The Efficient Provision of Entrepreneurial Innovation[*]

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Abstract

There exists a broad literature on whether or not patents promote innovation and invention. The information supplied to society under a patent is essentially a privately provided public good. To this end, questions of efficient provision of patents in lieu of innovation is tantamount to efficient resource allocation in a public good/project economy. Importantly, one might ask under what conditions and economic circumstances might the efficient provision of patents be obtainable. In this paper entrepreneurial innovation is treated as a public good as ideas once they are exposed become both non-rival and non-excludable. This paper incorporates the idea that heterogeneous agents exist in any economic system. It also exploits the fact that there are positive externalities generated from the set of resources and incomes available to agents in the economy. In such a setting it is shown that efficient outcomes in a public good sense, in terms of the licensing fees for taking advantage of a patent, can be achieved without side-payments. Furthermore, a strategy that can be easily implemented from a pragmatic viewing angle is presented. We also show that poverty and underdevelopment feed on themselves, and thus, is under-pinned by a vicious cycle that possesses a spiraling effect which is self -reinforcing.

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1 Introduction: Provision of Entrepreneurial Innovation

This paper tries to balance competing views on patents in the literature. On one hand, is the view as presented in Macdonald (2004) that "patents are essential to innovation, or at least to inventing, without which there would clearly be no innovation". On the other hand, Taylor and Silberston (1973) presents evidence to support a view that patents contribute very little to innovation and may therefore hinder innovation and, thus, may distort the process by which new products are developed and brought to market. The information supplied by the holder of a patent in return for that patent is essentially a public good which is privately provided. In this paper entrepreneurial innovation, the reason for patents, is treated as a public good as ideas once they are exposed become both non-rival and non-excludable[1]. However, patents create a degree of excludability and in the vein of Miller (1988) encourages innovation. That is, those who innovate can recoup costs and possibly profit from the innovation under a patent system.

Efficient private provision of public goods has long been among the major interests of economic scientists and philosophers. Due to both the non-rival nature of the information that becomes available from entrepreneurial innovations and the non-excludability of said, public good and entrepreneurial innovation are used interchangeably, especially because of the private provision posture of the discussions. Notwithstanding the relentless efforts of some of the most agile thinkers within the discussion of private provision of public goods there are substantial issues surrounding queries into the efficient provision of public goods, which render that further study is needed. The literature on the efficient provision of public goods burgeoned as an offspring of Samuelson (1954). In Samuelson's article the notion of a public good was made precise, as constituted by two main characteristics. These being; the good must be both 'non-rival' and 'non-excludable'. Also, found in Samuel's work, with Samuelson (1955) somewhat completing the sequel, are the exact conditions for efficient provision of a public good.

Starting with Samuelson (1954) a precise definition and the exact conditions, which are significantly different from those regarding 'private' goods, for the efficient provision of a public good were established. Since then, there has been far reaching queries into how to solve the conundrum embedded in these conditions. However, probably by far the most compelling theoretical postulates, those of Lindahl and Pigou, which overcome the problem remain widely criticized for the lack of a strategy to pragmatically implement either of these solution concepts.

[1] A quick example of these kinds of entrepreneurial innovations are the zero calorie versions of both Pepsi and Coke.

Furthermore, other solutions generated by *Mechanism Design*, an offspring of the seminal work of Myerson (1986, 1991), as well as *truth revealing designs*, found in the work of Groves (1973) and Clarke (1971, 1972) and commonly referred to as the Groves-Clark Mechanism, may require huge side payments. These side-payment models may not achieve optimal resource allocations in an overall sense, because of their side-payments which in and of themselves may distort resource allocation.

Though Samuelson seemed to have articulated the notion of a public good in precise terms for the first time; researchers like Pigou (1920) and Lindahl (1919) who were before Samuelson, had already launched investigations into the optimal conditions, or at least the prices to be paid, surrounding the provision of 'public goods'[2] Subsequent to Samuelson's work there was an explosion of researches, many of which revived the works of Pigou and Lindahl, into the efficient provision of public goods. However, these studies focused mainly on government provided public goods and were forced to grapple with the fact that the Lindahl solution even though theoretically elegant was not the most easily implemented from a practical standpoint. The Pigouvian endeavor, and models based on it also had their troubles in that tax rates seemed to be arbitrary. Despite these flaws, it could still be argued that as long as the public good/entrepreneurial innovation was provided by a central authority, then Pareto optimal allocations could, at least in principle, be achieved.

