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Econometric Analysis of Japan's Roadside Stations Provided with the New Type Grants※

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Abstract

The number of Roadside Stations in Japan is increasing rapidly; it increased from 103 in 1993 to 1173 in 2020. From 2007, two new subsidies were given to select Roadside Stations. In this paper, we discuss the endogenous development and the role of the Roadside Stations therein. We also consider the various models we constructed to estimate how subsidies contributed to the business of the Roadside Stations. We estimate the interrelationship between sales and the factors that influence sales amount using a simultaneous equation model. An econometric analysis shows that parking space and sales share a loop (mutual and reciprocal) relationship. We also find that the number of visitors and management expenses share a loop relationship. The r Roadside Stations that received the new subsidies showed excellent results.

Keywords: Roadside Station, New Type Ggrant, Sales Amount, Simultaneous Equation, Management Expense

Introduction

Roadside Stations were first constructed in Japan by the erstwhile Ministry of Construction (now known as the Ministry of Land, Infrastructure, Transport and Tourism) in 1993, when a total of 103 stations were set up. In 1999, this number had increased to 551, and by 2013, it had reached 1014. As of 2020, there are 1173 Roadside Stations. A Roadside Station system is a registration system for facilities with three roles: rest, offering information, and regional alliance functions. The activities of Roadside Stations lead to endogenous development. Therefore, we sought to measure their contribution to the economy. We used several simultaneous equation models, which include variables such as parking space, sales figures, management expense, number of visitors, number of events, and gross business expense. In previous papers, we calculated the ripple effect of the Roadside Station on the economy. Here, we demonstrate that the number of employees is estimated to have increased by 250 and 266 in the regions of Hanshin and Tajima, respectively. Moreover, according to our research, the effective multiplication factor in the Hanshin region in Hyogo Prefecture was 1.55.

The annual sales of all Roadside Stations in Japan were estimated to be approximately 250 billion yen in 2015. If the research result in the Hanshin region is applied to this annual total amount, the economic

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ripple effect of Roadside Stations for all regions in Japan is estimated to reach 375 billion yen. In 2007 and 2010, two grants were provided to selected Roadside Stations. One was the 2007 Nou-san-gyoson Kasseika Project Shien Kofukin (Grants to Support Projects to Revitalize Rural Areas, GSPRRA), and the other was the Shakaisihon Seibi Sogo Kofukin (Comprehensive Grant for Infrastructure Development, CGID) in 2010. Of the 83 stations in this study, 27 received the new type of grant. The stations that received these grants saw a significant improvement in their business. Therefore, it is important to measure the factors that impact the sales of Roadside Stations in Japan.

1. Endogenous development and Roadside Stations

(1) Tourism Nation Promotion Basic Law

According to the Tourism Nation Promotion Basic Law of 2006 and the Tourism Nation Declaration of 2003, tourism is defined as that which "… contributes to the development of the revitalization of the regional economy and an increase in employment management in all areas. This also contributes to the stabilization of national life through the promotion of health and creation of a charm-rich living environment". Furthermore, the basic idea is to revitalize the regional economy through "… the sustainable development of the community, which enhances the [sic] vitality. The local inhabitants can have a pride and attachment while respecting the independent action that makes use of the inventive idea in the region". With this law, the government positioned tourism as a policy focus for the first time in the 21st century.

The law set forth the basic policy of revitalizing the regional economy through tourism. The idea that it should be measured in order to improve the living conditions for residents under local leadership is central to this policy. This basic policy required that activation be conducted by the regional main constituent, which was further clarified in the "Action Program for Realizing a Tourism Nation" of 2013. In this program, three basic policies are mentioned: (1) creation of new tourism, (2) promotion of sightseeing interlinked with infrastructure projects, and (3) maximization of the tourism potential in the region.

These city planning measures that aim to attract sightseeing are implemented based on the view of "endogenous development," for which the city serves as a main constituent and seeks to develop regional economies. According to Miyamoto (2007), endogenous development is defined as "… the community development that improves the inhabitants' welfare by the local government. A group and individuals such as local companies, labor unions, cooperatives, NPOs, and inhabitants issues making a plan by voluntary learning, and being made from voluntary technology development, and using resources reasonably. In addition, it keeps the local environments in good condition, and doing the economic development that came from the culture". That is, this can be considered an idea for regional improvement, which enhances the appeal of the region and promotes city planning while the residents of the area tackle the development of regional economies positively.

The regional policy grounded in the Tourism Nation Declaration is based on the idea of such endogenous development. To be precise, the action program calls for Roadside Stations ("Michi-no-Eki" in Japanese) all over the country to serve as centers for information dissemination for tourists, and the action program will tackle the enhancement of this function. By stipulating these centers to promote the tourism policy, the planning of the regional revitalization policy for sightseeing is expected to be much more efficient. The policy that should be followed, especially in relation to tourism, is the newly

introduced subsidy system. Following the basic policy of endogenous development after the Tourism Nation Declaration, this system will issue the subsidy alongside the business plan that a municipal corporation formulates, and the actual plan will be implemented by the respective region. By combining the factors that strengthen the autonomy of an area with the subsidy system for conventional community development, a new system has been developed for the country, with prefectures maintaining autonomy.

(2) Endogenous development theory and endogenous development policy

In this section, the endogenous development perspective is summarized first, followed by an examination of the circumstances in which the administration implemented the endogenous development policy. Although endogenous development theory was intended to be submitted at the UN General Assembly' s Special Session on economics in 1975 as a method of encouraging developing countries to actively participate in the international economy[1], it came to be applied thereafter in advanced nations for regional economic development, such as in Japan and in European countries. As mentioned previously, the area serves as a subject, and endogenous development theory is based on the view that the residents themselves participate in the developmental process and engage in regional improvement.

In contrast, Miyamoto (2007) emphasized that the community development which has been undertaken in the developing countries was a from-abroad type of development that depended on public works using capital from outside the region, and that the technique did not lead to sustainable development of the area. Moreover, Okada (2005) pointed out that the regional improvement policy of major public works did not lead to continuous economic development in the area on a large scale, and the profit and production ripple effects would ultimately return to the head office in the Tokyo region. Furthermore, he noted that due to the shift of production bases overseas in line with economic globalization, the companies that were invited to the region left the region, which led to further depopulation of the region. He highlights the limitations of such exogenous development.

