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# Choice in the Rural Development Policies in San Francisco Bay Area Counties

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In this study environmental effect of development policy as well as the economic impact on the target region is investigated using the household production model of the environmental good. Based upon the theoretical model we test the significance and the direction of the effect of the socio-economic variables considered in the model using the survey data from San Francisco Bay area counties. Income, the type of job, and environmental amenity determine attitude toward income policy of a resident among others.

## I. Introduction

Rural development is a subject of policy debate. Government income policy aims at creating new jobs or increasing the household income. Government affects development of rural or suburban area through zoning, taxes, and subsides. In addition, government income policy could cause negative effects on factors such as air, open space or neighborhood characteristics including education, crime, and public facilities. Evaluation of a policy should consider the environmental effect of the policy as well as the economic impact on the target region. The literature of urban economics shows the self-selection of the residential location based on the physical conditions of the

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residential area and the economic status, and the preference of the residents. There are spatial distribution of people given environmental quality.

For policy purposes one can suggest the possibility of change in both natural resource policy and/or job enhancement policies within a residential area that might bear on a choice of residential location in the long run. This, in turn, suggests an analytical model for the choice of residential location as it is influenced by quality of life factors. If they are able to choose their residential locations, they will repeat self-selection process to choose new locations with the expectation about the effects of the policy. Or in case that residents are not able to change their residential location, as in the short run model, we can explore the different attitude of a resident within an area and across areas toward policies affecting the environmental qualities.

In order to create and implement the most suitable policy by local government in an area, which represents many heterogeneous people, policy makers need as much information as possible on the anticipated direct and indirect effects of the policy so they can weigh the possible results against the characteristics of residents and their probable policy preferences. In the economic literature about urban areas there have been studies on the effect of the differences in environmental quality on wages, rents, or both (Polinsky and Shavell [24]; Roback [27]). However the change in environmental quality in response to a change in demand of residents has not been intensively investigated as in the change in environmental quality of a residential area due to job creating income policies or changes in natural resource development or use.

Henderson [13] explores residential location choice under commute time constraints. Ziegert and Sullivan [34] criticize that most empirical literature of urban labor treats labor supply and commute time as exogenous. However, they show an insignificant relation between labor supply and commute time (i.e. choice of residential location) even though they were treated as endogenous.

These studies are not clear in explaining the relation between leisure and environmental quality. The insignificance of the relation between commute time and labor supply can be explained if we explicitly consider the relation between environmental quality and leisure not labor supply. If increasing environmental quality is a substitute for leisure in the utility of a commuter, increased commute time can be offset by a decrease in leisure consumption without affecting labor supply. A model that formalizes the relation between environmental quality and leisure demand offers a theoretical explanation about the insignificance in the relation between labor supply and residential location. In addition, we could investigate the change of labor supply when environmental quality changes with immobile residents.

In this paper, we explain the attitude toward income and environmental policy using income, the location a resident has chosen, and the difference in the environmental quality. Given the immobility of the residents, high income residents who live near the central business district with a great amount of environmental amenity would show stronger opposition against income policy than those who live in the area close to the central business district with inferior environment. The low income groups residing in the remote area from the central business district or living in the low quality of environmental amenity tends to support the income policy. For the middle income group they are widely distributed in their attitudes spatially depending upon the preference for the environmental quality.

The main focus of this paper is to give a theoretical background, using the household production model of the environmental good, regarding the choice of appropriate environmental policy and income policy, when one policy has multiple effects on income and environmental quality, given the choice of residential locations. Based on the theoretical model we test the significance and the direction of the effect of the variables considered in the model, as well as demographic and social factors, on the preference of the resident between income policy and environmental policy. Among the relevant characteristics of the residents are socio-economic ones such as income, type of jobs, family structure, the commute distance, and the residential environment. These results can be used as a guideline for the future policy implementation in each residential area.

The rest of the paper is organized as follows. In section 2, a model on the choice of environment and development policy of a resident will be presented. Both the description of the data and the results of a statistical analysis will be given in section 3. Conclusions and a suggestion for the further study will be in section 4.

# Ⅱ. Model

In this section, we consider direct and indirect effects of income (development) policies and investigate their effects on the utility of the residents. In contrast to the residential location choice models in which environmental amenities are fixed in each location, our model assume that policy affect both the quality and quantity of environmental attributes in any location.[1] As in the short-run model, immobility of residents is assumed as we examine their preferences of either income or environmental policy.