This conclusion led researches to turn to a slightly different question, that being; if efficiency was still obtainable if the public good/entrepreneurial innovation were privately provided. Many of the models of private-provision simply appealed to the Lindahl solution with sufficient modifications to support the analysis (see for example, Walker (1981), Foley (1970), Thompson (1999) and the references therein). Another set of models which rose to prominence under the assumption that public goods were privately provided were those based on Clarke (1971) and Groves (1973). However, these models may require that huge side payments be made to ensure that truth-revealing strategies could be enforced, and such side-payments served to detract from these otherwise eloquent models. Striding very close to these models were those based on non-cooperative game theory, essentially 'mechanism design' (for instance; Bergstrom, Blume and Varian (1986), Varian (1986), inter-alia), which in general found the generation of Pareto Optimal allocations to be a daunting task.

Continued efforts to solving the efficiency problem under private provision resulted in general equilibrium models where some of the basic Arrow-Debreu assumptions, including measurability and convexity, were discarded. Following the seminal work of Mas-colel (1980) where the concept of "valuation equilibria" is defined; Gilles and Hahn (1999), Diamantaras and Gilles as well as Hammond

[2] Public goods in quote here since the classical definition according to Samuelson would not have existed during the time of these earlier scholars.

and Villar (1998) explore the concept and find that sufficient conditions exist under which we can generate efficient outcomes. Additionally, applications of the concept in the context of new goods are provided by Gilles et. al. (2004) and Gilles and Diamantaras (2003), and reinforces the fact that efficient outcomes are attainable.

In this paper we investigate how heterogeneity of licensee preferences and/or income affect the problem of the provision of public good/entrepreneurial innovations and whether under such circumstances efficiency, in terms of the price of a license to utilize and established patent, is obtainable. This, of course, is not the first enquiry of its type; as the works of Bergstrom et. al. (1986), Varian (1986) and Chan et. al. (1998) are all in this vein from a pure public goods perspective. Usually the purpose of studies on the private provision of public goods focuses on whether or not private provision can generate the efficient outcome. The difference in this study is that even though we are largely concerned with efficiency; the main question is why we observe different agents in the economy paying licensing fees in different absolute amounts and even at different rates. Is this simply based on the ability to pay? We seek to present a model that explains this by positing high versus low demand licensees for the public good/entrepreneurial innovation and to allow a collection agency/patent holder to provide the good. The agency tries to maximize 'auxiliary revenues' (a concept to be made precise later) collected by offering contracts that meet individual rationality as well as incentive compatibility constraints. In this model the collection agency can be interpreted as a private-provider or as a central authority/government who collects the licensing fees and then pas over to the patent holder.

To facilitate this dual interpretation we will need to assume that the individual rationality constraints are always satisfied. By ensuring this we are guaranteed that all agents who seek to take advantage of the patent will have an incentive to pay for the public good/entrepreneurial innovation. However, if the public good/entrepreneurial innovation will still be provided if any such agent does not contribute, then agents are better-off not contributing, hence it is necessary to make the assumption that the public good/entrepreneurial innovation will not be provided if any agent does not contribute (see Bagnoli and Lipman (1989) for a model with no provision conditional on contributions). Under both the private provision and government scheme interpretation (see Bernheim (1986) for the possibility of the public good/entrepreneurial innovation being provided by either), we require that the marginal utility from the public good/entrepreneurial innovation must exceed that from the private good[3], to allow contributions to be optimal from the perspective of agents in the economy. To make this true it is necessary to assume that the marginal utility derived from the public good/entrepreneurial innovation is greater than that derived from private goods. On the other hand, if the public good/entrepreneurial

[3]All private goods will be treated as a composite good represented by each agent's income.

innovation is provided strictly by a government, then there must be some mechanism by which the government can force agents to contribute, if the public good/entrepreneurial innovation will always be provided.