It can be said that endogenous development is an effort led by the region, which was born out of a review of regional development policies led by the central government, however, many researchers do not deny the importance of assistance from the central government. First, Miyamoto (2007) stated that "… endogenous development does not refuse a foreign capital [sic] or technology at all …" and accepts the importance of a governmental bail-out package in an activation policy. Hobo (1996) also expresses the view that the administration's support is required as "… the combination of the new farming-and-mountainous-villages regional policy by a state is especially indispensable to the promotion policy of an intermediate and mountainous area".

Mizuno (1999) and Yamashita, Hoshino, and Kuki (2010) have conducted case studies of disadvantaged areas where endogenous development has had support from the administration. The former analyzes the endogenous development policy with governmental support in the case of Shimokawa-cho, Hokkaido. The latter carry out the same analysis on Sugiyama colony, Maizuru-city, Kyoto, with a particular focus on the interaction between the government and the community in the disadvantaged area, and the desirable level of local involvement with the government.

The legislation that provided for the local initiative approach and enabled the adoption of regional

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1 This part is incorporated by reference to "What should we do?", a report of the General Assembly Special Session on International Economic Cooperation by the Dag Hammarskjöld Foundation (Tsurumi and Kawata (1989)).

improvement by sightseeing is the "Tourism Nation Promotion Basic Law". In contrast, the "Tourism Basic Acts", enacted in 1963, which laid the foundation for the previous tourism policy, emphasized the from-abroad type development of public works, led by the central government, such as in the maintenance of tourism infrastructure or a tourism relations institution. It did not provide for local initiatives, which are an important part of endogenous development. Therefore, after the Tourism Nation declaration, the basic thrust of the regional development policy has shifted to local leadership, perhaps because the government itself has admitted the shortcomings of the come-from-abroad type development policy. To fully demonstrate the effect of the implementation of this policy on the target region, it is important that the human or structural conditions in the area are optimal. Therefore, we examined various conditions in the target areas.

(3) Cooperation between the main constituents and network formation

Miyamoto (2007) pointed out that a bail-out package that accompanied an endogenous development policy would not be effective unless voluntary action was taken by an organization, an individual, or a self-governing body (e.g., companies, labor unions, and cooperatives) in a region. He also asserted that it was important to not limit industrial exploitation in a region to a specific type of business, and to form industrial linkages from which additional value could flow to support localized innovation at all stages. About this point, Okada (2005) also says that forming a circular flow of the economic system in a region by self-consciously building inter-industrial relationships in an area leads to sustainable development of the regional economy.

Furthermore, Vazquez-Barquero (2002) argues that to improve the performance of a regional economy in this endogenous development process, it is important that a local government should, on its own initiative, involve various players in the area, such as organizations, public institutions, companies, cooperatives, and so on. Further, cooperation between the main constituents is vital to form a network in the region, and both are extremely important requirements to connect the sustainable development of the region to effective administrative support and aid from an endogenous development policy.

The endogenous development policy by the administration is generally considered to have begun with the "Special measures business for urban development", submitted in 1984. In this respect, there was criticism[2] that this undertaking was planned in great detail for every field, such as the park tree planting business that preserves the environment, the maintenance of streets in front of the station, or the maintenance of a sports tourist facility, and that old local governments' duties were relegated to merely receiving applications for the subsidy. Therefore, from the perspective of the original endogenous development, cooperation between the main constituents has not been achieved by the current plan, and at present, the endogenous development policy has not yet gone beyond a central government-led policy.

In contrast, the new subsidy system applied to Roadside Stations in Japan after the Tourism Nation declaration is, as we will describe, a truly collective plan that the target area formulates; it is a system where many players in the region can cooperate and implement a business plan, so that it is an actual

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2 Refer to Miyamoto (2007). It is said that "Local Development Special Task business is that the local governments, working in partnership with administrative agencies, move forward with planning and gaining consensus on large-scale urban development projects. And they promote the projects conducted only by local governments to boost the unique and fascinating local development tailored to the local circumstances." Therefore, these projects centered on physical aspects such as the development of facilities.

regional improvement policy that is based on the idea of endogenous development. Therefore, the regional improvement policy based on endogenous development theory in Japan is the first policy to emerge from the original idea of the Tourism Nation.

However, although the independence of an area is emphasized by the perspective that cooperation between the main constituents in the region is important for endogenous development, this does not preclude interchanges with other areas. Miyamoto (2007) argues that, in the current globalization and the times of an information-oriented society, no region can be independent with respect to the metropolitan area, and that it is important for the region to connect with the metropolis. Further, Yamamoto (2010) asserted that the regional economy was not closed, but rather that it opened towards the outside in pursuit of endogenous development. In other words, it is essential for the region to utilize external resources (e.g., markets) and to send information to outside areas; the region also forms an open network.

The way of thinking that developed the cooperation between the main constituents in regions and the local outside is the "Interchange of cities and agricultural, mountainous and fishing villages." The Ministry of Agriculture, Forestry, and Fisheries is seeking to promote a "… symbiosis and the convection of a city and an agricultural, mountainous and fishing village …" aimed at realizing a new lifestyle where people travel between a city and an agricultural, mountainous, and fishing village, back and forth in both directions, by mobilizing the travel of "… a person, a thing, and information". This wide concept includes settlement, half settlement, etc., in an agricultural, mountainous, or fishing village with green tourism. Miyazaki (2011) examined the importance of interchanges between the city and farms in such a regional vitalization project and found that it was important to build a policy or a system so that the interchange was tied to the direct promotion of the local agricultural, mountainous, or fishing villages in the future.

Thus, various views and studies regarding the city–farm village interchange reveal that cooperation between the main constituents in regional improvement and network formation are indispensable conditions for an endogenous development policy. The most important factor when tackling regional improvement activities to promote the network between the main constituents in the region is the motivation to vitalize each subject, as mentioned below.