Consider an utility maximizing household with one working member who commutes to the central business district from the residential area. The household gets utility from consumption of the composite good $X$, whose price is set to 1 and environmental goods $Z$.

$$U = U(X, Z) \tag{1}$$

The environmental good is produced by the household using a vector of environmental attributes, $Q(d) = (q_1(d), q_2(d), q_3(d), \cdots, q_n(d))$, which are increasing function of the distance of residential location from the central business district, $d$, and leisure, $l$. Leisure is an input to enjoy environmental amenities.

$$Z = Z(Q(d), l) \tag{2}$$

Let $P(d) = (p_1(d), p_2(d), p_3(d), \cdots, p_n(d))$ be a price vector of the environmental attributes. We assume the price of an environmental attribute $i$, $p_i(d)$, is a decreasing function of distance reflecting an increase in the quality of environmental attributes as the simple repackaging model (Deaton and Muellbauer [7]). Increase in the quality of an input is equivalent to the household paying less to get the same amount of attribute or

1) For example consider the open space as one of environmental attribute. The amount of open space varies as the distance from the central business district increases. If a new factory is built near the residential area, it may decrease the size of open space and/or decrease preferred scenery.

getting more at the old price as distance increases. Without loss of generality, we assume that there is only one environmental attribute.

$$Q(d) = (q_1(d), q_2(d), q_3(d), \cdots, q_n(d)) = q(d), q'(d) > 0 \qquad (3)$$

$$P(d) = (p_1(d), p_2(d), p_3(d), \cdots, p_n(d)) = p(d), p'(d) < 0 \qquad (4)$$

A household allocates one unit of endowment of time among commute time, $T(d)$, labor supply and leisure, $l$. Commute time is an increasing function of distance at decreasing rate.

$$T(d), T'(d) > 0, \quad T''(d) < 0 \qquad (5)$$

The household is also endowed with non-labor wealth, $I$, and earns a wage income, $W(d) = w(1 - T(d))$, where $w$ is the wage rate.

From (1) and (2) we can define utility function of a household whose commute distance to the central business district is $d$;

$$U(X, Z(q(d), l)) \qquad (6)$$

The utility function of a household is assumed as continuous, twice differentiable and strictly quasi concave in its arguments.

$$U_X > 0, U_Z > 0, U_{XX} < 0, U_{ZZ} < 0, \text{ and}$$

$$2U_{XZ}U_XU_Z - U_{XX}U_Z^2 - U_{ZZ}U_X^2 > 0 \qquad (7)$$

The budget constraint is

$$X + p(d)\,q(d) + wl = W(d) = w(1-T(d)) + I \qquad (8)$$

We assume perfect competition in the labor and attribute markets so that the price of leisure as well as attributes is given.

A household chooses its demand for a environmental attribute $q(d)$ and leisure $l$ to produce the environmental good as well as the composite good $X$ to maximize utility function given budget constraint;

$$\max_{X,\,q(d),\,l} U = U\,(X, Z\,(q(d), l); w, I) \tag{9}$$

$$\text{subject to } X + p(d)\,q(d) + wl = w(1 - T(d)) + I \tag{10}$$

The first order necessary conditions for utility maximization are

$$\frac{\partial U}{\partial X} = U_X - 1 = 0 \tag{11}$$

$$\frac{\partial U}{\partial q(d)} = U_Z \frac{\partial Z}{\partial q(d)} - p(d) = 0 \tag{12}$$

$$\frac{\partial U}{\partial l} = U_Z \frac{\partial Z}{\partial l} - w = 0 \tag{13}$$

$$X + p(d)\,q(d) - w(1 - l - T(d)) - I = 0 \tag{14}$$

In equation (12) the demand for an environmental attribute depends upon its quality at a given residential location. It also implicitly represents marginal willingness to pay for the attribute at distance $d^*$, $p(d^*)$, even though the household does not affect the price of the environmental attribute.

The optimal demand of the residents for environment attribute, leisure as well as composite goods can be represented as follows from equations (11) through (14);

$$X^* = X\,(p(d), w, T(d), I) \tag{15}$$

$$q^* = q\,(p(d), w, T(d), I) \tag{16}$$

$$l^* = l\,(p(d), w, T(d), I) \tag{17}$$

The demand for an environmental attribute depends on the wage rate, quality of environmental attribute, $p(d)$, and travel time.

