Analyse économique des politiques de transferts de technologie et la corruption

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Economic Analysis of technology transferring and corruption

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Résumé
Parmi les stratégies de transition vers la société basée sur la connaissance une place est allouée à la diffusion des savoirs et le transfert des technologies. Le succès des transferts de technologie dépend des accords entre les firmes, de la confiance mutuelle et des lois au sujet de la propriété intellectuelle. Le type d'accord de transfert, quant à lui, dépend de l'environnement institutionnel, et, naturellement, du type de concurrence. La violation des lois et des accords a souvent lieu à l'occasion des transferts de technologie et des connaissances. Une des formes de violation est liée à la corruption.
En premier lieu nous discutons les raisons économiques, culturelles et sociales qui font que la corruption existe et en quoi elle est nuisible pour des différents types d'économies.
En second lieu, nous analysons les raisons d'être des lois qui régissent les droits à la propriété intellectuelle, essayons de comprendre pourquoi elles ne sont pas toujours respectées, et quelle peut être le genre des dégâts que les violations provoquent.
En troisième lieu, nous analysons les politiques de diffusion des connaissances partant d'une situation simple, où le transfert se produit en forme d'investissements directs (vente de ses produits, procédés de fabrication ou connaissances) entre les firmes hétérogènes du point de vue d'équipement et de compétence technologiques. Nous présentons des modèles analysant des conséquences de la corruption dans quelques situations stylisées telles que:
Donateur et destinataire font usage des technologies de différents niveaux de performances :
— Le destinataire, « moins développé » des deux, cherche à pirater la technologie innovante ;
— La technologie légalement transférée (à bas prix par rapport aux coûts liés à sa conception) occasionne l'accroissement de la concurrence entre les deux agents au détriment du donateur;
— La corruption se produit, quand la technologie transférée est de qualité « médiocre » en comparaison avec celle qui a été négociée.
Dans chacun des cas la corruption peut se produire entraînant des contre-performances pendant le transfert et l'introduction d'une technologie dans le processus de la production, puisque l'efficacité d'une technologie peut être différente selon les entreprises acquéreuses.
Nos modèles, décrivent des circonstances dans lesquelles la corruption peut surgir, et ils montrent, d'une part, pourquoi le comportement corrompu peut être profitable pour des agents et pour la société dans son entier. D'autre part, ils permettent d'évaluer des pertes économiques de la politique de R&D dues à la corruption.

INTRODUCTION

The long run view on the sustainable and favourable development of knowledge–based society needs the inter-disciplinary analysis involving economists, philosophers and jurists. Innovation is a very complex process. Discoveries and new designs come out in various points of the world and at different time. They can be comprehend or not by the society, and they can be adopted and used by the group of people of different sizes.

In this text we pay attention to the role of intellectual property rights (IPR) and to the

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difficulties that countries experience trying enforcement of lows. In particular we study the role of corruption, which circumvent the law, in the process of new technology diffusion. As the elaboration of R&D policy requires the improvement of decision-making tools, we investigate more technical issues.

First we go over the literature on social ethics in order to comprehend why the corrupted behaviour exists and which forms it can take in different societies. After that we examine laws governing intellectual protection and their likely influence on the investment and innovation performance. Since, there is no systematic knowledge of whether different countries actually do have substantially different rules that might explain differences in their skills and technological policy. As a law is in a sense an incomplete contract, negotiations and bilateral agreement exemption may determine the modalities of knowledge transfers.

Finally, this paper contains some formal descriptions of the technology transfers among the firms or countries. Developing the ideas initiated by Chin and Grossman (1990), we analyse both the effects of IPR violations and of corruption on the welfare of innovative and adopting firms. The welfare effects depend on two types of IPR. One IPR system prohibits the technology transfers and the other system favours the licensing, which allows the propagation of innovation. Corrupters may be introduced in different situations. In the case when the transfer of technology is prohibited but occurs, it is supposed that corrupter can be innovator and/or imitator. If the transfer is authorised, the innovator may bribe the imitator and transfers the technology of lower quality than the technology contracted by the licence. Some simulations illustrate the margins of optimal IPR enforcement and of corruption for innovator, for adopter and for the welfare of both.

1. CORRUPTION

To analyse corruption is an occasion to think about the value of liberties, the dimension of needs, the reason for inequalities, and the logic of accountability and responsibility (Vygotsky 1924, Etzioni 1990, Romer (1994), Kolm 1996, Piketty 2001, Miller & al 2001, Benabou & Tirole 2002). A variety of characteristics of countries' economic, political, social and legal systems might affect the frequency and/or magnitude of acts of corruption (Tanzi (1998)).

The main factor of difference between legal systems is that some follow civil and others common law. Common law is the part of law that was originally unwritten and based on the common customs of the country. Common law developed on the principle of judicial precedent, by which a decision on a case would have to be taken into account when deciding a similar case. Traditionally, the common law systems provide greater protection of property against the state that is why they experience less corrupted governments, while, at the same time, the business related corruption might become even more insidious. The common law traditions are found in most present and former members of Commonwealth, and in Thailand, Liberia, and Namibia. In the rest of the world, the civil law traditions apply. Civil law codes are based on the Roman law where the role of judiciary is manifested through the widespread use of written materials. The willingness of judges to strictly follow procedures, even when results might threaten the power structures, increases the chance that the official corruption will be exposed and punished. The empirical study by Treisman (2000) verifies that the civil law systems have significantly higher perceived corruption.