(4) Motivation of the Japan-type endogenous development policy and activation

At the beginning of the 1980s, regional policy based on endogenous development began in European countries. According to Vazquez-Barquero (2002), the chief aim of the endogenous development policy of European countries is to promote local jobs through small and medium-sized enterprises in the region by providing an entrepreneur training program. That is, the endogenous development policy in European countries makes it a main purpose to accumulate capital in an area. In contrast, Miyamoto (2007) argued that endogenous development in Japan was understood in a frame of environmental conservation, and one of the main purposes of that was the improvement of welfare and culture of its regions, followed by the improvement in a local resident's settlement conditions.

In this respect, Yamamoto (2010) also shows that the features of the Japan-type endogenous development place greater importance on socio-cultural change in a region than on economic variables in the area. Furthermore, the author asserts that the endogenous development policy in Japan must be implemented according to the actual circumstances of each area that the main constituent of each region can measure using the resources in the area and the human network. Yamamoto finds that conserving

nature and maintaining beautiful cityscapes, and a regional policy based on human relationships and mutual trust are needed. At this point, Yamaguchi, Kotani, and Tamura (2009) give the example of Onomichi-shi, Hiroshima, and observe that measures to recover from low fertility in the region lead to the development of the area, and they emphasize the importance of the soft project in a regional policy.

Thus, the endogenous development policy in Japan is characterized by the importance of soft aspects such as the relationship between environmental preservation and human beings. In this respect, Shigemori (2003) states that, to clarify the purpose of the Japan-type endogenous development policy, it is instructive to draw a comparison with local sustainability in Europe. In other words, the Japanese policy unifies the endogenous development policy and the sustainable city policy of Europe, and by examining the idea of sustainable development used as a foundation for a sustainable city policy, the direction of the Japan-type endogenous development policy becomes clearer. The sustainable city policy mentioned above is a development policy in the European Commission (1996) that aims at the preservation of the quality of life of future generations through the preservation of ecosystems and social welfare.

Furthermore, research has found that this policy objective cannot be attained by technical competition, knowledge, and technique alone, and that the motivation of each main constituent, the flexibility of the organization, and a leader with a sense of responsibility toward and trust in the region are necessary for it. "Agenda 21," which was submitted at the United Nations Conference (U. N. C.) and supported the draft of the sustainable city policy, clearly mentions[3] that the motivation of each farmer and self-governing body is important for the success of sustainable development of a rural area. Therefore, it is desirable for Japan-type endogenous development policy to focus on soft infrastructure maintenance, such as childcare, education, welfare, medical treatment, health, and environment management, and that the motivation of each subject is important to achieve its goal.

Thus, although the concept of local sustainability is very important in the Japan-type endogenous development theory, Professor Toshiaki Kimura, who is the Cabinet Secretariat regional revitalization advisor at Tokyo University of Agriculture, asserts[4] that the upsurge of human relations and motivation has had an effect on regional vitalization in the actual field. Professor Kimura performs regional vitalization 200 times or more per year all over the country, and has developed the theory that the key to vitalizing a region, which is a common concern for all urban developers, is to increase the motivation of those who are engaged in city planning, and that community development means human resources development. The administration is also taking note of the effect of motivation on such regional vitalization, and the tourism division, the Japan Tourism Agency (2012), has taken up a successful example of regional revitalization in the Iwaki city, Fukushima Yumoto area, and the Tsukuba city, Ibaraki Miyamae area. This shows that regional development encourages the rise of entrepreneurs in regions.

The development theories discussed above can be summarized based on three conditions: (1) for the Japan-type endogenous development policy to be effective, the support of the administration is required, while regional improvement is locally led; (2) to harness support, cooperation between the main constituents and the formation of a network in the area are essential; (3) in the latter case, the opportunity for development and the motivation of the stakeholders in the region are important factors. Therefore, this study aims to quantitatively clarify how the subsidy system, a typical component of the

3 Please see "United Nations Conference on Environment & Development" (1992).
4 Please see Horikiri (2012).

endogenous development policy of Japan, can be utilized efficiently in collaboration with each main constituent of a region.

2. Endogenous development and a new type of grant for Roadside Stations

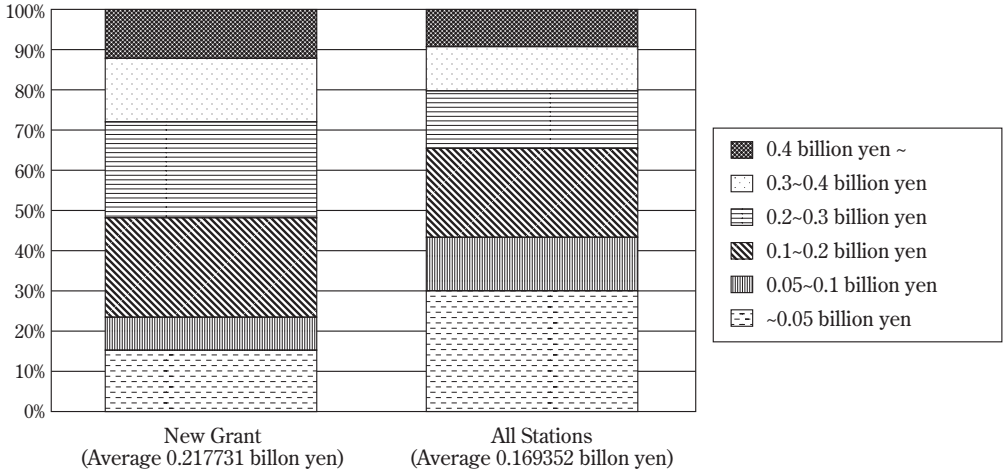
The basic concept of the Roadside Stations relies on endogenous development theory, and most Roadside Stations offer local agricultural products at their outlets and in the local food menus at their restaurants. In a study published in March 2018, Matsuo and Yamaguchi estimated the effective multiplication factors for Roadside Stations in Hyogo Prefecture; the factor is defined as the ratio of the total economic effects divided by the direct economic effects. According to the research, the effective multiplication factors in the Hanshin and Tajima regions in Hyogo Prefecture are 1.55 and 1.49, respectively. These results show that the regional economic effects of Roadside Stations are considerable, and even in rural areas such as Tajima, there are a few nonagricultural industries (Matsuo and Yamaguchi (2018), (2019)).