Now we can derive an indirect utility function of a household with given commute distance, *d*, as function of wage income, travel time, the price of an environment attribute, and wealth.

$$V = V(w(1 - T(d)), p(d), I) \tag{18}$$

The effect of introducing new industry in a residential area has two impact of interest. One is a decrease in commute time if employed, which makes it possible either to increase the local labor supply and wage income, or increase the leisure input. The other is the effect of externalities from the new industry on the quality of environmental attributes within the residential area. If we allow the pecuniary effect of new industry on environmental quality of residential area, this is equivalent to an increase in the price of environment attributes, $p(d)$. Introduction of new industry may also increase demand for the labor so that wage rate rises and income of household, $W(d) = w(1 - T(d))$, increases if there is no change in labor supply.

We can investigate the net effect of introduction of new industry or environmental policy on the utility of a resident by totally differentiating the indirect utility function, (18), keeping wealth constant with respect to commute distance, wage rate.

$$\begin{aligned} dV|_{dI=0} &= V_W(1 - T(d))\, dw - V_W w T'\, dd + V_p p'\, dp \\ &= V_W(1 - T(d))\, dw - V_W w dT + V_p dp \end{aligned} \tag{19}$$

where $dT = T'\, dd$, and $dp = p'\, dd$.

The first term in equation (19) is the marginal effect of a change in the wage rate on indirect utility. The second and the last terms in equation (19) are the marginal change in the utility of a household from change in the location of industry and its effect on the quality of residential area. Change in commute time, $dT = T'\, dd$, affects utility of a household through income effect. The degradation of environmental quality in residential area due to introduction of new industry causes the price of an environmental attribute to increase resulting in the decrease of the utility of a resident.

**Proposition 1** (a) The outside workers, defined as those who continue to commute even after the introduction of new industry, will be against the introduction of new industry reducing environmental quality of residential area.

(b) Any household in residential area will support the introduction of quality of life improving industry or policy even though there is no change in the wage rate(See 〈Appendix 1〉 for the proof).

A new industry reduces environmental quality of residential area, and increases the price of an environmental attribute so that the welfare of the outside worker decreases. However the introduction of new industry could increase labor supply of outside workers depending upon the household production technology of the environmental good. If leisure and an environmental attribute are substitutes for each other, the outside workers will increase the demand for the leisure resulting in decrease in the labor supply as environmental quality of residential area is deteriorated to keep the utility constant. On the other hand the labor supply will increase if they are complementary in the production of the environmental good.

We know $V_p = -q = X_p + pq_p + wl_p$ (See footnote (8)). Even though there is no change in travel time, the supply of labor increases or decrease as the environmental quality decreases depending on the production technology of the environmental quality. This implies that no evidence could be found on the relationship between travel time and labor supply as in Ziegert and Sullivan [34].

Marginal indirect utility of introduction of a new environment improving industry is always positive whether it creates job or increases wage rate of the residents. Both inside and outside workers will support the introduction of environment improving industry if it does not affect wage rate. Among them the inside workers will strongly support the policy because it will save their commute time, increase wage income and improve the quality of residential area.

**Proposition 2** (a) The attitude of the inside workers toward a development policy that increases the wage rate or creates jobs near residential area, and reduces environmental quality, is indeterminate.

(b) The higher the wage rate and/or the smaller the demand for an environmental attribute, the inside worker is more likely to support introduction of new industry reducing environmental quality of residential area even if there is no increase in wage rate(See 〈Appendix 2〉 for the proof).

Even though new opportunities for jobs near residential area may reduce commute cost of the resident or increase the wage rate, the residents who are the potential beneficiaries are not unanimous in supporting income policy because it also reduce the quality in residential area. If the new industry doesn't affect the wage rate, a household whose wage rate is very high and lives in the low quality environmental area may support development policy even it lowers the quality of life in residential area because the gain in wage income by transferring the savings in commute time into increase of labor supply will be big enough to compensate the disutility from the lowered environmental quality. On the other hand those in the high quality environmental area are more likely to oppose the income policy even though it could save their travel time.

