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An Empirical Study of the Physician-Induced Demand Hypothesis —The Cost Function Approach to Medical Expenditure of the Elderly in Japan—

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Abstract Increased medical expenditures for the elderly have become a social problem in Japan. One of the most powerful arguments to explain this increase is the physician-induced demand hypothesis. In this article, we adopt the expenditure function approach to examine the physician-induced demand hypothesis. In this approach, the improvement of health due to medical treatment is adjusted in the model and the nonvalid use of medical services can be measured. Furthermore, we allow for the possibility of substitution between hospital services and outpatient care. A change in the physician-population ratio may lead to a change in the ratio of inpatient service to outpatient care, and this may result in the medical expenditure. Therefore, to determine the degree of the reflection, we have allowed for the possibility of the substitution. We conclude that when the number of physicians per capita increases, the use of inpatient services and of outpatient services increases with statistical significance, respectively. The substitution between hospital services and outpatient services also exists. Moreover, the demand for inpatient or outpatient services is significantly influenced by the self-payment price.

1. Introduction

According to the physician-induced demand hypothesis, a physician can induce a patient to undergo more intensive medical treatment based on the fact that the physician has more medical information than the patient. This asymmetric information raises a serious problem. In the ordinary market, as the number of suppliers increases, the market becomes more competitive and the price falls. But when physician-induced demand is prevalent in the medical care market, an increase in the number of physicians per capita raises the demand for medical services as a result of the physician's discretionary power.

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In evaluating public policy for the training of physicians, for example, it is important to determine whether the physician-induced demand hypothesis holds or not. If this hypothesis is valid, the policy that promotes competition among physicians leads to unnecessary medical services. Although the physician-induced demand hypothesis has important political implications, a comprehensive empirical study of this theory has not been conducted in Japan. Therefore, in this paper we examine the physician-induced demand hypothesis positively.

Feldstein (1970) found that the number of physicians per capita correlated positively with the payments they received, and he pointed out that this positive correlation contradicted the results shown by the competitive market. Because the number of physicians per capita can be thought of as the degree of competition within the physician market in a particular region, we would assume that in a more competitive region, the supply of physicians will be large. And when competition among physicians exists, it follows that payments to physicians for services rendered must fall relative to other regions. But Feldstein found the opposite correlation.

It is Fuchs (1978) who provides a theoretical interpretation of the phenomenon described by Feldstein. According to Fuchs, the physicians who face a decline in income due to an increase in the physician-population ratio raise the demand for their services through their influence on patients. As a result, the drop in income due to the increased physician-population ratio is compensated. Based on this argument, Fuchs found that the number of operations rose 0.3% as the surgeon-population rate increased by 1%.

There is, however, criticism of the physician-induced demand hypothesis.[1] Most important, the physician-initiated demand cannot be distinguished from the patient-initiated demand. The physician-induced demand hypothesis claims that an increase in the physician-population ratio leads to an increase in the

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[1] Criticism is classified into three types. First, Auster and Oaxaca (1981) point out that Fuchs's research does not satisfy the identification condition in terms of econometrics. They insist that, to meet this condition, much variation in factor price is needed in estimating the physician supply function. The second type of criticism involves the estimation method. Dranove and Wehner (1986) examine the hypothesis that physician-induced demand exists as to the number of births by employing the instrumental variable method, also used by Fuchs. As a result, an irrational result that physician-induced birth is obtained. They say that the source of this problem is either ignoring the effect of border crossing or choosing the wrong instrumental variable. Third, Reinhardt (1985) insists that under the theoretical premise on which the physician-induced demand hypothesis is based, the process of medical treatment is not fully captured. He further contends that doing positive research under such a theory does not clarify the physician-induced demand. In contrast to this argument, Dranove (1992) suggests the theoretical model that includes the physician's process of medical treatment and the patient's process of receiving medical treatment. Although his theoretical model leads to a proposition that can be proved, it is difficult to suggest counterevidence due to the lack of data.

physician-initiated demand for treatment. Even if the physician has no discretionary power, the real price that a patient pays falls because of a decline in the cost of access to the medical service; as a result, the patient-initiated demand may increase. Rossiter and Wilensky (1983, 1984, 1987), Wilensky and Rossiter (1981, 1983), and Escarse (1992) also call attention to this problem. If the possibility of the patient-initiated demand is allowed for, then the effect of the physician-induced demand is overestimated.