We also estimate the employment effects of Roadside Stations in the same regions. The number of employees is estimated to have increased by 250 and 266 in the regions of Hanshin and Tajima, respectively. Further, according to our research, the effective multiplication factor in the Hanshin region in Hyogo Prefecture is 1.55. The annual sales of all Roadside Stations in Japan were estimated to be about 250 billion yen in 2015. If the research result in the Hanshin region is extrapolated to this annual total, the economic ripple effect of all Roadside Stations for regions in Japan is estimated to reach 375 billion yen. As mentioned previously, the regional economic circulations created by Roadside Stations follow the endogenous development theory and contribute to the promotion of regional economies.

For this study, we used data from two questionnaire surveys. The first is "Questionnaire Survey about the Disaster Protection Function of the Roadside Stations to the Station Masters," which was conducted by NPO Hito-to-Michi-Kenkyukai (Human and Road Research Group; NPO Representative is Junko Matsumoto, and Matsuo is a fellow, RIETI at this NPO), in August 2012. We sent a survey form to 986 Roadside Stations and received responses from 727 of them (73.7% response rate). The second is the "Questionnaire Survey of Station Masters about the Establishment and Management of the Roadside Stations" which was conducted by this study's coauthor, Matsuo, in September 2013. Survey forms were delivered to 307 Roadside Stations in the Kinki, Hokuriku, and Hokkaido regions, and responses from 94 of them were received. The response rate was low because some question items are too confidential, such as the sales numbers and number of visitors at the Roadside Stations. Therefore, we had an effective sample of 83 responses in this study because of some incomplete forms.

In this study, we conduct a factor analysis of the earnings of Roadside Stations using a simultaneous equation system. The Roadside Station was constructed by the erstwhile Ministry of Construction (now called the Ministry of Land) in 1993. The stations that received the new type grants were: Aito Marguerite Station, Ayu no sato Yadagawa, Ise Honkaido Mitsue, Inagawa, Ibuki no sato, Ibusuki, Onneyu Onsen, Kasaoka Bay Farm, Kita Harima, Kutsuki Shin-Honjin, Shiotsu-Honjin, Shiotsu-kaido Adikama no sato, Suzunari, Swan 44 Nemuro, Takigawa, Totsukawa-go, Harima Ichinomiya, Futakami Park Taima, Funaya no sato Ine, Fresh Asago, Miki, Mizu no sato Sawara, Mizuho no sato Sarabiki, Minami Haga, Myoe Furusato-kan, Youka Tajima no kura. Figures 1 and 2 show the difference in the percentage of each class in total sales. Both figures show how New Grants stations (NGS) are superior to the others. For example, the total percentage of sales in the top 3 stations (0.4 ～ , 0.3 ～ 0.4, and 0.2 ～ 0.3 billions) exceeds 50 in

Figure 1 Sales in Roadside Stations



NGS, but all other stations are only at 35%. Similarly, the total percentage of the top 3 stations in terms of the number of visitors (850 thousand people –, 550 – 850 thousand people, 250 – 550 thousand people) is about 60% in NGS, but all other stations are only at 45% (Matsuo and Yamaguchi (2016)).

A similar finding can be seen in Table 1. In all eight subjects (such as sales amount, number of visitors, etc.), the values of the NGS exceeded that of the non-NGS, except for the management expense item (33 and 32). Not only benefits such as total sales but also cost aspects such as gross business expense are larger in NGS. The sales amount/management expense is much higher in NGS. Therefore, N Grant has excellent performance. Table 2 shows the difference among the top 10 groups for sales between the two groups (i.e., the stations that received the grant and those that did not). For example, of the total of 83 stations, 27 were given the grant (32.5%). The table shows that the management expense and gross business expense are almost the same between the two groups (33.3 vs. 32.5). However, the parking space was smaller in the NGS. On the contrary, the number of events is much larger in the New Grant stations (NGS stations have about 60% and non-NGS stations have 40%). In addition, the number of visitors and total sales are higher in the NGS (40 vs. 32.5). Thus, the NGS have a much higher percentage (both 53.3 are much higher than 32.5) in sales amount/management expense and total sales/gross business. This shows how the number of events and the number of visitors are important to sales. Increasing the number of visitors involves considerable effort.

Here, we discuss the numerical values for station rank 1 and rank 20 for the sales amount with respect to 5 variables (number of visitors, number of events, parking space, gross business expense, and management expense. See Appendix Table 1). In terms of sales, No. 1 is 688 million yen, and No. 20 is 269 million yen. In terms of parking space, No.1 can accommodate 633 cars and No.20, 134 cars. For the number of visitors, No. 1 had 2.5 million people and No. 20 had 500,000 people. In terms of the number of events, No.1 had 45 events and No. 20 had 9. No. 1 had a gross business expense of 3,300 million yen and No. 20, 670 million yen. For management expenses, No. 1 incurred 150 million yen and No. 20, 46 million yen.

Next, we show the ranking of each of the six variables (total sales, parking space, number of visitors, number of events, gross business expenses, and management expenses) for the top 10 sales amounts.

Figure 2 Number of visitors in Roadside Stations

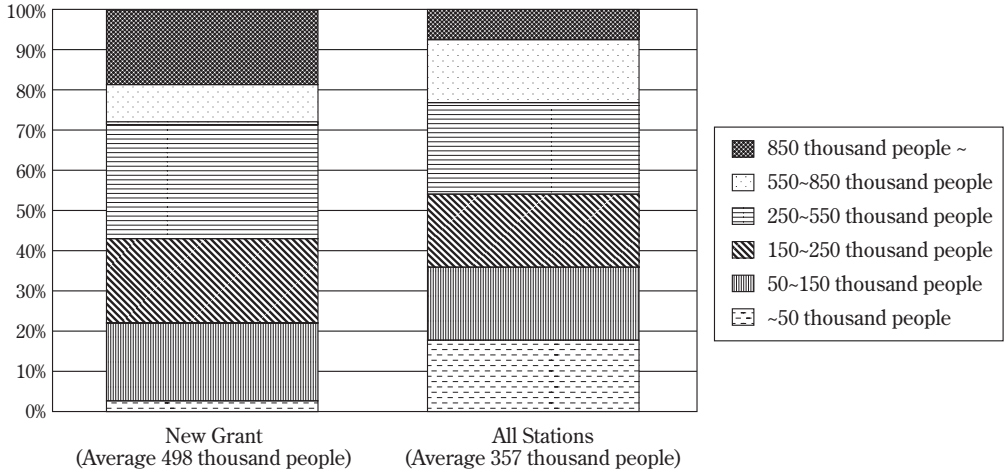


Table 1 Difference in business content between all stations and new grant station