Religious traditions have been thought to determine cultural postures towards authority and social morals. Thence confrontations with officeholders are rarer in societies where

Catholicism, Islam, and Orthodoxy, known as hierarchical religions, are pre-eminent than in cultures formed by more egalitarian religions such as Protestantism. Avoiding confrontations, the relations among people are liable to toadying and to bribery. Empirically revealed correlations show that the larger the proportion of Protestants in a country's population, the lower is the perceived corruption (Rose-Ackerman (1999), Schneider & Enste (2000), Shleifer & Vishny (1993).

Societies privileging the virtue of economic achievement engender corruption more than those who are less fascinated by economic progress (Lordon (2002)). Above some level of development, (non-capitalist, post-materialist motivation in Protestant Scandinavian societies, for example) corruption becomes smaller. Indeed, in contrast to economic growth, sustainable human development with the spread of education, literacy, health, and depersonalized access to the provision of these services, make corrupt acts not only morally wrong but simply vain.

The roots of corruption in developing regions might be found in the survival of the traditions of their societies, where presents, tribute and other social obligations were a customary and normal part of social networks. Where fundamental loyalties are due the family, the village, co-religionists or one's own ethnic group or caste (see Myrdal (1968) for South Asia), then for office holders favors and preferential treatment for kinsmen are more important than fidelity to the state. Added to this, in many developing countries government employees are so poorly paid that they are unable to maintain even a modest standard of living. In consequence, they have almost no other recourse than to seek to augment their income by bribing. Because of the confluence of poverty, relics of old traditions, and bad governance, Myrdal's principles of cumulative causation and circular interdependence intensify the effects of the corruption.

In countries of former USSR also the persistence and enlargement of a shadow economy and of corruption may be explained by some long terms background. Traditionally, citizens defy the state. Behaviour on the edge of the lawful is not morally condemned by societal opinion or by authorised social groups. But, the interruption in society development pathway and of long-lived aspects of cultural traditions during the 1990's nullifies the accumulated rules of justice, decreasing restrictions on egoistic forces and corruption. Thus a special push for corruption and other forms of iniquitous activity resulted from the deposition of the communist party and the soviet state, which in turn caused the slacking of legal protection of state ownership and of contracts between the state and enterprises. In this country, new legislation was slow in being implemented and the carrying out of laws, of decrees and of instructions was lost. Russian criminal organizations have been able to exploit this legislative vacuum as well as the increased ease of international travel, the liberalization of emigration policies, the expansion of international trade, the spread of high technology communications systems and of international financial networks to extend their criminal enterprises well beyond the borders of their own country.

The effects of corruption on the economy can be seen from different perspectives. One of them is the decay of personality (producer of cultural and material values) and of democracy, both weakening human development. Other effects are purely on economic development: growth, consumption, investment.

More often in economic literature corruption is reduced to the misuse of public power for private benefit, involving or not money changing hands. In the last case the problem of corruption relates to profit sharing and to the effects that it has on the economic activity of different agents and on their incentives. Theories classify situations of corruption depending on beliefs about government ethic as benevolent, contested, or self-seeking, and often use the Principal-Agent model to formulate the bribery acting (Lambsdorff 2001). The results become aware of model analysis with symmetric or asymmetric information that the government

(Principal) and other contractual parties (Agents) have. Usually for certain situations resulting from bribery the balance between costs and benefits are evaluated for each party, as well as the sum of losses and benefits of all participants, which is called traditionally the general welfare implication. As a rule the authors in their models take into account that reducing corruption, detecting and punishing it or/and inducing agents to behave honestly, is costly to implement.

2. R&D AND IPR

The infringements in patent protection may change the firms' location throughout the world and direct investment decisions. The patent litigation may change significantly the firm value upon the filing of litigation[1]. In today's economic literature prevailing wisdom is that strong patent rights are conductive to economic progress. Ginart and Park (1997) using an index of patent rights for 110 countries for the period 1960-1990, shown that in effect the more developed economies tend to provide tighter protection. By this, the authors admit that economic growth is likely correlated with IPR enforcement. Yet, the observations of Mansfield (1994), based on a sample of US manufacturing firms, claim that for economic reasons the IPR enforcement is not always or equally favourable. Indeed, it is very important for the firms with advanced technology and less important for firms with low one: only 20 % of firms reported that the strength of IPR was a major consideration in their decisions to invest in rudimentary production facilities, but 80 % deemed it important for locating R&D facilities. Mazzoleni and Nelson (1998) heighten the doubt about the virtuous of IPR enforcement, arguing that the present movement towards stronger IPR protection in weakly protecting countries may hinder rather than stimulate technological progress in some among them.

Economic analysis of intellectual property laws may be conducted through some points of view, and for some distinct ends: to determine what laws are economically efficient, to predict the effects of laws, to forecast what laws will be. The laws may be mandatory or they may incite and motivate. The economic studies on intellectual property rights (IPR) are trying to relate the impact of patenting and licensing rules on some particular activities, and especially in relation with technology. *Microeconomic analysis* emphasises the legal rules from their efficiency feature. It is supposed that the laws influence the individual behaviour. The law influence is of economic nature, and the law is implicitly conceived for achieving some objectives. Conceptually, an ethical objective might be social income or social welfare, that may be imagine as aggregation of individuals' incomes or of their welfare (utility). The incomes may be added, but it is more difficult to appreciate the welfare, since for that many subjective causes must be taken into account. Therefore, the income is retained usually for simplicity as a criterion of efficiency, and the legal rules are evaluated according to the principal of income maximisation. *Antitrust* law and legislation is another area of economic analysis. One important contribution has been to notify that some elements of law may be based on an inexact judgement of how firms get monopoly power. In some cases the antitrust law may be in disagreement with patent law, which protect firm's exclusive rights on new technology markets (Peaucelle (1999)).