The number of first contacts with physicians, or the rate of receiving medical treatments, can be thought of as the proxy of patient-initiated demands that are not subject to physician influence. On the other hand, the number of second contacts with physicians, or treatment intensity, may have the effect of the physician-induced demand. Therefore, to estimate physician-induced demand, we must divide the demand for medical services into the number of times of first and second contact, or into the rate of receiving treatment and the intensity of treatment.

According to Rossiter-Wilensky and Escarse, the physician-induced demand does not exist, or it is extremely small even if it does exist. But the studies of Rossiter-Wilensky and Escarse have a common pitfall. Based on their arguments, consumers are more likely to see their doctor when access cost falls due to a rise in the physician-population ratio. Generally speaking, the medical conditions of latecomers to hospitals are less severe than those of earlier arrivals. In this case, if medical expenditures per patient do not fall, it means that a hidden physician-induced demand exists.[2]

There are some studies of physician-induced demand in Japan.[3] In early research on this issue, Nishimura (1987) employed the medical care cost per claim as the explained variable in his model. He observed that the physician-population ratio had a positive significant effect on medical care cost per number. But this research cannot avoid the criticism that patient-initiated demand has not been

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[2] All the above research was done in North America, where the cost of medical care is determined by the market. On the other hand, the research in countries where price is politically determined is interesting in view of its application to Japan. Birch (1988), e.g., presents a positive analysis using English data, and Grytten, Dorthe and Laake (1990) do so using Norwegian data. Because England and Norway have adopted the fee-for-service system, we assume the existence of physician-induced demand in these countries. Birch and Grytten, et al., observe physician-induced demand, whereas Grytten, Carlsen and Sorensen (1995), do not.

[3] In addition to the research mentioned here, Yamada (1994) empirically examined whether physician-induced demand existed in dental services for the elderly by using the equilibrium analysis model and disequilibrium model. He found that physician-induced demand was supported in the equilibrium analysis model but not in the disequilibrium model. Ikegami, et al. (1997), examined the effect of dentist intensity on the amount of treatment for cavities by linking the claim data of nursery school children with data on a group examination in one prefecture. In this study, although the coefficient of dentist population ratio was positive, it was not significant; hence the physician-induced demand hypothesis was not supported.

distinguished from physician-induced demand.

Suzuki (1997), whose subject is the outpatient care of elderly people can be said to perform the Rossiter-Wilensky-Escarse type research. According to her findings, although expenditures for outpatient services increase due to an increase in the physician-population ratio, their effect is not dominant. Moreover, a coefficient of physician intensity to the expenditure per outpatient is not statistically significant, and the physician-induced demand hypothesis cannot be supported.

To overcome faults in the original research of Fuchs as well as the Rossiter-Wilensky-Escarse type of study, we have adopted the expenditure function approach to examine the physician-induced demand hypothesis. The expenditure function can measure the level of medical service needed to produce some level of health. Therefore, improvement of health due to a rise in the number of medical treatments is adjusted in the model, and the nonvalid input of medical services can be measured. The health level being adjusted, if it is confirmed that an increase in the number of physicians raises the demand for medical services, this implies that physician-induced demand is actually prevalent.

Furthermore, we allow for the possibility of substitution between the inpatient and the outpatient, which Suzuki (1997) ignores. A change in the physician-population ratio may lead to a change in the ratio between inpatient service and outpatient care, and this may result in the medical expenditure. Therefore, to analyze the degree of the reflection, we allow for the possibility of the substitution.

