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# **Health Care Quality, Income Transfer and International Trade: A Theoretical Analysis**

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**Abstract:** This paper deals with the aspect of trade in health services in the form of health care quality innovation from North to South in the presence of well established state interference in South. In accordance to the above mentioned scenario we have framed a theoretical structure where our health care is acting as a monopoly and the government has detected income transfer from richer people of South to the poorer section of South as an action to heal the welfare of the society. From such kind of set up we have discussed several possibilities through which a South based Multinational Health Service Provider (MNHSP) can export their health care quality innovation to the patients of North. Overall, we find price discrimination of the MNHSP between the Southern branches of MNHSP and the Northern branches of MNHSP with some standardisation is the main source of trade in health care innovation at least in our case.

**Key Words:** Health quality innovation, International trade, Full information dynamic game and Income transfer.

**JEL Classification:** I11, F12, F23, C73, D82.

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## 1. Introduction

Students of international trade are always interested to analyze the ways through which the society can improve its welfare by using the theory of gains from trade. However, gains from trade get hampered if world-wide economic recession, that started in 2008-09, lasts over half of a decade. It is to be noted that most of the conventional services through which trade can take place are also hampered when this economic slowdown persists. So it becomes essential to move from the trade in orthodox services towards some alternative services, for instance, trade in health services. Trade in health services are becoming now-a-days as one of the most attractive destinations for those who deal with economic services especially in the field of international trade. Interestingly, multilateral liberalization of trade in goods has taken place for the last half century. However, liberalization of trade in services began only in 1994 with the end of Uruguay Round. The General Agreements on Trade in Services (GATS) is the first and the only set of multilateral rules covering international trade in services. The agreement was concluded at the Uruguay Round (1986-1993), though it came into force in January 1995. The GATS has argued to gradually liberalize and expand trade in the service sector. It has a “*built in agenda*” mandating members to kick off progressive liberalization negotiation on services from January 2000. The Guidelines and Procedures of Negotiations were adopted by the Council for Trade in Services on March 2001, as provided in the GATS Article XIX:<sup>2</sup>. It seems useful to mention here that through the GATS, the member states of the World Trade Organization (WTO) have the option to commit themselves to liberalize health services. Article I of the General Agreement on Trade in Services (GATS), following Bhagwati, (1984) and Sampson and Snape (1985), discusses a four part typology of trade in health services<sup>3</sup>. It has been rightly pointed out in GATS that trade in health services may occur through four modes and they are: (1) *cross-border supply*: where the service is provided remotely from one country to another, such as telemedicine via Internet or satellite, or international health insurance policies; (2) *consumption abroad*: where individuals use a service in another country, such as patients travelling to take advantage of foreign health care facilities; (3) *commercial presence*: where a foreign company sets up operations within another country in order to deliver the service, such as hospitals, health clinics or insurance offices and (4) *presence of natural persons*: where individuals such as doctors, nurses or

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<sup>2</sup> See Kelegama, (2009) for details.

<sup>3</sup> Interested readers can go through the following papers by Bhagwati (1984), Sampson and Snape (1985) and Findlay and Warren, (2000).

midwives travel to another country to supply a service there on a temporary basis. The majority of the patients coming to India seek for good cardiac and cancer treatments. Orthopaedic and kidney-related treatment also forms a significant percentage. A little bimodality among cardiology patients – both under nineteen and middle-aged patients dominate youth and it has been noticed in the study of Banik, De, Bhaumik, Huq and Bajracharya (2010). Mudu (2004) has strongly argued for export in health services along with tourism. In his article he has shown that whether it is for cataract or cardiac surgery, dental treatment, or hip replacement operations, treatment cost in India is a fraction of what an identical procedure would cost in Europe or North America. Similarly from the paper by Turner (2007) we can say that India, Indonesia, Malaysia, the Philippines, Singapore, Thailand and many other countries market themselves as major destinations for ‘medical tourism’. Health-related travel, once promoted by individual medical facilities such as Bumrungrad International Hospital and Bangkok International Hospital, is now driven by government agencies, public–private partnerships, private hospital associations, airlines, hotel chains, investors and private equity funds, and medical brokerages. ‘Medical tourists’ include patients usually try to avoid treatment delays and opt for timely access to health care. Medical travellers also include uninsured Americans and other individuals unable to afford health care in their home settings. Destination nations regard medical tourism as a resource for economic development. However, attracting patients to countries such as India and Thailand could increase regional economic inequalities and undermine health equity. International medical travel might also have unintended, undesired outcomes for patients seeking affordable health care. With globalization, increasing numbers of patients are leaving their home communities in search of orthopaedic surgery, ophthalmologic care, dental surgery, cardiac surgery and other medical interventions. Reductions in health benefits offered by states and employers are likely to increase the number of individuals looking for affordable medical care in a global market of privatized-commercial health care delivery.

