

# Study on the Optimum Medical Payment System under the Asymmetric Information Structure

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## 1. Introduction

### 1.1 Awareness of the issue in the context of administrative and financial reform

The purpose of this paper is to study the optimum medical payment system from the perspective of healthcare reforms. However, there is also an awareness of the issue as a key in examining approaches to administrative and financial reforms. Based on this viewpoint, this paper considers the medical payment system, an issue of medical expenses, for the following two reasons. First, recent increases in medical expenses in Japan have resulted in their gaining a higher ratio within public sector spending and the national economy. Discussions about reducing the scale of the government to an optimum level, as part of administrative and financial reforms, should be accompanied by an examination of the factors that have contributed to the increase in government spending. For this purpose, it is necessary to focus on social security spending, which is showing characteristic movements among the various elements of government spending. This is an important consideration of the issue about the scale or the quantitative side. The second reason is that healthcare-related public spending is difficult to control, and, in addition, difficult to determine its appropriateness through inspections and audits. In general, medical service suppliers have the role of agents who are entrusted by customers and act for the benefit of customers at the expense of customers. This can be likened to the structure in which government bodies are entrusted by taxpayers and supply administrative services to enhance taxpayers' welfare at the expense of taxpayers. This is an important point regarding the qualitative side of the issue.

Thus, an examination of the medical payment system as a key when considering administrative and financial reforms is part of the critical concerns of this paper.

### 1.2 Viewpoints regarding present administrative and financial reforms

Improving the efficiency of public sector projects, which is under way in Japan, is one of the important objectives of the administrative and financial reforms. If it is difficult to continue to increase healthcare spending at the same pace to satisfy the ever increasing demand for such services in this aging society, it will become necessary to take measures to promote efficient project operations. It means that more projects can be carried out at the same cost, or that the same projects can be carried out at a lower cost.

The approaches that are actually under consideration within the framework of the present administrative and financial reforms include:<sup>1)</sup>

(1) To determine the appropriateness of projects through policy evaluation;

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1) One of the other most important reforms is public accounting reform. The public sector management is analyzed in detail in Osumi (1999 and 2002).

- (2) To manage the cost and scale of projects, setting numerical targets; and
- (3) To contemplate organizational and compensatory reforms of public entities through their transformation to independent administrative institutions.

Other relevant topics in connection with medical expenses include the following.

Measures aimed at securing appropriateness through evaluation as in (1) above, include the evaluation of the appropriateness of medical practices through audits by the Board of Audit and inspections by the Ministry of Health, Labor and Welfare. Provisions have been made that claims for the redemption or payment of medical fees shall be rejected if such inspections and audits find the case to be inadequate in failing to meet the requirements, or providing superfluous treatment. According to the *FY 2000 Audit Report* by the Board of Audit, "Audits of 27 Regional Social Insurance Offices of the Social Insurance Agency and 30 prefectures found improprieties in the payment of medical fees in 317,933 cases, to a total amount of 3,193,722,503 yen among the all cases of payment from 2,032 entities to 351 medical institutions between FY 1997 and 2001. This resulted in the improper payment from national treasury obligatory share of 1,828,463,586 yen." Although the difference in the number of audited institutions does not allow a simple comparison with FY 1999, the improper amount increased from that in the previous year, 2,430,537,661 yen. According to the Ministry of Health, Labor and Welfare, the investigations conducted by the Social Insurance Medical Fee Payment Fund (for employees' insurance) and the Federation of National Health Insurance Organizations (for national insurance) show that the payment of medical fees was rejected in 21,220,000 cases with a total amount of approximately 100 billion yen because of the excess treatment beyond accepted standards.<sup>2)</sup> The Ministry also indicates in its Guidance and Inspections for Medical Care Insurance Institutions in 2000 that a total of approximately 3.2 billion yen was returned as a result of the guidance, and approximately 2.7 billion yen was returned as a result of inspections conducted by insurance medical care institutions.

In addition, attempts have been made to empower patients as users of medical services to assess the appropriateness of their medical treatment based on their own case records disclosed to them. At the same time, some medical service suppliers perform patient satisfaction surveys to evaluate the appropriateness of the services supplied and examine improvements in their business.<sup>3)</sup> The *Guidelines for Social Security Reforms* announced by the Government in March 2001 sets forth a goal of "providing efficient and high-quality services from the standpoint of users" in the field of social security. These facts are in line with the recent trends in local authorities trying to reflect residents' needs as much as possible in making decisions about administrative services.

In connection with approach (2) "To manage the cost and scale of projects, setting numerical targets," targets have been established concerning total medical expenses. In the *Measures to Promote Fiscal Structure Reforms* announced in June 1997, prior to the *Guidelines for Social Security Reforms*, the Government made it clear it would "maintain the basic policy of controlling the growth of national medical care expenditure within the extent of the national income growth." With slower economic growth in recent years, the medical fee and drug price schedules were revised downward for the first time ever in April 2002. Furthermore, as part of FY 2002 reforms, the patient's share of payment for medical services was raised from 20% to 30%, and the system for premium calculation was also changed to 8.2% of total remuneration, including bonuses, in order to increase the income for medical care insurance accounts.

Lastly, with regard to the organizational and compensatory reforms as in (3), improvements in the efficiency of medical service supplies are expected through the change in the medical payment system from a fee-for-service basis to the prospective (fixed-amount) basis. In addition, separation of dispensing and prescribing has also been promoted as part of organizational reforms.

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2)Explanation by the Ministry of Health, Labor and Welfare to questions at the House of Representatives of Japan. (Yomiuri Shimbun, August 27, 2002).

3)These cases are summarized in the FY 2001 Report on the Projects to Promote Stable Management of Medical Care Institutions by the Ministry of Health, Labor and Welfare.

### 1.3 Problems in the approaches of administrative and financial reforms

There have been some advances through these reforms with the intention to introduce quantitative criteria in a field that has never been subject to evaluation, especially in numerical terms. However, there remain following problems to be considered.

First, in connection with judgments about the appropriateness and efficiency of projects through evaluation as mentioned in (1), such evaluation of the methods of supplying medical services and the quantity of resources provided, i.e. the medical expenses, may be performed by the Ministry of Health, Labor and Welfare, the Board of Audit, the Medical Fee Payment Fund, and patients themselves as the users of medical services. However, medical services are by nature non-physical goods that are specific to individual users having different characteristics, and observers cannot have more technical information than suppliers about the cost and effectiveness of the treatments when determining the supply level.<sup>4)</sup> Consequently, it is not easy for any persons other than the suppliers to make satisfactory ex post evaluations of the level and quality of individual treatments except for judgments about regularity, such as whether the claims for medical fee payment satisfy the specified requirements or not. This is natural, given the fact that medical service users consult professional suppliers because such users cannot possibly have the relevant knowledge about the most appropriate form of treatment. Even for regularity, the above-mentioned Audit Report by the Board of Audit points out the difficulty in keeping a close watch on the operation of the system by saying “such situations may be attributable to: (a) the failure of operational entities and payment agencies to perform thorough screening for improper claims for medical fees by medical institutions, in particular the failure to undertake thorough verification of various forms in connection with such claims; (b) the failure to utilize the data suggesting the shortages of healthcare professionals at medical institutions even though such data is available at Regional Social Insurance Offices and Prefectural Governments; and (c) the failure of Regional Social Insurance Offices and Prefectural Governments to provide sufficient guidance to medical institutions.” In other words, this means that the cost to the principals to monitor their agents is not insignificant.<sup>5)</sup>

It is extremely important from the point of view of taxpayer sovereignty to place emphasis on the evaluation of user satisfaction when making a decision over the supply level of public services. However, if the service users' benefits are discussed separately from the costs to be borne by them and consequently the supply level is determined with too much emphasis on the maximization of user satisfaction, this might result in excessive government expenditure, causing a disturbance in the optimum distribution of resources.

