of simplicity, the proportionality constant is set to one.

[8] If the negative psychological impact is zero, there may be an ex-post strategic behaviour such that the E-type principal is indifferent between fulfilling and not fulfilling the promise.

[9] In order to simplify notation, assume that the magnitude of the positive psychological impact for E-agents is equal to that of the negative psychological impact. We may assume that the negative psychological impact is higher than the positive psychological impact or vice versa; however the main results do not change.

technology is $y(e)=e^{\beta}$.[10] Technology is allowed to have different returns to scale by means of changes in the parameters β:

- $0<\beta<1$ decreasing returns to scale
- $\beta=1$ constant returns to scale
- $1<\beta<2$ increasing returns to scale

The parameter β must lie in the interval]0,2[since for values that lie outside this interval negative and/or infinite monetary profits arise. No access to credit is allowed in the model; therefore an explicit non-negative monetary profits condition must be imposed to any contract proposal. This must be such that $y(e)\geq B$. Indeed, it might happen that a very generous E-principal (i.e., F very high) gives a bonus that is higher than the revenues. This may drive the firm out of the market.

Players are randomly matched by drawing an agent from the **population** of agents and a principal from the population of principals.[11] Initially, assume that players interact only once, through a one-shot game. Further on, this hypothesis will be relaxed allowing for finitely repeated interactions. Two cases are considered:

I. The fraction of E-principals is α and all agents are of S-type.

II. The fraction of E-principals is α and that of E-agents is also α.

The type of player is private information, but the values of α are common knowledge. The parameter α is crucial in the model, and apart from being the share of E-players it can also be regarded as the level of trust/reliability/honesty within a certain society. The agents randomise according to the population share of fair-minded principals. In other words, they rationally set their beliefs on the probability of being or not being rewarded. However, it may occur that these beliefs may differ from the exact share of the population α, because the agents may have additional information

[10] We could introduce a multiplicative factor into the production function, however this does not add any further insight to the investigation. The introduction of uncertainty represents also an additional complication of the model that does not help in the solution and interpretation of the economic choices followed by agents.

[11] This hypothesis will be relaxed in subsequent investigations, allowing for more agents for one principal.

on the principal they are actually facing. In this case, the agents would adjust their beliefs to γ.

The **timing of the incomplete contract** consists of three periods. In the first period t_1, the principal asks for a certain effort level and announces the bonus. Under case II, the principal is unaware of the type of agent he is facing. In t_2, the agents decide whether to participate or not, by knowing the shares of the E- and S-type principals, and their respective utility functions, but without knowing the type of principal they are facing. If workers do not participate, both principal and agent will get zero. In the last period, t_3, after workers have accepted the gentleman's agreement and delivered their effort, the principal will decide between paying the bonus and not paying the bonus. In the one-shot game, S-principals must mimic the E-principals and propose the same contract. Indeed, if the S-principals were to propose a different contract, regardless of the benefits accruing to the worker, agents would immediately discover their true type. This simulation may not occur in a repeated game, and different contract proposals may arise.

The principals can choose to write a fully **complete contract**, by which they can enforce a specific effort level and pay a fixed monetary amount to the agent. However, complete contracting is costly in terms of the formalisation, enforcement, and verification of the contract. Under a complete contract, the E-type, both principal and agent, does not experience any emotional/psychological impact; therefore his behaviour is exactly the same as that of the S-type players. In such a case, the utility functions are as follows:

$$U_A = w - \frac{1}{2}e^2$$
$$U_P = y(e) - w - C$$

Below, Figure 1 depicts the **game tree** in the one-shot game and under Case I (i.e., only S-agents). In the first node, nature chooses the type of principals, which is going to be unknown to all agents. If the principals propose an incomplete contract, the agents will not know whether the proposal has been made by an E-principal or S-principal. This happens under complete contracting as well; however we already know that there are no distinctions between principals within a complete setting. Since S-principals would mimic

E-principals' behaviour, the S-principals' branches are similar to the E-principals' branches. If the agents reject the principal's proposal, both parties will get zero utility. For the sake of simplicity the agents are assumed to choose working, if staying idle gives the same utility.

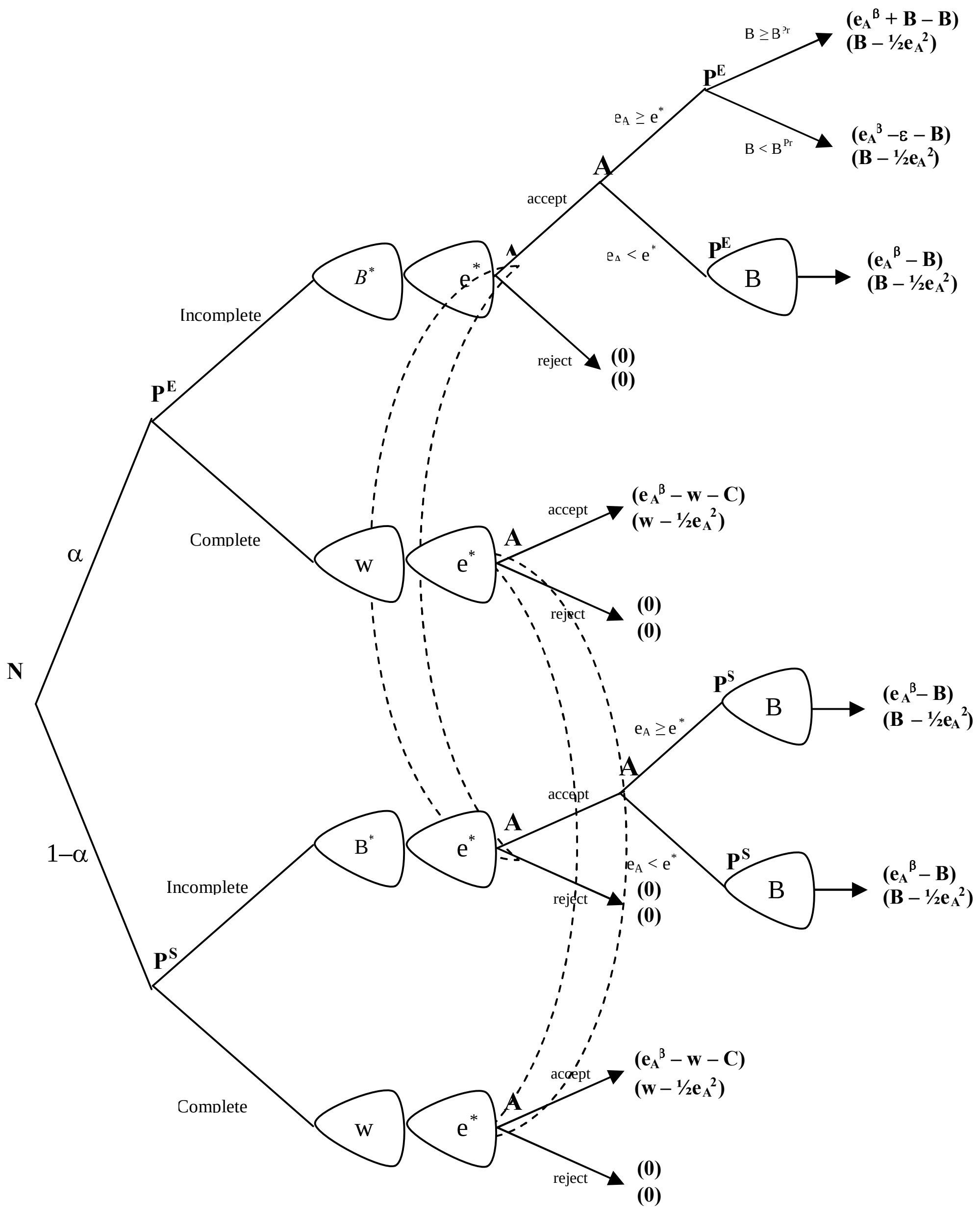


Figure 1. GAME TREE ONE-SHOT GAME + CASE I

All possible combinations of the choice variables available to each player determine the strategy space. All principals must choose which contract they want to implement, they have to promise a certain bonus and require a certain effort level from the worker, and finally they have to decide whether to pay the bonus, and in particular how much must be given. The agents must more simply choose whether to accept or reject the contract, and the amount of effort to be supplied. Thus, the strategy space will be the following:

Strategy Space

Principals → **Contract** x **B*** x **e*** x **B** = {Incomplete, Complete} x [0,+∞[x [0,+∞[x [0,+∞[
Agents → **Contract** x $\mathbf{e_A}$ = {Accept, Reject} x [0,+∞[

The equilibrium will consist of a single point in the strategy space of both principals and agents. Furthermore, we must bear in mind that the strategy space is bounded by the non-negative monetary profits constraint.

Now, we are going to investigate the one-shot game, first Case I, and in the subsequent section Case II.

3. *One-Shot Game – Case I*

In this section, only one type of agent, the S-type, is assumed. Thus, all agents will have the following expected utility function:

$$EU_A = \alpha\left(B - \frac{1}{2}e^2\right) + (1-\alpha)\left(-\frac{1}{2}e^2\right)$$

3.1. Incomplete Contracting

In order to find the private solution, we have to consider two different cases. First, $F \geq B^*$, where B^* is the optimal bonus promised, which is calculated as an internal solution.[12] Second, if $F < B^*$ the incomplete contract may still be realised but with a lower bonus. Indeed, if the maximum willingness to reciprocate is lower than B^*, the E-principal would impose the bonus to be equal to F.

Internal solution: $F \geq B^*$

First of all, the E-principal cannot promise a bonus that is higher than the optimal bonus B^*, which is also higher than F, thereby calling for a higher effort level and then in t_3 not keeping the promise. This promise will not be

[12] Note that the notation of the bonus in equilibrium is the same as that of the promised bonus. This should not create confusion since I assumed that the principal promises what is optimal. See the following observations and in particular the next footnote.

credible and, consequently, the agent will not accept the incomplete contract. Promising a bonus that is lower than B^* and then not keeping the promise is not rewarding for the E-principals. Thus, the optimal solution for the E-principal is to promise B^* and then keep the promise.[13]

The solution to the agency programme is the following:

$$e^* = (\alpha\beta)^{\frac{1}{2-\beta}} \qquad \text{and} \qquad U_P^E = (\alpha\beta)^{\frac{\beta}{2-\beta}} = U_P^S$$

$$B^* = \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} \qquad\qquad U_A = 0$$

Note that the agents get no surplus because the participation constraint holds binding. Principals get the same utility although the E-principals ‘neutralise’ the cost of the bonus through the positive psychological impact, whereas the S-principals mimic the E-principals but eventually do not pay the bonus by getting the revenues. From the three-dimensional graph below, we can infer that if β and α are high, it is very unlikely that B* will be implemented because F may not be high enough to sustain this gratuity. In this circumstance, we expect a corner solution. For instance, Figure 2 depicts a situation in which F is equal to one; as a result the actual bonus promised and then paid cannot exceed the value one.

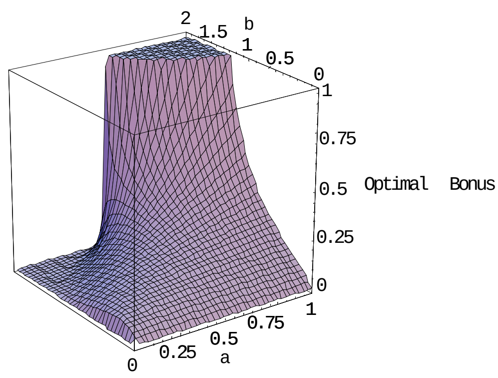


Figure 2. THE BONUS LEVEL

[13] If we assume *I* to be independent from the size of the bonus, we may be induced to think that the E-principal can promise a bonus $\underline{B}$ ($<B^*$), keep the promise, and get a positive psychological impact equal to F ($\geq B^* > \underline{B}$). B^* represents the maximising bonus for an internal solution. However, this circumstance would not arise because it is not optimal lowering the bonus. The inequality $(e^*)^\beta - B^* > (\underline{e})^\beta - \underline{B}$ is always true for any contract [e(α, β), B(α, β)]. Indeed, the function of monetary profits that satisfies the agent’s participation constraint (i.e., as a function of B, $[(2\alpha B)^{\beta/2} - B]$) is well behaving, with a unique maximum for any α and β.