	(1) Sales Amount (million yen)	(2) Number of Visitors (thousand)	(3) Number of Events (number)	(4) Parking Spaces (number of cars)
All stations	160	366	6	117
New Type Grant Stations	188	479	11	119
	(5) Gross Business Expense (million yen)	(6) Management Expense (million yen)	(1) / (5) Sales / Gross Business Expense	(1) / (6) Sales / Management Expense
All stations	526	33	0.506	7.5
New Type Grant Stations	557	32	0.555	10.0

For A, No.1, events is 1st, management is 2nd, parking is 6th, and business is 8th. Therefore, A has many events and offers a good service. The parking space is wide, gross business expense is large, and the building is probably in very good condition. For B, No. 2, parking is 5th, and events is 11th, which indicates a fair number of events and a large parking space as well. For C, No. 3, parking is 4th, and the visitors is 12th. Although other factors are not conspicuous, they remain 3rd. For D, No. 4, events is 2nd, visitors is 15th, and it has three parking lots. For E, No. 5, events and visitors are 9th. This station has three parking lots and hosts many events, and parking space is wide and can accommodate many visitors. For F, No. 6, gross business expense is 7th and parking is 11th, that is, a good building and wide parking space to attract visitors. For G, No. 7, gross business expense is 13th and parking is 18th, that is, a good building and wide parking space to attract visitors.

For H, No. 8, events is 7th, visitors is 12th, and gross business expense is 15th. For I, No. 9, visitors is 6th, and gross business expense is 22rd. For I, No.10, management expense is 10th, and events is 16th. Among the low 20 Roadside Stations, the stations of Hokkaido and the depopulated and difficult-to-access areas in Kinki have 9 stations each. Some stations that show fairly good positions in terms of parking, gross business, and management expenses still rank low in sales.

Table 2 Percentage of business content between new grant stations and non-new grant stations in the top 15 position in sales amount

	New Type Grant Sations (%)	Non-New Type Grant Stations (%)
Sales amount	40	60
Number of Parking Spaces	26.7	73.3
Number of Visitors	40	60
Number of Events	60	40
Gross Business Expense	33.3	66.7
Management Expense	33.3	66.7
Sales Amount / Manageent Expense	53.3	46.7
Sales Amount / Gross Business Expense	53.3	46.7
New Type Grant Station/ All Stations (%)	32.50%	

3. Model and econometric analysis

Here, we describe a model and our econometric analysis. Several previous works have dealt with the analysis of Roadside Stations. Kikuchi, Taniguchi, and Ohgaki (2005), Kikuchi and Taniguchi (2006, 2007), and Taniguchi and Kikuchi (2006) performed rigorous analyses of Roadside Stations but used a non-econometric method. Analysis using the least-squares method is rare, but Takase, Koyama, and Mori (2002) used the least-squares method for bus use. However, the estimation results were not accurate, and many results of the t value were not acceptable. In addition, Shima (2011) used the dummy variable of the Roadside Station, but many of the results were not significant. Nakamura, Yano, Maruyama, and Kikuchi (2008) used a probit model. However, these are simple OLS (Ordinary Least-Squares) and not a simultaneous equation model.

We will consider what elements are important in increasing the sales amount. One of the most important purposes of Roadside Stations is to increase sales. To increase sales, we can consider many factors. One is to increase the number of visitors, and increasing the number of events is also important, as is having a large parking lot. Moreover, providing good service is also crucial, as is having a good restaurant. Well-maintained buildings and clean toilets are important. Further, management expenses are an important indicator, as they are used for the many events and keeping clean toilets, and thus increase the number of visitors. Additionally, having a large parking space is important for sales. Conversely, the sales amount is important for having a large parking space when building the Roadside Station, as stations that expect very high sales would build a large parking space.

Based on the above, we now consider building the Roadside Station model. The six variables considered—sales amount, parking space, number of visitors, number of events, management expenses, and gross business expense—influence each other. Therefore, we have to be careful about multicollinearity as many combinations exist. We created numerous models and obtained the best estimation model. The following is the best-fit model of all estimations.

Table 3 Estimated results from the simultaneous equation model

No.	Dependent variable	Independent variable	Coefficient	t-value	p-value	Elasticity
		Constant	-29697.2	-0.2897	0.7731	
(1)	Sales amount	Parking spaces	1535.336	1.798355	0.0776	1.058
		New Grant	104674.9	2.367611	0.0214	
		Constant	59.44669	2.154245	0.0356	
(2)	Parking space	Sales amount	0.000237	1.820131	0.0742	0.344
		Hokkaido dummy	47.43532	2.145034	0.0364	
		Constant	111.3778	1.058228	0.2943	
(3)	Number of visitors	Number of events	27.63587	1.851784	0.0691	0.379
		Management expense	0.002394	3.653841	0.0006	0.250
		Constant	-3.16245	-0.87322	0.3864	
(4)	Number of events	Sales amount	0.000068	2.749418	0.0081	2.234
		Management expense	-0.0000546	-1.93971	0.0576	-0.411
		Constant	-84757.2	-2.21289	0.0309	
(5)	Management expense	Number of visitors	371.8791	3.976228	0.0002	3.603
		New Grant	-65764	-1.51575	0.135	

Sales amount = f (parking space, new grant)
Parking space = f (sales amount, Hokkaido dummy)
Number of visitors = f (number of events, management expense)
Number of events = f (sales amount, management expense)
Management expense = f (number of visitors, new grant)

Table 3 shows the estimated results. For the sales amount, we choose the parking space and NGS (dummy variable). A large parking lot makes it easy to approach a Roadside Station. A new station attracts visitors and leads to an increase in sales. Stations that expect large sales would have a large parking space, as previously stated. Hokkaido (dummy variable) would have a larger parking space than Honsyu, Shikoku, and Kyusyu. For the number of visitors, events attract people to visit the Roadside Station. Clean buildings, especially clean toilets, attract many visitors. Therefore, management expenses to keep the building clean affect the number of visitors. For the number of events, high sales amounts encourage more events to obtain many visitors. However, high management expenses make it difficult to have some events. Therefore, a negative sign is expected. An increase in sales increases management expenses. We investigate how NGS deal with management expenses.