From the proposition 2, we can examine the effects of the heterogeneity of the household production technology, the characteristics of the inside workers, and the environmental quality of the residential location on the attitude toward the income policy. The change of the utility of the inside worker in equation (A.5) in 〈Appendix 2〉 is

$$dV|_{dl=0} = V_T\left(dT + \frac{V_P}{V_T}\right) dp \tag{20}$$

Change in commute time and environmental quality of residential area is common to all inside workers. The intensity of support or opposition of the inside workers is determined by the size of $V_p / V_T$. The bigger the ratio is, the more intense the opposition is.

From footnote (8),

$$\frac{V_P}{V_T} = \frac{(X_p + pq_p + wl_p)}{(X_T + pq_T + wl_T)} \tag{21}$$

Define the elasticities of the demand for the composite good, an environmental attribute, and leisure with respect to the price of environmental attribute as $\varepsilon_{Xp}$, $\varepsilon_{qp}$, and $\varepsilon_{lp}$, respectively. And define the elasticities of the demand for the composite good, an environmental attribute, and leisure with respect to commute time as $\varepsilon_{XT}$, $\varepsilon_{qT}$, and $\varepsilon_{lT}$, respectively. The elasticity of demand with respect to commute time is equivalent to the income elasticity because $dW = -wdT$.

Then the equation (28) is

$$\frac{V_p}{V_T} = \frac{(\varepsilon_{Xp}X + \varepsilon_{qp}pq + \varepsilon_{lp}wl) / p}{(\varepsilon_{XT}X + \varepsilon_{qT}pq + \varepsilon_{lT}wl) / T} \tag{22}$$

The ratio of the marginal indirect utility of the price of an environmental attribute and commute time is the ratio of the weighted sum of the elasticities of the composite good, an environmental attribute, and leisure with respect to the price and commute time. The ratio is high if the demand for environmental attribute is elastic, and two inputs are complementary in the production of the environmental good, *ceteris paribus.* It is also high if the demands for the environmental attribute and leisure are inelastic with respect to income, which in turn depend upon the utility function and the production function of the household.

We have shown that the preference for development and environmental policy depends on commute time, the wage rate, current consumption of the environmental good, the household production technology of the environmental good, and degree of the negative externalities, as measured by $dp(d)$, caused by introduction of the industry. It is difficult to predict the attitude toward environment policy and development policy based upon a single characteristic such as wage of a household. This model suggests that the preferences of residents towards policy depends upon the multiple characteristics of the residents and the environmental conditions of the residential area because policy has multiple effects in residential area. This approach also emphasizes the importance of the technology of producing the environmental good in the choice of environmental policy and development policy.

## Ⅲ. Empirical Results

### 1. Data and Respondent Characteristics

In 1990, a survey aimed at identifying how the residents think about their quality of life[2] was conducted in three California counties, Marin, Napa and Solano, within

2) In the survey "Quality of Life" is defined as an individual's perceived or felt overall satisfaction or her / his needs over a period of time.

〈Table 1〉 Distribution of Commute Distance/Time

(unit : %)

| County | 9 Miles / 15 Minutes | 10~30 Miles / 15~60 Minutes | Longer / Longer |
|---|---|---|---|
| Marin County | 36 / 39 | 33 / 51 | 6 / 4 |
| Solano County | 35 / 39 | 21 / 46 | 13 / 8 |
| Napa County | 44 / 57 | 16 / 33 | 9 / 6 |

commute distance to main cities such as San Francisco, Vallejo and Oakland. This survey basically concerns two aspects of the feelings about community. One is on the physical and intangible aspects of environmental quality in their living area; the other is on the area's economic development.

Responses to some questions are similar in three counties, while others are not. Differences in response to development issues were especially marked.[3] It is our intent to identify factors resulting in the different attitudes on development and environmental policies among different groups by county and for all three counties. From the model presented in the previous section, they are such factors as commute time, characteristics of the residential area, income, the possibility of being employed in the new industry, and types of the current jobs.

In 〈Table 1〉, the distribution of commute distance / time of the residents in each county is summarized. More than half of the residents commute less than 30 miles or one hour. However, there are some differences among the three counties. In Solano County, a relatively large percentage of residents commute longer distances. In Napa County, more than half of the residents spend less than 15 minutes to commute.

The distribution of jobs in 〈Table 2〉 among the three counties is different too. There is a higher percentage of blue collar workers in Solano and Napa than in Marin County. In Marin, those who have professional jobs or are business executives are a larger share of the population than in Solano and Napa County. Napa County shows the lowest percentage for white collar and professional jobs.