According to the estimation results in this paper, substitution between the hospital service and the outpatient service exists. We find, in addition, that the demand for inpatient or outpatient services is significantly influenced by the self-payment price. Finally, when the number of physicians per capita increases by 1%, the hospital demand increases by 0.8% and the outpatient demand increases by 0.4%, while holding the health level constant.

In section 2 the model is constructed. In sections 3 and 4, after examining the data, we perform our statistical estimation. Finally, in section 6 we examine the result of the estimation and state the implications for the policy of planning for local medical care.

2. A Model

Is it possible to achieve the same health level by selecting a different combination of medical services? If for some technical reason, an alternative care mix cannot be offered, then only one care mix can be used for health improvement. On the other hand, if an alternative mix is available, a patient can select an outpatient-service-intensive combination of medical services when the outpatient service is relatively cheaper than the inpatient one. Similarly, when there is only one treatment for a particular disease, it is impossible to reduce the medical expenditure by changing the care mix unless we allow for a lower quality of medical treatment. On the other hand, if the treatment methodology is flexible, then it is possible to reduce costs by changing the combination of treatments/services.

It is important for medical policymakers to know whether treatments and services are flexible or not. The degree of flexibility is measured by the elasticity of alternative care mix substitution. When substitution is impossible, the elasticity becomes zero. The greater the elasticity, the more flexible will be the alternatives for care.

In a case where alternative inpatient and the outpatient services can be substituted, we consider the care mix that will minimize the expenditure for these services but provide an identical level of health. A locus of the combination of inpatient and outpatient services that will produce some health level is called the iso-quant. In Figure 1, the iso-quant is represented by I_0. This implies that, by increasing the inpatient service, the outpatient service can be saved, and therefore that these services are substitutable.

A locus of the combinations of the quantities of medical services bought for some fixed amount of money is called the iso-expenditure line. If p^1 denotes the

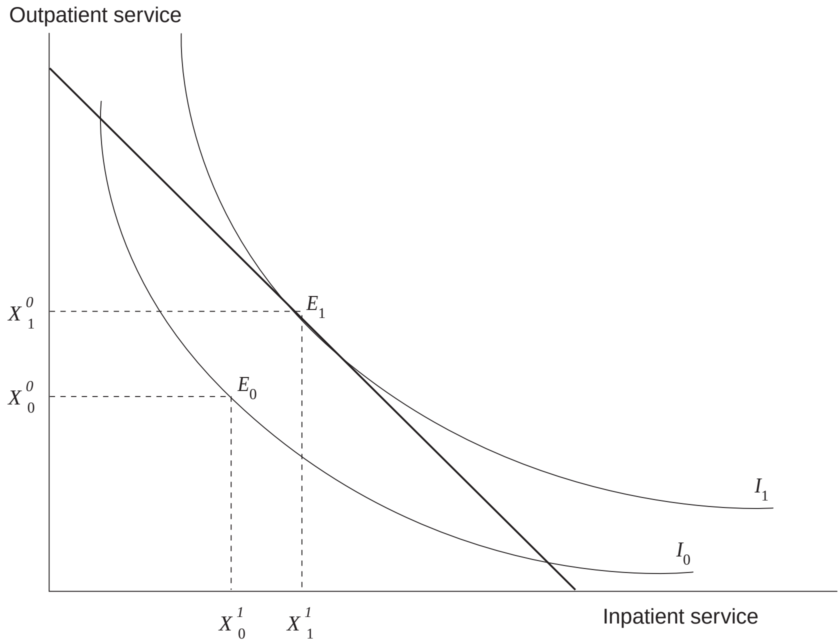

Figure 1 Medical care input and level of health

self-payment price of inpatient service, and p^0 denotes the price of outpatient service, then the combination of inpatient services x^1 and outpatient services x^0 that can be purchased for some expenditure $\overline{m}$ is

$$\overline{m} = p^1x^1 + p^0x^0 \tag{1}$$

Rearranging (1), we obtain the iso-expenditure line:

$$x^0 = \frac{\overline{m} - p^1x^1}{p^0} \tag{2}$$

The iso-expenditure line shows the combinations of inpatient and outpatient services that can be purchased for the same amount of money. Of course, the more northeast the iso-expenditure line locates, the higher the expenditure is.