The results in Table 3 appear robust. All t values are very good, and the estimated results are reasonable. We calculated the elasticity for all variables except the dummy variables, which do not have elasticity. We found a loop relationship between parking space and sales amount from the results of the econometric analysis in Table 3. A large parking space increases the sales amount because the coefficient is positive (1535.336). Likewise, a large sales amount has a positive effect on parking spaces (0.000237 in Table 3). Thus, a loop relationship exists between these two variables. Similarly, the relationship between the number of visitors and management expense has a loop.

In Table 3, the variables for parking space and sales amount are included. However, gross business expenses are not. This means that gross business expense is closely correlated with these two variables. Moreover, a multicollinearity problem exists with these variables. Therefore, we could not obtain a strong result for the estimation. From the elasticity of Table 3, a 1% increase in the parking space increases the sales amount by 1.06. Conversely, a 1% increase in sales increases the parking space by 0.344. This demonstrates the loop relations as stated above. The Hokkaido dummy has a positive sign; therefore, the station in Hokkaido has a wider parking space. From Table 3, the sales amount of NGS is 104.6749 million yen greater than that of other stations.

Second, the management expense was 0.002394 to the number of visitors. Conversely, the number of visitors was 371.8791 to the management expense. Therefore, the loop relationship between the number of visitors and management expenses is also demonstrated. In addition, Table 3 shows that NGS has a negative sign on management expense. Further, the sales amount increases the number of events. In addition, there is a clear correlation between the increase in the number of events and the increase in the number of visitors. The loop relationships between the two variables are summarized as follows:

(1)	→ 1.06↑ (Parking space↑ ⇔ Sales amount↑) Loop 0.34↑←	
(2)	→ 0.25↑ (Management expense↑ ⇔ Number of visitors) Loop 0.60↑←	

The above statements are summarized as follows:

(1) A 1% increase in parking space ↑ → Sale amount increases 1.06% ↑
Parking space ⇔ Sales amount ↑) Loop relationship exists
(Hokkaido (dummy) → Parking space increases ↑)
New type: Grant ↑ → Sales amount 104.67 million yen ↑

(2) A 1% increase in management expense ↑ → Number of visitors increases 0.25 ↑
(Number of visitor ↑ ⇔ Management expense 3.60 ↑) Loop relationship exist
New type: Grant ↑ → Management expense ↓

(3) Sales amount ↑ → Number of events 2.23 ↑ → Number of visitors 0.38 ↑

Gross business expense is very important for sales. However, Table 3 includes no gross business expenses. This is probably due to the multicollinearity among these variables, such as sales, parking space, number of events, and management expenses. Appendix Table 2 demonstrates this and shows how gross business expense is important. All estimations show that gross business expense is important and significant for almost all estimated equations. Appendix Table 2 shows that the gross business expense has a high t-value for almost all factors. For example, the first line of the estimation results shows that all t-values in line 1 are significant (the t-values for the sales, the parking space, the number of visitors, the number of events, and the management expenses are 2.148, 3.201, 3.545, 3.194, and 2.832, respectively). Additionally, the second line of the estimation results shows that all t-values in line 2 are significant (t-values are 2.107, 3.178, 3.530, 3.278, and 2.793).

Further, the six lines of the estimation results show that all t-values in line 1 are significant (the t-values are 1.802, 2.823, 3.167, and 3.383). These show that to enter variables such as the new grant dummy, the management expenses can be included. However, the t-values of the gross business expense become smaller and nonsignificant if we include the parking space, the number of visitors, and the number of events together. This is because these three variables and the gross business expense are closely related to each other, and multicollinearity occurred in these cases. This is only the case for the sales amount. However, for the other four variables (the parking space, the number of visitors, the number of events, and the management expense), all t-values are large and significant. These calculations show that gross business expense is a very important variable for Roadside Stations.

Appendix Table 3 shows the DEA, which shows the efficiency of the station. The stations such as Fresh Asago, Kasaoka Bay Farm, Inagawa, and Harima Ichinomiya are the top 15 in sales amount. However, Totsugawa-go is located in a very mountainous area but has excellent efficiency. In addition, Onneyu Onsen (hot spring) is located in a very difficult-to-access location, but its efficiency is the best among all stations.

Summary and Conclusion

We performed numerous analyses of Roadside Stations, as discussed above, and the discussion can be summarized as follows. First, the stations that received new grants had far better results than the other stations (in terms of sales amount, gross business expense, and management expense). Additionally, the sales amount, number of visitors, parking space, number of events, management expenses, and gross business expenses have a simultaneous dependence on one another. Therefore, we used various simultaneous equation models. Second, from the results of this estimation, we found that the number of stations that received new grant money increased by 147 million yen. Third, a 1% increase in the parking space increases the sales amount by 1.058%. Conversely, a 1% increase in the sales amount increases the parking space by 0.344%. Fourth, a 1% increase in the number of events increases the number of visitors by 0.379%.

In addition, a 1% increase in management expenses increases the number of visitors by 0.247%. A 1% increase in the sales amount increases the number of events by 2.234%. Conversely, a 1% increase in management expenses decreases the number of events by 0.411%. Further, a 1% increase in visitors increases the management expense by 3.603%.

These results demonstrate that the sales amount and parking space have a loop relation with each other. In addition, management expenses and the number of visitors also have loop relations with each other. These are important findings to determine how much the policy variable should increase to obtain an increase in the goal variables.