It is to be noted, the Indian government has also signalled its intention to promote medical tourism, but this has evoked criticism from health sector analysts<sup>4</sup>. The healthcare industry estimates that several thousand foreign patients are treated in private hospitals in India each year, with most coming from Asia and Africa. They seek treatment for a wide range of

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<sup>4</sup> “Where is the logic of the government spending energy and effort to attract foreign patients for the private sector when an overwhelming majority of patients in India have inadequate access to health care,” said Dr Amit Sen Gupta, joint convenor of the People’s Health Movement, a nationwide network of non-government organisations campaigning to improve the country’s public health services (see Turner (2007) for details).

conditions, including cancer, heart disease, and neurological problems. Some hospitals also arrange tours to sites of interest and lessons in yoga or traditional medicine as “perks” in the health package.

It is quite clear from the above that foreign patients have preferred Indian health care as their destination for better treatment. In spite of the presence of few obstacles in front of our health service provider, they have tried their best to cater the markets of foreign patients but still the proportionate of export of health services as percentage of global foreign consumer of health services is quite low. Poor infrastructure of domestic health services, lack of purchasing power for better health services of domestic patients, etc are some of the obstacles which are prevailing in most of the developing economy. To improve the scenario of export of health services government can intervene through income transfer from rich to poor to increase the purchasing power of home patients and hence it may raise the demand of domestic services. In order to capture this issue within a theoretical framework in this paper we have assumed a hypothetical monopoly medical service provider and we also assume that the representative health care firm can practice both in South and North, though it is basically a South-based firm. We can refer this health care as Multinational Health Service Provider (MNHSP hereafter). As this MNHSP enjoys monopoly power, it can charge different prices to either different individuals or different nations through the mechanism of price discrimination. However, in our paper we have assumed the price discrimination exists only between nations. Through such kind of set up we want to find out that under what condition, that is, under what price-quality scenario the MNHSP can increase the demand for their health services to the foreign patients in the presence of government intervention.

The issue of income redistribution in a vertical differentiation model with monopoly has been studied recently by Acharyya (2000). Using a linear utility function (as in Tirole (1988)), he has examined how a change in the income distribution can affect the quality choice of a monopolist. He has proved that income redistribution cannot only increase but also decrease the optimal quality provided by the monopolist. However, unlike in most of the vertical differentiation models, Alonso and O.Donnell (2001) have not been concerned with analyzing the strategic interaction between firms in the presence of income disparities. They have also analyzed the strategic interactions between a unique innovative firm which faces a competitive fringe in the established quality and a health care system which attempts to use income redistribution as a tool for increasing access to the health care innovation. In our

paper, we have used a log linear characterization of the utility of consumers which is closer to the original Alonso and O.Donnell (2001). Apart from that we have used a simple redistribution function which allows us to correlate individual's utility with prices, quality and the consumer's income.

Ganslandt and Maskus (2007) and Grossman and Lai (2006) have provided a detailed description of the literature on price arbitrage and price discrimination in the context of pharmaceutical markets. Both the above mentioned articles have defined the design of price regulation and its effects on firm's decisions. Again Jelovac and Bordoy (2005) have constructed a similar type of model to capture the optimal pricing of pharmaceuticals and parallel imports with exogenous quality. The price regulation consists of patients being reimbursed a proportion of the price they pay for medicines, which can be seen as a standard price subsidy. Alternatively, the reimbursement can be interpreted as the co-payment of patients to an insurance company. Still, in their paper, the reimbursement is identical for all consumers although allowed to differ across countries. A more developed insurance system policy can be found in Garber et al. (2006), where in the context of a closed economy the impact of insurance policies on the firm's incentives to innovate has been analyzed. However, both in Garber et al. (2006) and Jelovac and Bordoy (2005) have not considered income heterogeneity across patients. The heterogeneity comes entirely from the valuation for the pharmaceutical innovation in terms of its efficacy being different for each patient. A problem with this structure, as discussed in García-Alonso and García-Mariñoso (2008), is that the efficacy of medicines varies with each medicine so it is difficult to think of the design of general price regulation policies that would depend on the efficacy of different medicines across patient groups. On the other hand the Acharyya and García-Alonso (2008) have shown that income heterogeneity within a given market as the motive for the design of income related price subsidies. Again, Kovac and Zigic (2007) have examined optimal trade policy choice when in a vertically differentiated developing country market a quality leader developed-country firm faces the threat of imitation and learning from a follower developing-country firm. In another paper Sohn (2007) has shown imitation as a positive source through which welfare of the economy can be better off.

