Research on the Demand Elasticity of Importing Flowers in Germany -Based on Rotterdam Model

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Abstract: ***Use Rotterdam model to estimate total expenditure and demand elasticity of import prices of flowers from different countries in Germany flower market, the result indicates that, in Germany market, the gross expenditure of import demand for flowers from China, Italy and Netherland is highly elastic, but that of import demand for flowers from Kenya, Ecuador and Colombia is inelastic, which has proved that, in Germany flowers market, flowers from Italy, Netherland and China are more preferred. Therefore, as long as the market promotion, brand building and variety cultivation of Chinese flowers could be enhanced, Chinese flowers will substitute for Netherland flowers to occupy much more share of Germany market.***

Keywords: ***flowers, Rotterdam Model, demand elasticity; trade***

1. Introduction

Germany is a nation of the highest level of economic development in Europe union, and it's a traditional big nation in terms of consuming flowers. In recent years, it always keeps the first consumer in terms of flower consumption. In 2000, the total flower import was 719.713 million us dollars, and in 2011, it was 1.2076 billion us dollars, the annual average growth rate of flower import was 5.31% during the 12 years, and Germany correspondingly became the third market in terms of consuming flowers following North America and Japan in the world. China began to export flowers to Germany in 1990, although the gross flower export to Germany fluctuated seriously, it overall kept an increasing trend. In Germany flower market, China, Netherland, Kenya, Italy, Ecuador, Columbia and Israel have been fiercely competing for the share of flower market. Thus, researching the import demand and demand elasticity of flowers, especially that of the flowers from China, will be greatly meaningful for China to expand flower trade with Germany.

So far, although the existing literature about studying import demand for flowers and plants in Germany market is extremely rare, some scholars ever used Rotterdam model to analyze the EU's imports demand for flowers from developing countries, and they thought that the EU should end the General tax system of preferences for developing countries (Andrew Muhammad, William A.Amponsah, Jennifer H. Dennis，2010);

Andrew further used Rotterdam model to estimate the EU's demand elasticity of different flowers from different countries, and found the characteristics of significant own-price elasticity of flowers from Ecuador, Kenya and Israel in EU market, and that of positive cross-price elasticity of roses from Ecuador and other source countries, but to the other kinds of flowers, only the cross-price elasticity of flowers from Israel and other source countries was significantly positive; Some domestic scholars have done some research and found that the residents in Germany have a perennial habit of consuming flowers, there is a big market of flowers, and due to the economic recession in recent years, the demand for low price fresh flowers from China is increasingly growing, through the research of Germany flower market. (Zhou Yingheng, Qi Bo, 2006);

Besides flowers, Rotterdam model was also used for analyzing other products imported from overseas, Eales, Durham, Wessells (1997) used Rotterdam model to analyze the demand elasticity of Germany seafood imports structure in comparison with the aggregate expenditure, and pointed out that the demand for the high-valued fresh fish from Thailand and that of medium-valued fresh fish from Vietnam were high elastic; the import demands for marine mollush from Indonesia and marine shellfish from China presented the attribute of unit elasticity, and the demand for low-valued fresh fish from Mexico presented lack of resilience. The study further indicated that the marine products from Thailand, Mexio and China had a high resilience, while the marine products from Vietnam and Indonesia presented lack of resilience. Seale J.L, sparks A.L and Buxton B.M (2005), through analyzing with Rotterdam model, drew a conclusion that the import demand for fresh apple was lack of resilience in Germany fruit market; Some other scholars adopted Rotterdam model to research China's soybean import demand and found that the soybean demand of China from the source countries is elastic and sensitive to the price of soybean from America, Brazil and Argentina (GaoYin, Tian Weiming, 2007).

From the limited research literature, it's known that the Rotterdam model has been adopted in the empirical studies of agricultural products. Rotterdam is a kind of systematic model meeting the the needs of adding-up, homogeneity and symmetry, meanwhile, this model has the nature of being easy to estimate the elasticity, including the spending elasticity and price elasticity. And it's not strict for sample capacity; a smaller sample is ok in comparison with other demand systems. But, this model has its own impaction of assumption that the share of marginal expenditure and Slutsky items are supposed to be constant, which could be proved by any relevant researches. Of course, no demand model better than Rotterdam has been found so far （Mark B G，Lee J Y，Seale J L，1994，He Lei,Huo Xuexi, 2011）. Our research institution adopts Rotterdam model to study the demand for flowers in Germany market, allowing for the smaller sample as well as the annual data we could get.