[1] Lanjouw and Lerner (1998) report the market reaction to the filing of 20 patent infringement suits announced in The Wall Street Journal. It appeared that in the two-day window ending on the day the story appeared in Journal, the combined market-adjusted value of the firms fell by an average of –3.1%.).

Such analyses raise the questions: what portfolio of rules would induce an efficient economic result? Moreover, how easy will it be to negotiate changes if the initial set of rules inducing inefficient results? The IPR may be established through a public authority interaction or through a contract between partners.

From economic point of view the question is whether patent litigation distorts goods and technology markets ? Another one is how often the litigation may occur.

Theoretically patent litigation frequency depends on some factors (see Lanjouw and Schankerman (1997)). The likelihood of a potentially litigious situation, such as an infringement of patent rights, increases with:

— the appropriability of returns to inventions in different sectors of activity[2] (the more patents, the more lawsuits by industrial sector occur);

— the number of claims embodied in patent;

— the number of areas of patent adoption; and

— the number of firms involved in innovation activity in the same technology area.

The patent value is evaluated some time in terms of number of patent citations (Hall, Jaffe and Trajtenberg, (1998)). Usually the amount of damages recovered by the prevailing patentee is directly related to the ability to prove lost profits or a reasonable royalty[3] (Silverman (1993)). The changes in patent protection rules can affect more generally the timing of innovation activity by affecting agents' motive for imitation-risk smoothing; the situations analysed by Park (1997).

Patent infringement litigation frequently costs too mach, from the initial pre-litigation investigation, to the jury supervisors' reading of the verdict. The amount frequently constitutes in US more than the annual gross profits of some small or medium sized firms. For most of them, patent litigation is financially out of reach. The reasons for patent litigation may have different social effects. Lanjouw and Schankerman (1997) compare two types of successful litigation: patent challenges and patent infringements. They argue that if the plaintiff in a challenge suit is active in RTD, he may appropriate the gains of court decision of patent invalidation, and all other firms innovating in the opened technology space, using innovation freely may benefit also. By contrast, the gains from a successful patent infringement suit go mainly to patentee and their likely social positive effect is indirect.

3. IPR INFRINGEMENT AND CORRUPTION IN R&D TRANSFER PROCESSING

In this section we present some results[4] of our analysis, which consider both the effects of IPR violations and of corruption on the welfare of innovative and adopting firms or countries. Chin and Grossman (1990) initiated the main ideas that guided us. More recently they were also explored by Zigic (1998) (2000).

We analyze the policies of knowledge dissemination on the basis of a simple situation,

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[2] Arundel and Kabla (1998) evaluated the propensity rates of innovation of Europe's industrial firms for 19 sectors. The propensity rate is equal to the percentage of innovations for which a patent application is made. The propensity rated for product innovations average 36 %, varying between 8 % in textiles and 79 % in pharmaceuticals. The average for process innovations is 25, varying from 8 % in textiles to 47 % for precision instruments.

[3] A reasonable royalty is generally estimated to be the amount that a licensee would be willing to pay through typical negotiations between a licensor and a licensee.

[4] Some of them were previously exposed in the papers by Levin (1999), Levin & Zirik. (1998)

where the transfer occurs in the form of direct investments between the heterogeneous firms. We present some formal situations, which analyze the consequences of the corruption when Donor and Beneficiary make use of technologies of different levels of performances:

— The Beneficiary is technologically "less developed" then Donor, and seeks to pirate innovating technology; legally transferred technology (at low prices compared to the costs related to its design) causes the increase in competition between the two agents Donor and Beneficiary with the detriment for Donor;

— the corruption occurs, when transferred technology is of "poor" quality in comparison with that which was previously negotiated.

In each case, the cost increasing can occur during the transfer and the introduction of a technology, since the effectiveness of a new technology can be different according to adopting firm.

Our games describe circumstances in which the corruption can emerge, and they show, on the one hand, why the corrupted behavior can be advantageous for agents and the society in its entirety. On the other hand, they assess economic losses due to the corruption.

Basic model

We present a model that includes two firms: *N* and *S*. The firms compete on a common market. There are two different points in time. Initially, both firms can produce certain homogenous good at constant marginal cost, *a,* and engage the Cournot type competition[5]. At the second period the firm *N* faces an opportunity to devote resources to a R&D project in order to improve the existing production technology and reduce marginal cost. The firm can achieve a cost reduction of amount *d* by spending *R* on process innovation, with the degree *g* of effectiveness of this expenditure *g= f (R)*. The post-innovation marginal cost of production will be:

$$C_N = a - d = a - g\ . \qquad (1)$$

Three cases are considered here.

The first, the firm *N* transfers new technology to the firm *S*. The firm *S* adopts the new technology. Therefore, post-innovation marginal cost of firm *S* will also be:

$$C_S = a - d = a - g. \qquad (2)$$

The second, the new technology is not transferred, i.e. the firm's *S* cost of production remains:

$$C_S = a \qquad (3)$$

The third case takes place when transferred technology to firm *S* is worse than technology the firm N has produced, but it is better than old technology of the firm *S*. In this case, the cost of production of the firm S is located between (2) and (3).