3) For example, the percentage of the people's agreement on the idea that new business and industry should be encouraged to be located in their own county are different among counties. In Marin County, only 40 percent of respondents agree, while agreement was higher at 77 percent in Solano and 63 percent in Napa. On the question, "*Increased growth will hurt our quality of life,*" 62 percent agree in Marin County, 56 percent in Napa and 51 percent in Solano.

〈Table 2〉 Distribution of Jobs of the Respondents

(unit : %)

| Job | Marin County | Solano County | Napa County |
|---|---|---|---|
| Blue Collar | 8 | 19 | 20 |
| White Collar | 23 | 27 | 18 |
| Farmer / Rancher | 0 | 1 | 1 |
| Homemaker | 4 | 8 | 7 |
| Professional | 25 | 9 | 18 |
| Small Business | 6 | 6 | 6 |
| Business Executive | 9 | 3 | 5 |
| Retired | 17 | 17 | 18 |

〈Table 3〉 Distribution of Residential Locations

(unit : %)

| Residential Area | Marin County | Solano County | Napa County |
|---|---|---|---|
| Farm / Rural Area | 14 | 14 | 21 |
| Town under 5,000 | 10 | 8 | 6 |
| Town above 5,000 | 58 | 63 | 64 |
| Suburban Residency | 18 | 11 | 8 |

〈Table 4〉 Income Distribution

(unit : %)

| Income | Marin County | Solano County | Napa County |
|---|---|---|---|
| less than 25,000 | 18 | 21 | 24 |
| less than 50,000 | 28 | 37 | 34 |
| less than 80,000 | 25 | 21 | 22 |
| more than 80,000 | 18 | 7 | 8 |

The distribution of the residential location is summarized in 〈Table 3〉. In Marin County, about 28 percent of respondents live in suburban areas near cities or small towns whose population is less than 5,000, with 19 percent in Solano, and 14 percent in Napa. In Napa County, more than 20 percent live in unincorporated rural residential areas while 14 percent do so in Marin and Solano Counties.

Finally the distribution of the family income in 〈Table 5〉 shows that almost 20 percent of the residents earn less $25,000 a year in all three counties.

In Marin County, family income of 43 percent of the respondents is more than $50,000 a year, while 28 percent in Solano and 30 percent in Napa Counties. About 35 percent of respondents in Solano and Napa County earn from $25,000 to $50,000 in a year. The high percentage (18 percent) in the high income group in Marin County is closely related to the high percentage of professional and business executive jobs in its population.

## 2. Estimation on the Model

In the previous section we have seen the distribution and the difference among three counties of some characteristics of the residents assumed to be relevant to the preferences for development and environment policies in the San Francisco Bay area. To investigate the effect of these variables on the preferences, we chose one question in the survey for analysis, "*Preserving the county's natural resources is more important than increasing economic profits.*" The interviewees were asked to choose one of five alternatives, *strongly agree, agree, disagree, strongly disagree and no opinion.*[4]

The effect of the characteristics of the residents on the strength of the response is estimated by applying the ordered probit model. Let's assume the anticipated utility of residents if development policy were implemented as the function of the explanatory variables following a simple theoretical model.

$$U_i = X_i'\beta - e_i$$

where $U_i$ is the anticipated utility of a resident in the residential area; $X$ is a vector of the explanatory variables such as commute distance, income, and other personal characteristics; the error term $e_i$ due to the unobserved characteristics to the research is assumed to be normally distributed with mean 0 and variance 1, i.e. $e_i \sim N(0, 1)$. If we define the current level of a resident $i$ as $U_i$, the response, $R_i$, of a resident can be formalized as follows.

4) We have omitted "no opinion" from analysis because it is difficult to know its precise meaning.

$$
R_i = 1 \text{ (Strongly disagree)} \qquad \qquad U_i - \overline{U} < C_1
$$

$$
R_i = 2 \text{ (disagree)} \qquad \text{if} \qquad C_1 < U_{ii} - \overline{U} < 0
$$

$$
R_i = 3 \text{ (agree)} \qquad \qquad 0 < U_i - \overline{U} < C_2
$$

$$
R_i = 4 \text{ (Strongly agree)} \qquad \qquad C_2 < U_i - \overline{U}
$$

Two critical values, $C_1 < 0$ and $C_2 > 0$, divide the strength of the response into two categories. We can estimate the parameters, $\beta_j$'s, and critical values, $C_1$ and $C_2$, by the maximum likelihood estimation method. We include location of the house, commute distance, income, type of job, race, age and level of education of the residents as explanatory variables in the model.[5]

We apply the same statistical model to four different data sets. One is the pooled data set of three counties, Marin, Napa and Solano. The other three are the data set of each county.