2. The Current Status and Characteristics of Import Trade of Germany Flowers

2.1 Big Nation in Terms of Consuming Flowers

In recent years, Germany has become the biggest one in terms of flower consumption among European Countries, and in Germany market, flower import kept a steady growth (see Figure 1)

Figure1 indicates that, among the top 6 big nations including UK, France, Netherland, Belgium, Italy and Germany, Germany always kept the biggest consumer in terms of flower consumption in recent years (since 2004), and it also tells us that the import demand for flowers in Germany kept a steady increasing trend.

2.2 The source countries of flowers have highly concentrated

It's found that the geographical positions of countries of imported flowers in Germany market highly concentrate, and import share keeps much

stable. Netherland is the biggest source country of the imported flowers in Germany market, and Netherland is also the first and foremost one. Flowers from Netherland occupied a big share of consumption market in Germany between 1991 and 2011, and it continuously kept above 85%, that is to say, Netherland nearly monopolized the flower consumption market during the time; As the second big source country, Italy just occupied 0-2.5% of the share of flower consumption in Germany market; the other three traditional countries exporting flowers like Columbia, Kenya and Ecuador of course also occupied a certain share of the flowers in Germany market.

In comparison with the major countries exporting flowers, China only occupied a small share of the flower consumption in Germany market. In 1991, the flowers from China only occupied 0.01% of the consumption in Germany market, and in 2011, the share increased to 0.02%, it's proved that flowers from China are not competitive in Germany market so far.

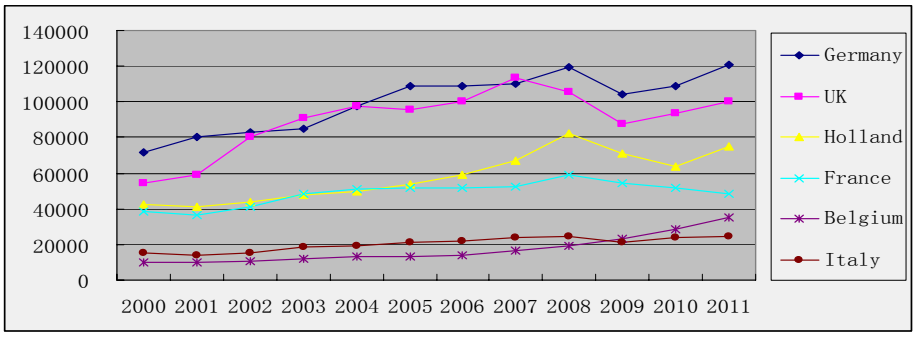

Figure1 Comparison of Germany Flower Imports

Table1 1991-2011 the share of the top 5 source countries and China (10 thousand dollars, %)

Year	Item	1	2	3	4	5	6
	import	106080.1	6636.1	2390．2	1772.2	186.9	15.1
1991	Country	Netherland	Italy	Colombia	Kenya	Ecuador	China
	share	(85.18)	(5.33)	(1.92)	(1.42)	(0.15)	(0.01)
	import	100614.5	3305.3	17737.8	1656.1	703.2	2.5
1996	Country	Netherland	Italy	Colombia	Kenya	Ecuador	China
	share	(88．3)	(2.9)	a(1.5)	(1.4)	(0.6)	(0.008)
	import	71347.6	1934.9	1435.9	1168.2	891	16
2001	Country	Netherland	Italy	Ecuador	Kenya	Colombia	China
	share	(88.9)	(2.4)	(1.7)	(1.4)	(1.1)	(0.02)
	import	97626.1	2514.1	1809.2	1262.9	1169.5	31.5
2006	Country	Netherland	Italy	Kenya	Ecuador	Colombia	China
	share	(89.6)	(2.3)	(1.6)	(1.1)	(1.0)	(0.03)
	import	107831	3148.7	3015.7	1961.4	785.3	20.8
2011	Country	Netherland	Kenya	Italy	Ecuador	Colombia	China
	share	(25.99)	(2.6)	(2.5)	(1.6)	(0.6)	(0.02)

Data source: calculated by the reduced data from United Nations Commodity Trade Statistics Database