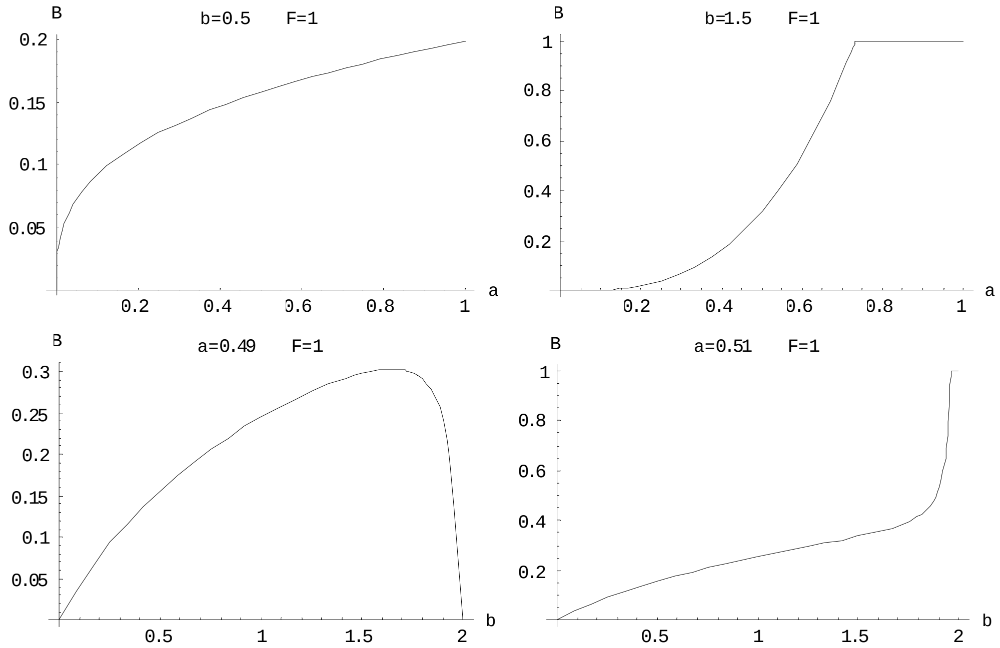


Figure 3. BONUS ACCORDING TO DIFFERENT VALUES OF α AND β

In more detail, from the two-dimensional graphs in Figure 3, we infer that, for a given β, the optimal bonus increases as α increases. The increase gets exponential as returns to scale start to increase, but the overall bonus is upward bounded by the level of F. Why does B^* increase as α increases? First, it is worthwhile noting that an increase in the bonus level in equilibrium has an incentive effect on workers' effort (i.e., $e^*=(2\alpha B^*)^{½}$). A higher α induces the agent to work more, in the same fashion as an increase in the bonus level, because there are higher chances that eventually the agent's effort will be actually rewarded. From the principal's viewpoint, an increase in B gives rise to a constant increase in the cost. However, the E-principal is not sensitive to this cost because it is offset by the psychological impact. On the contrary, an increase in the bonus level has a variable effect on the revenues, the latter effect depending on the level of β. In sum, an increase in α makes an increase of the bonus more valuable to the principal such that a larger effort can be delivered. The value of this increase essentially depends on β, so that higher β's make additional effort more valuable. For this reason the increase in the bonus level gets exponential as β gets larger than one.

Corner Solution: F<B*

According to the values of the parameters α and β, the maximum willingness to reciprocate F may not be high enough to keep up to the promise of a relatively high bonus. Therefore, it is optimal for the E-principals to lower the promised bonus to such an extent that they feel comfortable keeping the promise. Suppose for example, $B^*=1000$ and $F=500$.

$U_P^E = e^\beta - 1000 + 500$ if the bonus is paid

$U_P^E = e^\beta - \varepsilon$ if the bonus is *not* paid

Therefore, it is more preferable to promise a bonus that is equal to F, call it B^*_{cs}. Consequently, if F=500 and $B^*_{cs}=500$

$U_P^E = e^\beta + 500 - 500 = e^\beta$

In summary, promising a bonus that is higher than F is either not credible (i.e., the E-principal will not eventually pay the bonus), or it is just not profitable. Thus, if $F < \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} = B^*$, we substitute F into the agent's participation constraint and get the optimal level of effort for a specific level of F.

$$e^*_{cs} = \sqrt{2\alpha F}$$

Monetary profits are going to be equal to

$$\Pi^E_{cs} = (2\alpha F)^{\frac{\beta}{2}} - F \ (\geq 0 \ \forall \beta : 0 < \beta < 2)$$

The utility of E-principals in a corner solution is equal to

$$U^E_P = (2\alpha F)^{\beta/2}$$

Joint Solution

The overall utility of the S-principals is the same as that of the E-principals, because the former are not going to pay the bonus but at the same time have no positive psychological impact. However, their monetary profits are always higher since they do not pay the bonus. The optimal values of the utility function for both types of principals (U_P) are:

$$(\alpha\beta)^{\frac{\beta}{2-\beta}} \quad \text{for} \quad F \geq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}$$

$$(2\alpha F)^{\frac{\beta}{2}} \quad \text{for} \quad F < \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}$$

The three-dimensional graphical representation below depicts the utility for all admissible values of α and β.

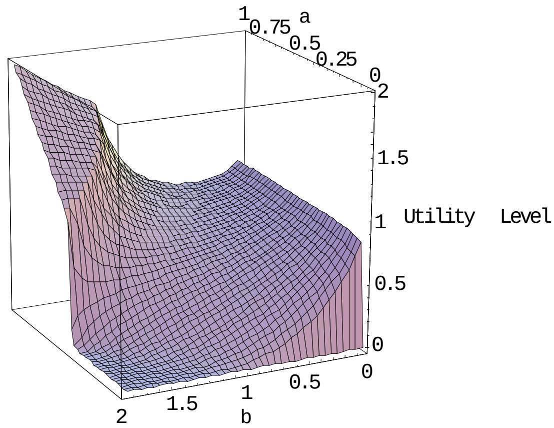


Figure 4. CASE I: UTILITY LEVELS OF AN INCOMPLETE CONTRACT (F=1)

Generally speaking, changes in the share of reciprocating principals have a larger impact for high returns to scale rather than low returns to scale. Put differently, by holding α fixed, an increase in returns to scale produces an impact on the utility level only for substantial shares of E-principals. These observations introduce the following somewhat important result: if only incomplete contracts were applied, the more widespread honesty and trust, the higher the overall surplus would be. Notice that for high levels of α and β, a corner solution is likely to occur. In this region, the utility is increasing in both α and β; although at a lower rate than the internal solution is within a close interval. Finally, further increases in F would only matter for high values of α and β, since only for high values of α and β, the optimal bonus B^* gets larger thereby allowing high effort levels.

3.2. Complete Contracting

The principal can secure the exchange by proposing a complete contract. However, in order to make the exchange verifiable and assure the agent about the payment of the bonus, the principal must bear an enforcement cost C. Analytically, by forcing the agent's participation constraint to be equal to zero and substituting *w* into the principal's utility function, the optimal effort level will be $e_C^* = \beta^{\frac{1}{2-\beta}}$, which is increasing in β. Thus the utility function is $U_P = \beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C$.

The non-negative profits condition is satisfied for 0<β<2 and $C \le \beta^{\frac{\beta}{2-\beta}}\left(1-\frac{\beta}{2}\right)$. The utility of the principal is depicted in Figure 5. Utility becomes negative for high values of C, and in this case, only high levels of β, where revenues become considerably high, can compensate for the cost of writing complete contracts. For a given C, profits are at their lowest level for β=1.

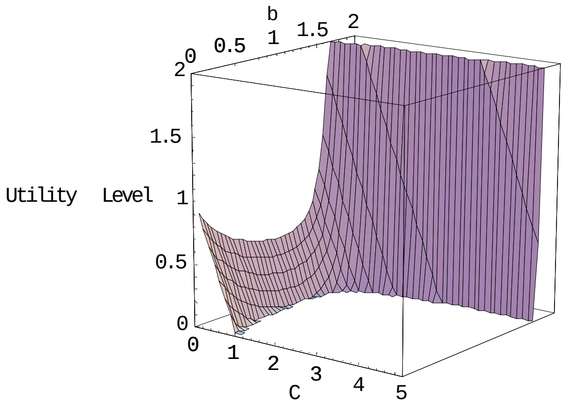


Figure 5. UTILITY LEVELS OF A COMPLETE CONTRACT

3.3. Comparison between Complete and Incomplete Contract

We want to check under which conditions the incomplete contract is preferable to the complete contract and vice versa. An instant picture of the comparison between the utility under incomplete contracts and that under complete contracts is reported in Figure 6. The cost of writing a complete contract C is set to 0.1. This latter value has not been randomly chosen. Indeed, it roughly represents 20% of the salary earned by the agent under constant returns to scale. Thus, it seems appropriate.

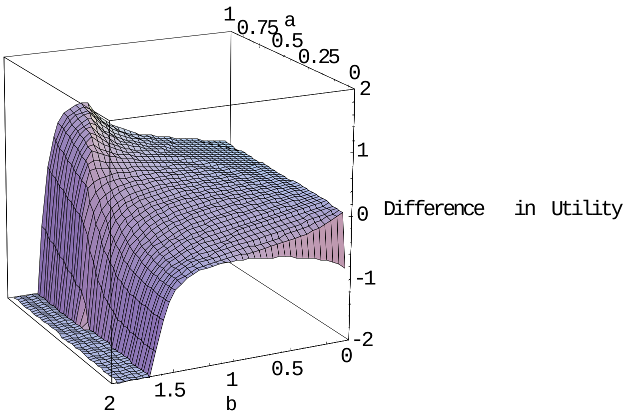
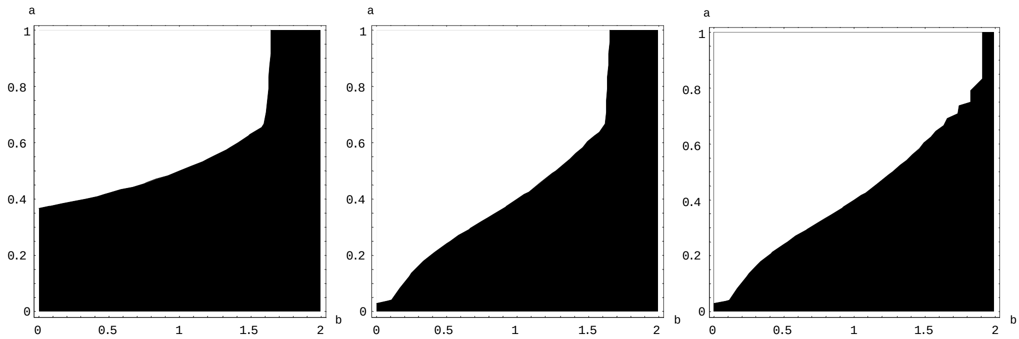


Figure 6. CASE I: DIFFERENCE BETWEEN THE UTILITY LEVELS UNDER INCOMPLETE AND COMPLETE CONTRACTS (C=0.1, F=1)

In order to carry out a comprehensive interpretation over the four parameters of our interest (i.e., α, β, F, and C), a contour graphical representation turns out to be more enlightening.[14]



C=0, F=1 **C=0.1, F=1** **C=0.1, F=100**

Figure 7. CONTOURS OF THE DIFFERENCE BETWEEN THE UTILITY UNDER INCOMPLETE CONTRACTS AND COMPLETE CONTRACTS - BLACK AREA WHERE COMPLETE CONTRACTS ARE PREFERRED

[14] The contour line at zero of the three dimensional graph in Figure 6 will give the exact level mapping of the choice between one contract and the other. Indeed, the zero level triggers the change in preference between the two contracts.

Regardless of the values of all other parameters (i.e., β, F, and C), an increase in the share of emotional principals augments the probability of the adoption of incomplete contracts. Little shares of reliable principals are not generally sufficient to put into effect incomplete contracts: agents would mistrust their principals and would be willing to accept only minor incomplete contracts. For, if the principal's promise were not fulfilled, the agents would only suffer from irrelevant losses. Within incomplete contracting, any increase in α is nothing but an increase in overall confidence, which gives rise to an increase in effort and consequently a boost in the principals' utility level. At some point, to wit, at $e^*_{cs} = \sqrt{2\alpha F}$, as α gets larger, incomplete contracting still increases its advantage with respect to complete contracting. This increase is only due to the direct α effect but still sustains higher levels of effort. This brings about an important observation. Those communities, where honesty and trust are widespread, are better off than those societies in which incomplete contracts can hardly be implemented due to lack of trustworthiness.

As returns to scale get larger, a higher utility accrues to the principal under both contracts. However, for very high returns to scale, complete contracts are always preferable. In practice, a complete contract does not suffer from the upwards-bounding effects of F, so that it can fully exploit increasing returns to scale. Thus, as the size of the exchange gets larger, complete contracts dominate.[15] However, for moderately increasing returns to scale, the leverage effect of increasingly higher shares of reciprocating principals on effort is significant. This is observable in Figure 6, where the positive peak highlights the strong preference for incomplete contracting.