The results are summarized in 〈Table 5〉. Most estimates, summarized in the first column, are significant when the model is applied to the pooled data set. Those who live in the countryside or small towns are more likely to show a stronger preference for preserving the natural resource (environment) than those living in cities or dense suburban areas. This result suggests that attitude toward development are reflected by a family's residential location. Since environmental quality is better in small towns or rural areas than in larger urban areas, people who choose to live there are more likely to prefer environmental leisure or attributes as predicted in the model.

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5) The variables are defined as follows;

*small town* = 1 if the resident lives in the countryside or in a town / city of less than 5,000 people.
*big town* = 1 if the resident lives in a town / city, more than 20,000 people, or lives in a suburban area close to town / city over 5,000 people.
*distance* : commute distance. Distance 2 = distance* distance.
*income* : family income of the resident. Income 2 = income*income.
*business executive* = 1 if the job of the person is a business executive.
*professionals* = 1 if the job of the person is a professional one.
*white collar* = 1 if the job of the person is a white collar one.
*blue collar* = 1 if the job of the person is a blue collar or small business.
*not employed* = 1 if the person is retired or a student or homemaker.
*education* = 1 is the ethnic group of the person is white.
*age* = 1 if the age of the person is between 25 and 50.

〈Table 5〉 Preserving the County's Natural Resources is More Important Than Increasing Economic Profits

| Variables | Three Counties | Marin County | Napa County | Solano County |
|---|---|---|---|---|
| Big Town | 0.2063* | 0.2344 | 0.9295** | −0.2028 |
| | (0.1166) | (0.1818) | (0.4233) | (0.2393) |
| Small Town | 0.4341** | 0.5714** | 1.2355** | −0.0647 |
| | (0.1385) | (0.1997) | (0.4274) | (0.2949) |
| Distance | 0.0194** | 0.0182 | 0.0104 | 0.0336** |
| | (0.0090) | (0.0152) | (0.0165) | (0.0159) |
| $\text{Distance}^2$ | −0.00029** | −0.00036* | −0.00012 | −0.00049* |
| | (0.00015) | (0.00021) | (0.00025) | (0.00029) |
| Income | 0.97E−5** | 0.11E−4* | −0.29E−5 | 0.19E−4** |
| | (0.373E-5) | (0.61E−5) | (0.80E−5) | (0.66E−5) |
| $\text{Income}^2$ | −0.37E−10** | −0.38E−10 | 0.11E−10 | −0.99E−10** |
| | (0.16E−10) | (0.26E−10) | (0.34E−10) | (0.31E−10) |
| Business Exec | −0.0663 | 0.4345 | −0.2574 | −0.8877** |
| | (0.2652) | (0.4281) | (0.5327) | (0.3659) |
| Professionals | 0.5566** | 0.6975* | 0.2787 | 0.6909* |
| | (0.2200) | (0.3790) | (0.4124) | (0.4046) |
| White Collar | 0.3729* | 0.6916** | 0.3678 | 0.1874 |
| | (0.1988) | (0.3375) | (0.4034) | (0.3448) |
| Blue Collar | 0.4277** | 0.4715 | 0.4202 | 0.3659 |
| | (0.1947) | (0.4236) | (0.3682) | (0.3054) |
| Not Employed | 0.5475** | 0.3378 | 0.6143* | 0.7457** |
| | (0.1789) | (0.3297) | (0.3915) | 0.2978 |
| Race | 0.5611** | 0.5291** | 0.4244 | 0.5160** |
| | (0.1196) | (0.2458) | (0.3114) | (0.1750) |
| Education | 0.0905 | −0.0276 | 0.0080 | 0.3301** |
| | (0.1097) | (0.2409) | (0.1993) | (0.1654) |
| Age | 0.1764** | 0.1633 | 0.2826* | 0.1075 |
| | (0.0961) | (0.1757) | (0.1820) | (0.1631) |
| a1 | 1.0205** | 0.9813** | 1.0286** | 1.0944** |
| | (0.0400) | (0.0787) | (0.0737) | (0.0628) |
| a2 | 1.2158** | 1.2821** | 1.1328** | 1.3052** |
| | (0.0284) | (0.0501) | (0.0527) | (0.0502) |

Source : Standard errors of the estimates are in ( ).
* Significant at $\alpha = 0.10$.
**Significant at $\alpha = 0.05$.