3. Theoretical Analysis and the Model Introducing

3.1 The theoretical analysis

Factor endowment theory believes that the difference between input proportion and the

comparative costs in different areas leads to price difference of the same product. According to the consumption theory, the utility of consumers is determined by the quantity of some product consumed by consumers, which can be functioned by U = U (Q), where, Q is the quantity of some product consumed by consumers, U is an increasing function of Q. Resource scarcity theory points out that under established source constraints, the consumption of goods depends on its market price, namely, Q = Q (P, Y), where, P is the price, Y is the consumer's income from possessed resources. Consumers pursuing the maximum utility will always choose the biggest consumption Q_{max} at established income Y and commodity prices. In an open economy, the import demand for some goods in a country is the function of gross national income and prices, which can be expressed as $M_t = f(Y_t, P_t)$, where M_t is the import demand in t period, Y_t is the gross national income level of t period, and P_t is the price level at the same time, and P is also the price vector of the import price of the goods from the country of origin as well as the domestic price. Under the condition of the given national income, the net import demand for some goods depends on the prices of the goods from the source countries. And the demand for this goods in any country of origin is not only influenced by own-price, but also affected by cross-price. Therefore, demands for the goods from the source countries can be identified through its own-price elasticity, and the relationship between the demands for the goods of same kind from other source countries may be analyzed through cross-price elasticity. If the cross- price elasticity of the goods from two source countries is less than 0, it indicates that there is fully complementary relationship, or there is substitution relationship.

3.2 Rotterdam model

In order to accurately identify the different demands for flowers from different source countries and correspondingly their mutual relationships in Germany flowers market, Rotterdam model is employed to measure the price elasticity and cross- price elasticity. The model was first put forward by Barten (1964) and Theil (1965), which has a characteristic of reaching more reasonable estimation of price elasticity and expenditure elasticity of demand even under the circumstance of smaller sample size, and this model has been widely used in researching the demand for importing agricultural products. It can be functioned as,

$$w_i d\log q_i = \alpha_i d\log Q + \sum_{j=1}^{n} \beta_{ij} d\log p_j ,$$
$$i, j = 1, 2, \cdots, n$$

Where, w_i, q_i, p_i separately represents the proportion, the volume and the price of the flowers from country i in the total of flowers imported by Germany, $d\log q_i$ represents the growth rate of imported flowers, $d\log p_i$ represents the growth of import price, α_i is the marginal expenditure, β_i is the net effect of import price. Generally, w_i can be estimated approximately by $(w_{it} + w_{it-1})/2$, and $d\log q_{it}$ can be approximately estimated by $\log(q_{it}/q_{it-1})$, and $d\log p_{it}$ can be approximately estimated by $\log(p_{it}/p_{it-1})$, and $d\log Q$ can be approximately estimated by $\sum_{j=1}^{n} w_j d\log q_j$ as well.

This model meets the following constraints: (1) adding-up, that is to say, $\sum_{i=1}^{n} \alpha_i = 1$, $\sum_{i=1}^{n} \beta_{ij} = 0$; (2) homogeneousness, namely, $\sum_{j=1}^{n} \beta_{ij} = 0$; (3) symmetry, namely, $\beta_{ij} = \beta_{ji}$. The following formulas are employed to calculate the kinds of elasticity. Expenditure elasticity can be calculated by $\eta_i = \alpha_i / w_i$, Slutsky price elasticity can be calculated by $\varsigma_{ii} = \beta_{ii} / w_i$ (own-price elasticity) and $\varsigma_{ij} = \beta_{ij} / w_i$ (cross-price elasticity), and Slutsky price elasticity refers to that of eliminating the income effect.

This paper employs Rotterdam to estimate the

marginal expenditure share and the net effect of import prices of the flowers from different source countries in Germany flowers market, and further estimate the expenditure elasticity and price elasticity of the flowers from different source countries, then, explore the relation between the flowers from China and that from other source countries in Germany market, so as to provide favorable recommendations to improve the competitiveness of Chinese flowers and plants in Germany market.

3.3 Data sources

According to the procurability of certain data of the flower from China and that of the imported flowers in Germany market, the data from 1988 to 2011 are adopted in this work; all the data are just from United Nations Commodity Trade Statistics Database. The source countries of the flowers in Germany market include China, Netherland, Italy, Columbia, Kenya and Ecuador, and in the past 20 years, and the flowers from these countries occupied 90% share of the consumption in Germany flower market, therefore, this paper mainly researches the import price elasticity and import proportion of the flowers imported from these seven countries, and the import prices are all CIF.

4. Estimation and Analysis of the Elasticity of Demand for Imported Flowers

4.1 Binding Test of the parameters in Rotterdam

There are several ways to test model binding parameters, such as F test, Wald test and T test (Junli Li, 2008). This paper employed seemingly uncorrelated regression, being used by Jingjuan Zhou (2010), Lei He, Xuexi Huo (2011), to estimate model (1) under unconstraint and constraint conditions, then further do F-test of the residual sum of square of them, to finally test the parameters with constraint conditions of model (1).