Next, the problem in connection with management using numerical targets as mentioned in (2) is examined. Given the purpose of medical policy, which is to improve health levels through the effective supply of medical services, it is obvious that the reduction or control of medical expenses itself is not the ultimate goal. The most critical point is not the increase in the medical expenses but the assessment of their effect as measured by the improvement in health levels relative to spending on medical care. If the improvement in the health level—the benefit—is more significant than the spending for medical care—the cost, it means an improvement in national welfare, even if the resultant growth of medical expenses is in excess of that of national income. Thus, although management with numerical targets brings us great expectations for sure results, it will be less effective without well-laid plans to facilitate the process of achieving those numerical targets or careful analysis to identify the reasons for failing to achieve the goals to date. As a matter of fact, the consultation report, *FY 2002 Healthcare System Reforms*, published by the Medical Insurance Group of the Social Security Council in November 2001, points out that “the goal of controlling the growth of national medical care expenditure within the extent of the national income growth has not been fulfilled to date.” Furthermore, the numerical target, developed in the whole context of the financial reforms by the Government, of reducing the annual government bond issuance to 30 trillion yen or lower was met in the original budget in an initial basis, but this was made possible by applying accounting techniques, such as deferring the transfers from the General Account to the Special Account. This also suggests the difficulty in satisfying the target on a real basis.

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4)Such a problem is called “asymmetry of information.” See Hiller (1997) for details about asymmetric information.

5)See Heymann (1988) for details about monitoring costs.

Lastly, let us examine management through reforms in the organizational structure and the medical payment system. Apparently, discussions on organizational reforms, including the transformation into an independent administrative institution, reorganization of special public corporations, and privatization—many of the organizations in such discussion have the role of government agents—have been lacking a perspective on the operational advantages brought about by such organizational reforms, as well as on their impact on business efficiency. In some cases, emphasis has been placed on discussions on the organizational reforms themselves rather than on the careful prior analysis of the organizational structure that will allow the most efficient implementation of the business at the minimum cost. Thus, when implementing reforms of the medical payment system to solve problems relating to medical expenses, it is necessary to analyze the advantages and disadvantages of the fee-for-service payment system and the prospective payment system to make a thorough examination in advance to determine the mechanisms of these systems in achieving the maximum results toward the goals of medical policy.

In summary: (1) While it is important and necessary to determine the appropriateness and efficiency of public sector projects by some means, either before or after their implementation, this is not an easy task; (2) While the establishment of numerical targets is possible, there may be cases in which the national welfare level is not improved or the effectiveness for such improvement cannot be secured even if the numerical targets have been fulfilled. It needs extensive analysis of the relation between the numerical targets and ultimate policy goals of the projects and the fundamental causes of the failure to fulfill the targets to date; and (3) It is necessary when building up or reforming the scheme, including organizational structure and medical payment system, to examine the impact of the scheme on agent behavior as well as the mechanisms for improving project efficiency.

In Chapter 2, the quantitative aspects of these problems are explored by outlining the financial condition of the public sector in Japan and social security costs, in particular for medical expenses. Next, the medical payment system under the Guidelines for Healthcare System Reforms is described in Chapter 3. In Chapter 4, the difficulty of developing the optimum medical payment structure—the qualitative aspect of the problem—and the corresponding system are examined and discussed. In the model, we consider a medical payment system in which a proper supply level can be chosen under the constraint that observers cannot have complete information.

## 2. Financial Conditions and Social Security Costs in Japan

### 2.1 Changes in the financial condition of the Government

This section overviews the financial condition of the public sector, in particular, social security costs and medical costs. As the first step to look into the financial condition of the public sector in Japan, let us examine the present condition of government debt. As shown in Table 1, the ratio of the outstanding national and local government debt to GDP in Japan is the largest among major advanced nations.

Table 1 also shows that the Japanese government debt to GDP ratio in 1993 was not as large as the present level. The most immediate factor on the increasing government debt on a stock basis is the yearly increase in budget deficit on a cash flow basis. Given the following equations:

$$\text{Expenditure} = \text{Tax revenue} + \text{Public bond revenue}$$

$$\text{Public bond revenue} = \text{Expenditure} - \text{Tax revenue.}$$

The increase in public bond revenue (budget deficit) is determined by the annual expenditure and tax revenue.

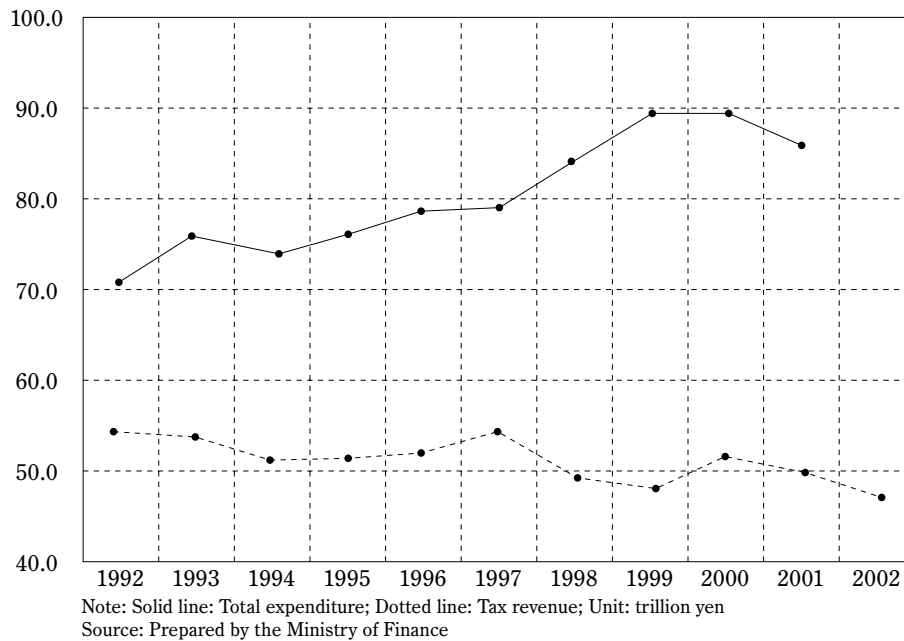
**Table 1. Debt to GDP (Ratio) of National and Local Government**

| (Calendar year) | JAPAN | U.S. | U.K. | GERMANY | FRANCE | ITALY | CANADA |
|-----------------|-------|------|------|---------|--------|-------|--------|
| 1993            | 69.0  | 75.8 | 58.1 | 47.4    | 51.6   | 117.9 | 116.0  |
| 2002            | 143.3 | 58.9 | 51.8 | 61.3    | 65.6   | 106.3 | 99.7   |

Unit: % Source: Prepared by the Ministry of Finance based on OECD Economic Outlook (Vol. 71, June 2002)

Figure 1 shows the total government expenditure and the tax revenue in the past ten years to help identify the factors in the increase in the Japanese government debt. As shown in Figure 1, while tax revenue decreased slightly in the past ten years from the 50 trillion yen range to the latter half of the 40 trillion yen range, total expenditure increased from about 70 trillion yen to nearly 90 trillion yen at its peak.