As expected, the higher the cost of contract enforcement C, the more likely is the adoption of incomplete contracts. Nonetheless, for very high returns to scale, the complete contract is still preferable even at high levels of α. Conversely, in the extreme case of complete contracting with no transaction costs, as α is high and returns to scale are not very high, the complete contract

[15] This result, which is not particularly surprising with respect to the logic of the model, is in contrast with the predictions of Fehr, Klein, and Schmidt (2001), who sustain that important obligations are left deliberately incomplete even if enforcement is not particularly costly, because parties can achieve higher payoffs through reciprocal exchange. This may be the case for many contracts, but not for those whose effort exertion is critical for achieving incremental profits.

is not chosen. This result occurs because the disutility of giving the bonus for an E-principal is compensated by the positive utility stemming from interior motivation of fulfilling the promise of giving the bonus, whereas in a complete contract, the bonus is given because it is stated on the contract, and therefore enforced by law. However, as high α's are coupled with high β's, the optimal bonus of an incomplete contract increases such that E-principals would eventually find fulfilling the promise psychologically unaffordable, namely F becomes binding. Consequently, a complete contract is chosen because it can fully exploit high returns to scale. As a final remark, changes in the level of maximum willingness to reciprocate have little importance for the contractual choice at middle-low levels of α. The parameter F starts to play a certain role as α gets higher and returns to scale become larger. Indeed, if the constraint that F imposes on the size of incomplete contracts were partly lifted thorough increased levels of F, incomplete contracting would gain some ground by informally sustaining more exacting contracts with no transaction costs. Yet, these marginal effects arise under infrequent circumstances.

The table below summarises E-employers' preferences for the different types of contracts. At high levels of β, the preference towards complete contracts is basically insensitive to the cost of writing a complete contract. For decreasing returns to scale and low α, the preference for one contract or another depends essentially on C. Changes in F would only affect choices at high values of α and β. In particular, an increase in F, by making active the

<table>
<tr><th></th><th>Decreasing Returns</th><th>Moderate Increasing Returns</th><th>High Increasing Returns</th></tr>
<tr><td>Low α</td><td>Complete/ Incomplete (depends on C)</td><td>Complete</td><td>Complete++</td></tr>
<tr><td rowspan="2">High α</td><td rowspan="2">Incomplete</td><td>Incomplete++[16]</td><td>Complete</td></tr>
<tr><td colspan="2">↑F pushes upwards the turning point from incompleteness to completeness of β</td></tr>
</table>

[16] Read (++) as contract highly preferable with respect to the other contract.

corner solution for high effort levels, raises the utility of incomplete contracts and pushes the turning point of β between the two contracts upwards.

4. One-Shot Game – Case II

In a bonus contract setting, whether the agents may or may not receive the reward for their effort exertion depends on the type of principal, who can be or not be fair-minded. Depending on the outcome of the contract, some agents, let us call them the E-agents, could show certain emotions. If the principal reciprocated to the effort elicited from the agent, the latter would be glad and could experience a positive psychological impact on top of the monetary value of the bonus. Conversely, if the principal has withheld the bonus for simple selfishness, the E-agents could emotionally experience the cheating of the gentleman's agreement and suffer from a negative psychological impact. On the contrary, the other type of agents, the S-agents, is absolutely free from emotional concerns, as usually the standard economic theory assumes. This difference gives rise to different levels of agents' utility for each incomplete contract, and the difference among the utilities depends primarily on the level of trust α in the society. Thus, the E-principal may find it optimal to separate the two types of agents, one working with an incomplete contract and the other working within a complete setting. Consequently, in the remaining part of this section, pooling and separating equilibria are introduced, when both types of agents work under the same contract or when they accept different contracts respectively.[17] At this point, for the sake of simplicity, we should make one of these two assumptions. Either we assume that the population of agents is multiple of the population of principals, so that for each principal the share of E-agents and S-agents is preserved. Alternatively, if it is a pair wise matching with identical populations as assumed at the beginning, the principal cannot change the contractual proposal after knowing the agents' choice, and thus their true type. These assumptions allow maximisations over expected utilities, and thereby ex-ante comparisons among principals.

[17] We should bear in mind that even in the separation case, in order to find the optimal contractual choice, we still need to make a comparison of the separating equilibrium under incomplete contracting with the full complete contract.

4.1. Incomplete Contract

By comparing the expected utilities between the two agents from Section 2, we infer that for α>½ the E-agent has a higher expected utility than the S-agent, whereas for α<½, the S-agent has higher expected utility than the E-type. For α exactly equal to a half, the expected utilities of the two types are the same. Thus, high levels of trust would 'reward' emotional workers more than they would do for self-regarding workers, because there are higher chances to experience a positive psychological impact by receiving the bonus.

The optimal levels of bonus that make each agent's participation constraint binding are the following:

$$B_E^* = \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi$$

$$B_S^* = \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}$$

Consequently, if both types of agents will work under the incomplete contract, one type will have a binding constraint whereas the other type will earn a 'psychological' rent. The solution to the principal's programme will be the joint solution of the three following cases.

Case α > ½

For every incomplete contract (B*, e*), the E-agents will have higher expected utilities than S-type agents. The following sub-cases can arise.

1) $F \geq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} = B_S^* > B_E^*$

The utility for the E-principal will be: $U_P^E = (\alpha\beta)^{\frac{\beta}{2-\beta}}$

Whereas the utility for the agents will be: $U_A^S = 0$, $U_A^E = (2\alpha - 1)\chi$

2) $\frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} > F \geq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi$

Under this case two options can emerge. The principal may find it profitable to separate the two types of workers such that S-agents would work under a complete contract whereas, since the chances to get the bonus are high, E-agents would work under an incomplete contract and would experience a positive psychological impact. The separation may not be profitable under two circumstances. Firstly, when monetary profits are negative, and secondly, when making both types working under a single incomplete contract, whose optimal solution is a corner solution, could be more profitable. In sum, the results are as follows:

If $\alpha\left((\alpha\beta)^{\frac{\beta}{2-\beta}} - \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} - \frac{1-2\alpha}{\alpha}\chi\right) + (1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) \geq 0$ Non-negative monetary profits with separation

and if $\frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi > 0$ the bonus is positive

Then

$$U_P^E = \mathrm{Max}\left\{(2\alpha F)^{\frac{\beta}{2}}, \alpha(\alpha\beta)^{\frac{\beta}{2-\beta}} + (1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right)\right\}$$

$U_A^S = 0, U_A^E = (2\alpha - 1)\chi$ pooling; $\quad U_A^S = 0, U_A^E = 0$ separating.

If $\alpha\left((\alpha\beta)^{\frac{\beta}{2-\beta}} - \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} - \frac{1-2\alpha}{\alpha}\chi\right) + (1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) < 0$ Negative monetary profits with separation

or if $\frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi \leq 0$ the bonus is not positive

Then

Pooling Equilibrium: $U_P^E = (2\alpha F)^{\frac{\beta}{2}}$; $U_A^S = 0, U_A^E = (2\alpha - 1)\chi$

3) $F < \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi$

In this case there are also two options. The E-principal can choose to separate the agents by writing a complete contract for the S-agent, and make the E-agent work with an incomplete contract under a corner solution. Alternatively, there may be a pooling equilibrium in the same fashion as defined in case 2. Once again, we need to be sure that monetary profits with the first option are non-negative. Thus,

If $\alpha\left((2(\alpha F + (2\alpha - 1)\chi))^{\frac{\beta}{2}} - F\right) + (1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) \geq 0$ Non-negative monetary profits with separation

Then[18]

$$U_P^E = \mathrm{Max}\left\{(2\alpha F)^{\frac{\beta}{2}}, \alpha\left(\left(2(\alpha F+(2\alpha-1)\chi)\right)^{\frac{\beta}{2}}\right)+(1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}}-\frac{1}{2}\beta^{\frac{2}{2-\beta}}-C\right)\right\}$$

$U_A^S = 0$, $U_A^E = (2\alpha-1)\chi$ pooling; $U_A^S = 0$, $U_A^E = 0$ separating.

If $\alpha\left(\left(2(\alpha F+(2\alpha-1)\chi)\right)^{\frac{\beta}{2}}-F\right)+(1-\alpha)\left(\beta^{\frac{\beta}{2-\beta}}-\frac{1}{2}\beta^{\frac{2}{2-\beta}}-C\right)<0$ Negative monetary profits with separation

Then

Pooling Equilibrium: $U_P^E = (2\alpha F)^{\frac{\beta}{2}}$; $U_A^S = 0$, $U_A^E = (2\alpha-1)\chi$

Case α = ½

Under this circumstance, the two types of agents have the same utility functions. We should distinguish the internal solution from the corner solution. Therefore,

If $F \geq \left(\frac{1}{2}\beta\right)^{\frac{2}{2-\beta}} = B^*$ then $U_P^E = \left(\frac{1}{2}\beta\right)^{\frac{\beta}{2-\beta}}$

If $F < \left(\frac{1}{2}\beta\right)^{\frac{2}{2-\beta}}$ then $U_P^E = F^{\frac{\beta}{2}}$

Monetary profits are non-negative in both circumstances. The agents' utility is zero.

Case α < ½

This case mirrors the α > ½ case. However, this time S-agents' utility is higher than E-agents' utility for any incomplete contract. Again, the following circumstances can arise:

1) $F \geq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi = B_E^* > B_S^*$

Monetary profits under this internal solution may turn out to be negative. If this arises, two sub-cases would occur. First, we allow for pooling, so that both groups work under an incomplete contract with a lower bonus (i.e., lower than B_E^*). We compare this option with the separating equilibrium, where E-agents work under a complete contract whereas S-agents get an incomplete contract.

[18] In this case the bonus is necessarily positive.

However, under a pooling equilibrium monetary profits may still be negative. If this is the case, either the incomplete contract cannot be proposed or, as before, we just separate the agents. Thus,

If $(\alpha\beta)^{\frac{\beta}{2-\beta}} - \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} - \frac{1-2\alpha}{\alpha}\chi \geq 0$ Non-negative monetary profits with pooling

Then $U_P^E = (\alpha\beta)^{\frac{\beta}{2-\beta}}$; $U_A^S = (1-2\alpha)\chi$, $U_A^E = 0$

One may notice how the 'psychological rent' now belongs to the S-agent, which is a monetary rent, contrarily to the E-agents whose surplus was due to a positive psychological impact at $\alpha > ½$.

If $(\alpha\beta)^{\frac{\beta}{2-\beta}} - \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} - \frac{1-2\alpha}{\alpha}\chi < 0$ Negative monetary profits with pooling

Then two options:

a) If $\left(2(\alpha F + (2\alpha-1)\chi)\right)^{\frac{\beta}{2}} - F \geq 0$ Non-negative monetary profits with pooling and corner solution

Then $U_P^E = \text{Max}\left\{\left(2(\alpha F + (2\alpha-1)\chi)\right)^{\frac{\beta}{2}}, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(\alpha\beta)^{\frac{\beta}{2-\beta}}\right\}$

$U_A^S = (1-2\alpha)\chi$, $U_A^E = 0$ pooling; $U_A^S = 0$, $U_A^E = 0$ separating.

b) If $\left(2(\alpha F + (2\alpha-1)\chi)\right)^{\frac{\beta}{2}} - F < 0$ Negative monetary profits with pooling and corner solution

Then $U_P^E = \text{Max}\left\{0, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(\alpha\beta)^{\frac{\beta}{2-\beta}}\right\}$ If separation gives negative utility no incomplete contract in any form is proposed

$U_A^S = 0$, $U_A^E = 0$

2) $\frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} < F \leq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} + \frac{1-2\alpha}{\alpha}\chi$

Again, a pooling equilibrium with an incomplete contract could give rise to negative monetary profits. If this is the case, the E-principal is forced to separate the two types of agents, by making E-agents work with a complete contract, whereas S-agents can be retained in the incomplete setting. In the latter case, if the cost of writing a complete contract is relatively high, the principal has no choice but to propose no contract. Thus,

If $\left(2(\alpha F + (2\alpha-1)\chi)\right)^{\frac{\beta}{2}} - F \geq 0$ Non-negative monetary profits with pooling

Then $U_P^E = \text{Max}\left\{ \left(2\left(\alpha F + (2\alpha - 1)\chi\right)\right)^{\frac{\beta}{2}}, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(\alpha\beta)^{\frac{\beta}{2-\beta}} \right\}$

$U_A^S = (1-2\alpha)\chi$, $U_A^E = 0$ pooling; $U_A^S = 0$, $U_A^E = 0$ separating.