When a patient chooses E_0 where the iso-quant line I_0 touches the iso-expenditure line B_0, the expenditure is minimized. Then, both the outpatient service x_0^0 and the inpatient service x_0^1 are used respectively. If a combination other than E_0 is chosen on the iso-quant line, the expenditure will increase. On the other hand, the health level corresponding to I_0 cannot be produced for less money. Therefore, the expenditure is minimized on E_0.

Now, we suppose that the self-payment price of the inpatient service rises and that the slope of the iso-expenditure line becomes steep. Then, new point E'_o where the iso-expenditure line B'_0 comes in contact with the iso-quant I_0 is chosen. As a result, less inpatient services and more outpatient services are demanded than before. The higher a patient is willing to raise his/her health level, the more medical services will be needed. Therefore the iso-quant corresponding to that level is located more northeast than I_0, and more medical services and a higher medical expenditure will be needed.

Suppose that the number of physicians increases and competition among physicians becomes severe. Then, can a physician induce a patient to receive medical service that is unnecessary? This is the question suggested by the physician-induced demand theory. Now let us consider the physician-induced demand hypothesis within the framework used here. A physician’s influence can be thought of as moving the subjective iso-quant to the northeast which the patient faces. Suppose that the actual technology that produces some health level is located at I_0. If a physician makes a patient believe that more medical service is needed and a patient misunderstands that it is located at I_1, then the patient will select point E_1 and request an unnecessary medical service, which is unrelated to the diagnosis. In this case, the inpatient service x_1^1 and the outpatient service x_1^0 are demanded. These medical services do not improve the health. Therefore, the inpatient service, $\left(x_1^1 - x_0^1\right)$ and the outpatient service, $\left(x_1^0 - x_0^0\right)$

represent excess consumption or pure waste.

Patients' medical expenditures are determined both by the self-payment price of the medical service and by the desirable level of health. Of course, a rise in the desired health level or a rise in the self-payment price will increase the medical expenditure. If the physician-induced demand theory is correct, then the number of physicians per capita also will have a positive effect on medical expenditures. This relationship between medical expenditures and self-payment costs or between medical expenditures and health level or between medical expenditures and the number of physicians per capita is expressed by the following expenditure function:[4]

$$m = m\left(h,\ \mathbf{p},\ z\right) \tag{3}$$

where m = the medical expenditure that a patient pays himself, p = the vector of the self-payment price, h = the realized health level, and z = the number of physicians per capita.

To estimate the expenditure function, we must specify the form of the function. Here, we apply a generalized Leontief production function that is used widely as well as the Trans-Log production function:[5]

$$m = h\left(A_0 = \frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2} A_{ij}\sqrt{p_i}\sqrt{p_j} + \sum_{i=1}^{2} B_i p_i z\right). \tag{4}$$

Using the Shepard's lemma,[6] we obtain a demand function,

$$\frac{\partial m}{\partial p_i} = x_i = h\left(A_i + A_{ij}\frac{\sqrt{P_j}}{\sqrt{P_i}} + B_i z\right). \tag{5}$$

When estimation is done using time-series data, because both the explained variable and the explaining variable have a trend, we often see a large value of coefficient of determination even if the formalization has no meaning from an economic viewpoint. Therefore, it is needed to eliminate the factor of trend. Moreover, the economic model gives a causal relation in the long-term steady state. But the data that can be used in empirical analysis are nonsteady state data that have a trend. It is difficult to obtain the robust parameter even if the ordinary regression analysis is done using these data. To avoid these problems,

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4 Grossman (1972) was the first investigator to consider the input of medical care service as a derived demand for the production of health.