Resident responses are not monotonically increasing in commute distance and income. The preference for preserving environment to economic development gets stronger as income or the commute distance increases up to a certain point, but weaker after that point. In the theoretical model, some commuters are against development even if they can be employed and get paid the same wage rate if the cross elasticity of leisure with respect to environment quality is negative or sufficiently small or its own elasticity is large.

At low wage rate the demand for leisure is decreasing as the wage rate goes up, so that she / he demands more environmental attribute to substitute for leisure if both inputs are substitutes. Agreements on the preserving environment become stronger as the wage rate rises for the outside workers. If they are insider workers their responses depend on the utility change from the increased wage income and the disutility from deteriorated environmental quality. Our empirical results suggest that the increase in the utility from wage income dominates the decrease from the deterioration of the residential environment for the residents whose income is above a certain level. If the wage income is below that level, the demand for leisure decreases as the wage rate increases, and demand for environmental attributes increases if they are substitute for leisure.

If we assume the current type of job affects the possibility of being employed when a new industry is introduced in residential area, the empirical results are significant in explaining the difference in the perception on the benefit of development policy. Among the five current job types, those who are retired or students and the professionals show the strongest preference for environmental policy. The blue collar workers show a weaker preference for environmental policy than the white collar ones.

When we divide the sample into three counties, the significance of the estimates are quite different from those of the pool. In Marin county, the effect of commute distance and income on the strength of the preference are monotonic. Those who commute a shorter distance or earn higher incomes show a stronger preference for environmental policy than those who commute longer or have lower incomes. The share of the professionals in the population in Marin county is the highest among three county as shown in 〈Table 2〉. This may be responsible for the monotonic relation of the preference for environment policy relative to development policy with income. Professionals and the white collar workers living in Marin county have very strong preference for environmental policy.

In Napa county only a few variables are significant. Napa has the highest percentage of rural residents and shows about twice as strong as the other two counties preference for environmental policy.

Solano county shows two distinct result differences. One is the insignificance of the estimates concerning the influence of residence upon environmental policy. The other is that the data indicate a negative preference for environmental policy by "business executives." The retired show the strongest preference for environment policy among three counties.

The commute distance, income, types of current job as well as the living place are important determinants of stated preference for environment policy relative to development. However the effects of those variables on the strength of the preference are not linear and are different among three counties whose environmental amenity and degree of industrialization are different.

## Ⅳ. Conclusion

In this paper we present a simple model on the choice of a household, whose residential location is fixed, between development policy and environmental policy and perform an empirical test of the hypotheses derived from the model. In the model we have shown the sign of utility change of the household depending upon the wage rate, current environmental quality of the residential area, and the possibility being employed in the newly introduced industry. The new industry is assumed to create more job opportunities, pay higher wage, but reduce quality of residential area. We have also illustrated how differences in the household production technology of the environmental good and the utility of the residents affects the preferences for environment and development policy.

The empirical results partially for three counties in the San Francisco Bay area support the hypotheses. In the empirical results income level of the resident, types of current jobs, environmental amenity of the residential area are the most important factors affecting the attitude towards preservation. As the descriptive summary on the characteristics of three counties suggests, the effect of those variables on the attitude toward environmental and development policy are different implying the heterogeneity of the utility and household production technology as well as environmental quality among three counties.

For further studies more detailed and organized data collection is required. If it is available, we can directly estimate the utility function of the residents, the household production technology of the environmental good, the time allocation behavior, and the externality effect on environmental quality of the new pollution sources so that more reliable test on the hypotheses developed in this paper be performed.

This paper can be extended to investigate explicitly the choice of policies for development and improving environment. There is an asymmetry in the benefit and the cost of two policies. The benefit from the introduction of new industry or creation of jobs in or near residential area is private in the sense that the benefit goes only to the residents who are employed and/or paid higher wage. But the cost, the negative externality caused by the introduction of the industry, is public. The benefit of the environmental policy is, in most cases, public as is the cost. Of course the cost can be private. If this study extended in this way, more rigorous theory on the choice of development and environment policy could be developed.