Unconstrained model (1) contains 7 equations corresponding with the seven major source countries and the other countries exporting flowers to Germany, and 8 column vectors corresponding with 1 import variable and 7 import prices relevant to the source countries, and we obtained the residual sum of square 0.0016 through estimating with seemingly unrelated regression ; the Constrained model (1) contains 7 equations, 8 column vectors (7 equations corresponding with the seven major source countries and the other countries exporting flowers to Germany, and 8 column vectors corresponding with 1 import variable and 7 import prices relevant to the source countries) and three constrains ($\sum_{i=1}^{n} \alpha_i = 1$, $\sum_{j=1}^{n} \beta_{ij} = 0$; $\sum_{i=1}^{n} \beta_{ij} = 0$; $\beta_{ij} = \beta_{ji}$), and we further obtained the residual sum of square 0.0023 through estimating with seemingly unrelated regression; and F value is 1.136. At the significant level 0.05, the number of constraints is 3, and F value is 2.66 when the degree of freedom is 11 (21-9-1), namely, $F<F(4, 13)_{0.05}$, the original hypotheses are accepted, and it's deemed that model (1) meets the constraints of the parameters and it is suitable to account for the expenditure elasticity and price elasticity of the demand for flowers in Germany market (see table 3).

Table 2 Demand system model parameter with binding test

	residual sum of squares	F Value	5% critical value
Unconstrained system	0.0016	1.136	2.66
Constrained system	0.0023		

4.2 Parameter estimation of demand

Using the seemingly unrelated regression method to estimate the constrained model (1), the result is indicated in Table 3, and the corresponding analysis is as follows:

Table 3 the estimation results of Germany Rotterdam model parameters

Origin country	Spending parameters	Price parameters						
		Netherland	Kenya	Italy	Ecuador	Colombia	China	Others
Netherland	0.927*** (75.48)	-0.08*** (-3.05)	0.007 (0.935)	0.036*** (3.357)	0.004 (0.553)	0.045** (4.89)	-0.006 (-0.748)	0.016** (2.561)
Kenya	0.0001 (0.03)		-0.0007 (-0.174)	-0.008** (-2.006)	0.001 (0.513)	-0.004 (-0.996)	-0.003 (-0.958)	0.005* (1.793)
Italy	0.044*** (7.92)			-0.018*** (-2.561)	-0.007** (-2.183)	-0.006 (-1.178)	0.001 (0.386)	0.001 (0.76)
Ecuador	0.002 (0.566)				-0.0003 (-0.09)	-0.001 (-0.227)	0.006** (2.324)	-0.003 (-0.478)
Colombia	0.01** (2.148)					-0.017* (-1.696)	0.001 (0.274)	0.001 (1.264)
China	0.0008 (0.203)						-0.007* (-1.873)	0.007 (0.325)
Others	0.104* (1.961)							-0.026** (-2.341)

Note: *the spending parameters of other countries are calculated by adding-up, homogeneity and symmetry as well as the constraints of the model, data in the brackets are the corresponding T statistics of the parameters, * indicates that it's significant at the level 10%.*

The analysis of model estimation is as follows:

(1) The result of parameter estimation indicates that the expenditure coefficient of every equation is positive, and the expenditure coefficient of every equation is not equal to zero at different significant level 1%, 5% and 10% correspondingly, which means when the Germany budget for importing flowers increases by 1%, the import budgets for flowers from Netherland, Italy, Columbia, Colombia and other countries consequently increase by 0.927%, 0.044%, 0.01% and 0.104% respectively. The expenditure coefficient of the flowers from China is not significant, indicating the increase of import demand for the flowers from China is not significant when the import demand for the flowers overseas increases in Germany market, but it's true that the expenditure coefficient of the flowers from China is still positive, indicating the import demand for the flowers from China in Germany market is potential.

(2) table 3 tells us that the own-price coefficients of the demands for flowers from Netherland, Kenya, Italy, Ecuador, Colombia, China and other source countries are all negative in Germany flower market, indicating the flowers from Netherland, Kenya, Italy, Ecuador, Colombia, China and other source countries to Germany flower market are all normal goods and their demands are negatively correlated to prices respectively. While, it must be pointed out that the self –price coefficients of the import demand for flowers from Netherland, Italy, Colombia, China and other countries are significantly not zero, indicating the import prices of the flowers from Netherland, Italy, Colombia, China and other countries are significantly negatively impact on the import demands for flowers from these source countries; although the self- price coefficients of the import demands for flowers from Kenya and Ecuador are significantly negative, they are not equal to zero, indicating that, in Germany market, the negative impact of the import prices of the flowers from these two source countries on the demand for flowers overseas in Germany market are not significant.