The motivation behind the present study originates from the fact that Though there exists quite a few theoretical works based on issues like monopoly health care, quality innovation and international trade, but unfortunately none of these papers have examined the condition under which a monopoly health service provider of a developing economy can cater the

market for the same of North. This issue is highly relevant in the context of developing economies in the globalization era. The present study attempts to fill up this gap in the context of the literature on health and trade. Moreover, unlike others in this paper we have introduced sensitivity type of analysis to examine the impact of different combinations among marginal propensity to consumption of health quality for both South and North along with proportion of foreign patients prefer South for their treatment on price-quality combination of the representative health care. In this respect this paper is the first attempt in the literature through which the preference of Northern patients on the health care quality of Southern firm is considered. From our model we find that price discrimination of the MNC between the Southern branches of MNC and the Northern branches of MNC, with some standardisation, is the main source of trade in health care services. This result is striking and can be considered an important contribution in the context of health sector of a developing economy. This result provides additional insights not only in the context of research on health sector but is very much relevant to the policy makers interested in improving efficiency of health sector in developing economies.

The paper is organized as follows: In section 2, we introduce the model at autarky. Section 2 has three subsections. Subsection 2.1 states the basic structure of the model. In subsection 2.2 we explain the rationale of state to determine quality of health care at South and subsection 2.3 examines the model with international trade. The structure of the game starts under subsection 2.1 and continues over subsection 2.2. It ends before subsection 2.3. In the next section, that is, in section 3, we introduce some numerical experiments to analyse the status of high quality health care and its price in different economic conditions with Economic Implications. Finally, section 4 concludes.

## **2. The Model**

### **2.1. The basic structure of the model**

In this section we are emphasising on the determination of price and quantity of our health care quality producing MNC. Therefore, we are introducing a complete information dynamic game. The timing of the game is as follows. Here we consider a two stage game. It is to be noted that the redistribution aspect has been taken into consideration by the government. Given such redistribution of income, in the first stage the health care decides price and quantity of innovation regarding health services and also takes care about international market coverage. In the second stage the consumers/patients in both countries select/choose the quality of health services. Finally, they will choose whether to purchase health care services in the developing country or in the developed country. The solution is obtained by backward induction.

*Stage 2: Patients select quality of innovative health services*

Here we assume patients' income,  $Y^S$  and it is assumed that  $Y^S$  is uniformly distributed between  $Y^M$  and 0. Then frequency function of  $Y^S$  can be written as

$$f(Y^S) = \begin{cases} N_{R1} & \text{for } Y^M \geq Y^S \geq Y^{HS} \\ N_{B1} & \text{for } Y^{HS} > Y^S > 0 \\ 0 & \text{otherwise.} \end{cases}$$

Where,  $N_{R1}(Y^M - Y^{HS})$  and  $N_{B1}Y^{HS}$  are the number of rich and poor in country 1 (South) respectively as  $Y^S$  of South is distributed between  $Y^M$  and 0 with frequencies of rich and poor as  $N_{R1}$  and  $N_{B1}$  respectively,  $Y^M$  is the maximum level of income in South and  $Y^{HS}$  is the level of income of the society with which a patient can afford high quality of health services or high quality of health care innovations.

The representative patient's utility function can be written as<sup>5</sup>

$$V(Y - e(Q_h), Q_h) = \ln U[Y - e(Q_h), Q_h] = \ln[Y - e(Q_h)] + \ln Q_h \quad (1)$$

Here,  $V(Y - e(Q_h), Q_h)$  implies utility derived from both quality of health services and also as a result of expenditure on other commodities, where  $Q_h$  is the quality of health services. Moreover, we denote  $Q_h^H$  and  $Q_h^L$  as the high and low quality of health care services in South. The expenditure on health quality  $Q_h$  is given by  $e(Q_h)$ . The first component of the utility function on the right hand side of equation (1) implies utility derived from commodities other than quality of health services. Second component of the utility function on the right hand side of equation (1) implies utility derived from the quality of health services. The actual level of health quality will be determined on the basis of expenditure by patients on different levels of health care quality. It is to be noted that the level of expenditure on health care quality is positively associated with its prices and hence we can produce the following distribution:

Expenditure for no treatment:  $e_0(Q_h^0) = 0$ .

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<sup>5</sup> This specification follows from the expected utility function as used by Goddeeris (1984a) and Goddeeris (1984b). In the context of health services it can be specified as  $EU = \psi U^1(Y) + (1-\psi) U^2(Y - e(Q_h), Q_h)$ , where  $\psi$  and  $(1-\psi)$  are respectively the probability of occurrence of  $U^1$  and  $U^2$  utility functions. This type of utility function is widely used in the literature on quality of health services. Consideration of such type of utility function implies the following: i) willingness to pay for health care quality increases with income and ii) preferences will be of convex . For details see Alonso and O'Donnell (2001). For our analysis we have considered only the  $U^2(Y - e(Q_h), Q_h)$  utility function and has denoted it by  $V(Y - e(Q_h), Q_h)$ . The specification of  $V(Y - e(Q_h), Q_h)$  in terms of (additive) natural logarithmic form also follows from the work of Alonso and O'Donnell (2001).

Expenditure on treatment with quality less than  $Q_h^H = e_L(Q_h^L) = P_L = c_S$

Expenditure on treatment with quality  $Q_h^H = e_H(Q_h^H) = P_H^S$ .