Corruption in this model is the bribery sum accepted by *N* in exchange of advanced technology transferred to *S*. The size of bribery depends on gains and waste of each firm. We suppose that its amount is equal to the difference between welfare of N and of S.

The following notations will be used:

a - marginal cost before innovation has occurred

[5] Cournot competition: The assumption, assumed to be made by firms in an oligopoly that other firms hold their outputs constant as they themselves change behavior. Contrasts with Bertrand competition. Both are used in models of international oligopoly, but Cournot competition is used more often.

d - cost reduction

R - innovation cost

g - effectiveness of innovation

r – corruption intensity, $0 \le r \le 1$ (is a share of the profits of the Firm *S* that it offers to the Firm N as bribe)

C_N - post-innovation marginal cost of production in the firm N

C_S - post-innovation marginal cost of production in the firm S

c_N, c_S - marginal cost per unit of product accordingly of the firm N and the firm S

Q_N, Q_S - consumer surplus on the N and on the S

W_N, W_S - welfare of the firm N and of firm S

W - total welfare equals to sum of profits and of consumers' surplus

$z_N = z_N(c_N, c_S)$ and $z_S = z_S(c_N, c_S)$ - production functions that are profits of the firm N and the firm S in the Cournot duopoly at prices c_N and c_S

1/t - a fraction of total sale (consumption) asked to *S*

(1 – 1/t) - a fraction of total sale (consumption) asked to *N*

q - total output of *N* and *S*

$p = b - q$ - price

B(R) - value of bribe that the firm *N* have got for transfer of technology

L - license payment

l - a share of total profits growth.

We adopt following assumptions about properties of demand and production functions. The demand in the integrated market is a linear function, and inverse demand function is denoted as $P = b - (q_N + q_S)$, where q_N and q_S are outputs of the firm *N* and the firm *S*. p is the equilibrium price. Let the demand for the firm S be a fraction 1/t of total demand for any prices, i.e. volumes of sale of S and of *N* are equal to 1/t and (t – 1)/t respectively. The marginal cost is constant.

"Innovator - Imitator" and IPR respect or violation

In this paragraph, we propose to answer the following questions: Is it profitable to produce new knowledge and to hold technological R&D if the pirating of the innovation technology exists? When the transferring of new technology is profitable? When the effective transferring occurs? What are conditions of the effective transferring from the point of view of *N*? from the point of view of *S*? and from the whole economy system's point of view?

We look at some situations:

First, technology is transferred "free of charge", that signifies that the protection of intellectual property rights is absent, or it is violated. We denote this situation V (violated);

Second, when technology is not transferred, we consider that full protection of intellectual property rights is satisfied and we denote it - P (protected).

At the first period the firm N decides to invest in R&D. According to sub-Nash equilibrium, the firm N should decide on amount of R expenditure anticipating its profit at the second period.

In case P (protected), the profit of firm *N* is always higher then profit of firm *S*. Three

types of equilibrium may arise: 1) asymmetric duopoly, 2) monopoly of strategic predation, and 3) unfettered monopoly, depending upon the size of parameter *g* describing the effectiveness of innovation in the reduction of production costs.

We shown that for relatively big *g* and relatively large share of consumers' demand for firm *S* the case P can be profitable for *S*. It signifies that *S* benefits from providing the IPR protection in some circumstances.

In the case V - Violation of IPR and symmetric duopoly - the only one regime can arise. The profit of the firm *S* is always higher then firm's *N* profit because the firm *N* spends money for new knowledge and researches, which reduce its profit.

It is easer to show that for some combinations of parameters *g* and *t* the situation P (protected) may be more advantageous for S than situation V (IPR violation).

By comparing the levels of welfare for the society across two regimes P and V, we shown that for small *g*, the case V is more profitable then the case P; in contrast for high *g*, the case P is favourable. In other worlds, to maximise the society welfare one must protect the intellectual property rights when effectiveness of innovation is high and should not do it when the effectiveness is low.

Technological transfer and corrupt behaviour

Let the firm N defines its cost of innovation subject to the bribe. Both of the contracting parties N and S enter into corrupt action already before the beginning of innovation process. Consequently following game may be exposed :

— Both of the firms N and S arrange about illegal bargain of technology transfer. At that they agree on the amount of bribery depending on the share of future income, which the firm S is willing to accord (it is an exogenous variable), and amount of R (it is an endogenous variable) which the firm *N* is willing to spend for new technology production.

— The firm N defines optimal level of R in function of the amount of its feature profit (after the innovation project will be realized) subject of the bribery amount it get for the new technology transferring.

— The produced technology is transfered to the firm S.

Notice that it is a very simple model, because we suppose that illegal and, generally speaking, unbeneficial for the firm N transfer of technology is realised only for a bribe appropriated by the firm N. Indeed, in this paper, we do not consider the third agent (official or inspector), and so there is no possible penalty for corrupt action.

Consider two cases of corrupt bargains that can occur.

The amount of bribe depends on the difference between profits of the firm S (without taking into account the bribe it will transfer to N) when new technology has been adopted and its profits when the technology stay old.