**Figure 1. Total Expenditure and Tax Revenue**



The increase in expenditure during the past ten years, while tax revenue was slightly decreasing, or the failure to control expenditure in coordination with tax revenue, may have triggered government bond issuance and caused the increase in government debt. In such case, the focus of the problem should be the composition of expenditure. Table 2 shows the itemized expenditure in the General Account since FY 1998.

According to Table 2, the largest expenditure item in the General Account is social security expenditure. Many of the expenditure items show negative in annual growth, and public project expenditure, which is often referred to as the spending to stimulate the economy, has been restricted under spending cut requirements. Unlike these expenditure items, social security expenditure has been increasing every year without significant fluctuations. Therefore, it is necessary to focus on social security expenditure in discussions on government expenditure.

## 2.2 Importance of social security expenditure

The modern social security system has been established centering on the social insurance system. Among the items constituting social security expenditure, including expenditures for social welfare, public assistance, public health service, social insurance, and unemployment, social insurance expenditure has been the principal item. Those for public assistance and public health service expenditures have been losing their shares due to the economic growth and the improvement in the public health level. In fact, the share of social insurance expenditure in the total social security expenditure increased from 40.4% in FY 1965 to 77.5% in FY 2002. Social insurance expenditure refers to the nondiscretionary and mandatory spending that is entitled by law, irrespective of the economy and tax revenue, as represented by the expenditure for unemployment insurance, which naturally increases during an economic recession, and that for pension and medical care insurance. Such nondiscretionary spending by nature tends to be determined without a case-by-case decision by the Government, and some components, such as unemployment benefit, which increases during an economic recession, play an effective role as a built-in stabilizer. On the other hand, as the Government has less control over such spending, increases in pension and healthcare spending will accelerate with the aging of the population structure.

**Table 2. Itemized Expenditure Budget of the General Account**

|   | FY 1998 |        | FY 1999 |        | FY2000  |        | FY2001  |        | FY2002  |        |
|---|---------|--------|---------|--------|---------|--------|---------|--------|---------|--------|
|   | Amount  | Growth | Amount  | Growth | Amount  | Growth | Amount  | Growth | Amount  | Growth |
| Total expenditure of the General Account                    | 776,692 | 0.4%   | 818,601 | 5.4%   | 849,871 | 3.8%   | 826,524 | -2.7%  | 812,230 | -1.7%  |
| Expenditure for public bond                                 | 172,628 | 2.7%   | 198,319 | 14.9%  | 219,653 | 10.8%  | 171,705 | -21.8% | 166,712 | -2.9%  |
| Local allocation tax  | 158,702 | 2.5%   | 135,230 | -14.8% | 149,304 | 10.4%  | 168,230 | 12.7%  | 170,116 | 1.1%   |
| General spending  | 445,362 | -1.3%  | 468,878 | 5.3%   | 480,914 | 2.6%   | 486,589 | 1.2%   | 475,742 | -2.2%  |
| Social security   | 148,598 | 2.0%   | 161,123 | 8.4%   | 167,666 | 4.1%   | 175,552 | 4.7%   | 182,795 | 4.1%   |
| Education and science                                       | 63,457  | 0.0%   | 64,632  | 1.9%   | 65,285  | 1.0%   | 66,472  | 1.8%   | 66,998  | 0.8%   |
| Government employee pensions and others                     | 15,310  | -4.1%  | 14,783  | -3.4%  | 14,256  | -3.6%  | 13,562  | -4.9%  | 12,727  | -6.2%  |
| National defense  | 49,397  | -0.2%  | 49,322  | -0.2%  | 49,358  | 0.1%   | 49,553  | 0.4%   | 49,560  | 0.0%   |
| Public projects   | 89,891  | -7.8%  | 94,338  | 4.9%   | 94,340  | 0.0%   | 94,352  | 0.0%   | 84,239  | -10.7% |
| Economic assistance   | 9,803   | -10.2% | 9,877   | 0.8%   | 9,842   | -0.4%  | 9,562   | -2.8%  | 8,566   | -10.4% |
| Small and medium-sized business assistance                  | 1,858   | -0.4%  | 1,923   | 3.5%   | 1,943   | 1.0%   | 1,948   | 0.3%   | 1,861   | -4.5%  |
| Energy measures   | 6,682   | -2.6%  | 6,531   | -2.3%  | 6,351   | -2.8%  | 6,139   | -3.3%  | 5,694   | -7.2%  |
| Major foodstuff measures                                    | 7,070   | -2.5%  | 6,929   | -2.0%  | 6,853   | -1.1%  | 6,952   | 1.4%   | 7,297   | 5.0%   |
| Transfer to the Industrial Investment Special Account       | 1,595   | -7.0%  | 1,595   | 0.0%   | 1,595   | 0.0%   | 1,537   | -3.6%  | 1,455   | -5.3%  |
| Miscellaneous   | 48,201  | 2.7%   | 49,322  | 2.3%   | 54,924  | 11.4%  | 54,460  | -0.8%  | 50,781  | -6.8%  |
| Contingencies for public projects                           | —       | —      | 5,000   | —      | 5,000   | 0.0%   | 3,000   | -40.0% | —       | —      |
| Contingencies   | 3,500   | 0.0%   | 3,500   | 0.0%   | 3,500   | 0.0%   | 3,500   | 0.0%   | 3,500   | 0.0%   |
| Carry back from the fund for adjustment in settling account | —       | —      | 16,174  | —      | —       | —      | —       | —      | —       | —      |

Unit: 100 million yen

Source: "FY 2002 Graphical Representation of Japanese Finance"

**Table 3. Estimates of the Social Security Benefits and Burdens**

|                            | FY 2005         |               | FY 2010         |               | FY2025          |               |
|----------------------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|
|                            | In trillion yen | Ratio to NI % | In trillion yen | Ratio to NI % | In trillion yen | Ratio to NI % |
| Social security benefit    | 100             | 23            | 127             | 26            | 207             | 31.5          |
| Pension                    | 53              | 12            | 67              | 13.5          | 99              | 15            |
| Healthcare                 | 32              | 7.5           | 40              | 8             | 71              | 11            |
| Welfare                    | 16              | 3.5           | 21              | 4.5           | 36              | 5.5           |
| (including) Care           | 7               | 1.5           | 10              | 2             | 21              | 3             |
| Burden of social insurance | 99              | 23            | 122             | 25            | 204             | 31            |
| Social security burden     | 69              | 16            | 85              | 17.5          | 142             | 21.5          |
| Public burden              | 29              | 7             | 37              | 7.5           | 62              | 9.5           |
| National income            | 433             | -             | 490             | -             | 660             | -             |

Source: Estimates by the Ministry of Health, Labor and Welfare (October 2000)  
"Ratio to NI" is the ratio to national income.