Where,  $c_S$  is the marginal cost of production for  $Q_h^H$  quality of health care innovation in the South. Here  $P_L$  or  $c_S$  are given for given level of  $Q_h^L$ . However, they will increase if  $Q_h^L$  increases. Readers should not confuse  $P_L = c_S$  as price equals to marginal cost as we find in competitive markets. The interpretation here is different. It is to be noted that here we have considered imperfect markets and  $P_L = c_S$  actually implies price of low quality health services (in South) is equals to given marginal cost of high quality health services in South. It is just a simplifying assumption and hence does not reflect any type of competitive equilibrium condition. In fact marginal cost of low quality health services in South can be considered as given and we can denote it by  $c_L$ . For our model  $c_L < c_S$  implying  $c_L < P_L$ . It is to be noted that  $Q_h^H$  is the threshold level of health quality and  $0 < c_S < P_H^S$ . It is also to be noted that  $Q_h^H > Q_h^L$  as the level of high quality health care is always greater than the level of low quality health care.

From the rationality of the patients' psychology we can assume that

$$\begin{aligned} \ln[Y - e(Q_h^L)] + \ln Q_h^L &> \ln[Y - e(Q_h^0)] + \ln Q_h^0 \\ (Y - c_S) / Y &> Q_h^0 / Q_h^L \end{aligned} \quad (2)$$

The above inequality implies the condition under which treatment with low quality is preferred to no treatment.

Similarly, the fact that treatment with quality  $Q_h^H$  is preferred to treatment with quality  $Q_h^L$  implies,

$$\ln[Y - e(Q_h^H)] + \ln Q_h^H > \ln[Y - e(Q_h^L)] + \ln Q_h^L \quad (3)$$

and if we include the indifferent patients in the argument of equation (3) we get,

$$(Y - P_H^S) / (Y - c_S) \geq Q_h^L / Q_h^H \quad (4)$$

By using similar argument in equation (2) we can get,

$$(Y - c_S) / Y \geq Q_h^0 / Q_h^L \quad (5)$$

From the equality of equation (5)

$$Y^{PS} = [Q_h^L / (Q_h^L - Q_h^0)] c_S \quad (5.1)$$

Here,  $Y^{PS}$  is the level of income of those patients whose preferences regarding health care quality innovation become indifferent between no treatment and treatment with low quality health care innovation. It is to be noted that for all  $Y^S \in [Y^{HS}, Y^{PS}]$  the patients are considered as poor with potential buyer of high quality health care and in this paper we are treating them as our target group of patients at least in South. On the other hand for all  $Y^S \in [Y^{PS}, 0]$  the patients are considered as poor with zero potentiality to buy high quality health care. From the above equation we can show that  $Y^{PS}$  will move in the downward direction in case of an increase in quality health care services, that is, if  $Q_h^L$  increases,  $Y^{PS}$  will go down for given  $c_S$  as the multiplier term of equation (5.1), i.e.,  $[Q_h^L / (Q_h^L - Q_h^0)]$ , decreases due to increase in  $Q_h^L$ . We call this multiplier as  $c_S \cdot Y^{PS}$  multiplier. In other words innovation in health services, leading to increase in  $Q_h^L$ , may reduce  $Y^{PS}$ . Again, for variable  $c_S$ , that is,  $c_S = e_L(Q_h^L)$ , if  $Q_h$  increases from  $Q_h^L$  to a higher level leads to an increase in  $e_L(Q_h^L)$  and hence an increase in  $c_S$ . Thus from equation (5.1) we can see that the movement of  $Y^{PS}$  depends upon two opposite forces and hence the movement of  $Y^{PS}$  will be ambiguous. However, if we assume that the effect of an increase in  $c_S$  due to increase in  $Q_h$  dominates over the effect of an increase in  $Q_h$  in the term  $[Q_h^L / (Q_h^L - Q_h^0)]$ ,  $Y^{PS}$  will go up<sup>6</sup>. This leads to us the following proposition.

**Proposition 1:** *Innovation in quality of health care services may not be possible at a low level of income in South for either given  $c_S$  or even if for variable  $c_S$ .*

So, innovation of health services at low level of income is not possible. Thus we should focus on high level of income for innovation of high quality health care services in South. It is to be noted that among  $N$  number of consumers health care only  $N_{R1}(Y^M - Y^{HS})$  number of patients can afford higher level of health care quality or innovation, that is, higher than  $Q_h^L$  level. It implies  $N_{B1}Y^{HS}$  numbers of patients are unable to purchase higher level of health care innovation, though their level of utility increases along with an increase in health care innovation. It means  $N_{B1}Y^{HS}$  number of consumers will be deprived as they will use lower levels of health services and from the point of view of the MNHSP, production of higher level of innovation of quality of health care services will become unprofitable due to lack of demand and hence they will provide lower quality of health services. Therefore,

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<sup>6</sup> In the alternative case, that is, when the effect of an increase in  $Q_h$  in the term  $[Q_h^L / (Q_h^L - Q_h^0)]$  dominates over the effect of an increase in  $c_S$  due to increase in  $Q_h$ , we can get a reduction in  $Y^{PS}$ .

redistribution of income becomes an essence as both the consumer surplus and the producer surplus will be affected under such circumstances.