If $\left(2\left(\alpha F + (2\alpha - 1)\chi\right)\right)^{\frac{\beta}{2}} - F < 0$ Negative monetary profits with pooling

Then $U_P^E = \text{Max}\left\{ 0, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(\alpha\beta)^{\frac{\beta}{2-\beta}} \right\}$

$U_A^S = 0$, $U_A^E = 0$

3) $F < \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}$

The two options are still available under this circumstance with the only exception that with a separating equilibrium, S-agents work with the incomplete contract under a corner solution. Thus,

If $\left(2\left(\alpha F + (2\alpha - 1)\chi\right)\right)^{\frac{\beta}{2}} - F \geq 0$ Non-negative monetary profits with pooling

Then $U_P^E = \text{Max}\left\{ \left(2\left(\alpha F + (2\alpha - 1)\chi\right)\right)^{\frac{\beta}{2}}, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(2\alpha F)^{\frac{\beta}{2}} \right\}$

$U_A^S = (1-2\alpha)\chi$, $U_A^E = 0$ pooling; $U_A^S = 0$, $U_A^E = 0$ separating.

If $\left(2\left(\alpha F + (2\alpha - 1)\chi\right)\right)^{\frac{\beta}{2}} - F < 0$ Negative monetary profits with pooling

Then $U_P^E = \text{Max}\left\{ 0, \alpha\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right) + (1-\alpha)(2\alpha F)^{\frac{\beta}{2}} \right\}$

$U_A^S = 0$, $U_A^E = 0$

Joint Solution

The three cases are merged and the overall solution gives rise to the graphical representation in Figure 8. The main differences with respect to Case I in Figure 4 concern the portion of increasing returns to scale. Indeed, as β gets higher the probabilities to separate the agents increase because internal solutions are less likely to be applied given the constraint imposed by the maximum willingness to reciprocate. Thus, a share of agents would be required to supply first best effort levels under complete contracting. This is in fact missing from Case I. However, a more detailed comparison between the two cases is illustrated in the subsequent subsection, because we already observed in Case I that, in equilibrium, for high returns to scale, a fully complete contract is chosen. This observation suggests that the final outcomes under the two cases will be substantially similar.

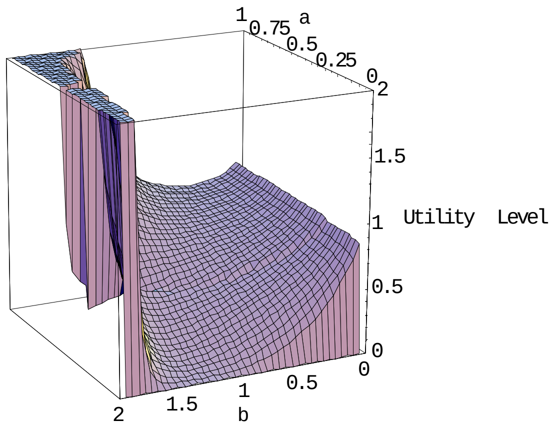


Figure 8. CASE II: UTILITY LEVELS OF AN INCOMPLETE CONTRACT (F=1, χ=0.5, C=0.1)

4.2. Comparison between Case I and II

First, we must observe that writing a complete contract with two types of agents does not differ from the case with only one type. As stated above, no emotional concern shows up within a complete setting where rewards and punishments are stated under contractual enforceable terms. Consequently, the utility levels are the same as seen before with single-type agents.

Compared to Case I, the choice between a complete and an incomplete contract is not severely affected by the introduction of emotional agents, who respond not only to their economic drives but also to emotional drives. In equilibrium, the difference between Case I and Case II is only evident under a very special circumstance, where three conditions must occur simultaneously:

1) The psychological impact on the E-agents from being cheated or rewarded (χ) is comparatively higher than the maximum willingness to reciprocate (F);

2) Both psychological impacts are rather small;

3) The share of E-players is greater than a half.

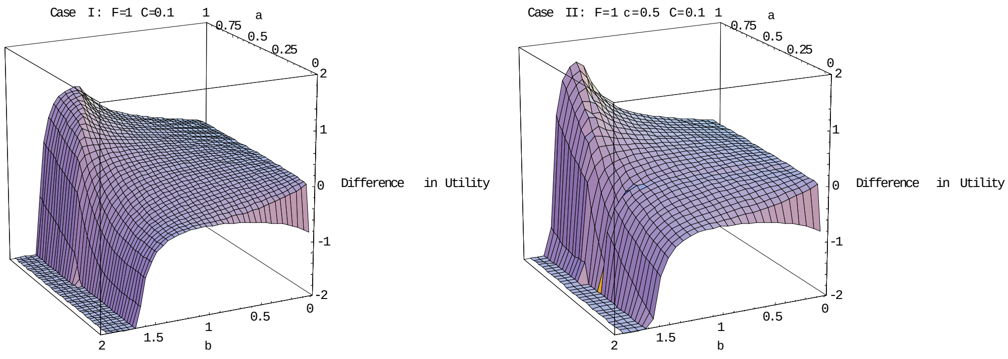


Figure 9. CASE I AND II: DIFFERENCE BETWEEN THE UTILITY UNDER INCOMPLETE CONTRACTS AND COMPLETE CONTRACTS

The investigation of the magnitude of different psychological impacts is interesting but extremely difficult to recognise. Further, introducing cardinality to psychological elements may appear rather controversial. Hence, the fact that the magnitude of psychological impacts plays little role in the results makes the model very robust. The three-dimensional graphical representation in Figure 9 compares the difference between the utility levels under the incomplete and the complete contracts for Case I and Case II. With respect to Case I, Case II shows a slightly favourable pattern for incomplete contracting. In Case II, within an incomplete setting, the principal can choose between pooling and separation, and this makes this option rather valuable.

The zero contour lines of the previous graphs have been reported in Figure 10, so to have a clearer picture of which contract is preferable within the admissible region of the (α,β) plane. The black region denotes the preference for a fully complete contract. The analysis of the contour lines corroborates the impression that the difference between the two cases is not marked. However, under Case II, incomplete contracting gains some ground for high β and high α if compared with Case I. As observed before, a clear difference emerges only when the three conditions set out above arise.

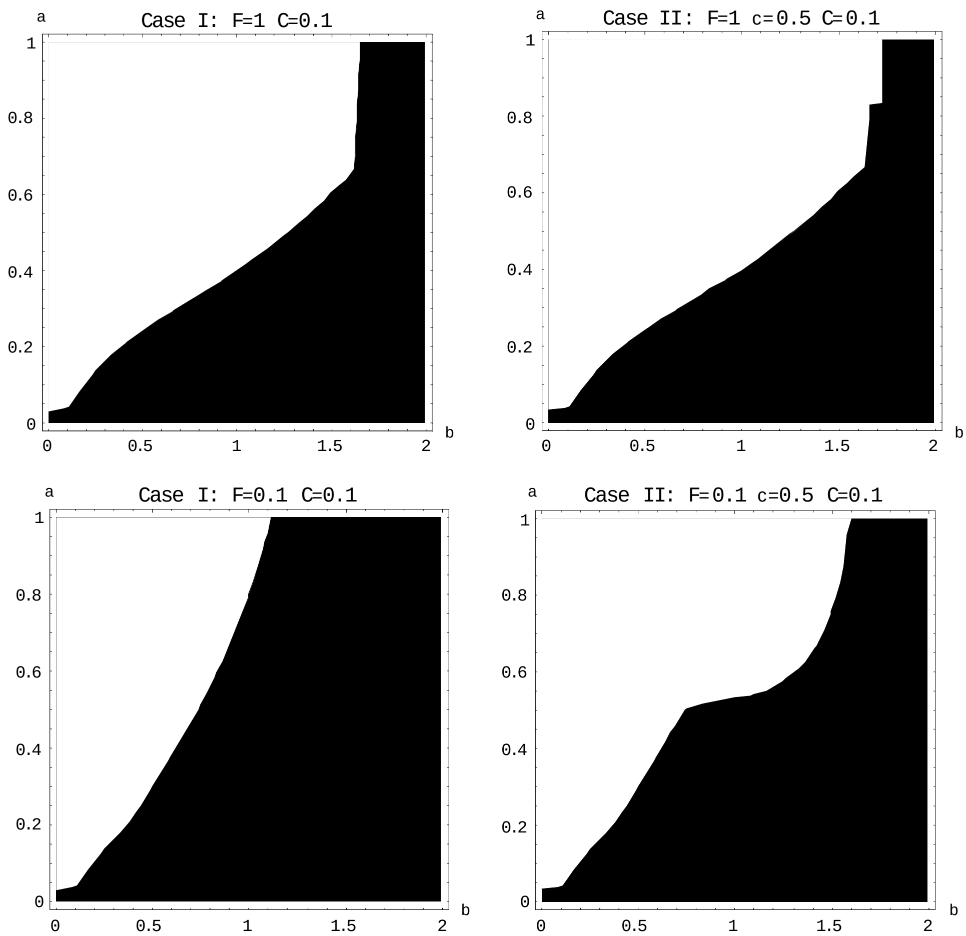


Figure 10. CASE I AND II: CONTOUR GRAPHS AT ZERO FOR FIGURE 9

This happens because with two types of agents, the principal may find it profitable to separate the two types. Since the principal cannot propose two different incomplete contracts to the two types of agents, there can still be separation by proposing two different types of contracts, thereby exploiting the advantages of the two different contractual proposals. Consequently, the area favourable to the incomplete contract gets larger as one may notice from the contour graphs. However, as F gets larger, a pooling equilibrium is more likely, regardless of the value of χ, by making the two cases very similar. The remaining regions appear to show the same pattern. Even if not reported in the graphs, changes in C affect only the Southwest region of the surface. Yet, all things equal, this would not bring about any difference between the two cases. Finally, as F increases, the Northeast region (i.e., high α and high β) is the only one to be affected; but eventually for high F's the two pictures would be exactly the same.

5. Signalling

The E-principals would be better off if they could signal their trustworthiness as employers to the agents. Indeed, if the E-principals could send a credible signal, they would offer a first best contract without paying any transaction cost. The agents would not suffer from the uncertainty arising from the lack of information about which principal they are facing, thus they would set their belief γ on the fulfilment of the gentleman's agreement equal to one. Finally, once signalling works credibly, the S-principals have no choice but to propose a complete contract, since the agents will not accept a deal with somebody who is going to break the promise.

The first issue related to signalling is the credibility of the signal itself. A monetary investment R could represent a credible signal if the S-principal does *not* find it profitable to signal in his turn that he is an E-type and then cheat the agent once the latter has supplied his effort. On the contrary, the S-principal must find it profitable to propose a complete contract. One may think of R as investments in advertisement or alternatively a monetary transfer to the agents.[19] Another condition to be satisfied is that signalling is actually profitable for those who want to implement it.

Are these conditions fulfilled? The answer crucially depends on the assumptions we make on the psychological impact on E-principals. If we take into account the main conjecture about the size of the positive psychological impact, to wit, the psychological impact is exactly equal to the given bonus so as to neutralise the utility reduction of the bonus, then signalling is not possible. On the contrary, if we assume that the psychological impact is disjointed with respect to the bonus, and in particular, it can exceed the bonus level thereby gaining a 'psychological profit', then the E-principal may be willing to raise the investment and make it credible.

The following analytical investigation will take into account this deviation from this important assumption of the model. Thus, suppose the positive psychological impact to be independent from the bonus. Additionally,

[19] If we assume, as I do in the following, that agents are all S-type, a transfer cannot take place before effort is exerted, because the agents would take the transfer and leave, without supplying any effort.

suppose that the E-principal can send a credible signal to the agent, whose belief γ will consequently be equal to one. This raises the optimal bonus that should be offered to the agent but raises effort as well, and eventually overall profits. Under signalling, the optimal solution gives the following utility to the E-principals:

$$U_P^{E\gamma} = \begin{cases} \beta^{\frac{\beta}{2-\beta}} + F - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - R & \text{for} \quad F \geq \frac{1}{2}\beta^{\frac{2}{2-\beta}} \\ (2F)^{\frac{\beta}{2}} - R & \text{for} \quad F < \frac{1}{2}\beta^{\frac{2}{2-\beta}} \end{cases}$$

$U_P^{E\gamma}$ stands for the utility of the E-principal when $\gamma(=1)\neq\alpha$.[20]

Signal is an efficient strategy if the following conditions are satisfied. First of all, the investment R should be such that the E-principal's utility with signal $U_P^{E\gamma}$ is higher than the E-principal's utility without signal with an incomplete contract $U_P^{E\alpha}$ and with a complete contract $U_P^{Complete}$. This means that the E-principal must find it profitable spending money in signalling: $U_P^{E\gamma} - \text{Max}\{U_P^{E\alpha}, U_P^{Complete}\} > 0$. Additionally, we must be sure that monetary profits under signalling are non-negative: $\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - R \geq 0$ or $(2F)^{\frac{\beta}{2}} - F - R \geq 0$ if corner solution. A third condition is related to credibility: a signal is credible if the S-principal cannot imitate the E-principal.

In other words, the S-principal must find it more profitable to implement a complete contract than an incomplete contract with signalling: $U_P^{Complete} > \beta^{\frac{\beta}{2-\beta}} - R$ or $U_P^{Complete} > (2F)^{\frac{\beta}{2}} - R$ if corner solution.[21] Finally, if the

[20] Note that under the usual hypothesis about the size of the psychological impact, $F - \frac{1}{2}\beta^{\frac{2}{2-\beta}}$ is equal to zero in an internal solution.