First case

The innovation cost R chosen by N is subject to a possible bribe. In this game the optimal bribe level and the best innovation cost level might be determine by "reverse motion method". As the cost of innovation is R, in result the cost of the firm N after innovation is $c_N = a - d(R)$, and it chooses the amount R to maximise its total profits:

$$w(R) = z_N(c_N, c_N) + B(R), \qquad (4)$$

where $B(R) = r\,[z_S(c_N, c_N) - z_S(c_N, c_S)]$ is amount of bribe the firm N can got for transfer of technology; $c_N = a - d(R)$ and $c_S = a$, $0 \le r \le 1$.

Second case

We assume that the law prohibits the transfer of technology, thus the property rights are protected. However the illegal actions took place. In this case the innovation cost R leaves out of account a possible bribe. It means that the firm N defines its optimal cost level been sure that its intellectual property rights are protected. Note that a bribe is considered there as an "indemnity" of the firm N producing innovation with supplementary costs for research.

Contrary to the previous model, the firm N chooses in this case the amount of bribe and the amount of its optimal innovation expenditure R** considering the fact that the bribe is a function of two indicators of the firm's S performance. One of them is the result of marginal cost after transfer of technology; another is the marginal cost when technology is not transferred, i.e. if intellectual property rights of N are protected.

Emphasize once again differences between the case 1 and the case 2. In case 1, we define feature profits of the firm S from R*. In case 2, the feature profits is defined in advance; generally, before the issue of technological transfer, i.e. the firm N chooses the level R^P (R&D expenditure when IPR are protected) to maximize

$$z_N^P(R^P) = z_N^P(a - d(R^P), a) = p^P - [a - d(R^P)]y_N - R^P, \quad (5)$$

where price p^P is given by equilibrium price in the Cournot duopoly with technologies $c_N = a - d(R^P)$, $c_S = a$, and y_N is equilibrium output of the firm N.

Therefore, in this model, the firm N makes its choice under corruption, and the corrupt behaviour leads to transfer of technology. Hence, the optimal innovation cost level, R**, is determined from following extreme problem:

$$\text{Max } w(R) = z_N(c_N, c_N) + B(R), \quad (6)$$

where $B(R) = r\,[z_S(c_N, c_N) - z_S^P]$ is amount of bribe that the firm *N* will get.

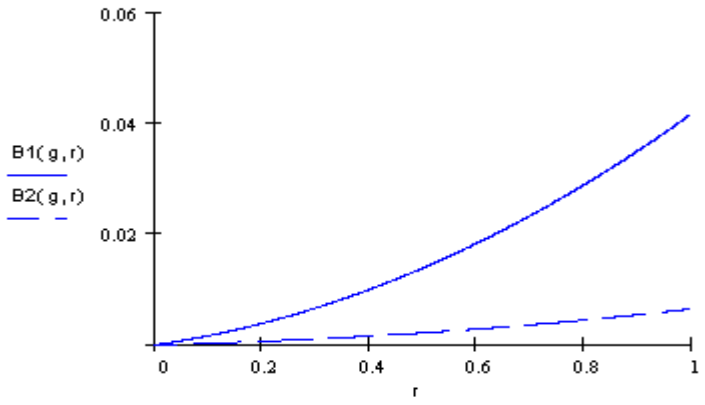
Some simulations

In this paragraph we present some figures that illustrate the consequences of corruption as it was analysed in previous section.

Figure 1 illustrates the relationship between amount of bribe and r ($0 \le r \le 1$) in the two types of the corruption B1(g,r) and B2(g,r), at g = 1.

We can see that the amount of bribe in the first type of corruption (IPR not protected) can be more important than in the second type of corruption at the same levels of *g* and *r*.

Figure 1



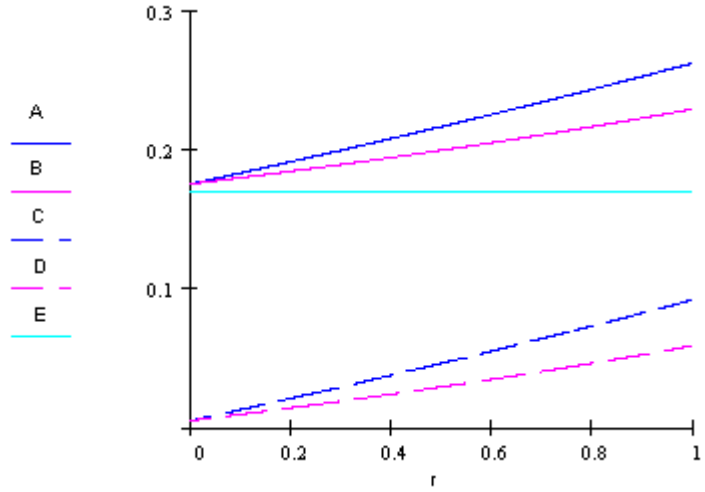
We can also appreciate through simulations the "effectiveness" of corruption. For this

proposes we consider the difference between values of welfare functions depending on the parameters *g* and *r*, i.e. effectiveness of technology and the rate of corruption. The rate of corruption, in this text, is a share of the profits of the Firm *S* that it offers to the Firm *N* as bribe. The net welfare of the Firm *S* is a welfare of the Firm S minus a bribe it pays.

In Figure 2, we have plotted the relationship between the growths of welfare of the Firm *S* in the two types of corruption.