Table 3 shows estimates for expenditure on social security benefit extracted from overall social security expenditure as published by the Ministry of Health, Labor and Welfare in October 2000.

According to Table 3, social security benefit is expected to increase from about 100 trillion yen in 2005 to 207 trillion yen—more than double—by 2025, and the ratio of the social insurance burden to the national income will exceed 30%. The largest element of social insurance spending is public pensions, followed by the healthcare service. With regard to public pension expenditure, it has been planned to control by restricting the future benefit level in advance through policy reforms, such as raising the pensionable age, introducing a “net slide system” that limits the change in the benefit amount within the range of the disposable income increase, and cutting component of contribution in proportion to income by a certain ratio. It is true that these plans have dominant characteristics of the above-mentioned approach of management with numerical targets and therefore may not be sufficient to secure effectiveness in the future. Given the direct payer-recipient relation between the Government and recipients, however, effectiveness in terms of the amount of benefit may be secured to a certain degree if the recipients’ consent to benefit levels can be obtained. On the contrary, with regard to the medical care insurance benefit, which is a benefit in kind provided through healthcare service suppliers, the system must be designed taking into consideration not only the behavior of healthcare service users but also those of suppliers as well. In addition, it is difficult to provide absolute ceilings for medical service benefits, such as the restriction on taking medical advice in advance. Thus, it is more difficult to secure effective control over the amount of medical benefit than that of pension benefits.

### **3. The Medical Payment System within the Framework of Healthcare Reforms**

#### **3.1 National medical care expenses and the financial position of the medical care insurance system**

In the previous chapter, the discussion focuses on the increase in government expenditure as a factor of the budget deficit, and it is predicted that the structural increase in social security expenditure, which has nondiscretionary characteristics, will continue. Regarding social insurance expenditure, which is the principal element of social security expenditure, it is also observed that the expenditure for medical care insurance may be more difficult to control using numerical targets as compared with expenditure for pension services. This chapter looks at the reform plans that are under examination relating to medical care expenditure.

The above-mentioned report by the Social Security Council indicates that “the financial position of the medical care insurance system has deteriorated to such an extent that its institutional sustainability is doubtful.” This statement implies that the medical care system reforms have been considered in the context of the fact that increasing medical expenses exceed the present level of contribution.

The national medical care expenditure, which is the aggregate of the medical care expenditures in Japan, nearly doubled from around 16 trillion yen in FY 1985 to 30.9 trillion yen in FY 1999, and its share of the national income exceeded 8%. As medical care expenses in Japan largely rely on public medical care insurance programs, an increase in medical expenses has a significant impact on the financial position of the medical care insurance system.

Looking at the present financial condition of the medical care insurance system, the government-managed health insurance programs for employees of small- and medium-sized enterprises revealed a total deficit of 316.3 billion yen in FY 1999. The society-managed health insurance programs for employees of large enterprises showed a loss in 69.7% of the societies to a total amount of 298 billion yen (or a total loss of 199.2 billion yen when offset against the surplus of the other societies) in 1999. The national health insurance programs, which are provided on a municipal level, also showed a loss of 120.5 billion yen in the same year. It should be pointed out that all of these insurance systems were in the black in FY 1983.

#### **3.2 The medical payment system within the framework of healthcare reforms**

In order to improve the trends of increasing medical care expenditures and the worsening insurance service budget balance, the Government and Ruling Party’s Social Security Reform Study Group issued the *Guidelines for Healthcare System Reforms* in November 2001. It indicates as its basic point of view that “as it is critical to promote the moderation of medical care expenditures and the improvement in efficiency of the healthcare service system,

we will make a fundamental revision of the healthcare service system and the medical payment system in general.” The future goals indicated in the Guidelines include the unification of the medical care insurance systems, the creation of a healthcare system for the elderly, and the revision of the medical payment system. The following sections focus on the medical payment system.

The Guidelines for Healthcare System Reforms specify several matters to be examined relating to medical fees, such as the expansion of the prospective payment system, with a view to implementing a fundamental revision of the medical payment system. The *Report on the FY 2002 Healthcare System Reforms* published by the Medical Insurance Group of the Social Security Council also suggests that “the prospective payment system should be expanded.” The report contains the conclusions of the discussion on the Draft Plan for the Healthcare System Reforms presented by the Minister of Labor, Health and Welfare on September 25, 2001.

In response to the Draft Plan by the Minister of Labor, Health and Welfare, the Japan Medical Association argues that “in relation to the DRG (diagnosis related group)-based medical payment system, there are still many problems to be verified, such as the lack of the established DRGs of Japan’s own and the wide variations between medical institutions that were found in the trial stage. The Ministry should not act rashly but continue its prudent deliberations.”<sup>6)</sup>

The discussions and examinations toward the revision of the medical payment system have been started but not yet reached any conclusions or agreements. In the next chapter, the details of the prospective payment system and medical service supply levels, which have been a focus of discussion, are examined theoretically using abstract models.

## 4. The Medical Payment System and Medical Service Supply Levels

### 4.1 Examination from the point of view of maximizing net benefits

In order to utilize medical resources more efficiently and achieve better results at the same cost, it is necessary to examine the optimum distribution of medical resources.

Assuming the benefit that the patients can receive from a medical service supply level  $q$  is:

$$B(q) \quad (B' > 0, B'' < 0) \quad (1).$$

And further assuming that the cost necessary to supply the medical service (medical cost burden) depends on the supply level  $q$  as follows:

$$C(q) \quad (C' > 0, C'' \geq 0) \quad (2).$$

If the full cost to supply the medical service is paid by patients on an individual basis, the optimum medical care supply level  $q$  for these patients is the value that maximizes the net benefit  $NB$ , which is calculated by deducting the cost payment from the benefit.

$$NB = B(q) - C(q) \quad (3).$$

Then, differentiate  $NB$  with respect to  $q$ , and determine the first-order condition to maximize the net benefit  $NB$ :

$$\frac{\partial NB}{\partial q} = B'(q) - C'(q) = 0 \quad (4).$$

Assuming, for example, that the cost function is linear, the optimum medical care supply level is  $q^*$ , as shown in Figure 2.

If it is assumed that medical care should be provided to the maximum within the cost, the medical care supply level  $q$  will be the value that satisfies:

$$B(q) - C(q) = 0 \quad (5).$$

<sup>6)</sup>As mentioned later, the prospective payment system is also called the DRG-based medical payment system because the amounts of medical fees are determined for individual DRGs.