[21] If the S-principal can imitate the E-principal, the signal would not be credible, and γ would be set to α. Both the E-principal and the S-principal would have burnt money with respect to the case in which both would have sent no signal. Consequently, in order to satisfy the credibility condition, the incomplete contract must be calculated at $\gamma=1$, thereby making the lower bound level of R higher than the case with an incomplete contract calculated at $\gamma=\alpha$. Indeed, if the E-principal invests a sum R that satisfies the inequality for $\gamma=\alpha$ but is not good enough for $\gamma=1$, the S-principal may still be tempted to signal his untrue type and offer a first best incomplete contract and then cheat the agent, as this would be still more profitable than a complete contract. Hence, this makes the signal not credible, and consequently R must be raised by setting $\gamma=1$.

cost of implementing a complete contract is prohibitively high, to wit, $C > \beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}}$, the S-principal will necessarily offer an incomplete contract. In other words, no signal is credible because the S-principal would signal as well up until signalling itself brings about negative profits to the E-principal. Hence, since the agent recognises that signalling is never credible, he would set $\gamma=\alpha$, and consequently any investment R would result only in money waste because there cannot be separation between principals.

Given the parameters α, β, F, and C, the value of the investment R should correspond to the lowest admissible point satisfying simultaneously all these conditions. The black area below depicts the combinations of α and β that allow the E-principal to signal his type as C or F increase.

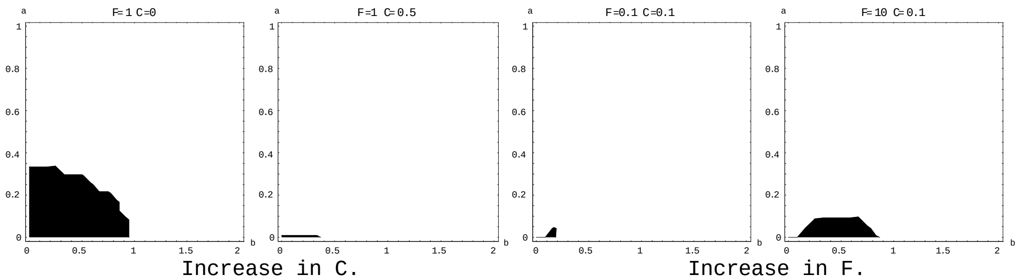


Figure 11. SIGNALLING FOR DIFFERENT VALUES OF THE PARAMETERS C AND F

As will be evident, the chances of having a separating signal between the E-principals and the S-principals are very limited and above all we need to assume the existence of a *psychological rent*. Even by making this assumption, signalling is confined to settings with low shares of reciprocating principals and decreasing returns to scale. Indeed, when reciprocating principals are not numerous, the few E-principals find it very attractive to invest in signalling. When $\gamma \gg \alpha$ and F rises above the bonus level, the gain from separating is rather large.[22] This gain gets increasingly larger as β increases; however as returns to scale rise, investing in signalling becomes attractive to the S-principal as well, thereby making signalling impossible to be pursued because of the cost to keep the S-principal into the complete setting through further rises of R. On the

[22] Unlike the separating and pooling equilibria analysed above, which referred to agents, the following separating and pooling equilibria concern principals.

contrary, if the share of reciprocating principals is already close to one, the few S-principals can get from incomplete contracts similar revenues to those stemming from complete contracts but without paying the bonus and any transaction costs. Thus, the incentive for the S-principals to move to an incomplete contract and imitate the E-principals is very strong. This makes signalling extremely costly to the E-principals and a pooling equilibrium will be observed.

The chances of implementing a signal get lower and lower as the cost of writing a formal contract rises. As transaction costs increase, the complete contract becomes less attractive than the incomplete contract. Thus, the investment in signalling R must be increasingly high in order to keep the S-principal in a complete setting. In other words, as C rises, any signal quickly becomes unprofitable up to the point where it cannot be implemented. An increase in the willingness to reciprocate F will increase the chances of the E-principal to signal his trustworthiness. Indeed, a high F means that the E-principal would be willing to offer increasingly high bonuses to the agent, thereby raising the chances to implement an internal solution for γ=1. At the same time, high F's increase the psychological profits. However, further increases in F do not bring about any benefit to the E-principal in terms of signalling.

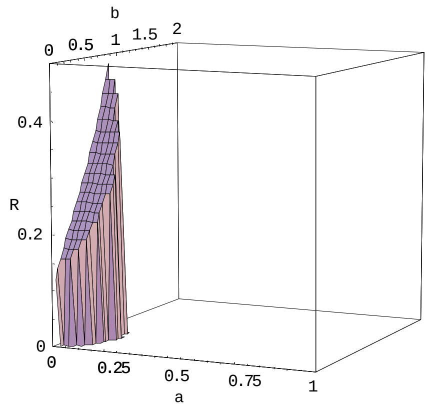


Figure 12. THE LEVELS OF INVESTMENT IN SIGNALLING (F=1 C=0.1)

From Figure 12, as β increases the level of R increases; however returns to scale must be decreasing. As already mentioned, better productivity levels attract S-principals towards incomplete contracts wanting to seize the whole gain from effort without paying the costs related to salary and contract enforcement. This induces the E-principal to increase the level of investment in order to keep away the S-principal from these lucrative contracts, which would otherwise be applied at the expense of the reciprocating behaviour of the E-principals.

In sum, in those circumstances in which the psychological impact of the E-principal is not linked to the bonus, incompleteness could be accompanied by investments in advertisement that would encourage trust towards reciprocating/emotional principals. If no credible investment is made when it should be made, the agents would then reject any offer of incomplete contracting, giving rise to a failure of informal supply of labour services, and in the worst case, no market for these services would occur.

6. Reputation

Playing a one-shot game, especially in a labour relationship, sometimes may appear unrealistic. As shown above, E-principals cannot basically send credible signals about their true type within a one-shot setting, and as a result, no trust can be acquired because no information is available to the agents. However, the E-principals can differentiate themselves from the S-principals by acquiring a reputation, and this can be achieved by playing a repeated game. If the S-principals defect from the bonus payment and if information were available at no cost to everybody, any agent would distinguish immediately after defection the self-regarding principals from those who are trustworthy. Therefore, the E-principals would be able to establish their reputation for fair-mindedness, and offer advantageous incomplete contracts without fearing that S-principals could mimic them. However, S-principals may also find it profitable to invest in reputation by paying the bonus itself, because the alternative of a complete contract could appear disadvantageous.[23] In that case, in the last game the S-principal will anyway adopt an opportunistic behaviour and cheat, because acquiring further reputation carries no additional benefit. In other

[23] Some authors (see for example Trivers 1971) call this behaviour ‘reciprocal altruism’. In other words, even the S-principal may be willing to reciprocate due to the future rewards arising from reciprocal actions. In these circumstances, no emotion intervenes because S-principals act only for strategic reasons. In the jargon of game theory, these types of reciprocal actions are supported by the folk theorem in infinitely repeated games.

circumstances, if the S-principals have taken advantage of the asymmetric information in the incomplete contract at the first game, the behaviour of the two types of principals can differ. Indeed, S-principals may find it profitable to deviate through a *hit-and-run* strategy and subsequently secure a complete contract.

In the following, a finite number of periods *T* is assumed. This is an important assumption because in this way we can understand for which reasons principals move from one contract to another on the basis of the length of the labour relationship. Another assumption, which follows a more pragmatic stance, is that agents are all S-type, as commonly assumed in the literature. Thus, following the previous terminology, we will consider Case I, because the complexity of Case II (i.e., two different types of agents) makes an intelligible analysis impossible. Finally, assume that no psychological profit is allowed.

Like the investigation about signalling and in contrast to the one-shot game case without signalling, a repeated setting may allow the agents to know exactly the principals' response to effort. In an incomplete setting, this could bring about a first best production level by setting the agents' belief γ to one. Three cases can arise:

1) $F \geq \frac{1}{2}\beta^{\frac{2}{2-\beta}}$

2) $\frac{1}{2}\beta^{\frac{2}{2-\beta}} > F \geq \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}$

3) $\frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}} > F$

This time, the S-principal's choice will affect which type of contract will be chosen. Indeed, the agent would never provide a first best effort if the S-principals were likely to implement a hit-and-run strategy. In that case, the agents would set γ equal to α, exactly as in the one-shot game. The S-principals must choose between three options:

a) To implement a hit-and-run strategy: they imitate the E-principals in the first game, cheat, and subsequently offer complete contracts;

b) To acquire reputation by paying the bonus, the latter depending on the actual share α of fair-minded principals, and cheat only in the last game;

c) To choose a complete contract from the very beginning.

In order to get the optimal contract we need to solve the following set of inequalities. If the maximum willingness to reciprocate is such that $F \geq \frac{1}{2}\beta^{\frac{2}{2-\beta}}$, all possible profits levels for an S-principal can be the following:

1a) $\beta^{\frac{\beta}{2-\beta}} + (T-1)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right)$ Hit-and-run from first best effort

1b) $(T-1)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}}\right) + (\alpha\beta)^{\frac{\beta}{2-\beta}}$ Reputation from first best effort

1c) $(\alpha\beta)^{\frac{\beta}{2-\beta}} + (T-1)\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right)$ Hit-and-run strategy with agents that do not fully trust their principals

1d) $(T-1)\left((\alpha\beta)^{\frac{\beta}{2-\beta}} - \frac{1}{2}\alpha^{\frac{\beta}{2-\beta}}\beta^{\frac{2}{2-\beta}}\right) + (\alpha\beta)^{\frac{\beta}{2-\beta}}$ Reputation with agents that do not fully trust their principals

1e) $\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C$ Profits under a complete contract

First of all, if the agent figures out that 1a) is greater than 1b) he would never agree upon a first best effort level because his expected utility over T periods would be negative. As a result, the S-principal should choose the strategy that offers the highest profits between 1c), 1d), and 1e). However, if reputation from first best effort were more profitable than a hit-and-run strategy (i.e., 1b>1a), the agents would trust all principals to pay the bonus, with the exception of the last game, where S-principals have no interest to acquire further reputation. Thus, acquiring reputation would be the optimal strategy for all principals.

As said before, the E-principal must follow the S-principal's choice, essentially as a consequence of the agents' reaction towards the untrustworthy behaviour of the S-principals. In particular, if 1a) is greater than 1b), a first best effort level is asked to the agents only if the S-principals have already cheated or alternatively if the S-principals have chosen a more profitable complete contract, thereby implicitly giving the signal of being S-types. Thus,

If (1a)≥(1b) and if (1c) is preferred ⇒ $U_P^E = (\alpha\beta)^{\frac{\beta}{2-\beta}} + (T-1)\beta^{\frac{\beta}{2-\beta}}$

If (1a)≥(1b) and if (1d) is preferred ⇒ $U_P^E = T(\alpha\beta)^{\frac{\beta}{2-\beta}}$

If (1a)≥(1b) and if (1e) is preferred ⇒

$$\Rightarrow U_P^E = \mathrm{Max}\left\{(\alpha\beta)^{\frac{\beta}{2-\beta}} + (T-1)\beta^{\frac{\beta}{2-\beta}}, T\left(\beta^{\frac{\beta}{2-\beta}} - \frac{1}{2}\beta^{\frac{2}{2-\beta}} - C\right)\right\}$$

Finally, if (1a)<(1b), the agent is willing to grant a first best effort in an incomplete setting to all principals because there is no fear from promise breaking; thus, $U_P^E = (T-1)\beta^{\frac{\beta}{2-\beta}} + (\alpha\beta)^{\frac{\beta}{2-\beta}}$. If F is lower than the bonus to be paid under a first best effort, the other two cases must be considered. The procedure to be followed is exactly the same, with the values changing accordingly.

Three main observations arise from the analysis of a dynamic setting, where principals can acquire reputation. Firstly, compared to the S-principals, the E-principals apply incomplete contracts more frequently. Indeed, acquiring reputation is less costly to E-principals than S-principals and the two types are likely to offer diverging contractual typologies. However, when transaction costs rise significantly, the alternative of a complete contract becomes no longer feasible, and both types of principals converge to incomplete contracts. As shown in Figure 13 below, as the number of interactions increases, contractual pooling appears more likely.[24]

The black area highlights the separating contractual equilibria, where the two types prefer two different contracts. In particular, it is always the case that, where they differ, the S-principal applies a complete contract whereas the E-principal applies an incomplete contract.

[24] If the S-principals cheat in the first game and apply complete contracting afterwards, the latter counts for the comparison.