Appendix Table 1 Ranking of 8 business contents of the top and bottom 20 stations

(1) The top 20 stations

High Ranking		Sales Amount	Number of Visitors	Number of Events	Parking Spaces	Gross Business Expense	Management Expense	New Type Grant	PFI
○	1	688243	19	1	6	8	2	1	0
○	2	640000	30	11	5	76	56	0	0
○	3	442751	12	66	4	32	44	0	0
○	4	422731	15	2	34	44	43	1	0
○	5	407000	9	9	57	45	80	1	1
○	6	405429	21	30	11	7	33	0	0
○	7	390000	24	30	18	13	59	1	0
○	8	384300	12	7	30	15	11	0	0
○	9	383782	6	45	26	22	29	0	0
○	10	345000	31	16	62	26	10	0	0
○	11	340000	40	45	21	54	40	0	0
○	12	326000	11	5	3	1	31	0	0
○	13	323000	10	16	29	9	41	0	0
○	14	320000	42	45	67	46	42	1	0
○	15	300000	39	4	53	18	60	0	0
○	16	300000	4	30	10	10	5	1	0
○	17	280000	37	35	13	34	13	0	0
○	18	270000	28	35	32	31	24	0	0
○	19	270000	18	30	9	14	4	0	0
○	20	269360	47	14	61	46	8	1	0

(2)The bottom 20 stations

Lower Ranking		Sales Amount	Number of Visitors	Number of Events	Parking Spaces	Gross Business Expense	Management Expense	New Type Grant	PFI
●	20	44200	67	56	80	57	55	0	0
●	19	43000	63	15	77	33	47	1	0
●	18	40000	71	56	67	51	27	0	0
●	17	33000	36	56	12	19	17	0	0
●	16	32680	33	21	51	50	28	0	0
●	15	30000	15	66	2	6	9	0	0
●	14	30000	75	55	19	74	54	0	0
●	13	27500	77	23	64	36	75	0	0
●	12	26900	79	23	78	75	64	1	0
●	11	24000	21	35	53	58	50	1	0
●	10	23000	66	66	63	67	70	0	0
●	9	23000	62	13	34	28	35	1	0
●	8	20000	77	55	76	76	51	0	0
●	7	19000	71	23	42	46	73	0	0
●	6	18639	70	66	52	37	78	0	0
●	5	17305	80	66	45	72	72	0	0
●	4	16669	67	66	70	71	46	0	0
●	3	16000	60	55	59	62	56	0	0
●	2	11680	57	35	53	76	35	0	0
●	1	340	74	66	79	76	24	0	0

Appendix table 2 Estimated results for gross business expense using several OLS methods