## 2.2 Rationale behind the presence of the State

In a developing economy as the purchasing power of the consumers remain lower compared to its developed part we find that less number of consumers can afford the higher quality health services. In short the demand for high quality health services in the South remains low. However, state can intervene in such a situation through income transfer and can resolve the above mentioned scenario some what extent. Let  $Y^{HS}$  be the level of income through which consumer can purchase  $Q_h^H$  level of health quality.

From the equality of equation (4) we get,

$$Y^{HS} = (Q_h^H / Q_h^H - Q_h^L) P_H^S - (Q_h^L / Q_h^H - Q_h^L) c_S \quad (6)$$

So, the patients with income lower than  $Y^{HS}$ , have to need a transfer by an amount  $T (= tY^{HS})$  at a transfer rate  $t$  of the corresponding level of income.

$$\text{Then, } Y^{HS} = Y^{PS} + tY^{HS},$$

The tax transfer process can be explained in the following manner

$$\int_{Y^{HS}}^{Y^M} N_{R1} t Y^S dY^S = \int_{Y^{PS}}^{Y^{HS}} N_{B1} t Y^S dY^S \quad (7)$$

LHS of equation (7) indicates tax revenue collected by the government from rich and RHS of the same equation indicates total amount of distributed tax to the poor in the form of income transfer.

$$\begin{aligned} N_{R1} t \{(Y^M)^2 - (Y^{HS})^2\} &= N_{B1} t \{(Y^{HS})^2 - (Y^{PS})^2\} \\ (Y^{HS})^2 &= (N_{R1}/N_{R1} + N_{B1}) (Y^M)^2 + (N_{B1}/N_{R1} + N_{B1}) (Y^{PS})^2 \end{aligned} \quad (8)$$

**Remarks 1:** i) Square of  $Y^{HS}$  is nothing but the weighted average of square of both  $Y^M$  and  $Y^{PS}$ . ii) After transfer there will be only one income level  $Y^{HS}$  which will remain in the economy (South).

For an individual patient using equations (5.1) and (6) we can write

$$T = (Q_h^H / Q_h^H - Q_h^L) P_H^S - (Q_h^L / Q_h^H - Q_h^L) c_S - (Q_h^L / Q_h^L - Q_h^0) c_S \quad (9)$$

After some manipulation we get

$$T = (Q_h^H / Q_h^H - Q_h^L) P_H^S - [Q_h^L (Q_h^H - Q_h^0) / (Q_h^H - Q_h^L) (Q_h^L - Q_h^0)] c_S \quad (10)$$

**Remarks 2:** a) *Income transfer from rich to poor in South depends upon  $P_H^S$  and  $c_S$ . Specifically, income transfer is positively related to  $P_H^S$  and inversely related to  $c_S$ .*

b) *As a result of transfer only high quality health care services will be purchased in South by all Categories of patients.*

This completes stage 2 of the game and we now proceed towards stage 1 of the game.

### **Stage 1: Health service Provider select prices and quality of innovation in health services**

Full market coverage for the multinational health service provider (MNHSP) at home

$$\{N_{R1} (Y^M - Y^{HS}) + N_{B1} (Y^{HS} - Y^{PS})\}(\alpha Y^{HS} - P_H^S) \geq 0 \quad (11).$$

Where,  $\alpha$  is the proportion of income spent on high quality health care at South. Here, income means income of those people who can purchase high quality health services. Actually this is the only possibility<sup>7</sup>. Here, we assume after transfer of income from rich to poor that patients of South spend  $\alpha Y^{HS}$  for health quality and  $(1 - \alpha)Y^{HS}$  for consumption of other commodities, i.e.,  $\alpha Y^{HS} + (1 - \alpha)Y^{HS} = Y^{HS}$ .

From the equality of the above expression we can write it in functional form as

$$N(\alpha Y^{HS} - P_H^S) = 0$$

Where,  $N = \{N_{R1} (Y^M - Y^{HS}) + N_{B1} (Y^{HS} - Y^{PS})\}$

$$Y^{HS} = (1/\alpha) P_H^S \quad (12)$$

Using (6) in (12)

$$P_H^S = [\alpha Q_h^L / \{Q_h^L - Q_h^H(1 - \alpha)\}] c_S \quad (13)$$

$P_H^S$  is determined for home and this is the end of this game.

### **2.3 International Trade and Health Care Quality**

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<sup>7</sup> See point b of remarks 2.