In what follows we present three versions of the model building up from the simplest case to the most general as well as realistic. In the first version of the model presented; agents are entirely homogeneous and given our definition of auxiliary revenues the outcome is always efficient according to the Samuelsonian condition. In the second version of the model we allow for heterogeneous agents, but under the premise that the system cannot be beat and therefore that only the individual rationality (and, not necessarily the Incentive compatibility constraints) are satisfied. As a matter of fact, we prove that if the Incentive Compatibility constraints are to be satisfied it is impossible to solve the model if agents are to be heterogeneous and different licensing fees are to be applied to the different types of agents. In the final version of the model we augment the heterogeneous agents set-up by assuming that the set of amenities/goods and income already available to agents augments the benefit derived from the public good/entrepreneurial innovation. This is essentially a positive externalities story. We then show that the outcome is efficient for the high type licensees and that poverty/underdevelopment is self perpetuating. In formal terms, the remainder of the paper is organized as follows. Section 2 presents the Homogeneous agents model and its implications. Section 3 develops and outlines the model of heterogeneous agents with no externalities and the inability to beat the system. Section 4 allows for externalities from income and amenities and section 5 presents our conclusions.

2 A Homogeneous Agent Model: A Baseline Representation

Firstly, we set out to define the objective function of the collection agency/patent holder. Consider that the collection agency seeks to maximize auxiliary revenues formally defined as $\prod^M$, where for the general case allowing for heterogeneous agents the following is true:

$$\prod{}^M = \sum_{i=1}^{n_I} \lambda_i (g_i - \frac{c}{n_i} G) + \sum_{j=1}^{n} \lambda_j (g_j - \frac{c}{n_j} G); i\varepsilon I, j\varepsilon J, I, J \subset H \equiv \{1, 2, ..., N\}$$

where,

λ_i ≡proportion of possible licensee population of type i and similarly for

$$\sum_{\forall i} \lambda_j = 1$$

.

$g_i \equiv$ revenue paid (licensing fees) to the collection agency by agent i, and similarly for g_j

$c \equiv$Marginal cost of providing the entrepreneurial innovation.

$G \equiv$Amount of entrepreneurial innovation provided.

$n_R \equiv$total number of licensee agents in category R, with categories being mutually exclusive.

Also, assume always that agents have quasi-linear utility functions. As such we have:

$U_i = \gamma_i V(G) + W_i - g_i$.Where W_i is defined to be the fixed income of licensee agent i, hence omitted from the rest of the discussion (See Varian (1994)).

2.1 The Model with Homogeneous Agents Only:

In the case where there is only one type of licensee agent in the economy the auxiliary revenue function of the collection agency is reduced to:

$$\prod{}^{M} = \sum_{i=1}^{n_I}(g_i - \frac{c}{n_I}G), i \,\varepsilon\, I \equiv \{1, 2, ..., n_I\}$$

The individual Rationality (IR) constraints are:

$$IR_i : (i)\gamma_i V(G) = g_i.$$

Therefore the collection agency's problem is:

$$Max \prod{}^{M} = (g_i - \frac{c}{n_I}G)$$

substituting for g_i from (i) gives:

$$Max \prod{}^{M} = (\gamma_i V(G) - \frac{c}{n_I}G)$$

Therefore, the FOC is:

$$\gamma_i V'(G) = \frac{c}{n_I}$$

now sum min g over all agents and noting that c is a constant gives:

$$\sum_{i=1}^{n} \gamma V'(G) = c$$

, which is the classical Samuelsonian condition for the efficient provision of public goods, in this case entrepreneurial innovation.

Consequently, we have shown that provided the collection agency seeks to maximize auxiliary revenues the entrepreneurial innovation will be efficiently provided.

3 A Baseline Heterogenous Agent Model

We restrict our analysis to situations in which only two distinct types of agents exist in the economy. As such the auxiliary revenue function of the collection agency is reduced to:

$$\prod{}^{M} = \lambda(g_1 - \frac{c}{n_1}G) + (1-\lambda)(g_2 - \frac{c}{n_2}G), n_1 + n_2 = N$$