Figure 2

Welfare and the growth of welfare on the Firm S at g = 1, t = 0.5



At this juncture A is welfare of the Firm *S* in the corruption of first type, B is welfare of the Firm *S* in the corruption of second type, C and D are the welfare increases in the two cases respectively, E is welfare of the Firm S in the case when intellectual property rights are protected, i.e. the firm S uses the old technology. We can see that firm *S* always benefits from new technology transferring, but it profits more using the first type of corruption behaviour.

The Figure 3 we present the comparative evolution of net welfare of firm S at different rate of corruption and for two types of corruption.

Figure 3

The net welfare of the Firm S at g = 1 and t = 0.5

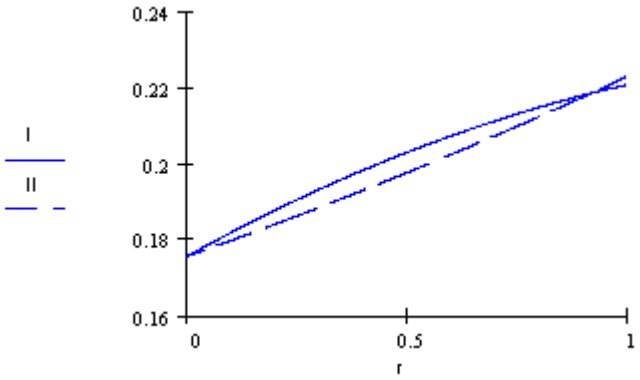
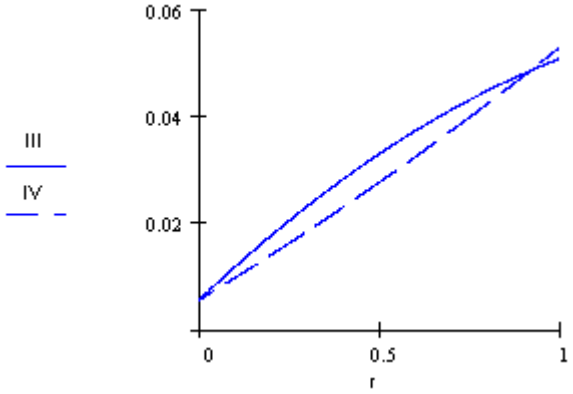


Figure 4 illustrates the evolution of increase of net welfare of the Firm S in the two cases of corruption.

Figure 4

The increase of net welfare on the Firm S at g = 1 and t = 0.5



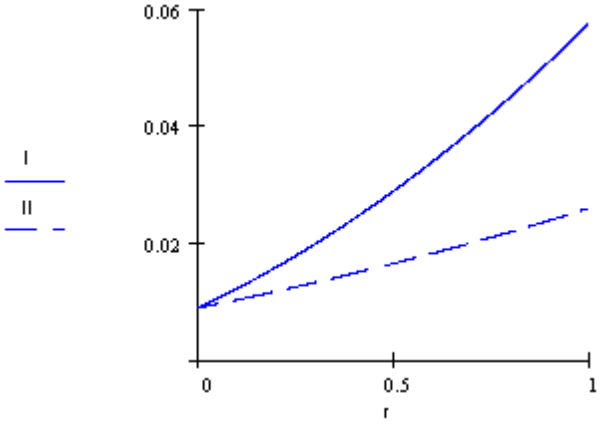
We can see on these examples that the welfare of the Firm *S* increases in corruption case 1 even when the bribes it pays (r share of profits) is large.

Now we compare the welfare of the Firm *N* on the case of corruption and when its intellectual property rights are protected.

Figure 5 shows the growth of the Firm *N* welfare in the two corruption (g = 1 and t = 0.5). In these cases, the growth of the Firm N welfare equals to the difference between the Firm N welfare when intellectual property rights are protected (I) and under corruption (II).

Figure 5

The growth of the Firm N welfare under corruption



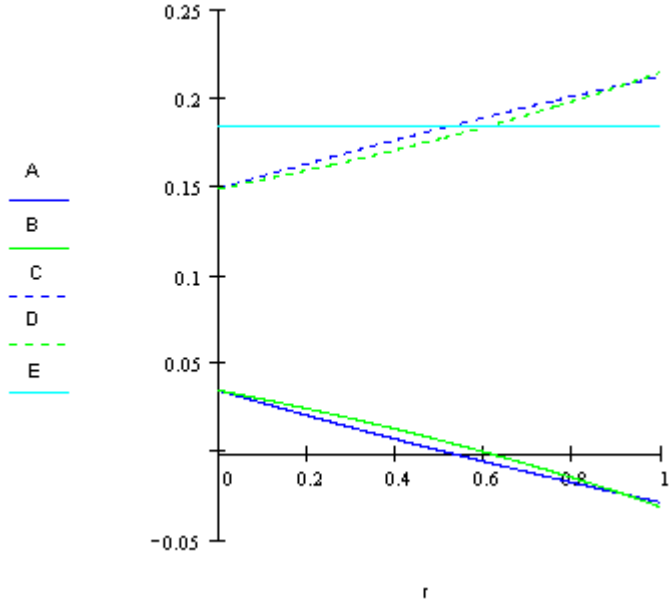
We can see that the Firm N welfare depends largely on IPR protection. The Firm N does not benefit from corruption.

The figure 6 presents the results of simulation of the value of total welfare of the system. As usually, we define the total welfare as sum of the Firm *N* welfare and the Firm *S* welfare. We calculate the increase of total welfare, as the difference between total welfare increase when intellectual property rights are protected and under corruption. On this figure 6 A is total welfare under first type of corruption, B is total welfare under second type of corruption, C and D are growth of welfare under corruption 1 and 2 respectively, E is welfare when intellectual property rights are protected.