We are now going to introduce country 2 as the foreign country and we assume that country 2 is a developed one. Then for foreign country we assume patients' income,  $Y^N$  and it is assumed that  $Y^N$  is uniformly distributed between  $Y^M$  and  $2Y^{HS}$ . Then frequency function of  $Y^N$  can be written as<sup>8</sup>

$$f(Y^N) = \begin{cases} N_{R2} & \text{for } Y^M \geq Y^N \geq 2Y^{HS} \\ 0 & \text{otherwise.} \end{cases}$$

Where,  $N_{R2}(Y^M - 2Y^{HS}) = N_N$  is the number of consumers of the high quality health care services in country 2 (North).

The M NHSP located in South will go for full international coverage if the following inequality holds

$$\{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(\alpha Y^{HS} - P_H^S) + N_{R2}(Y^M - 2Y^{HS})(P_H^N - P_H^S) \geq 0 \quad (14)$$

Here,  $P_H^N$  is the price of the high quality health services at North and this inequality holds from the point of view of producers of health care quality.

All the branches of the M NHSP (both in the North and in the South) will become profitable from the point of view of health care producers implies

$$\{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(\alpha Y^{HS} - P_H^S) + N_{R2}(Y^M - 2Y^{HS})(P_H^N - c_N) \geq \{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(\alpha Y^{HS} - P_H^S) + \gamma N_{R2}(Y^M - 2Y^{HS})(P_H^N - P_H^S) \quad (15)$$

Here,  $c_N$  denotes marginal cost of production of high quality health services at North and  $\gamma$  stands for proportion of foreign patients prefer to get treatment from South. It is to be noted that first term of LHS of inequality (15) indicates consumer surplus of the patients of South if they produced at South and the second term of the LHS of the same indicates consumer surplus of the patients of the North if (South based) M NHSP produce at North. Similarly, first term of the RHS of inequality (15) indicates the same as of the first term of the LHS and the second term denotes consumer surplus of the patients of North if they consume health services from South based M NHSP by moving to the South. In short, LHS of the expression (15) implies total consumer surplus enjoyed by the patients of South as well as of North when

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<sup>8</sup> The lower interval of  $Y^N$  is shown as  $2Y^{HS}$ . This is just a simplifying assumption. However, the main reason behind this is to show that the person with threshold level of income in the South has a lower income than the person with lowest level of income in the North. To simplify matters we assume that the person with lowest level of income in the North has an income level which is twice the threshold level income of South.

they get treatment from their home based branches of M NHSP and RHS of (15) shows total consumer surplus enjoyed by the patients of South as well as of North when all of them prefer to get treatment from South based M NHSP in South.

We now raise the question under what condition the North based patients move to the South. Earlier we have considered the inequality (15) from the point of view of producers. Here we want to focus on the particular condition regarding movement of patients from North to South by shifting our attention from producers to consumers. The patients of North will move to the South for their treatment if the following inequality holds

$$\gamma N_{R2}(Y^M - 2Y^{HS})(\beta Y^{HN} - P_H^S) \geq N_{R2}(Y^M - 2Y^{HS})(\beta Y^{HN} - P_H^N) \quad (16)$$

Where,  $\beta$  is the proportion of income spent on high quality health services by the consumers of the North and  $Y^{HN}$  is the minimum level of income for North at which patients of North can buy high quality health care services from North and here  $Y^{HN} = 2Y^{HS}$ . The above inequality holds from the point of view of patients or consumers of North.

From the equality of the expression (16) we get

$$P_H^N = \beta(1-\gamma)Y^{HN} + \gamma P_H^S \quad (17)$$

Thus equation (17) gives us the prices of high quality health care services at North in terms of  $Y^{HN}$  and  $P_H^S$ .

### **3. Some Numerical Experiments with Economic Implications**

Here we consider three cases to consider our numerical experiment. These cases are, Case 1 indicates the situation where treatment with high quality at South are preferred by almost all patients of North and this case also considers that the patients of South are willing to spend almost all of their income to get high quality health services. The second case assumes the situation in which a fraction of total patients of North will prefer to get treatment from South and the patients of South are willing to spend almost all of their income to get high quality health services. The last case indicates the opposite of the second case and in this case we consider the situation where almost all the patients of North will move to South to get high quality treatment and the patients of South are now going to spend less on high quality health care. However, the spending behaviour of the patients of North remains same for all of these

cases, that is, they will spend a fraction of their income to get high quality treatment. For each of these three cases we need four conditions and they are as follows:

- i. full market coverage condition for M NHSP at home (given by inequality (11)),
- ii. full international coverage condition for M NHSP (given by inequality (14)),
- iii. condition under which all the branches of the M NHSP (both at North and in South) will become profitable (given by inequality (15)),
- iv. condition under which patients of North will move to the South for their treatment (given by inequality (16)).

Apart from these, here we assume two different inequalities for our numerical experiments, i)  $\alpha \geq \beta$  and ii)  $\beta Y^{HN} \geq P_H^S$ . The first inequality is obvious as the proportion of income spent on consumption of health quality of the consumers of South is higher compared to the same of North and the second inequality follows from the fact that the patients from North move to the South as their expenditure on high quality health care quality in North ( $\beta Y^{HN}$ ) is higher than the expenditure on high quality health care in the South ( $P_H^S$ ). We now consider various cases to analyze our numerical exercises.