Under the postulate of quasi-linear utility functions assume $\gamma_2 > \gamma_1$, implying the high demand licensees are type 2 agents. The Individual Rationality (IR) constraints are therefore:

$$IR_i : \gamma_R V(G) = g_R, R = 1, 2 \tag{1}$$

The Incentive Compatibility (IC) constraints need not be enforced because agents in the economy cannot 'beat the system' by pretending that they are of the wrong type in order to secure a lower licensing fee burden or improve upon their current position. Therefore the collection agency's problem is:

$$Max \prod{}^{M} = \lambda(g_1 - \frac{c}{n_1}G) + (1-\lambda)(g_2 - \frac{c}{n_J}G)$$

Substituting for g_1 and g_2 from the $IR_i{}'s$:

$$Max \prod{}^{M} = \lambda(\gamma_1 V(G) - \frac{c}{n_I}G) + (1-\lambda)(\gamma_2 V(G) - \frac{c}{n_J}G)$$

Therefore, the FOCs are:

$$[\lambda(\gamma_1 V'(G) - \frac{c}{n_I}) + (1-\lambda)(\gamma_2 V'(G) - \frac{c}{n_J}] = 0$$

$\Leftrightarrow$

$$[\lambda(\gamma_1 V'(G)) + (1-\lambda)(\gamma_2 V'(G))] = \lambda \frac{c}{n_I} + (1-\lambda)\frac{c}{n_J}$$

and note that all the elements in this quantity are constants, therefore, summing over all agents we have:

$$\sum_{H=1}^{N} [\lambda(\gamma_1 V'(G)) + (1-\lambda)(\gamma_2 V'(G))] = \lambda \frac{Nc}{n_I} + (1-\lambda)\frac{Nc}{n_J}$$

but, $\lambda = \frac{n_1}{N}, (1-\lambda) = \frac{n_J}{N} \Rightarrow$

$$\sum_{H=1}^{N} [\lambda(\gamma_1 V'(G)) + (1-\lambda)(\gamma_2 V'(G))] = 2c > c$$

which $\Rightarrow$ that the outcome is in general not efficient.

However, we can show that under certain conditions the outcome under this set-up is in fact efficient and that in general there cannot be an entrepreneurial innovation equilibrium where the Incentive Compatibility (IC) constraints are satisfied. These results are stated as Propositions 1 and 2.

Proposition 1:

If $N = 2$, implying that $n_I = n_J = 1$ and $\lambda = (1-\lambda)$, then the outcome of the 'can't beat the system set-up' is super efficient.

Proposition 2:

There is no entrepreneurial innovation equilibrium if no externalities exist, agents are heterogeneous and the IC constraints are satisfied.

Proof of Proposition 1:

Provided the assumptions of proposition 1 hold, the collection agency's problem is:

$$Max \prod{}^{M} = \lambda(g_1 - cG) + (1-\lambda)(g_2 - cG)$$

substituting for g_1 and g_2 from the IR's:

$$Max \prod{}^{M} = \lambda(\gamma_1 V(G) - cG) + (1-\lambda)(\gamma_2 V(G) - cG)$$

Therefore, the FOCs are:

$$[\lambda(\gamma_1 V'(G) - c) + (1-\lambda)(\gamma_2 V'(G) - c)] = 0$$

$\Leftrightarrow$

$$[\lambda(\gamma_1 V'(G)) + (1-\lambda)(\gamma_2 V'(G))] = \lambda c + (1-\lambda)c$$

$\Leftrightarrow$ $(divide\, through\, by\, \lambda)$

$$\gamma_1\, V'\,(G)) + (1-\lambda)(\gamma_2\, V'\,(G)) = \frac{c}{\lambda} \Rightarrow\ super\ efficient$$

which $\Rightarrow$ that the outcome is efficient, because it is exactly the Samuelsonian condition;

$$\sum_{\forall} i\, MRS_i = MC$$

Proof of Proposition 2:

Assume that there are no externalities, the IC constraints are satisfied, an equilibrium exists and that agents are heterogeneous, that is, $\gamma_2 \neq \gamma_1$.

To satisfy the $IR_i^\prime s$ we require $g_1 = \gamma_1 V(G)$ and $g_2 = \gamma_2 V(G)$

and for the $IC_i\,'s$

$$g_2 = \gamma_2\, V(G) - (\gamma_2 - \gamma_1)V(G) = \gamma_1\, V(G)$$

but,

$$IR_2 \Rightarrow\ g_2 = \gamma_2\, V(G)$$

therefore,

$$\gamma_1\, V(G) = \gamma_2\, V(G) \Rightarrow \gamma_1 = \gamma_2$$

a contradiction, and thus our proof.