Corruption behaviour in both cases is approximately equivalent from social point of view, i.e. for total welfare and its increase.

Figure 6

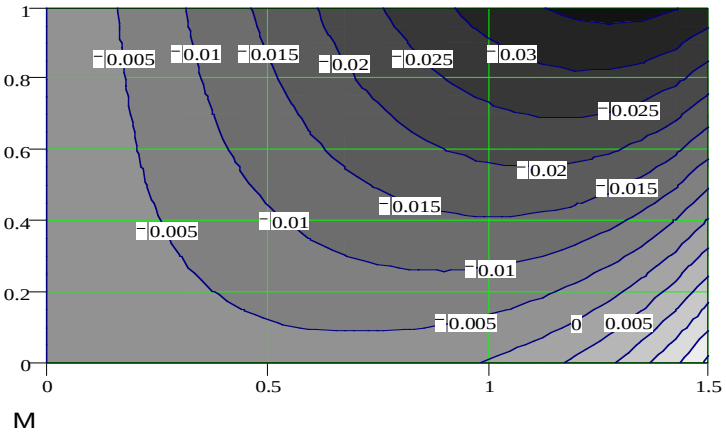
Total welfare and growth of total welfare of the system (g = 1.4 and t = 0.5)



Finally, Figure 7 shows level curves of total welfare function evolution in the space g – r.

Figure 7

Isocurves of total welfare function in g – r coordinates.



Some conclusions of this paragraph :

The simulations show that the total welfare increases when corruption level rises. We can presume that this growth is possible because of considerable spreading of new technology facilitated by bribes (corrupt behaviour). However, we can see that under a certain level of corruption, public welfare is higher without corruption than under corruption. Thus, under some economic conditions, when the intensity of the spreading of innovations is low, corruption can be useful means for societal purposes. When advanced technology can be transfer legally, corruption plays negative role. This case will be considered in next section.

Technological transfer with licensing and corruption

In this section, we present a model of corruption that can arise when agents conclude technological transfer agreement under licensing[6], i.e. the innovator grants its superior technology and the imitator pays the usage of technology according to licence agreement. Thus, intellectual property rights are still protected, and the technology might be transferred.

We consider three players: the firm N, the firm S, and official. The official presents interests of the Firm S, i.e. he purchases the superior technology. The transfer agreement proceeds in two stages:

1st stage is legal negotiations;

2nd stage is illegal, corrupt agreement.

On the first stage, the firm N and the firm S conclude an agreement about the technology that the firm N will produce spending resource R. Transfer of technology occurs as a result of license agreement. The firm N gets license payment L, that is added to its profits and subtracted from profits of the firm S. Amount of license payment, naturally, depends on "quality" of transferring technology. This is a result of legal stage.

The second stage is an agreement between the firm N and the official. The latter presents "interests" of the firm S for quality of the technology that will be transferred. The firm N offers to the official a bribe, and the really transferred technology is worse then the technology negotiated at the first stage. The official accepts it instead of the technology sold at the price L. Thus, the firm N reduces borrowing power of the firm S on the common market, and the officer gains a bribe B in money. Obviously the bribe is subtracted from profits of the firm N. However, corrupt action might be reveal with a certain probability. In this case, the two agents will be punished: the firm N will be fined on the license payment has been got; the officer also will be punished by a fine depends on size of the bribe he has got. Each of them maximizes expected value of its profits subject to "penalty" for corrupt behaviour. We assume that the officer chooses the amount of bribe that he would like to gain, as a share of real profits of the firm N plus a certain guaranteed amount "for risk". The firm N defines "quality" or "type" of technology it transfers to the firm S or, rather, value of the firm's S marginal cost reduction after the technology is transferred. We also suppose that the firm N transfers worse technology then it uses by itself, and which is an object of agreement on the first stage.

The corrupt bargain between the firm N and the officer is modelled as a Nash equilibrium. At $0 \le d \le d_N$ and $1 \ge r \ge 0$, the system of equations defines a Nash equilibrium - corruption equilibrium - in internal points of the intervals. This system of equations can have either unique solution or a number of solutions that are maximum of corresponding utility functions. It can also not have solutions. It is internal points that are of special interest for us, since transferring of impaired technology occurs there. In particular, this fact essentially distinguishes the model of this section from the models discussed in the sections 2 and 3.

Knowing a corruption equilibrium, it is possible to calculate expected profits of the Firm N and the Firm S, consumer surplus, and welfare functions of the Firm N, the Firm S, and the system as whole at different values of the parameters r and d. In plus we can compare different estimated values with those that have been estimated for the first stage. By this way, we can estimate the influence of corruption on the change of profits as well as consumer surplus and welfare.

Some Figures illustrate the change of expected utility functions of the Firm N, profits of

[6] See Rockett (1990), Vishwasrao (1994)

the Firm S, utility of the official, the welfare of the Firm N, the Firm S, and the system as whole at different values of innovation effectiveness g, and the same values of other parameters of the model. The Table 1 summarises the results of simulations.