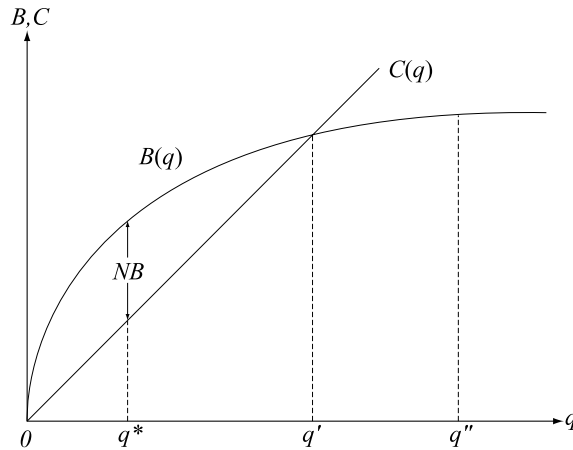
This medical care supply level is represented by  $q'$  in Figure 2.<sup>7)</sup>

If it is assumed that medical treatment should be provided without regard to the cost until the marginal effect of the treatment ceases to exist, the medical care supply level  $q$  will be the value that satisfies:

$$B'(q) = 0 \tag{6}.$$

This medical care supply level is represented by  $q''$  in Figure 2. Neither  $q'$  nor  $q''$  is the point at which the net benefit  $NB$  is maximized.

**Figure 2. Optimum Medical Care Supply Level from the View Point of Maximizing Net Benefits**



In reality, medical costs are partially paid by self-payment and the rest is paid by the benefits from the insurance system. However, the benefits from the insurance system are financed from the insurance burden and the public burden sourced from tax revenue, and so medical costs are ultimately paid for by the people. This means that the medical care cannot be supplied exceeding the cost paid by the people.

For each patient, there is a gap between the amount of self-payment and the cost  $C(q)$  that is required for medical care at level  $q$ . In such case, it may be reasonable that the individual will choose a level that is higher than  $q^*$ . However, if the supply level is chosen from the viewpoint of the national economy, the optimum supply level will be determined as the point which maximizes  $NB$  because medical care services cannot be supplied exceeding the fund paid by the people.<sup>8)</sup>

#### 4.2 Suppliers' role as agents

In the previous section, it is assumed that the medical service demand level  $q$  is chosen by patients themselves based on a comparison between the cost and benefit. This section examines how the medical service supply level  $q$  is chosen under a specific medical payment system, taking into consideration the existence of suppliers. Here, it is assumed that the supply level  $q$  is mainly determined by the medical service suppliers.<sup>9)</sup> In other words, medical service suppliers have a role as agents who act for the benefit of medical service users at the expense of those users. If the suppliers are to act as agents who are fully faithful to users (principal), they will determine the

7) Since it is assumed that the optimum value of the supply level  $q$  is the one which maximizes the net benefit  $NB$ , the value of  $q$  may be large enough in an absolute term if  $B'(q)$  for a certain value of  $q$  is judged to be large enough and to exceed  $C'(q)$ . However, meeting the condition  $B'(q) - C'(q) = 0$  with a  $q$ -value large enough must be considered separately from supplying services to the level  $q'$  or  $q''$ .

8) Although the medical service supply level  $q$  can be determined for net benefit, the gap between the medical cost that an individual user can pay and the actual medical cost should also be examined separately from the point of view of income redistribution.

9) It is assumed that the medical treatment is initiated by patients but the amount of the treatment is determined by the suppliers. It is also assumed that patients can terminate the treatment when they recover completely, but will continue the treatment until they recover completely, except in extreme cases.

medical service supply level at  $q^*$  as analyzed in the previous section so that the net benefit  $NB(q)$  for the users will be maximized.

However, if the agents in general are not fully faithful to the principals, the resultant level of transaction will be different. In such cases, the agents determine their behavior taking into consideration the benefits of both the principals and themselves. In an extreme case the agents may determine their behavior mostly based on their own benefits. In the following analysis, it is assumed that the medical service suppliers will act taking into consideration the surplus  $\pi(q)$ , which is the difference between the medical payment  $R(q)$  they can receive from the medical service supply  $q$  and the cost  $C(q)$  necessary for such supply.

$$\pi(q) = R(q) - C(q) \tag{7}$$

In other words, the suppliers will pursue the maximum  $\pi(q)$ . In the following section, how the medical service supply level  $q$  is influenced by the differences in the medical payment system  $R(q)$  is examined.

### 4.3 Supply level chosen in the fee-for-service payment system

The present medical payment system in Japan is mainly based on the fee-for-service system except for some cases. In this system, the medical fee  $R$  is paid in accordance with the medical service supply level  $q$ ,<sup>10)</sup> where:

$$R = R(q) \quad (R' > 0) \tag{8}$$

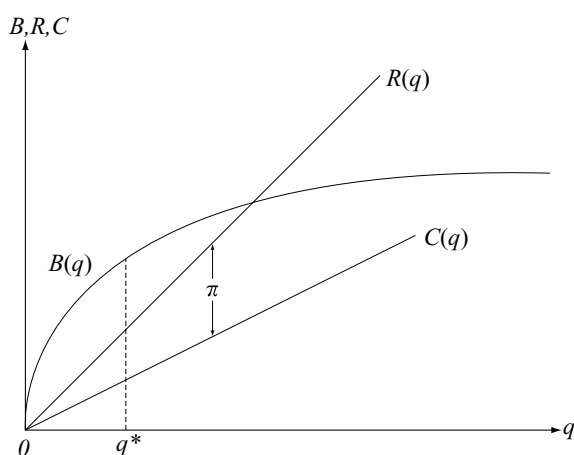
For simplification, assuming that  $R(q)$  is an increasing linear function, this structure can be plotted as shown in Figure 3. If the medical service suppliers acting as agents pursue the maximization of the surplus  $\pi(q)$ :

$$\pi(q) = R(q) - C(q) \tag{9}$$

the supply level  $q$  does not necessarily agree with  $q^*$ , which is determined from the point of view of net benefit. It is considered the larger the  $q$ -value, even in excess of the  $q^*$ -value, the better for the agents.

Thus, in the fee-for-service payment system, the necessary medical care supply level  $q^*$  can be secured, but there is a disadvantage that the chosen medical care supply level  $q$  may be excessive.<sup>11)</sup>

**Figure 3. Medical Service Supply Level under the Fee-for-Service Payment System**



10)The actual medical payment system is very complicated and does not show such a simple form proportional to  $q$ . In the following analysis, however, a simplified model is used to consider how the medical payment system influences the supply level.

11)See the *Social Security Ten-day Report* (August 2002), etc. for a discussion about problems in the medical payment system on a fee-for-service basis. There are also problems in the present medical payment system. These include the manner that the insufficiency of medical fees, which go towards the purchase of equipment that is necessary for treatment and the provision of advanced medical techniques, has influenced the supply level as suppliers seek to cover such a deficiency.

#### 4.4 Supply level chosen in the prospective payment system

One of the medical payment systems that are under examination to solve the current problems in the fee-for-service payment system is the prospective payment (fixed-amount) system. In the United States, the prospective payment system (PPS) that is based on the diagnosis related group (DRG) was introduced in 1983 to control increasing medical expenses under the public medical insurance system.