**Case 1, where  $\alpha = 1, 0 < \beta < 1$  and  $\gamma = 1$ ,**

Inserting  $\alpha = 1$  in equations (12) and (13) we get

$$Y^{HS} = P_H^S = c_S \quad (18)$$

**Remarks 3:** At home for full market coverage M NHSP will set the price of high quality health care innovation at the marginal cost if  $\alpha = 1$ .

Now the M NHSP will go for full international coverage if the following inequality holds (from inequality (14) we get)

$$\{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(Y^{HS} - P_H^S) + N_{R2}(Y^M - 2Y^{HS})(P_H^N - P_H^S) \geq 0 \quad (19)$$

As we have already found that  $P_H^S = Y^{HS}$  from equation (18), for maintaining the above inequality  $P_H^N$  has to be greater or equals to  $P_H^S$ , that is,

$$P_H^N \geq P_H^S \quad (20)$$

Again using  $\gamma = 1$  in (16) we can say that all patients of foreign country (North) will move to the South for their treatment for the following inequality

$$P_H^N \geq P_H^S \quad (20)$$

**Remarks 4:** The M NHSP will cater full international coverage and all the patients of North will move to the South for their treatment if  $P_H^N \geq P_H^S = c_S$ .

On the other hand (from equation (15)) if,

$$\{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(Y^{HS} - P_H^S) + N_{R2}(Y^M - 2Y^{HS})(P_H^N - c_N) \geq \{N_{R1}(Y^M - Y^{HS}) + N_{B1}(Y^{HS} - Y^{PS})\}(Y^{HS} - P_H^S) + N_{R2}(Y^M - 2Y^{HS})(P_H^N - P_H^S)$$

$$P_H^S \geq c_N \quad (21)$$

**Remarks 5:** If marginal cost of producing health care quality of level  $Q_h^H$  at South is greater or equal to marginal cost of producing health care quality of same level at North, all the branches of the M NHSP (both at North and in South) will become profitable and export of health quality health services from South to North will be profitable iff,  $c_S < c_N$ .

This case leads to us the following proposition.

**Proposition 2:** Under the situation where  $\alpha = 1, 0 < \beta < 1$  and  $\gamma = 1$ , we can get the following results,

- i) at home for full market coverage M NHSP will set the price of quality  $Q_h^H$  at the marginal cost if  $\alpha = 1$ ,
- ii) the M NHSP will go for full international coverage either in case of  $P_H^N \geq P_H^S$ ,
- iii) all the branches of the M NHSP (both at North and in South) will become profitable and export of health quality from South to North will be profitable iff,  $P_H^S = c_S \geq c_N$ ,
- iv) patients of North will move to the South for their treatment if a)  $P_H^N \geq P_H^S$ .

**Case 2, where  $\alpha = 1, 0 < \beta < 1$  and  $0 < \gamma < 1$ ,**

It is to be noted that here the relationship among  $Y^{HS}$ ,  $P_H^S$  and  $c_S$  and the inequality for which the M NHSP will go for full market coverage have been remain unchanged, as we set  $\alpha = 1$ . It implies, here  $Y^{HS} = P_H^S = c_S$  and from the inequality (14) we can show that the M NHSP will go for full international coverage if  $P_H^N \geq P_H^S$ .

Interestingly by using the interval of  $0 < \beta < 1$  in inequality (16) we obtain the following conditions for which patients of North will move to the South for their treatment

$$P_H^N \geq (1 - \gamma)Y^{HN} + \gamma P_H^S \quad (22)$$

In this case, with present set up from inequality (15) one can say that all the branches of the M NHSP (both at North and in South) will become profitable if

$$P_H^S \leq [(1/\gamma)\{c_N - (1 - \gamma)P_H^N\}] \quad (23)$$

**Proposition 3:** Under the situation where  $\alpha = 1, 0 < \beta < 1$  and  $0 < \gamma < 1$ , we can get the following results,

i) at home for full market coverage M NHSP will set the price of quality  $Q_h^H$  at the marginal cost if  $\alpha = 1$ ,

ii) the M NHSP will go for full international coverage either in case of  $P_H^N \geq P_H^S$ ,

iii) all the branches of the M NHSP (both at North and in South) will become profitable and export of health quality from South to North will be profitable iff,

$$P_H^S \geq [(1/\gamma)\{c_N - (1 - \gamma)P_H^N\}],$$

iv) patients of North will move to the South for their treatment if a)  $P_H^N \geq (1 - \gamma)\beta Y^{HN} + \gamma P_H^S$ .