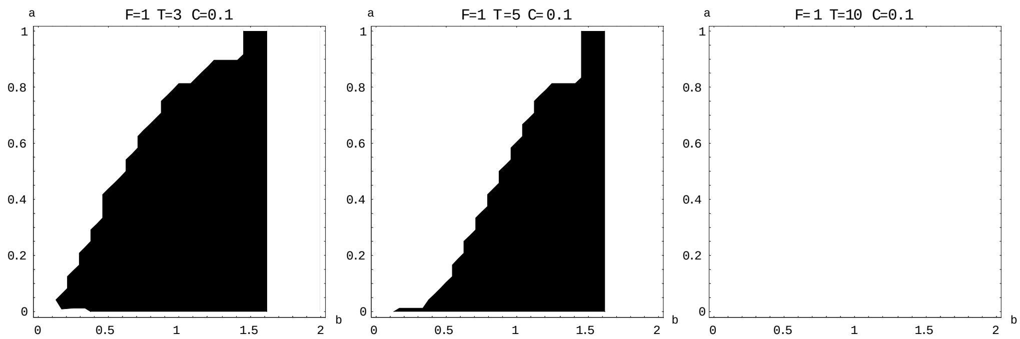


Figure 13. THE CONTRACT CHOICE BETWEEN S- AND E-PRINCIPALS DIVERGES IN THE BLACK AREA

If the game is repeated only a few times, the benefits from reputation last only a short period of time; therefore, the S-principals have little incentive in investing in reputation. Rather, they would like to move as quickly as possible to more profitable complete contracts. On the contrary, in a long-lasting relationship, acquiring reputation becomes more profitable, especially for low α's. This would give rise to a move to incomplete contracting. Recapping, with low T's, the E-principals can quickly show to the agents their true type because of the poor incentive for S-principals to simulate for the whole length of the relationship, and consequently, the principals' choices are likely to diverge visibly. With high T's, S-principals want to invest in reputation and be rewarded by high effort levels. Both principals find the gains from this action very lucrative, especially at low α's.

Secondly, another regularity, which was already observed in the one-shot game, is the predominance of complete contracts for very high returns to scale. The reason is the same as in the one-shot game: reciprocity is upward bounded by the maximum willingness F to reciprocate: we may think of F as the limitation of human generosity, which imposes severe limits to our ability to informally regulate human exchanges. Analytically, this limitation brings about corner solutions to incomplete settings; thereby reducing their surplus and making explicitly contracted transactions more efficient. Another reason why large returns to scale need formalised contracting is the rise in the probability of opportunistic actions due to the large gains from cheating. Below, the graphs from Figure 14 report the contract choice of both the S-principals and the E-principals. The black area corresponds to the choice of a complete contract.

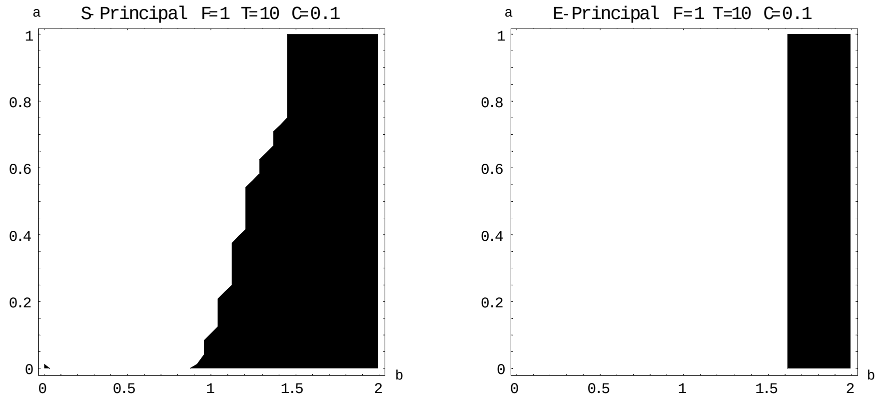
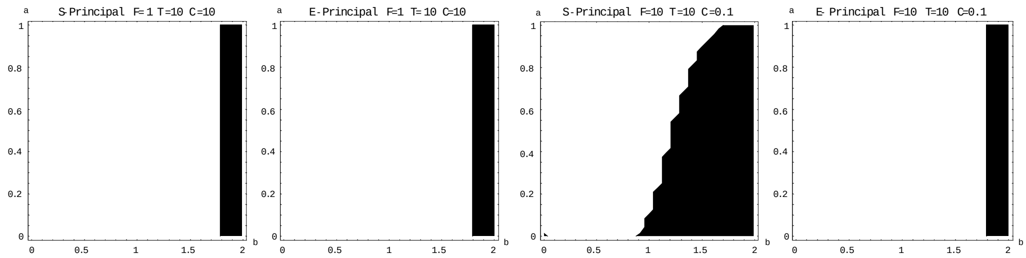


Figure 14. PRINCIPALS' CONTRACT CHOICE WHERE THE BLACK AREA STANDS FOR COMPLETE CONTRACTING

Thirdly and most logically, a rise in C and/or F induces both principals to choose mostly incomplete contracts. As shown below in Figure 15, for very high values of C and F, the complete contract, whose region is drawn in black, is chosen only as returns to scale get larger. We infer from the comparison of the left-hand side Graph from Figure 14 and the c-Graph in Figure 15 that high F's have an effect only on very large shares of reciprocating principals.



a-b. Choice for high values of C. c-d. Choice for high values of F.

Figure 15. PRINCIPALS' CONTRACT CHOICE UNDER REPEATED INTERACTIONS

Compared to one-shot games, repeated games should lead to higher profits since the reputation strategies implemented by principals would increase the information available to the workers, who, in turn, rise their trust towards principals. Below in Figure 16, two graphical representations are reported respectively for S-principals and E-principals. The graphs depict the difference between the *average* (i.e., per period) utility in a dynamic setting and the utility of a one-shot game. Thus, positive values are associated with better performances of repeated interactions. E-principals, unlike S-principals, gain with repeated games for any combination of α and β. The gains for E-principals are particularly visible for middle-low shares of reciprocating principals and moderately increasing returns to scale. On the one hand, when reciprocating principals are not numerous, they would prefer additional interactions with the agents so as to show their honesty and reliability. As mentioned above, middle-low levels of α can also be lucrative for S-principals who want to invest in reputation; so in this region they can also obtain some gains compared to static single interactions. On the other hand, where moderately increasing returns to scale arise, incomplete contracts are preferred. However, unlike the one-shot game, in a repeated setting, E-principals can better exploit their long-term reliability and implement successfully first best effort levels. On the contrary, for moderately increasing returns to scale and a large share of reciprocating principals, S-principals are likely to move quickly to complete contracts, without securing those benefits that accrue to the E-principals thanks to their reputation.

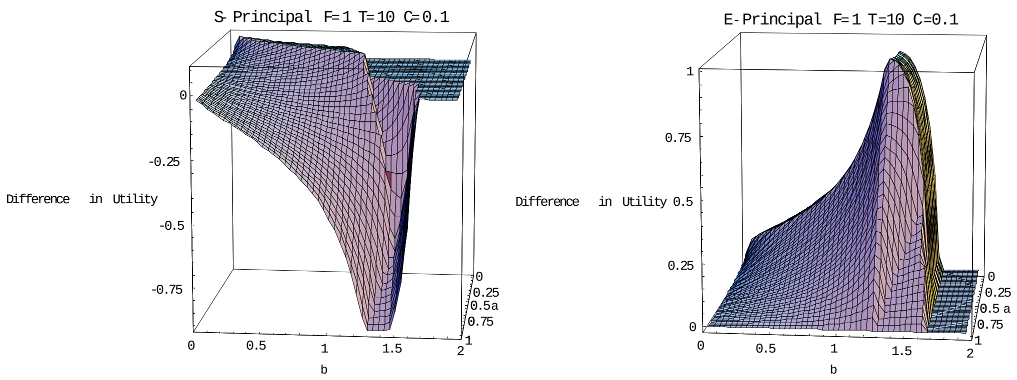


Figure 16. DIFFERENCE IN AVERAGE UTILITY BETWEEN REPEATED INTERACTIONS AND SINGLE INTERACTION

Compared to single interactions, large α's under repeated interactions are never profitable for the S-principals. Where honesty and reciprocity are widespread, they have to face two additional costs with respect to the one-shot case. Either they have to build up reputation by paying the bonus for several periods with revenues that may not be particularly gratifying (especially for low levels of β), or alternatively, they give up to reputation and cheat the agents in the first period, knowing that during the subsequent periods no reputation will allow them to imitate the E-principals; this can give rise to costly complete contracts.

As a final investigation, a static analysis for the values of F, C, and T has been carried out so as to understand what would change in the comparison between one-shot and repeated games by changing these parameters. The graphs are not reported here so as not to overwhelm the reader with other graphical representations. An increase in transaction costs C as well as in the number of periods T is beneficial for the dynamic setting, so as to make the difference with the one-shot game increasingly marked. The S-principals' benefits from repeated games are concentrated at middle-low α's, and with an increase in T and C, repeated interactions becomes little by little more preferable than single interactions in that region. In more detail, as C increases, in contrast to one-shot games, S-principals have the alternative to acquire reputation by behaving like E-principals, paying the bonus, and remaining in an incomplete setting for a long period. Higher T's make S-principals' reputation strategy more credible, and agents' trust towards S-principals increases correspondingly. In turn, E-principals would choose a repeated interaction regardless of the values of C and T. Finally, changes in F do not have serious effects on the comparison between the two utility levels. It is only worthwhile noticing that an increase in the maximum willingness to reciprocate produces a shift of the most favourable regions for reputation from decreasing returns to scale to increasing returns to scale.

7. Comparison between Private and Public Solution

The calculation of the social optimum provides the maximum expected social surplus when production is centralised and all players follow the instructions of a central planner and no transaction costs occur. In this way, we provide a benchmark to assess the efficiency of a decentralised solution in equilibrium, in which principals suffer from transaction costs and/or asymmetric information affects the labour transaction. In particular, we will able to measure how far the surplus achievable under a decentralised solution is from the maximum achievable surplus, so as to understand the value of a specific contractual choice in terms of its social value. Call *W* the welfare function. When we consider two types of agents W is the following:

$W=\alpha(e^{\beta}+I-B)+(1-\alpha)e^{\beta}+\alpha[\alpha(B-½e^2+\chi)+(1-\alpha)(-½e^2-\chi)]+(1-\alpha)[\alpha(B-½e^2)+(1-\alpha)(-½e^2)] = \mathbf{e^{\beta}-½e^2}+\alpha I+(2\alpha-1)\alpha\chi$

I will focus on the production part of the welfare function (i.e., $e^{\beta}-½e^2$) by casting aside the psychological impacts. This choice has the following rationale. Firstly, we would have to make further assumptions about the role of psychological variables in a welfare function and therefore in a social optimum. This would give rise to further speculations on the magnitude of the psychological impacts, and I would rather avoid that because it lies beyond the scope of this paper. Of course, the psychological variables are important for the model, but when we want to investigate the social welfare, their magnitude and comparison can be subjected to questioning, and we need a deeper psychological understanding. In sum, the focus will be on more measurable factors such as revenues and costs of production. Yet, I will keep intact the more realistic structure of a world incorporating psychological factors, whose measurability and comparability are nevertheless hard to assess.

The maximisation of the welfare function over effort produces the following production surplus:

$$W=\beta^{\frac{\beta}{2-\beta}}-\frac{1}{2}\beta^{\frac{2}{2-\beta}}$$

The welfare function has its minimum for β equal to one and goes to infinity for β equal to two. Repeated interactions do not change the welfare achieved each period because the central planner allocates production factors optimally already in one-shot game.

In the following, the production surplus attained from the decentralised solution will be compared in percentage terms with the total production surplus, the latter being attained by a central planner. In one-shot games, we already observed that Case I and Case II differed only under exceptional circumstances. Thus, the comparison between private and public solutions will be reported by focussing on the usual values of our parameters for Case I (i.e., one type of agent), because Case II turns out to be largely exactly the same.[25]

[25] Welfare analyses were carried out for both cases with the same values, by making additional static analysis by changing the value of the agents' psychological impact χ in the two-types-agents case. The results are totally similar for any reasonable level of χ. Some deviations were evident, but only for small

In this way, we are able to make more reliable and sensible comparisons between one-shot games and repeated games, because in the latter we investigated exclusively the single-agent case.

The graphs in Figure 17 show the surplus achieved by a complete contract for the whole range of returns to scale. Increasing transaction costs severely affect the market exchange of certain labour services. A large share of technologies cannot afford any formalised relationship because the cost of formally sanctioning uncooperative behaviour exceeds the profits. In principle, only particularly high returns to scale could break even as transaction costs rise considerably.