In this system, medical fees are not paid according to the amount of medical service supply  $q$ , but an inclusive medical fee  $\bar{R}$  is paid at a fixed amount based on the cost that is deemed necessary on average to cure the patients depending on the DRG, which is determined in accordance with certain criteria. The simplest medical fee payment structure is:

$$R = \bar{R} \tag{10}$$

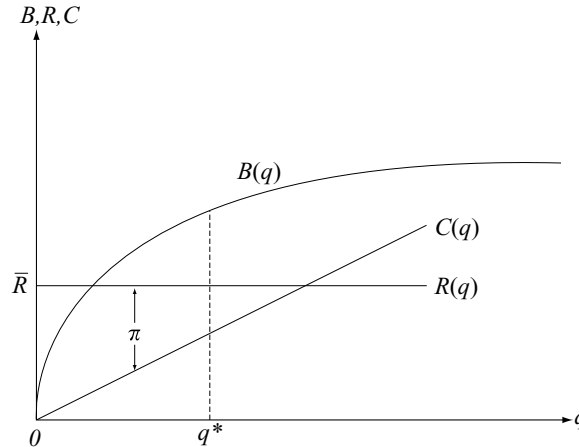
Such a system can be plotted as in Figure 4.

If the medical service suppliers acting as agents pursue the maximization of the surplus  $\pi(q)$ :

$$\pi(q) = \bar{R} - C(q) \tag{11}$$

it cannot be assured that the supply level  $q$  always agree with  $q^*$ , which is determined from the point of view of net benefit for individual users. For such agents, the lower the supply level  $q$  is below the  $q^*$ , the better, in order to increase this surplus. In an extreme case, the maximum surplus can be obtained when  $q = 0$ . Thus, while the prospective payment system does not have the problem of excessive supply as in the fee-for-service payment system, there remains a disadvantage that the resultant medical service supply level  $q$  may be lower than the necessary medical care supply level  $q^*$  in some cases.<sup>12)</sup>

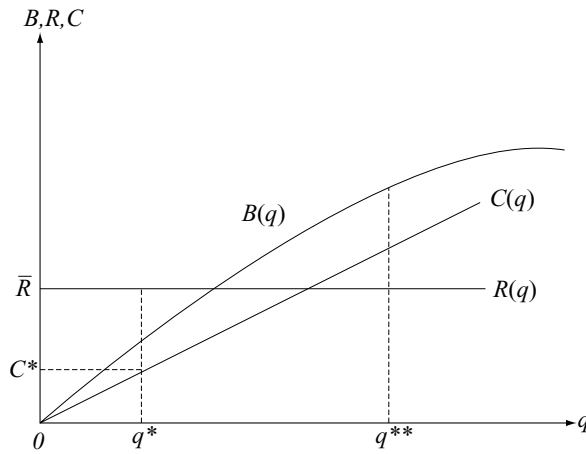
Figure 4. Medical Service Supply Level under the Prospective Payment System



The fixed-amount fee  $\bar{R}$  is determined based on the cost that is deemed necessary on average to cure the patients depending on their DRGs. As shown in Figure 5, in the case of patients whose physical conditions require more  $q$ , even if the net benefit  $NB$  is maximized at  $q^{**}$  with  $B'(q) = C'(q)$ , supply to the  $q^{**}$  level will be difficult because a loss will be caused for the suppliers due to the condition  $R(q) = \bar{R} < C(q)$ . On the other hand, there is also the problem that the excess payment beyond the cost  $C^*$  for  $q^*$  is not returned when patients recover earlier than expected.

12) Although the problem of undersupply of medical service is discussed here, assuming that the agents will not greatly impair the principals' benefits or discontinue the treatment before the patient recovers, the condition of  $q < q^*$  in a significant term, or even  $q = 0$ , will be unrealistic.

**Figure 5. Medical Service Supply Level under the Prospective Payment System (in the case of patients who need more treatment)**



**4.5 Medical payment system with heterogeneous characteristic patients**

As mentioned above, while the prospective payment system has the advantage that excessive supply can be avoided, it also has a problem that there may be cases in which the medical fee is overpaid when the cost is smaller than the average  $\bar{R}$ . And there is a deficiency that further supply will be prevented when the cost is larger than the average  $\bar{R}$ . The reason is that the medical fees are determined based on the average cost in spite of the nature of medical services that are particular to individual patients and such patients have heterogeneous characteristics.

As the prospective payment system determines the relations between the input of medical resources and their effects on an average basis based on the statistically processed data by DRG, there may be cases in which such relations are not applicable to individual patients. In other words, even within the same DRG category, some patients may recover with a relatively small amount of medical resources or others may require more medical resources, depending on their physical conditions.

In the following, we will examine the structure in which suppliers receive variable amount of medical fees depending on the physical conditions of individual patients.

**Figure 6. Medical Service Supply Level When Multiple Prospective Payments Are Employed**

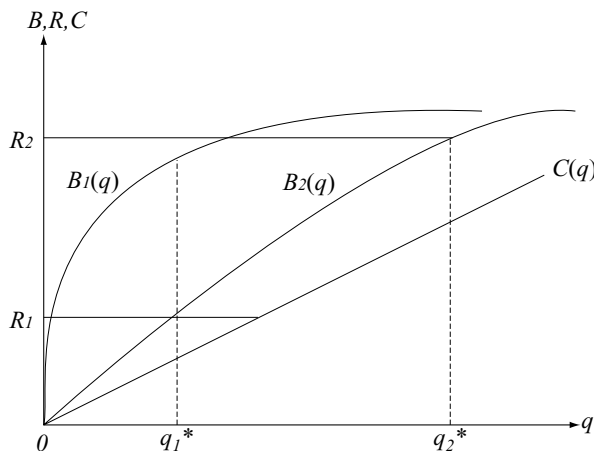


Figure 6 shows the benefit curve  $B_1(q)$  that represents Patient 1 who will be able to recover with less medical services, and the benefit curve  $B_2(q)$  that represents Patient 2 whose physical condition will require more medical services. It is assumed that Patient 1 will recover with the medical treatment level  $q_1^*$  and the cost  $C(q)$  will be within the extent of the medical fee  $R_1$  while Patient 2 will require the supply level  $q_2^*$  and the cost will exceed  $R_1$ .

When assuming that the amount of prospective payment can be selected from either  $R_1$  or  $R_2$  as appropriate to satisfy the medical service supply, while it is desirable for each patient to apply  $R_2$  that will fully satisfies the supply level in both cases, it is more desirable from the point of view of efficient distribution of limited funds for medical expenses to apply  $R_1$  to Patient 1 who requires less supply, and  $R_2$  to Patient 2 who requires more supply, so that over or short payment can be avoided. In reality, medical service users do not have sufficient medical knowledge about their own physical recovery to make proper decision in advance. Thus, it is assumed that medical service suppliers will make a technical decision to apply  $R_1$  to Patient 1 with the smaller supply level  $q_1^*$  and  $R_2$  to Patient 2 with the higher supply level  $q_2^*$ .

If the medical service supplier chooses the prospective payment corresponding to the necessary supply level  $q$  faithfully based on his/her technical knowledge regardless of the surplus  $\pi = R - C(q)$ , the medical resources are distributed appropriately to satisfy the condition  $B'(q) = C'(q)$  for each Patient 1 and 2. However, if the medical service supplier intends to increase the surplus  $\pi = R - C(q)$  and is allowed to choose the medical fee  $R_2 (> R_1)$  for Patient 1 who will be able to receive optimum service at a lower supply level, the surplus will be  $\pi = R_2 - C(q_1) > R_1 - C(q_1)$ . Although the appropriate medical service level  $q$  may be examined through ex post third-party evaluation if there is a significant discrepancy between  $B_1$  and  $B_2$ , it will not be easy to determine the appropriateness of the levels in individual cases in comparison with the general level in such a circumstance where patients have heterogeneous characteristics as assumed here. In addition, even though each case is investigated closely, it needs a huge monitoring cost to cover all cases.