**Case 3, where  $\gamma = 1, 0 < \beta < 1$  and  $0 < \alpha < 1$ ,**

In this case from (12), when  $0 < \alpha < 1$ , we find  $Y^{HS} > P_H^S$ . Thus here we find a lower value for  $P_H^S$ . Here,  $P_H^S$  will move in accordance with the expression (13). It is to be noted that as  $0 < \alpha < 1$ , the multiplier term with  $c_S$  on the right hand side of equation (13) will decline compared to the earlier cases<sup>9</sup>. Moreover, from equation (12) we can say that for maintaining the same level of preferences (that is, for given  $Y^{HS}$ ) as earlier the producers will cut down the price of health quality  $Q_h^H$  as  $\alpha$  becomes less than one. It leads to the following remarks.

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<sup>9</sup> In earlier cases we get  $P_H^S = c_S$ , where [.] becomes 1 since  $\alpha$  was set at 1. In the present case where,  $0 < \alpha < 1$ , we can assume [.] < 1 to satisfy the basic argument of our study, that is,  $Q_h^L < Q_h^H$ .

**Remarks 6:** Price of the health quality  $Q_h^H$  in South will rise as marginal cost of high quality health care production in South rises, but it will increase at a lower proportion. Again, price of high quality health care at South will be lower compared to the earlier two cases.

It is to be noted that with such kind of set up our M NHSP can cater full market coverage at home even if  $0 < \alpha < 1$ . To cater full market at South M NHSP has to satisfy the inequality (11) which actually implies  $\alpha Y_H^S \geq P_H^S$ . Therefore, from the expression (14) one can argue that the M NHSP will cater full international market if  $P_H^N \geq P_H^S$ . Again from (16) we get patients of North will move to the South for their treatment if  $P_H^N \geq P_H^S$  and (15) implies that the M NHSP will operate both in South and North if  $P_H^S \geq c_N$ .

**Proposition 4:** Under the situation where  $\gamma = 1, 0 < \beta < 1$  and  $0 < \alpha < 1$ , we can get the following results,

- i) at home for full market coverage M NHSP can set the price of quality  $Q_h^H$  at  $P_H^S > \alpha Y^{HS}$  for very low level of  $\alpha$ , otherwise  $\alpha Y_H^S \geq P_H^S$  will remain the condition under which Local M NHSP can cater full market coverage,
- ii) the M NHSP will go for full international coverage either in case of  $P_H^N > P_H^S$  or in case of  $\alpha Y^{HS} \geq P_H^S$ , under some reasonable conditions,
- iii) all the branches of the M NHSP (both at North and in South) will become profitable and export of health quality from South to North will be profitable iff,  $P_H^S \geq c_N$ ,
- iv) patients of North will move to the South for their treatment if  $P_H^N \geq P_H^S$ .

#### 4. Concluding Remarks

The present paper examines the role of price discrimination of a Multinational health service provider (M NHSP) regarding different tradable possibilities between North and South. To make our theoretical structure as more realistic, here we incorporate the role of the government in South through income transfer from rich people of South to the poorer section of the same. To capture such scenarios of international trade of health care quality innovation in the context of North-South framework we have considered a hypothetical monopoly medical service provider or M NHSP and we also assume that the representative M NHSP can

practice both in the South and in the North, though it is basically a South-based firm. In such a framework we have derived the threshold level of health care quality and the price of the threshold level of health care quality from the rationality constraint of both consumers as well as of producers of same economy. At the very next section we have introduced a foreign rich economy (North) and we have also determined the price level of high quality health treatment (here the high quality treatment of North or of South are same) at North. Apart from these we have considered three different case studies to capture different economic situations.

From the above mentioned set up we have shown that whatever be the case, price discrimination between North and South regarding high quality health treatment becomes the issue due to which South based M NHSP can enjoy the comparative advantage in trade in high quality health services and hence they can export their high quality services to the foreign patients. It is also implies that they will sell the same quality treatment to the local patients. In short high price of high quality health care at North compared to the price of the same quality health care at South becomes a mandatory criterion for our representative M NHSP to cater full international coverage.

Apart from full international coverage, price discrimination between North and South regarding high quality health care is also determined the movement of foreign patients to South if most of the foreign patients prefer to get treatment from South. However, if this demand for domestic health care by the foreigners is relatively low, before moving towards South patients of North will compare between the expenditure on high quality health care in North and the same in South. In other words the patients of North will move to the South for their treatment if they find that the price of high quality treatment in North is either greater or is equal to the weighted average of the price of high quality treatment in South and the income of the North.

Though full international market coverage does not depend upon the expenditure behaviour of domestic patients on health care or upon the preference of the foreign patients on domestic health services, the full market coverage at South for M NHSP is depends upon the above-mentioned parameters. Whether foreign patients prefer more or prefer less to get high quality treatment from South, high quality health service providing M NHSP will cater full domestic market if they decide their production decision at the price-marginal cost equality for high quality treatment. Of course it depends upon the factor that patients of South are willing to spend more on high quality health services. However, if domestic patients are willing to pay

less for high quality health care, M NHSP will cater full domestic market if they choose their production decision at the price-total expenditure equality on health care quality.

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