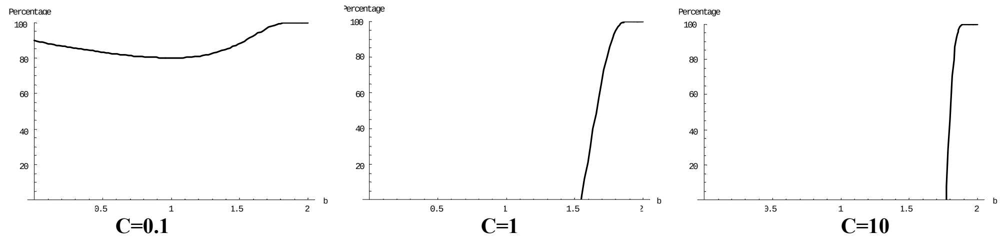


Figure 17. EFFICIENCY LEVELS ACHIEVABLE WITH A COMPLETE CONTRACT: [(DECENTRALISED SURPLUS*100)/TOTAL PRODUCTION SURPLUS]

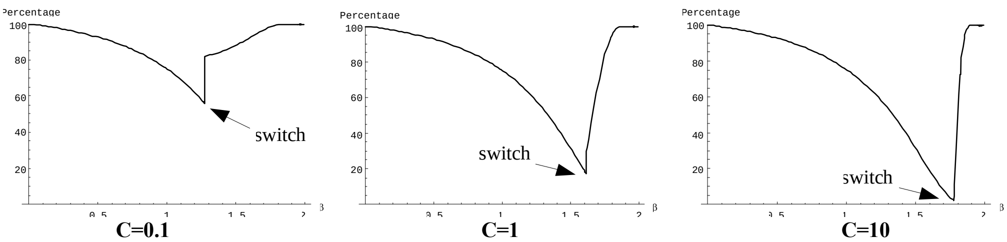


Figure 18. EFFICIENCY LEVELS ACHIEVABLE WITH AN OPTIMAL DECENTRALISED SOLUTION – ONE-SHOT GAME (α=0.5 AND F=1)

Provided that a certain amount of fair-minded principals is introduced, say one half, which could enforce labour contracts only by means of their reliability and trustworthiness, some of these inefficient outcomes would be prevented but, surprisingly, others would get socially worse. As emphasised by the Graphs in Figure 18, incomplete contracting is particularly beneficial when transaction costs are high, by allowing many markets to emerge. However, when the cost of contract enforcement is within reasonable limits, incompleteness wastes surplus. This is highlighted by comparing the Graphs

intervals of β, when χ became particularly large, and say, unreasonable. Even at these unreasonable levels, the substance of the observations did not change, confirming the robustness of the results.

for the case C=0.1 in Figure 17 and Figure 18 in an interval including constant returns to scale. As a consequence, the sustainability of the incomplete contract may become socially rather costly: the extraction of effort is not efficient for the amount of production that could be generated but, in particular, production surplus is lower than what could be achieved with full complete contracting. For increasingly high returns to scale, at some point, incomplete contracting becomes costly to the principal, too. Thus, a switch occurs from an incomplete contract to a complete contract.

The surplus loss arising in incomplete contracting when compared to complete contracting is intrinsically due to the nature of reciprocating behaviour. On the one hand, the positive psychological impact hitting the E-principal introduces a virtuous behaviour, so that new markets, that otherwise would not exist, come to light, and other markets improve their performances because of the levels of trust established. On the other hand, the E-principal's psychology neutralises the monetary cost of the bonus. Thus, apart from the upper bound that is imposed by F to the bonus level, the E-principal may give generous bonuses when they are not economically optimal.

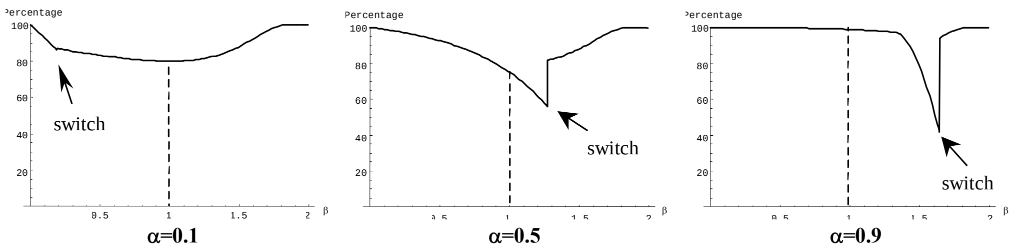


Figure 19. EFFICIENCY LEVELS ACHIEVABLE WITH OPTIMAL DECENTRALISED SOLUTION – ONE-SHOT GAME (F=1 C=0.1)

The bonus contract introduces distortions that are more severe for increasingly high shares of reciprocating principals. In Figure 19, three graphs depict the comparison between decentralised and centralised solutions according to three different shares of reciprocal players in a one-shot game. As α increases, the private profitability of the incomplete contract improves, and this contractual typology is also applied for increasingly high values of β. However, as β gets higher, one can observe from the last two graphs the waste of surplus caused by incomplete contracting getting worse at very high αs within specific small intervals of β. For α equal to 0.9, more than 50% of the social surplus is not achieved for some values of β, precisely where increasing returns to scale occur. This result is interesting. Low shares of reciprocating principals may generate sometimes more surplus than high shares, for the simple fact that complete contracts are used in lieu of incomplete contracts. Much however depends on the technology.

As returns to scale get high, an increase in the number of reciprocators, by acting as a sort of leverage, improves productivity levels. Indeed, we observed in the previous sections that for a given high β, a general increase in the level of trust reduces the uncertainty over the agents' reward, thereby allowing for higher levels of effort. However, increased effort levels require higher bonus levels. This process may waste large resources because the E-principal offsets the bonus' growth by means of increasingly high positive psychological impacts. However, bonuses will grow up to the maximum willingness to reciprocate F; thereby quickly reducing profitability for higher α's and/or β's and determining a contractual switch from incomplete to complete contracts.

Equally interesting is the comparison in Figure 19 of the loss of welfare for three different degrees of reciprocal behaviour and for constant returns to scale (i.e., β=1). For high levels of trust (i.e., α=0.9), the surplus is at its highest point if compared with lower levels of trust. Indeed, the society is able to implement an incomplete contract that does not waste surplus and at the same time saves on transaction costs. For instance, if the case α=0.9 is compared with the case α=0.1, we realise that higher levels of trust allow the implementation of more efficient contracts. However, for medium levels of trust (i.e., α=0.5), even if the incomplete contract is preferred, resources turn out to be used rather inefficiently. Interestingly, for those technologies showing constant returns to scale, the society gains from high levels of trust/honesty but only beyond a specific threshold. Achieving this threshold becomes socially recommendable. Introducing a virtuous environment of reciprocal players is rewarding only if their share is substantial. Thus, it may occur that the diffusion of reciprocating practices is not large enough to sustain optimal production levels. But once a substantial α is attained, the gain from a widespread reciprocating behaviour is particularly robust, and saving from transaction costs becomes socially desirable.

Up until now, the focus has been on one-shot games. We observed that the introduction of fair-minded principals opens many markets that would otherwise fail to emerge. However, if the level of trust in the society is very low, many markets may still not be available as the Graph on the left in Figure 20 depicts. On the one hand, the enforcement of complete contracts yields negative profits; therefore this contractual typology cannot be stipulated. On the other hand, very low levels of α make the incomplete contract costly to such an extent that monetary profits turn out to be negative. In other words, reciprocators are not enough to sustain incomplete contracting. Indeed, we may observe that in some societies some markets are nonexistent because of the high cost of contract enforcement coupled with a low level of reciprocal attitude. One solution to this inefficient outcome is the development and diffusion of reciprocal attitudes such that these markets can eventually emerge and be sustained by informal and incomplete contracting. Another, more 'natural' solution is related to reputation.

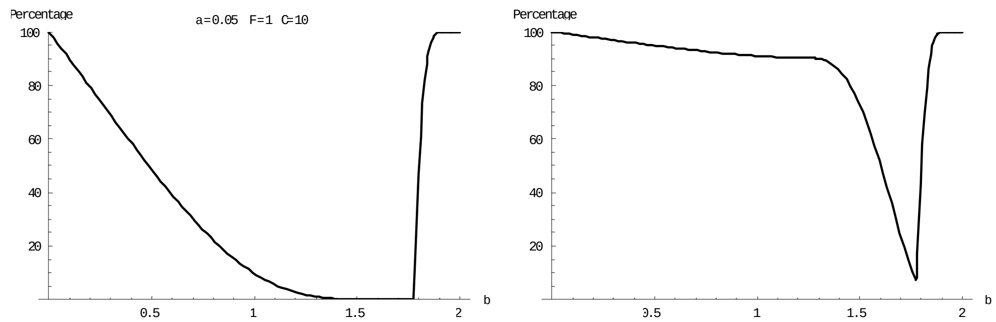


Figure 20. REPRESENTATION OF THE IMPROVEMENT FROM SINGLE INTERACTION TO REPEATED INTERACTIONS (T=5)

Repeated games provide an overall improvement in the performance of the decentralised solution as shown in the second Graph in Figure 20. Reputation expands markets and raises surplus for existing markets. In a repeated game, increasing the number of interactions T raises remarkably the overall surplus especially when the level of fair-mindedness is not very widespread. For large shares of reciprocating principals, an increase in T does not produce a visible impact, because high α's already positively affect middle-low levels of returns to scale, to wit, where reciprocal behaviour generates large gains. Additionally, larger shares of reciprocators do not motivate S-principals to co-operate because of the larger gains obtainable from the hit-and-run strategies.

The returns from reputation are mainly due to the general improvement in agents' trust and the materialisation of the co-operative attitude of S-principals. On the one hand, a high number of interactions increases the chances for E-principals to show their trustworthiness. On the other hand, as T increases, S-principals find co-operative behaviour with agents more attractive because of the gains from reputation in long-term relationships. In other words, principals' pooling under incomplete contracting enhances social performance. However, for high α's and moderately increasing returns to scale, long-period relationships are not enough to induce S-principals to implement reputation strategies, and consequently repeated interactions are not able to fully eliminate the surplus loss arising in this region.

8. Conclusion

High costs of enforcement can make many markets unprofitable. These markets can only emerge through incomplete contracting, which are primarily sustained by trust and consequently enforced by reciprocal exchange. However, the sustainability of incomplete contracts depends crucially on the existence of fair-minded principals or, as they are called in this paper, emotional principals. In particular, a large share of emotional principals represents a very powerful enforcement device because it enhances the overall trust level. Therefore, this paper has formally proved that incomplete contracting helps to release new resources that otherwise would be kept constrained by high levels of formal enforcement costs. If the share of emotional principals is not large, completeness appears the only way to get principals and agents to agree on a labour relationship. High returns to scale also make the provision of complete contracts a safer instrument, because the 'cost-opportunity' of inefficient effort levels increases as returns to scale rise; thus, complete contracts are preferred. In other words, incomplete contracting shows limitations for important labour relationships, those in which very productive and innovative technologies are adopted and small changes in effort produce an important impact on profits.

The maximum levels of generosity of the last player, the principal in our case, limit the potential of incomplete contracts. The introduction of this parameter, which is original to this paper, is important for reciprocity analyses because it adds realism to these types of exchanges. Principals are willing to reciprocate, but up to a certain point. Incomplete contracting, without this *natural* limit, would otherwise make emotional principals' competitiveness unsustainable *vis-à-vis* self-regarding principals.

We have been able to assess the impact of the introduction of emotional agents into the model. A share of agents could experience a positive or negative psychological impact on top of their monetary utility as a consequence respectively of principals' promise fulfilment or promise breaking. The principal's choice between complete and incomplete contracts has not been particularly affected. However, the two types of agents could be separated because under certain circumstances those relationships that necessarily have to be complete for one type of agents could become incomplete for the other type.

Self-regarding principals represent a negative externality on the share of reciprocators. If reciprocators would be immediately recognised by the agents without mistake, they could implement first best effort levels without paying the cost of contract enforcement. However, self-regarding principals have all interest to mimic the fair-minded principals, and consequently reciprocating principals would like to differentiate themselves by investing a certain amount of money, which should credibly signal their type. Yet, signalling can never be credible and profitable at the same time, unless we believe that emotional principals can gain some psychological rents; in other words, we need to assume that the psychological impact could exceed the monetary loss from promise fulfilment. But even in this circumstance, the applicability of signalling is very marginal. On the contrary, acquiring reputation through repeated interactions appears to be more effective.

Repeated interactions allow emotional principals to considerably increase their utility because once self-regarding principals find defection more profitable, emotional principals would be recognised as true reciprocators, and first best effort levels can be attained. However, self-regarding principals may operate strategically and fulfil their promise as well, because this can be an optimal strategy in the long-term. In particular, as the relationship is repeated more times, reputation induces higher levels of agents' trust and consequently an increasingly wide adoption of incomplete contracts will arise.