#### 4.6 Suppliers' behavioral patterns

In order to make the point clear, Table 4 shows the surplus  $\pi$  which will result from the combination of prospective payment  $R_1$  or  $R_2$  chosen in advance and the resultant two possible supply levels ( $q_1$  or  $q_2$  in this example) for each of Patients 1 and 2. In the following, each of these cases on the table is examined to identify the conditions that are required for the medical payment system to be developed.

First, the cases of Patient 1 (cells (1) to (4) shown on the left side of Table 4) are examined. If the prospective payment  $R_1$  is selected and medical service  $q_1$  is supplied to Patient 1, the surplus is  $\pi_a = R_1 - C(q_1)$  as in (1). Since medical service  $q_1$  is supplied to Patient 1 with the medical fee  $R_1$  chosen, this case may be deemed appropriate. This case (1)  $\pi_a$  is used as the benchmark in the examination of the other cases.

In the next case (2),  $R_1$  is chosen for Patient 1 and the medical service  $q_2 (> q_1)$  is supplied. The surplus is  $\pi_b = R_1 - C(q_2)$ . As the surplus takes a negative value, a supplier who concerns the level of surplus will be unlikely to select this case. Therefore, this case (2)  $\pi_b$  is excluded in the following examination.

Next, the cases in which the prospective payment  $R_2$  is chosen as in the lower cells are examined. If medical service  $q_1$  is supplied to Patient 1 at a medical fee  $R_2$ , the surplus is  $\pi_c = R_2 - C(q_1)$  as in (3). This case is inefficient from the viewpoint of distribution of medical resources because the medical fee  $R_2$  is paid for the treatment of a patient for whom medical service supply  $q_1$  is appropriate. On the other hand, surplus  $\pi_c$  is larger than  $\pi_a$ , and therefore it may be reasonable for suppliers to chose this pattern from the viewpoint of surplus maximization. Thus, it is necessary to design a payment structure in which the surplus  $\pi_c$  will be smaller than  $\pi_a$ , in order to prevent this case from being chosen.

If the medical fee  $R_2$  is selected for Patient 1 and service  $q_2$  is supplied, the surplus is  $\pi_d = R_2 - C(q_2)$  as in (4). Although there is not an overpayment, this case is inefficient because excessive services have been provided as expressed by  $B_1(q_2) < C'(q_2)$  despite of the fact that the supply level  $q_1$  is most appropriate. In order to prevent this case,  $\pi_d$  must be smaller than  $\pi_a$  at the least. The quantitative relation between  $\pi_c$  and  $\pi_d$  which must be considered will be clarified through the analysis of Patient 2's cases.

Next, the cases for Patient 2 (cells (5) to (8) shown on the right side of Table 4) are examined. If the prospective payment  $R_1$  is selected and medical service  $q_1$  is supplied to Patient 2, the surplus is  $\pi_e = R_1 - C(q_1)$  as in (5). For Patient 2, the relation  $B_2'(q_2) < C'(q_2)$  exists at  $q_2$ , which is the optimum supply level. As  $q_2$  is larger than  $q_1$ , the

point  $q_1$  represents a short supply. Although the patient has less technical information than the supplier, assuming that the patient will not accept the termination of the service while there is a short supply ( $q_2 < q_1$ ), or in other words that the patient will not accept the termination of treatment before he/she is cured, this case will be unlikely to be chosen, either. Even assuming that Patient 2 may accept the termination of treatment at the supply level  $q_1$ , the supplier will be able to obtain more surplus at the same supply level  $q_1$  if he/she chooses the payment  $R_2$  as in (7). Therefore, this case (5)  $\pi_e$  is excluded in the following examination.

If the medical fee  $R_1$  is chosen for Patient 2 and the medical service  $q_2 (>q_1)$  is provided, the surplus is  $\pi_f = R_1 - C(q_2)$  as in (6). As the surplus is negative, the supplier will not choose this case, for the same reason as in (2). Therefore, this case (6)  $\pi_f$  is excluded in the following consideration.

Next, the cases in which the prospective payment  $R_2$  is selected for Patient 2 shown in the lower cells are examined. If medical service  $q_1$  is supplied at a medical fee  $R_2$ , the surplus is  $\pi_g = R_2 - C(q_1)$  as in (7). In the same way as case (3) for Patient 1 above, this case is inefficient because the medical fee  $R_2$  is paid for supply level  $q_1$ . The difference from case (3) is that the patient has not been cured and the condition  $B_2'(q_1) > C'(q_1)$  still exists, and therefore the patient will not accept the termination of treatment. As compared with case (5), which also causes a short supply at  $q_1$ , the surplus  $\pi_g$  is larger than  $\pi_e$  in (5), and there is a greater incentive for the supplier. Consequently, it is desirable to develop a payment structure that will encourage the supplier to choose  $\pi_h$  and continue the supply to the level  $q_2$  rather than choosing  $\pi_g$  and terminating the supply at  $q_1$ , once he/she has chosen  $R_2$  appropriate for Patient 2.

Finally, if medical fee  $R_2$  is selected for Patient 2 and service  $q_2$  is supplied, the surplus is  $\pi_h = R_2 - C(q_2)$  as in (8). This case is considered as appropriate because medical service  $q_2$  is actually provided to Patient 2 who needs a higher supply level and medical fee  $R_2$  is chosen. However, in order to avoid the short supply at  $q_1$  as described in case (7), it is necessary to develop a payment structure that satisfies the condition  $\pi_h > \pi_g$  so that the supply level  $q_2$  is secured in case (8) when  $R_2$  is selected. As the conditions  $\pi_g = \pi_c$  and  $\pi_h = \pi_d$  exist, a quantitative relation  $\pi_c < \pi_d (< \pi_a)$  is established.

**Table 4. Selection of the Prospective Payment Level and Surplus Depending on the Necessary Supply Level**

|                                       | Patient 1, who needs less supply $q_1$  |                                   | Patient 2, who needs more supply $q_2$  |                                   |
|---------------------------------------|---|-----------------------------------|---|-----------------------------------|
|                                       | Supply level $q_1$                      | Supply level $q_2$                | Supply level $q_1$                      | Supply level $q_2$                |
| Prospective payment $R_1$ is selected | (1)<br>$\pi_a = R_1 - C(q_1)$           | (2)<br>$\pi_b = R_1 - C(q_2) < 0$ | (5)<br>$\pi_e = R_1 - C(q_1)$           | (6)<br>$\pi_f = R_1 - C(q_2) < 0$ |
| Prospective payment $R_2$ is selected | (3)<br>$\pi_c = R_2 - C(q_1) (> \pi_a)$ | (4)<br>$\pi_d = R_2 - C(q_2)$     | (7)<br>$\pi_g = R_2 - C(q_1) (> \pi_e)$ | (8)<br>$\pi_h = R_2 - C(q_2)$     |

**4.7 Theoretical observations on the optimum medical payment system**

In the previous section, we have discussed the selective prospective payment system will cause the termination of treatment before the patient is cured or may result in excessive supply and overpayment of medical services in some cases. As pointed out several times in this paper, it is difficult for patients or third parties to determine whether the supply level is appropriate or excessive unless they have more information and techniques for judgment than the suppliers. This section discusses the medical fee payment structure in which the suppliers will choose behavior that is deemed appropriate (cells (1) and (8) in Table 4) under the asymmetric information structure.