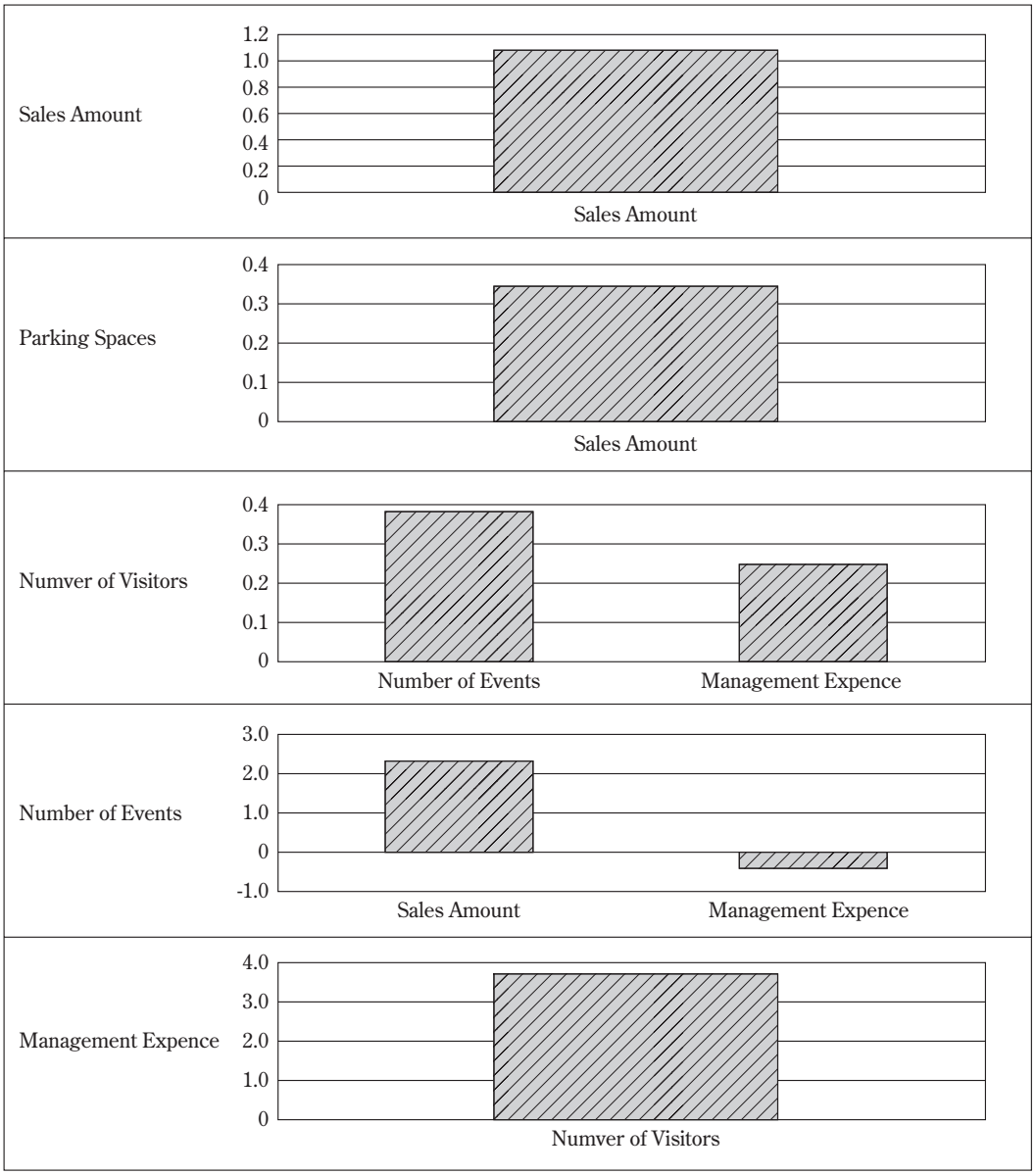
No.		Sales Amount			Parking Spaces			Number of Visitors			Number of Events			Management Expense		
		Coefficient	t-value	p-value	Coefficient	t-value	p-value	Coefficient	t-value	p-value	Coefficient	t-value	p-value	Coefficient	t-value	p-value
(1)	Constant	135755.200	6.088	0.000	86.489	6.294	0.000	217.146	3.544	0.001	3.377	2.471	0.016	27128.640	6.478	0.000
	Gross business expense	0.063	2.148	0.035	0.000	3.201	0.002	0.000	3.545	0.001	0.000	3.194	0.002	0.016	2.832	0.006
	(Elasticity)*	(0.197)			(0.261)			(0.411)			(0.473)			(0.233)		
	Adjusted R^2	0.042			0.101			0.124			0.101			0.079		
(2)	Constant	116635.400	4.798	0.000	86.301	5.642	0.000	160.501	2.411	0.018	1.223	0.866	0.389	25492.500	5.492	0.000
	New Grant	62097.060	1.840	0.070	0.611	0.029	0.977	183.970	1.990	0.050	6.996	3.567	0.001	5313.810	0.825	0.412
	Gross business expense	0.061	2.107	0.038	0.000	3.178	0.002	0.000	3.530	0.001	0.000	3.278	0.002	0.015	2.793	0.007
	(Elasticity)*	(0.191)			(0.261)			(0.402)			(0.454)			(0.230)		
	Adjusted R^2	0.070			0.090			0.155			0.215			0.075		
(3)	Constant	78184.700	2.816	0.006				-39.191	-0.584	0.561	-1.313	-0.824	0.413	23523.640	4.272	0.000
	New Grant	61824.760	1.896	0.062				182.556	2.317	0.023	6.978	3.729	0.000	5299.867	0.820	0.415
	Gross business expense	0.035	1.186	0.239				0.000	2.035	0.045	0.000	2.239	0.028	0.014	2.398	0.019
	(Elasticity)*							(0.209)			(0.314)			(0.211)		
	Parking spaces	445.544	2.596	0.011				2.314	5.580	0.000	0.029	2.982	0.004	22.814	0.670	0.505
	(Elasticity)*	(0.309)						(0.736)			(0.537)					
	Adjusted R^2	0.132						0.386			0.285			0.069		
(3)	Constant	102114.700	4.160	0.000	66.693	4.940	0.000				0.414	0.289	0.773	24689.430	5.117	0.000
	New Grant	45453.190	1.348	0.181	-21.863	-1.179	0.242				6.068	3.089	0.003	4393.312	0.663	0.509
	Gross business expense	0.036	1.176	0.243	0.000	1.420	0.160				0.000	2.321	0.023	0.014	2.353	0.021
	(Elasticity)*										(0.338)			(0.209)		
	Number of visitors	90.471	2.273	0.026	0.122	5.580	0.000				0.005	2.173	0.033	5.004	0.639	0.524
	(Elasticity)*	(0.197)			(0.384)						(0.289)					
	Adjusted R^2	0.116			0.339						0.249			0.068		
(4)	Constant	108500.300	4.787	0.000	82.089	5.599	0.000	146.815	2.246	0.028				25882.860	5.542	0.000
	New Grant	15553.960	0.461	0.646	-23.484	-1.077	0.285	105.669	1.086	0.281				7547.172	1.086	0.281
	Gross business expense	0.024	0.850	0.398	0.000	2.102	0.039	0.000	2.643	0.010				0.017	2.917	0.005
	(Elasticity)*				(0.175)			(0.313)						(0.257)		
	Number of events	6653.101	3.726	0.000	3.444	2.982	0.004	11.193	2.173	0.033				-319.248	-0.868	0.388
	(Elasticity)*	(0.252)			(0.189)			(0.195)								
	Adjusted R^2	0.199			0.172			0.192						0.072		
(5)	Constant	106461.100	3.719	0.000	79.985	4.441	0.000	134.264	1.712	0.091	1.977	1.191	0.237			
	New Grant	59976.270	1.763	0.082	-0.705	-0.033	0.974	178.501	1.916	0.059	7.153	3.626	0.001			
	Gross business expense	0.055	1.802	0.075	0.000	2.823	0.006	0.000	3.167	0.002	0.000	3.383	0.001			
	(Elasticity)*	(0.171)			(0.244)			(0.379)			(0.492)					
	Management expense	0.399	0.679	0.499	0.000	0.670	0.505	0.001	0.639	0.524	0.000	-0.868	0.388			
	(Elasticity)*															
	Adjusted R^2	0.063			0.084			0.148			0.212					

*In this table elasticity was calculated only when the t value of the coefficient estimate was significant.

Appendix Table 3 Efficiency of the stations that obtained the new type of grants (DEA method)

Name of Roadside Station	Efficiecy	Prefecture	Name of Roadside Station	Sales Amount
Fresh Asago	1.000	Hyogo	a	6.88
Kasaoka Bay Farm	1.000	Okayama	b	4.23
Totsugawa-go	1.000	Nara	c	4.07
Inagawa	0.822	Hyogo	d	3.90
Youka Tajima no kura	0.803	Hyogo	e	3.00
Shiozu-kaido Ajikama no sato	0.798	Shiga	f	2.69
Ibuki no sato	0.774	Shiga	g	2.50
Harima Ichinomiya	0.748	Hyogo	h	2.40
Onneyu Onsen	0.723	Hokkaido	i	2.24
Minami Haga	0.713	Hyogo	j	2.20
l	0.561		k	2.20
s	0.478		l	2.08
a	0.451		m	2.00
i	0.417		n	1.92
p	0.398		o	1.85
q	0.364		p	1.55
e	0.335		q	1.30
r	0.326		r	1.20
m	0.244		s	1.14
x	0.237		t	0.72
k	0.218		u	0.57
v	0.213		v	0.50
w	0.210		w	0.43
u	0.205		x	0.27
z	0.081		y	0.27
y	0.078		z	0.24
zz	0.046		zz	0.23

Appendix Figure 1 Obtained elasticities for five variables



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