Finally, despite the common impression that reciprocators possess efficiency-enhancing features for all markets, under specific circumstances incomplete contracts waste social surplus more than complete contracts would do. The waste is caused by an inherent inefficiency of reciprocity, which may be called *the cost of generosity*. A fair-minded psychology is necessary in regulating informal agreements and in many occasions it is truly effective, but at some point it creates distortions because an excessive surge of generosity sustains contracts with particularly low levels of productivity. This is not fully internalised by reciprocal principals, who keep on sustaining contractual provisions which are not supported by the certainty of law. Two main variables intervene to moderate this hidden cost. Firstly, there exists a natural upper bound to generosity, which is imposed by the maximum willingness to reciprocate. Secondly, repeated interactions reduce self-regarding principals' defection, and therefore uncertainty, thereby supporting reciprocity and inducing more efficient levels of effort.

The evolution of preferences incorporating psychological effects has not been examined here, since the literature is still vague and rather unsatisfactory.[26] Every evolutionary analysis in economics seems still lacking in serious psychological foundations that cannot help to address in a fully satisfactory way this complex area of study. Additionally, this area appears controversial but nevertheless very interesting, which makes it a promising subject for future investigations.

[26] In particular, see Guttman (1999), Sethi and Somanathan (2001), Frey and Jegen (2001), and Bowles (1998).

Bibliography

Bohnet, Iris, Frey Bruno S. and Steffen Huck (2001), "More Order with Less Law: On Contract Enforcement, Trust, and Crowding", *American Political Science Review*, 95(1), March, pp. 131-144.

Bolton, Gary E. and Axel Ockenfels (1999), "ERC: A Theory of Equity, Reciprocity, and Competition", *American Economic Review*, 90(1), pp. 166-193.

Bowles, Samuel (1998), "Endogenous Preferences: The Cultural Consequences of Markets and other Economic Institutions", *Journal of Economic Literature*, 36(1), pp. 75-111.

Falk, Armin and Urs Fischbacher (2006), "A Theory of Reciprocity", *Games and Economic Behavior*, 54(2), pp. 293-315.

Falk, Armin and Simon Gachter (2002), "Reputation and Reciprocity: Consequences for the Labour Relations", *Scandinavian Journal of Economics*, 104(1), pp. 1-26.

Fehr, Ernst, Gachter Simon and Georg Kirchsteiger (1997), "Reciprocity as a Contract Enforcement Device", *Econometria*, 65(4), pp. 833-860.

Fehr, Ernst, Klein Alexander and Klaus M. Schmidt (2001), "Fairness, Incentives and Contractual Incompleteness", CEPR Discussion Paper 2790.

Fehr, Ernst and Klaus M. Schmidt (1999), "A Theory of Fairness, Competition, and Cooperation", *Quarterly Journal of Economics*, 114(3), pp. 817-868.

Fehr, Ernst and Klaus M. Schmidt (2001), "Theories of Fairness and Reciprocity - Evidence and Economic Applications", CEPR Discussion Paper 2703.

Frey, Bruno S. and Reto Jegen (2001), "Motivation Crowding Theory", *Journal of Economic Surveys*, 15(5), pp. 589-611.

Guttman, Joel M. (2000), "On the Evolutionary Stability of Preferences for Reciprocity", *European Journal of Political Economy*, 16(1), pp. 31-50.

La Porta, Rafael, Lopez De Silanes Florencio, Shleifer Andrei and Robert W. Vishny (1997), "Trust in Large Organizations", *American Economic Review*, 87(2), pp. 333-338.

Loewenstein, George (2000), "Emotions in Economic Theory and Economic Behvaior", *American Economic Review Papers and Proceedings*, 90(2), pp. 426-432.

Rabin, Matthew (1993), "Incorporating Fairness into Game Theory and Economics", *American Economic Review*, 83(5), pp. 1281-1302.

Rabin, Matthew (1998), "Psychology and Economics", *Journal of Economic Literature*, 36(1), pp. 11-46.

Sethi, Rajiv and E. Somanathan (2003), "Understanding Reciprocity", *Journal of Economic Behavior & Organization*, 50(1), pp. 1-27.

Trivers, Robert (1971), "The Evolution of Reciprocal Altruism", *Quarterly Review of Biology*, 46(1), pp. 35-57.

Discussion Papers - Dipartimento Scienze Economiche – Università di Pisa

1. Luca Spataro, Social Security And Retirement Decisions In Italy, (luglio 2003)

2. Andrea Mario Lavezzi, Complex Dynamics in a Simple Model of Economic Specialization, (luglio2003)

3. Nicola Meccheri, Performance-related-pay nel pubblico impiego: un'analisi economica, (luglio 2003)

4. Paolo Mariti, The BC and AC Economics of the Firm, (luglio- dicembre 2003)

5. Pompeo Della Posta, Vecchie e nuove teorie delle aree monetarie ottimali, (luglio 2003)

6. Giuseppe Conti, Institutions locales et banques dans la formation et le développement des districts industriels en Italie, (luglio 2003)

7. F. Bulckaen - A. Pench - M. Stampini, Evaluating Tax Reforms without utility measures : the performance of Revenue Potentialities, (settembre 2003, revised June 2005)

8. Luciano Fanti - Piero Manfredi, The Solow’s model with endogenous population: a neoclassical growth cycle model (settembre 2003)

9. Piero Manfredi - Luciano Fanti, Cycles in dynamic economic modelling (settembre 2003)

10. Gaetano Alfredo Minerva, Location and Horizontal Differentiation under Duopoly with Marshallian Externalities (settembre 2003)

11. Luciano Fanti - Piero Manfredi, Progressive Income Taxation and Economic Cycles: a Multiplier-Accelerator Model (settembre 2003)

12. Pompeo Della Posta, Optimal Monetary Instruments and Policy Games Reconsidered (settembre 2003)

13. Davide Fiaschi - Pier Mario Pacini, Growth and coalition formation (settembre 2003)

14. Davide Fiaschi - Andre Mario Lavezzi, Nonlinear economic growth; some theory and cross-country evidence (settembre 2003)

15. Luciano Fanti , Fiscal policy and tax collection lags: stability, cycles and chaos (settembre 2003)

16. Rodolfo Signorino- Davide Fiaschi, Come scrivere un saggio scientifico:regole formali e consigli pratici (settembre 2003)

17. Luciano Fanti, The growth cycle and labour contract lenght (settembre 2003)

18. Davide Fiaschi , Fiscal Policy and Welfare in an Endogenous Growth Model with Heterogeneous Endowments (ottobre 2003)

19. Luciano Fanti, Notes on Keynesian models of recession and depression (ottobre 2003)
20. Luciano Fanti, Technological Diffusion and Cyclical Growth (ottobre 2003)
21. Luciano Fanti - Piero Manfredi, Neo-classical labour market dynamics, chaos and the Phillips Curve (ottobre 2003)
22. Luciano Fanti - Luca Spataro, Endogenous labour supply and Diamond's (1965) model: a reconsideration of the debt role (ottobre 2003)
23. Giuseppe Conti, Strategie di speculazione, di sopravvivenza e frodi bancarie prima della grande crisi (novembre 2003)
24. Alga D. Foschi, The maritime container transport structure in the Mediterranean and Italy (dicembre 2003)
25. Davide Fiaschi - Andrea Mario Lavezzi, On the Determinants of Growth Volatility: a Nonparametric Approach (dicembre 2003)
26. Alga D. Foschi, Industria portuale marittima e sviluppo economico negli Stati Uniti (dicembre 2003)
27. Giuseppe Conti - Alessandro Polsi, Elites bancarie durante il fascismo tra economia regolata ed autonomia (gennaio 2004)
28. Annetta Maria Binotti - Enrico Ghiani, Interpreting reduced form cointegrating vectors of incomplete systems. A labour market application (febbraio 2004)
29. Giuseppe Freni - Fausto Gozzi - Neri Salvadori, Existence of Optimal Strategies in linear Multisector Models (marzo 2004)
30. Paolo Mariti, Costi di transazione e sviluppi dell’economia d’impresa (giugno 2004)
31. Domenico Delli Gatti - Mauro Gallegati - Alberto Russo, Technological Innovation, Financial Fragility and Complex Dynamics (agosto 2004)
32. Francesco Drago, Redistributing opportunities in a job search model: the role of self-confidence and social norms (settembre 2004)
33. Paolo Di Martino, Was the Bank of England responsible for inflation during the Napoleonic wars (1897-1815)? Some preliminary evidence from old data and new econometric techniques (settembre 2004)
34. Luciano Fanti, Neo-classical labour market dynamics and uniform expectations: chaos and the “resurrection” of the Phillips Curve (settembre 2004)
35. Luciano Fanti – Luca Spataro, Welfare implications of national debt in a OLG model with endogenous fertility (settembre 2004)
36. Luciano Fanti – Luca Spataro, The optimal fiscal policy in a OLG model with endogenous fertility (settembre 2004)
37. Piero Manfredi – Luciano Fanti, Age distribution and age heterogeneities in economic profiles as sources of conflict between efficiency and equity in the Solow-Stiglitz framework (settembre 2004)

38. Luciano Fanti – Luca Spataro, Dynamic inefficiency, public debt and endogenous fertility (settembre 2004)

39. Luciano Fanti – Luca Spataro, Economic growth, poverty traps and intergenerational transfers (ottobre 2004)

40. Gaetano Alfredo Minerva, How Do Cost (or Demand) Asymmetries and Competitive Pressure Shape Trade Patterns and Location? (ottobre 2004)

41. Nicola Meccheri, Wages Behaviour and Unemployment in Keynes and New Keynesians Views. A Comparison (ottobre 2004)

42. Andrea Mario Lavezzi - Nicola Meccheri, Job Contact Networks, Inequality and Aggregate Output (ottobre 2004)

43. Lorenzo Corsini - Marco Guerrazzi, Searching for Long Run Equilibrium Relationships in the Italian Labour Market: a Cointegrated VAR Approach (ottobre 2004)

44. Fabrizio Bulckaen - Marco Stampini, Commodity Tax Reforms In A Many Consumers Economy: A Viable Decision-Making Procedure (novembre 2004)

45. Luzzati T. - Franco A. (2004), "Idrogeno fonti rinnovabili ed eco-efficienza: quale approccio alla questione energetica?"

46. Alga D. Foschi , "The coast port industry in the U.S.A: a key factor in the process of economic growth" (dicembre 2004)

47. Alga D. Foschi , "A cost – transit time choice model: monomodality vs. intermodality" (dicembre 2004)

48. Alga D. Foschi , "Politiques communautaires de soutien au short sea shipping (SSS)" (dicembre 2004)

49. Marco Guerrazzi, Intertemporal Preferences, Distributive Shares, and Local Dynamics (dicembre 2004)

50. Valeria Pinchera, "Consumo d'arte a Firenze in età moderna. Le collezioni Martelli, Riccardi e Salviati nel XVII e XVIII secolo" (dicembre 2004)

51. Carlo Casarosa e Luca Spataro, "Propensione aggregata al risparmio, rapporto ricchezza-reddito e distribuzione della ricchezza nel modello del ciclo di vita "egualitario": il ruolo delle variabili demografiche" (aprile 2005)

52. Alga D. Foschi – Xavier Peraldi – Michel Rombaldi, "Inter – island links in Mediterranean Short Sea Shipping Networks" (aprile 2005)

53. Alga D. Foschi (2005), "Lo shipping, la cantieristica ed i porti nell'industria marittima" (aprile 2005)

54. Marco Guerrazzi, "Notes on Continuous Dynamic Models: the Benhabib-Farmer Condition for Indeterminacy" (settembre 2005)

55. Annetta Binotti e Enrico Ghiani, "Changes of the aggregate supply conditions in Italy: a small econometric model of wages and prices dynamics" (settembre 2005)

56. Tommaso Luzzati, “Leggere Karl William Kapp (1910-1976) per una visione unitaria di economia, società e ambiente” (dicembre 2005)

57. Lorenzo Corsini (2006), “Firm's Entry, Imperfect Competition and Regulation”

58. Mario Morroni (2006), “Complementarities among capability, transaction and scale-scope considerations in determining organisational boundaries”

59. Mario Morroni (2006), “Innovative activity, substantive uncertainty and the theory of the firm”

60. Akos Dombi (2006), "Scale Effects in Idea-Based Growth Models: a Critical Survey"

61. Binotti Annetta Maria e Ghiani Enrico (2006), “La politica economica di breve periodo e lo sviluppo dei primi modelli mocroeconometrici in Italia: dalla vicenda ciclica degli anni ’60 alla prima crisi petrolifera”

62. Fioroni Tamara (2006), “Life Expectancy, Health Spending and Saving”

63. Alga D. Foschi (2006), “La concentrazione industriale per i sistemi di trasporto sostenibile: un caso di successo nel Mediterraneo orientale”

64. Alga D. Foschi (2006), “La concentrazione industriale per i sistemi di trasporto sostenibile