5 For the generalized Leontief function, see Diewert (1971). McAvinchey and Yannopoulos (1993) estimate the elasticity of substitution between private medical care and public medical care.

6 For the Shephard's lemma, see Shephard (1970).

econometrics researchers developed the Error-Correction Model.[7] Converting the demand function of the medical service (5) into ECM,

$$\Delta \frac{x_i}{h} = a_i \Delta \frac{\sqrt{P_j}}{\sqrt{P_i}} + \beta_i \Delta z - \gamma_i \left(\frac{x_{i,-1}}{h_{-1}} - A_i - A_{ij} \frac{\sqrt{P_{j,-1}}}{\sqrt{P_{i,-1}}} - B_i z_{-1} \right) \quad (6)$$

where Δ represents the difference between the previous period and the current period, α is the parameter that denotes the short-run effect of a price on the demand for medical service, and A is the parameter that denotes the long-run effect. Similarly, β and B denote the effect of the change of the number of physicians on the medical service demand; γ denotes the adjustment speed, which means the degree of the effect of the number of physicians or the price on the demand for medical service.

We estimated the demand function of the inpatient service and the outpatient service simultaneously, to obtain the parameters. In the estimation, each explanatory variable was divided by its mean value.

3. Data

Our analysis is based on regional data, according to prefecture, collected from 1984 to 1994. The sources of these data are summarized in Table 1.

Table 1 Sources of data

Variable	Source
Number of physicians	*Survey of Physicians, Dentists, and Pharmacists*, Ministry of Health and Welfare
Medical expenditure	*Annual Report on Health Care for the Elderly*, Ministry of Health and Welfare
Individuals eligible for health insurance	
Amount of self-payment	
Days of care	
Population	*Population Estimation*, Management and Coordination Agency
Death rate	*Vital Statistics*, Ministry of Health and Welfare

[7] A brief commentary on the Error-Correction Model is provided in the Appendix.

For medical care expenditures, we used the total amount of self-payment that was reported in the *Annual Report on Health Care for the Elderly*, published by the Health and Welfare Bureau for the Elderly in the Ministry of Health and Welfare. As the cost of medical care, we used the amount of self-payment of inpatients and outpatients per day. As the indicator of the level of health, we used the alive rate above age 70. The alive rate was obtained from the number of deaths above age 70 reported in *Vital Statistics* of the Ministry of Health and Welfare and *Population Estimation* of Management and Coordination Agency.

To calculate the physician population rate, we used "the number of physicians engaged in a medical institution," according to prefecture, reported in the *Survey of Physicians, Dentists, and Pharmacists* by the Ministry of Health and Welfare. Because the latter survey was conducted every other year, there are years for which data were not obtained. For those years, we calculated values by the linear complement method. Descriptive statistics for these variables are summarized in Table 2.

Table 2 Descriptive statistics for variables

	Mean	S.D.	Min.	Max.
Physician-population ratio	1.591	0.334	0.285	2.418
Alive rate	0.944	0.005	0.886	0.957
Demand for hospital services (days)	22.458	13.934	2.413	263.657
Demand for outpatient service (days)	41.075	8.103	5.313	64.225
Self-payment price of hospital services (¥1,000)	8.336	4.450	1.716	17.153
Self-payment cost of outpatient services (¥1,000)	0.726	0.448	0.299	9.946

4. Estimation Results

The estimation results of parameters are shown in Table 3. The short-run parameter related to prices is not necessarily good. The parameter related to the number of physicians is positive in the case of both inpatient services and outpatient services, and the former is significant. The long-run parameters have the same sign as the theory predicted and are statistically significant. The adjustment speed is negative, as the theory predicted. Hence we can conclude that these results are fairly good estimates.