Note further that $\gamma_1 = \gamma_2 \Rightarrow\ g_1 = g_2$

The result that $g_1 = g_2$ is quite compelling and says that in an economy with Entrepreneurial Innovation and heterogeneous agents the only way for an equilibrium, with differentiated patent payments for use of the innovation to exist is if some agent; for example, the courts/patent authority, have(s) the power and authority to force the participants to pay these differential patent rates. Otherwise, the same rates must be charged to all agents. This, of course, explains why we observe courts/patent authoritys/courts making; payments for patent breaches, which are usually different for dissimilar agents in the economy, mandatory rather than voluntary.

4 The Model with Heterogeneous Agents, and Externalities

This section[4] focuses on the case where there are two types of agents in the economy, externalities exist and the system can be beat. To motivate this set-up consider the provision of an entrepreneurial innovation in the amount G. However, licensee agents in the economy of different types benefit in varying ways from the entrepreneurial innovation. That is, there are positive externalities, which accentuate the degree to which disparate agents will be able to take full advantage of the entrepreneurial innovation, G. Once again we posit that agents have quasi-linear utility functions of the form:

$$U_i = \gamma_i\, V(G) + w_i - g_i$$

Where,

$G_i = G\, f(A_i + w_i)$, where f is a strictly increasing function.

$A_i \equiv$ the set of amenities or resources already available to agent i

The auxiliary revenue function of the collection agency is reduced to:

$$\prod{}^{M} = \lambda(g_1 - \frac{c}{n_1} G_1) + (1-\lambda)(g_2 - \frac{c}{n_2} G_2)$$

(NB: Again assume $\gamma_2 > \gamma_1$, implying high demand licensees are type 2 agents)

The individual Rationality (IR) constraints are :

$$IR_i : \gamma_R\, V(G_R) = g_R,\ R = 1, 2$$

.

The Incentive Compatibility (IC) constraints are:

$$\gamma_R\, V(G_R) - g_R = \gamma_R\, V(G_{-R}) - g_{-R} \tag{2}$$

Now,(1) implies

$$\gamma_1\, V(G_I) = g_1 \tag{3}$$

and (2) implies

$$\gamma_2\, V(G_2) - g_2 = \gamma_2\, V(G_I) - g_1 \tag{4}$$

[4] We will use the term ‘private good efficient’ several times in this section. This is analogous to Hammond and Villar’s (1998) concept of an outcome being ‘private good competitive’.

Substituting (3) into (4) gives:

$$g_2 = \gamma_2 V(G_2) - \{\gamma_2 - \gamma_1\} V\{G_1\} \tag{5}$$

In what follows it is also necessary to assume:

$$(A1) : V(G_i) = 0$$

for,

$$G_i \leq A_i + w_i + \varepsilon$$

and

$$(A2) : \gamma_R V'(G_R) > 1$$

Also, to ensure that the FOCs will be sufficient to guarantee the solution assume that V() is concave. (A1) ensures that all agents will contribute to the provision of the entrepreneurial innovation and (A2) ensures that doing so generates greater utility to the agent than from consuming the private good, over an appropriate range. Therefore the collection agency's problem is:

$$Max \prod{}^{M} = \lambda(g_1 - \frac{c}{n_1} G_1) + (1 - \lambda)(g_2 - \frac{c}{n_J} G_2)$$

substituting for g_1 and g_2 from the $IR_i{}'s$:

$$Max \prod{}^{M} = \lambda(\gamma_1 V(G_1) - \frac{c}{n_1} G_1) + (1 - \lambda) [(\gamma_2 V(G_2) - (\gamma_2 - \gamma_1) V(G_1) - \frac{c}{n_J} G_2)]$$

Therefore, the FOCs are:

$$\frac{\partial \prod{}^{M}}{\partial G_1} : V'(G_1) [\lambda \gamma_1 + (1 - \lambda)(\gamma_2 - \gamma_1)] = \lambda \frac{c}{n_1} \tag{6}$$