# 〈Appendix 1〉

**Proof** (a) By definition of the outside workers, $dw = dT = 0$. A negative effect of the new industry on environmental quality of an residential area implies the increase of the price of an environmental attribute, $dp > 0$. Then equation (19) becomes

$$dV|_{dI=0} = V_P\, dp \qquad \text{(A.1)}$$

From $V_P < 0$, and $dp > 0$, the utility of the outside worker decreases if new industry moves in, $dV < 0$. Q.E.D.

**Proof** (b) (i) For a outside worker $dw = dT = 0$, and improvement of environmental quality implies $dp < 0$. From (A.1) the indirect utility of the outside worker increases;

$$dV|_{dI=0} = V_P\, dp > 0$$

(ii) For a inside worker, $dT < 0$, $dp < 0$ and $dw = 0$ by assumption.

From (19) we have

$$dV = -V_W wdT + V_P dp \qquad \text{(A.2)}$$

Both the first and second term in (A.2) is positive because of $V_w > 0$ and $V_p < 0$.

Q.E.D.

## 〈Appendix 2〉

**Proof** (a) Consider a newly introduced industry will save commute time of the insider worker and pays higher wage rate, but reduce quality of environmental attribute, i.e. $dT < 0$, $dw > 0$, and $dp > 0$.

$$dV|_{dI=0} = V_W (1-\mathrm{T}(d))\, dw - V_W wdT + V_P dp \qquad (19)$$

where $V_W (1-\mathrm{T}(d))\, dw > 0$, $-V_W wdT > 0$, and $V_P dp < 0$

The first two terms represent the marginal benefits of income policy and the last term is the marginal cost to the inside worker. Therefore,

$$dV|_{dI=0} \gtreqless 0 \quad \text{if} \quad V_W (1-T(d))\, dw - V_W wdT \gtreqless -V_P dp \qquad \text{(A.3)}$$

**Proof** (b) From the assumptions in Proposition 2(b), $dT < 0$, $dp > 0$ but $dw = 0$, we can simplify equation (19);

$$dV|_{dI=0} = -V_W wdT + V_P dp \qquad \text{(A.4)}$$

Using the relation, $V_T = -wV_W$, we can replace $V_W$ in equation (A.4) with $V_T$.

$$dV|_{dI=0} = V_T\, dT + V_P dp$$

$$= V_T\left(dT + \frac{V_P}{V_T}\right) dp \qquad \text{(A.5)}$$

From Roy's identity[6)]

$$\frac{V_P}{V_T} = \frac{q}{w} \qquad \text{(A.6)}$$

From equation (A.5) and (A.6),

$$dV|_{dI=0} = V_T\left(dT + \frac{q}{w}\right) dp \qquad \text{(A.7)}$$

$$dV|_{dI=0} > 0 \qquad \text{if} \qquad -wdT > q \qquad \text{(A.8)}$$

$$dV|_{dI=0} > 0 \qquad \text{as} \qquad q \rightarrow 0 \text{ and / or } w \rightarrow \infty$$

Q.E.D.

6) The indirect utility function of a household is from (15), (16), and (17)

$$V = V(X(p, w, T, I),\ Z(q(p, w, T, I), l(p, w, T, I)))$$

Differentiate indirect utility function and budget constraint with respect to $p$ and $T$ holding $dw = dI = 0$.

$$V_p = V_X X_p + V_Z(Z_q q_p + Z_l l_p)$$
$$V_T = V_X X_T + V_Z(Z_q q_T + Z_l l_T)$$
$$X_p + q + pq_p + wl_p = 0$$
$$X_T + pq_T + wl_T = -w$$

From first order conditions

$$\frac{V_P}{V_T} = \frac{V_X\left(X_p + \frac{V_Z}{V_X}(Z_q q_p + Z_l l_p)\right)}{V_X\left(X_T + \frac{V_Z}{V_X}(Z_q q_T + Z_l l_T)\right)} = \frac{\left(X_p + p\left(q_p + \frac{w}{p} l_p\right)\right)}{\left(X_T + p\left(q_T + \frac{w}{p} l_T\right)\right)} = \frac{(X_p + pq_p + wl_p)}{(X_T + pq_T + wl_T)}$$

Therefore,

$$\frac{V_P}{V_T} = \frac{-q}{-w} = \frac{q}{w}$$

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