Next, from the estimated parameters we calculated the elasticity of substitution, the price elasticity of demand, and indicators related to physicians

Table 3 Estimation results

	Parameter	Coefficient	*t*-value
Short-run Parameter	α1	–5.73565	–3.68647
	α2	0.10849	0.15857
	β1	3.13111	1.95623
	β2	0.65107	1.44497
Long-run Parameter	A1	–5.66492	–1.53561
	A12	9.29415	3.33756
	A2	15.13080	3.52132
	B1	16.99160	10.21110
	B2	17.20820	3.92278
Adjustment Speed	γ1	–0.37220	–2.78960
	γ2	–0.08325	–4.49970

and the demand for medical care. The Hicks-Allen partial elasticity evaluated at mean can be obtained from the following equation.

$$AES_{ij} = \frac{m m_{ij}}{m_i m_j} \tag{7}$$

The estimation results of the elasticity of substitution are shown in Table 4. The elasticities of the medical service inputs are negative, as the theory predicted, and they are statistically significant. The elasticity of inpatient/outpatient substitution is significantly positive. Therefore, we can conclude that these services are substitutable. The rise in the self-payment cost of a particular medical service leads to a decrease in the demand of that service and an increase in the demand for another service.

Table 4 Elasticity of substitution

	Estimates	*t*-value
AES11	–0.68035	–3.01837
AES22	–0.16691	–3.43587
AES12	0.33698	3.22418

The elasticity of demand is shown in Table 5. The short-run price elasticity of inpatient service demand—0.14—is positive. The short-run elasticity of outpatient service—0.001—is negative, but it is insignificant. On the other hand, the long-run price elasticity of medical care demand is negative, as the theory predicted, and significant. A 1% rise of the self-payment price results in a 0.2% decrease in inpatient service demand and a 0.1% decrease in inpatient service and outpatient service demand, respectively.

Table 5 Elasticity of demand

	estimates	*t*-value
Inpatient (short-run)	0.13907	3.81879
Outpatient (short-run)	–0.00130	–0.15846
Inpatient (long-run)	–0.22536	–3.15502
Outpatient (long-run)	–0.11620	–3.36558

Next, we measure the elasticities of medical care demands with respect to the number of physicians. The effect of the number of physicians on medical care service is shown in Table 6. According to our estimates, in the short-run, a 1% increase in the number of physicians will lead to a 0.2% increase in the demand for inpatient services and a 0.02% increase in the demand for outpatient services. But, for outpatient services, the standard error of estimates is large and insignificant.

Table 6 The effect of the number of physicians on medical care service

	Estimates	*t*-value
Inpatient (short-run)	0.15184	1.96539
Outpatient (short-run)	0.01564	1.44647
Inpatient (long-run)	0.82400	9.55939
Outpatient (long-run)	0.41333	4.04451

On the other hand, in the long run, a 1% increase in the number of physicians will lead to a 0.8% increase in inpatient service demand and a 0.4% increase in outpatient service demand, respectively. We can think that the short-run effect on the demand for medical care services is small when the number of physicians changes and that the effect becomes gradually strong. According to our estimation, the increase in medical care services derived from an increase in the number of physicians is unrelated to the improvement of health and can be regarded as a pure waste of resources.

5. Conclusion

Allowing for inpatient/outpatient substitution, we estimate the generalized Leontief expenditure function to be as follows: a 1% increase in the number of physicians per capita leads to a 0.8% increase in inpatient demand and a 0.4% increase in outpatient demand. The point of our analysis is that we have used the expenditure function for an estimation model. Because we estimate the effect of the physician-population ratio on the demand for medical care services and on expenditures adjusting for the level of health, the measured increase in the demand for care indicates an increase in the demand induced by physicians. As a result, we can determine the extent of the physician-induced demand. As far as we know, this is the only study of physician-induced demand in which the expenditure function approach is used.