$\Leftrightarrow$ (dividing through by λ)

$$\gamma_1 V'(G) = c/n_1 \{1 - [(1 - \lambda)/\lambda][(\gamma_2 - \gamma_1)/\gamma_1]\} \tag{7}$$

Now if:

(a) $\lambda \geq 1/2, \{1 - [1 - \lambda)/\lambda] \ [(\gamma_2 - \gamma_1)/\gamma_1]\} < 1/n_1$

$\Rightarrow \gamma_1 V'(G) > c$, which says that the efficiency condition for a private good is not satisfied. It is also clear that the outcome is not efficient in the public good/entrepreneurial innovation sense. That is,

$$\sum_{H=1}^{n_i}[(\gamma_1 \, V'(G))] = n_1 \, c > c$$

which $\Rightarrow$ that the outcome is not efficient for low demand types under these conditions.

(b) If $\lambda = 1$, or $\gamma_2 = \gamma_1$, then the efficient amount is provided.

Proof:

(7) becomes $[\gamma_1 \, V'(G))] = c/n_1$

$$\Rightarrow \sum_{H=1}^{n_i}[(\gamma_1 \, V'(G))] = c$$

$(c)\ if\{1 - [(1-\lambda)/\lambda]\,[(\gamma_2 - \gamma_1)/\gamma_1]\} = 1/n_1$

$\Rightarrow \gamma_1 V'(G) = c$, which says that the efficiency condition for a 'private' good is satisfied. It is also clear that the outcome is not efficient in the entrepreneurial innovation sense. That is,

$$\Rightarrow \sum_{H=1}^{n_i}[(\gamma_1 \, V'(G))] = n_1 \, c > c$$

which $\Rightarrow$ that the outcome is not efficient for low demand types under these conditions.

(d) If $1 - [(1-\lambda)/\lambda]\,[(\gamma_2 - \gamma_1)/\gamma_1] > 1/n_1$,

then the outcome is super efficient, in a private good sense.

(7) becomes $[\gamma_1 \, V'(G)] < c$, and type 1 agents are receiving a subsidy from the provision of the entrepreneurial innovation. Also, the amount provided is 'Super Efficient' from the standpoint of type 1's. But it is not 'entrepreneurial innovation' efficient. That is:

$$\Rightarrow \sum_{H=1}^{n_i}[(\gamma_1 \, V'(G))] \neq c$$

Now, the FOC wrt G_2 is:

$$\frac{\partial \prod^{M}}{\partial G_2} : \gamma_2 \, V'(G_2) = \frac{c}{n_J} \implies \sum_{J=1}^{n_j}[\gamma_2 \, V'(G_2) = c$$

Therefore, the amount of the entrepreneurial innovation provided to the high types is always efficient from an entrepreneurial innovation perspective. Consequently, if case (b) above were true then we would have overall efficient provision of the entrepreneurial innovation. However, one should note that when condition (b) is satisfied we are back to the model with homogeneous agents and the only extension to the previous section is that we have incorporated externalities, which would be the same to all agents since they are now homogeneous. Note also, that the entrepreneurial innovation is provided at less than cost to each of the high type individuals[5] and so from a private goods viewing angle the outcome is 'Super-efficient'. Also, arising from the model is a very far reaching result, which we will call the 'vicious cycle of poverty/underdevelopment'. This result will be stated as proposition 3.

Proposition 3: The Vicious cycle of Poverty/Underdevelopment.

Under certain conditions low demand licensee agents in the economy must also suffer from having lower incomes and/or amenities available to them.

Proof of Proposition 3:

Provided

$$[1 - \frac{(1-\lambda)}{\lambda}\ \frac{(\gamma_2 - \gamma_1)}{\gamma_1}\ ] < \frac{1}{n_1}$$

and recalling that $\gamma_2\, V'(G_2) = \frac{c}{n_J}$,

then we know that

$$n_J\, \gamma_1\, v'(G_1) > c = n_J\, \gamma_2\, v'\,(G_2)$$

$\Leftrightarrow$

$$\gamma_1\, v'\,(G_1) > c = \gamma_2\, v'\,(G_2)$$

and since $\gamma_2 > \gamma_1$,then

$$\gamma_2\, v'(G_1) > \gamma_2\, v'\,(G_2)$$

dividing through by γ_2 gives:

$v'\,(G_1) >\ v'(G_2)$, but since V() is concave then

$$G_1 < G_2 \;\Leftrightarrow\; G\, f(A_1 + w_1) < G\, f(A_2 + w_2)$$

and since f is strictly increasing we know by the inverse function theorem that the inverse of f exist, which when applied to the above implies:

$A_1 + w_1 < A_2 + w_2$

[5]Note that this is in general true if the entrepreneurial innovation is efficiently provided in an entrepreneurial innovation sense and there are more than one agent in the economy, all with positive marginal rates of substitution.