As evident from the analysis of Table 4, it is unlikely that cases other than (1)  $\pi_a$ , (3)  $\pi_c$ , (4)  $\pi_d$ , (7)  $\pi_g$ , and (8)  $\pi_h$  would be selected by suppliers or accepted by patients. Furthermore, given the relations  $\pi_g = \pi_c$  and  $\pi_h = \pi_d$ ,

examination of only three cases, (1)  $\pi_a$ , (3)  $\pi_c$  and (4)  $\pi_d$ , will be enough. In order to make sure that the appropriate supply level is chosen for both Patients 1 and 2 as in cases (1) and (8) respectively meeting the condition of  $B'(q) = C'(q)$ , it is necessary to develop a payment structure that satisfies the condition  $\pi_c < \pi_d < \pi_a$  so that the chosen  $q$ -value when the supplier maximizes the surplus and the  $q$ -value that represents the optimum treatment level for the patient will agree.

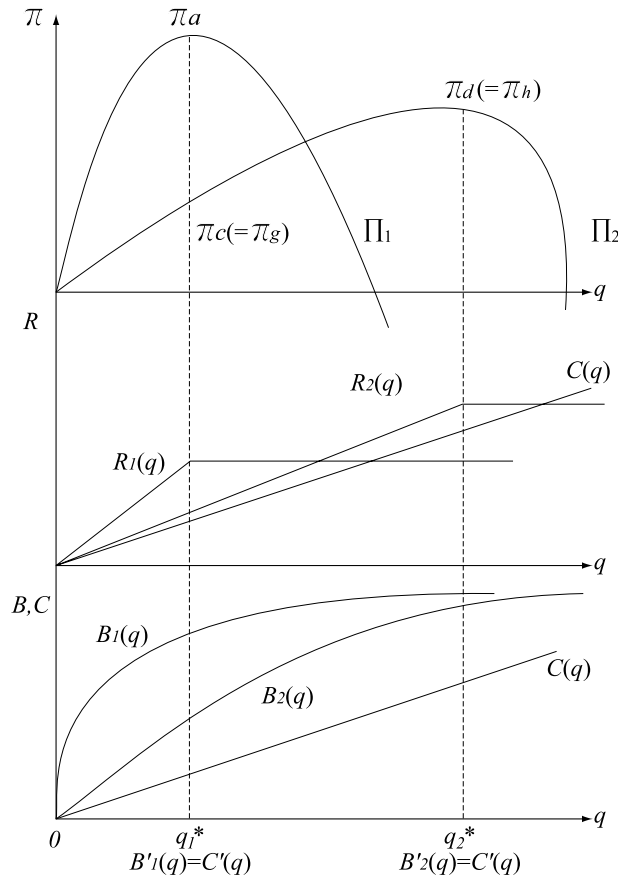
In order to ensure that the specific treatment level is selected according to the characteristics of individual benefits from the medical care services, we need to develop a nonlinear payment structure that is similar to the nonlinear benefit function  $B(q)$ . Given that the benefit curves are  $B_1(q)$  and  $B_2(q)$ , the payment structure that satisfies the condition  $\pi_c < \pi_d < \pi_a$  will be as shown in Figure 7.

In this process, the patient is classified as either  $B_1$  or  $B_2$  at an early stage of the medical service supply based on the results of medical examinations, diagnoses and other information, and professional judgments, and then the supplier selects the medical fee table  $R_1$  or  $R_2$ . Once this selection is made,  $\Pi_1$  and  $\Pi_2$  represent the surplus when  $R_1$  or  $R_2$  is selected, respectively. This system is structured so that the treatment level that is suitable to each patient ( $B'(q) = C'(q)$ ) will make the surplus maximization for the supplier.

In the medical payment system shown in Figure 7, if the medical service supplier who gives attention to the surplus  $\pi$  judges the patient to be classified as  $B_1(q)$  based on his/her own information, the supplier will choose  $R_1$  and provide medical service  $q_1$  in order to maximize  $\pi$ , which is the optimum level. If the supply level  $q_2$  or medical fee table  $R_2$  is selected here, the final surplus will be smaller than  $\pi_a$ . When the supplier considers the patient to be classified as  $B_2(q)$ , the optimum option is to select table  $R_2$  and supply services at the level  $q_2$  to obtain surplus  $\pi_h$ . Although the selection of table  $R_1$  and supply level  $q_1$  will result in  $\pi_a > \pi_h$ , this case means the termination of treatment before the patient is cured and the patient will not accept it. Thus, this option cannot be selected.

In order to allow this system to work properly, it is necessary to develop a treatment plan that can lead the supplier to make an appropriate selection of either  $R_1$  or  $R_2$  at an early stage of medical service supply. At present, it is encouraged to create such a treatment plan for the process from the patient's admission to discharge, and this is already taken into consideration in terms of medical payments. Informing the patient of his/her treatment plan also has other benefits, such as improving patient satisfaction and increasing the productivity of treatment by a medical team. In addition, if such a treatment plan is closely connected with the medical fee to be paid later as proposed in this paper, its significance and effectiveness will further improve. It will also become meaningful to create a treatment plan not only for inpatients but for outpatients as well.

**Figure 7. Examples of Optimum Medical Fee System**



**5. Conclusions**

This paper has examined the problems in social security and medical expenditures from the perspective of taking a close-up look at spending items in the context of administrative reforms. Examinations have been also made on the present situation and problems of the approaches of present administrative and financial reforms, which employ evaluation, numerical targets, and organizational and remuneration reforms. Furthermore, medical system reform, in particular that of the medical payment system, has been examined as a key in considering administrative reforms.

As a result, it has been found possible to develop a medical payment system in which the agent will voluntarily select the supply level that is most desirable to the principal in a situation against the problems of the agency system, high monitoring costs, and an asymmetrical information structure.

As mentioned above, the problems in the medical payment system may be a key in considering general administrative and financial reforms. However, when considering the medical payment system only in the context of medical expenses, the analysis in this paper still relies on a number of assumptions. It is assumed that the medical service suppliers are superior to other players in terms of professional knowledge and information required for making judgments. But the uncertainty they may face when providing medical care services is not taken into consideration. Even under the payment structure shown in Figure 7, suppliers who try to avoid such uncertainty may select  $\Pi_2$  even though the expected surplus is smaller than  $\Pi_1$ .

In addition, since the medical payment system shown as examples here are the second best system, the cost is a little larger than that in the case where the symmetrical information structure exists. This can be seen in Figure 7, in which  $\pi_a$  is larger than  $\pi_d$ .



Furthermore, although the patients are assumed to act passively, they have their own behavioral principles, and therefore their roles must be also taken into consideration when discussing the problems of medical expenses.

Lastly, as mentioned in the footnotes, the medical care insurance system must be separately analyzed from the points of view of its risk reduction function and income redistribution function. Such analyses will also contribute to the discussion concerning patients' self-payment levels.

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