Now, let us examine the implications of the estimation results for actual government policy. To narrow the regional gap in medical care services by prefecture, the regional medical project has been enforced since 1988. But it regulates only the upper limit of the number of beds in each prefecture; it does not regulate the number of physicians. Entry regulations that limit the number of physicians have been regarded as one of the most realistic prescriptions for limiting medical care expenditures. On the other hand, it has been pointed out that a significant weakness of such regulation is that it has the effect of protecting the benefits of existing physicians and lowering the incentive for competition among physicians to provide high quality medical care.

Based on this research, increased demand for medical services does not necessarily lead to improved health. Although our findings justify the policy that constrains increases in the number of physicians, we must note the following points. First, we have analyzed only health care for the elderly. Because in that age group the rate of chronic disease is relatively high compared to the rate for youth, there is much room for a physician’s discretion. This may produce a greater demand for medical care and thus substantially increase the pool of physicians. Therefore, to evaluate the policy restraining the number of physicians comprehensively, positive analysis of medical care services for youth is needed.

Finally, the argument of the physician-induced demand hypothesis includes asymmetrical information about physician and patient. If we return to the starting point of this argument, constraining the number of physicians may be only a symptomatic response to the problem. It is a policy that excludes asymmetric information and can become an essential solution. For our purposes, a policy that reduces the asymmetry of information such as medical education for the users of medical care services or disclosure of medical care information to patients is important.

Appendix: The Error-Correction Model

Suppose that Y and X satisfy the following equation in long-run equilibrium:

$$Y=\alpha_0+\alpha_1 X+u \tag{A-1}$$

But it takes time to approach equilibrium and the adjustment process has a time lag. The short-run relationship, for example, is expressed by the following distribution lag model:

$$Y=\beta_0+\beta_1 X+\beta_2 X_{-1}+\lambda Y_{-1}+\varepsilon \tag{A-2}$$

If the economy reached the steady state, from (A-2):

$$Y=\frac{\beta_0}{1-\lambda}+\frac{\beta_1+\beta_2}{1-\lambda}X+\frac{\varepsilon}{1-\lambda} \tag{A-3}$$

Because (A-3) must equal (A-1), we obtain

$$\frac{\beta_0}{1-\lambda}=\alpha_0,\ \frac{\beta_1+\beta_2}{1-\lambda}=\alpha_1,\ \frac{\varepsilon}{1-\lambda}=u.$$

or

$$\beta_0=\alpha_0(1-\lambda),\ \beta_2=\alpha_1(1-\lambda)-\beta_1.$$

Substituting this relation into (A-2),

$$Y=\alpha_0(1-\lambda)+\beta_1 X+\left[\alpha_1(1-\lambda)-\beta_1\right]X_{-1}+\lambda Y_{-1}+\varepsilon. \tag{A-4}$$

Subtracting Y from both sides of (A-4) and rearrange, we have

$$\Delta Y=\beta_1\Delta X-(1-\lambda)\left(Y_{-1}-\alpha_0-\alpha_1 X_{-1}\right)+\varepsilon. \tag{A-5}$$

The second term of (A-5) expresses the following error collection. When Y is large and the error is positive in the previous term, Y becomes smaller than Y in the current term and adjustment to equilibrium is acted. In contrast case, adjustment to opposite direction takes place. Like this, Y is changed by ΔX and the error collection in ECM.

It is possible to think of ECM as a partial adjustment model that has been often used in positive analysis:

$$Y_t - Y_{t-1} = \gamma\left(Y_t^* - Y_{t-1}\right),\ 0 < \gamma < 1$$
$$Y_t^* = \alpha_0 + \alpha_1 X_t \tag{A-6}$$

where Y^* denotes an optimal level of Y at long-run equilibrium and γ denotes the parameter that expresses the adjustment speed. It is clear that

$$\alpha_1 X_t = \alpha_1 \Delta X_t + \alpha_1 X_{t-1}. \tag{A-7}$$

From (A-6) and (A-7)

$$\Delta Y_t = \beta_1 \Delta X_t - \gamma\left(Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}\right) \tag{A-8}$$

This is the same as (A-5).

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