Hence, the wealth and/or amenities available to low demand licensee agents must be less than that for high demand licensee agents.

To make sure that our model holds up to scrutiny we are required to show that IR_2 and IC_1 are satisfied since we only used their respective counterparts in solving the model. Now, to show that IR_2 is satisfied recall from IC_2 that

$\gamma_2\, v(G_2) - g_2 = \gamma_2\, v(G_1) - g_1$

$> \gamma_1\, v(G_1) - g_1 = 0$, because by $IR_1\; \gamma_1\, v(G_1) = g_1$

$\Rightarrow$

$\gamma_2\, v(G_2) - g_2 > 0$. Hence IR_2 is satisfied.

Now to show that IC_1 is satisfied consider

$\gamma_1\, v(G_2) - g_2$, but $g_2 = [\gamma_2\, v(G_2) - (\gamma_2 - \gamma_1)\, v(G_1)]$

$\Rightarrow$

$\gamma_1\, v(G_2) - g_2 = -[(\gamma_2 - \gamma_1)\, v(G_2) + (\gamma_2 - \gamma_1)\, v\,(G_1)] < 0$

but we know by IR_1 that $\gamma_1\, v(G_1) - g_1 = 0$

This $\Rightarrow$ implies that type 1's would be better-off choosing the bundle intended for them and therefore, IC_1 is satisfied.

4.1 Discussion

The broad conclusion to be drawn from the model as presented in section 3 is that high demand licensee agents are subsidized by low demand agents. Consequently, the system of licensing fees is inherently unfair as poorer people bear a higher cost with regard to the provision of the entrepreneurial innovation. The importance of the vicious cycle of poverty/underdevelopment proof cannot be over emphasized because what it says is that even if the most advanced economic system, rule of law, trading or transportation infrastructure were implemented as an entrepreneurial innovation in a poor region (of a country, say rural parts) versus a relatively wealthy region (of a country, say the suburbs or major city centers); as another example, the developing world, versus say, the developed world; then the wealthier counterpart would benefit much more than its poorer opposite number. To this end, we reach the conclusion that income distribution does matter. This is a postulate which runs counter to[6] BBV's (1986) 'Neutrality theorem', and Varian's (1994) argument that income distribution does not matter. However, note that these other models assumed no externalities of any kind, specifically they pointed out that there is no 'warm-glow' effect.

[6]BBV is an abbreviation for Bergstrom, Blume and Varian.

5 Conclusion

In this paper we have shown that under the assumption that the provider of the entrepreneurial innovation maximizes 'auxiliary revenue' the entrepreneurial innovation can be efficiently provided as long as agents are Homogeneous. However, in models with heterogeneous agents this result is much harder to come by, and, in particular, if there are no externalities then no such solution exists. That is, in order to arrive at a solution where agents reveal their type through the licensing fee contract they sign it is impossible to ensure that the incentive compatibility constraints are satisfied and therefore that agents 'self-select'. Additionally, if only two agents exist in such an economy then the outcome will be efficient.

On the other hand, when positive externalities which augment the value of the entrepreneurial innovation to different agents exist in the heterogeneous agent model, the outcome is in general not efficient. Contrary to this though, the good is provided efficiently to the set of high demand licensees who are subsidized by the low demand agents. The result is that a vicious cycle of poverty/underdevelopment unfolds as proven for Proposition 3. This contribution shows that the efficient provision of patents for entrepreneurial innovations is still an interesting issue and further work in this vein ought to investigate the model with a continuum of agents, check for strategy proofness, and the implications of using a general utility function rather than the simple quasi-linear utility function used in our analysis.

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