Table 1

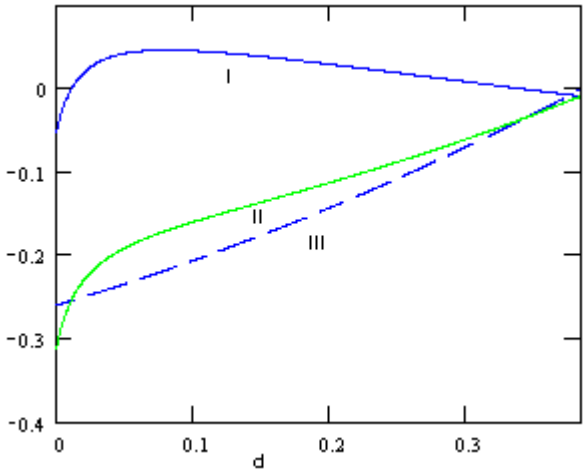
The table of equilibrium states for the model of technological transfer with licensing

$g = 0.6$	$g = 0.8$	$g = 1$	$g = 1.2$
$d^* = 0.0605$	$d^* = 0.061$	$d^* = 0.0731$	$d^* = 0.0883$
$r^* = 0.504$	$r^* = 0.183$	$r^* = 0.085$	$r^* = 0.045$
$z_N^K = 0.171$	$z_N^K = 0.225$	$z_N^K = 0.283$	$z_N^K = 0.353$
$u_b = 0.103$	$u_b = 0.073$	$u_b = 0.059$	$u_b = 0.0.51$

We adduce graphs for each equilibrium at $g = 1$.

Figure 8

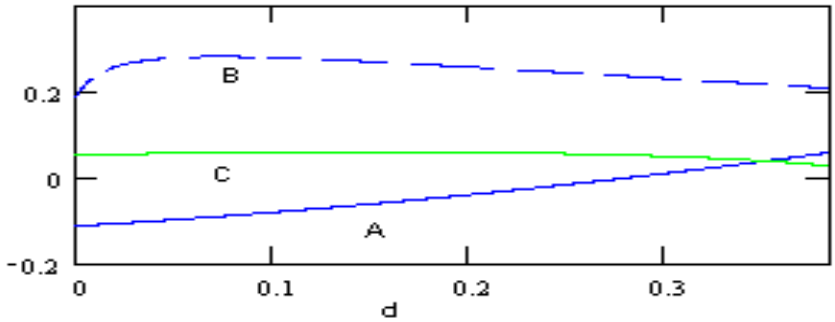
Change of the total welfare, the Firm N welfare, and the Firm S welfare at g = 1



Were I corresponds to change of the Firm N welfare; II is change of the Firm S welfare; III characterises change of total welfare.

Figure 9

Change of utilities of the Firm N, the official, and the Firm S at g = 1

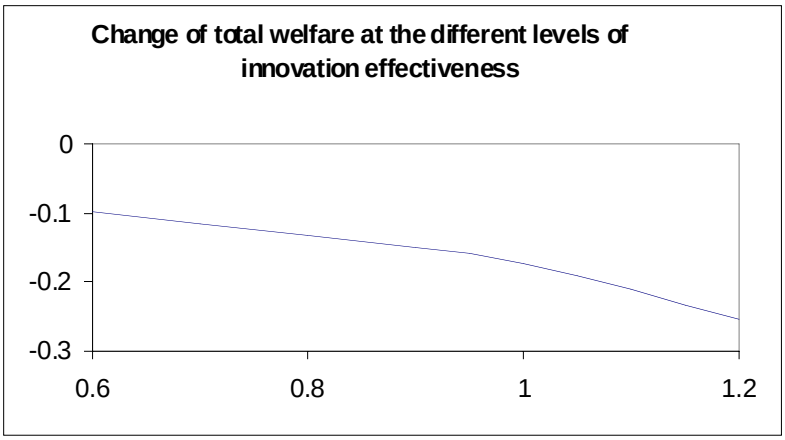


Here A is utility of the Firm N; B is utility of the official; and C is utility of the Firm S.

Finally, Figure 10 illustrates influence of innovation effectiveness on the change of the

total welfare under corruption equilibrium. And we can see that more the effectiveness of innovation is high, more negative is the corruption influence upon the total welfare of the system.

Figure 10



CONCLUDING REMARKS

Consideration of the reasons and types of corruption allows drawing a conclusion, that at an exchange of technologies and of direct investments between the countries, it is necessary to take into account the likely superposing of corrupted forces, thus the economic social effect from innovational activity can appear insignificant (and neutral for this reason) in comparison with efforts of scientists and with expenses of a society for a science.

In the certain frameworks, enforcement of laws protecting rights of inventors on the intellectual property is a way to reduce corruption connected to transfer of technologies.

The simulations of some simple models describing the corruption activities in R&D transferring have shown the ambiguity in the likely consequences of the exertion against the infringement of IPR law. In terms of corruption, we can conclude that IPR protection-oriented corruption is not profitable for society when the effectiveness of innovation is low and is profitable when the effectiveness is high. It means, therefore, that if effectiveness is low, and the innovator offers bribe to imitator in order to protect his intellectual property rights, this activity ought to be strongly chased as unprofitable for society in general. When the effectiveness of technology is high corrupt activity of imitator, who aims to bribe the innovator in order to get the technology, is socially unprofitable, and the corrupt action must be suppressed.

From opposite point of view we have shown that when transferring of technology is profitable for society as whole (when the effectiveness is low) but is illegal, the violate-rights-oriented corruption promotes the co-operation and may be seen as profitable for society. When the effectiveness is high, the society benefits from the illicit activity as corruption if it is oriented to cancel "beneficent" transferring of technology, for example, from advanced country to developing one.

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