4.3 The endogenous test of independent variables

The result of seemingly uncorrelated estimation

of the parameters of each function in the demand system indicates that there is an independent variable dlogQ in each equation in the system, which may have correlations with random residuals (see table 3). If the independent variable dlogQ is an endogenous variable in model (1), then the estimation result of model (1) may be distorted, thus it is necessary to test the endogeneity of the independent variable dlogQ. According to the method put forward by Theil (1976) that if the endogeneity of dlogQ in model(1) is false, namely, dlogQ is exogenous to model (1), then the covariance of the random residuals of each function in this system is several times the Slutsky coefficient, namely, $\mathrm{cov}(\varepsilon_i, \varepsilon_j) = \lambda\beta_{ij}$. What's more, we continue to do linear regression using $\mathrm{cov}(\varepsilon_i, \varepsilon_j)$ as dependent variable, and β_i as independent variable, it's concluded that $\mathrm{cov}(\varepsilon_i, \varepsilon_j) = 1.43 \times 10^{-6} (1.071) - 0.0007 (-10.531) \times \beta_{ij}$. From the corresponding T values in the brackets, it's concluded that the constant of the equation is not significant, while the parameters before β_{ij} are significantly not 0, implying that $\mathrm{cov}(\varepsilon_i, \varepsilon_j)$ is negative times the Slutsky, therefore, this proves the endogeneity of dlogQ is false, and the parameter estimation of whole demand system is effective.

4.4 Estimation and analysis of demand elasticity

Using Rotterdam model, we can calculate the expenditure elasticity and price elasticity of Germany import demand for the flowers and plants from Netherland, Kenya, Italy, Ecuador, Colombia, China and other countries with sample average 1988 and 2011(see table 4).

Table 4 Expenditure elasticity and price elasticity of import demand for flowers from different countries

	Expenditure elasticity	Netherland	Kenya	Italy	Ecuador	Colombia	China	Others
				Compensation price elasticity				
Netherland	1.050	-0.094	0.008	0.041	0.005	0.029	-0.007	0.018
Kenya	0.007	0.412	-0.059	-0.471	0.059	-0.235	-0.176	0.294
Italy	1.582	1.286	-0.286	-0.643	-0.250	-0.214	0.036	0.036
Ecuador	0.150	0.333	0.083	-0.583	-0.025	-0.083	0.500	-0.167
Colombia	0.815	2.000	-0.308	-0.462	-0.077	-1.308	0.077	0.077
China	4.260	-30.000	-15.000	5.000	30.000	5.000	-35.000	35.000
Others	0.330	0.348	0.109	0.022	-0.043	0.022	0.152	-0.565
				Non-compensation price elasticity				
Netherland		-1.021	-0.010	0.011	-0.008	0.029	-0.007	-0.030
Kenya		0.405	-0.059	-0.471	0.046	-0.241	-0.176	0.294
Italy		-0.111	-0.313	-0.687	-0.269	-0.235	0.035	-0.037
Ecuador		0.201	0.081	-0.588	-0.027	-0.085	0.500	-0.174
Colombia		1.280	-0.322	-0.484	-0.087	-1.318	0.077	0.039
China		-33.762	-15.072	4.881	29.949	4.945	-35.001	34.804
Others		0.056	0.103	0.012	-0.047	0.017	0.152	-0.580

From the perspective of expenditure elasticity, it's concluded that, in Germany market, the total import demand for flowers from Netherland, Italy and China are highly elastic, and their elastic

coefficients are respectively 1.050, 1.582 and 4.260. However, the total expenditures of import demand for flowers from Kenya, Ecuador, Colombia and other countries are inelastic, and their elastic coefficients are respectively 0.007,0.150, 0.815 and 0.330, which suggests that every 1% increment of total expenditure for Germany importing flowers and plants will lead to1.058% import increment of the flowers from Netherland, 1.582% import increment of the flowers from Italy, and 4.260% import increment of the flowers from China, while the increments of import expenditure for flowers from Kenya, Ecuador, Colombia and other countries are respectively only 0.007%, 0.15%, 0.815% and 0.33%. Namely, when the imports demand for flowers and plants in Germany market increases, Germany consumers prefer the flowers from Netherland, Italy and China to that from Kenya, Ecuador, Colombia and other countries. The reason may be that the flowers from the other source countries, such as the Netherland, Ecuador, Colombia and etc. traditional countries exporting flowers, are fresh cut flowers, and fresh cut flowers are not easy to reserve and storing, probably most of the flowers from China are dry or potting. By contrasting the expenditure elasticity of demand for flowers from the 6 source countries, we further find that expenditure elasticity of demand for flowers from China is the largest, followed by the expenditure elasticity of demand for flowers from Netherland and Italy, that of the flowers from Colombia is smaller than the former, but still larger than those of the flowers from Ecuador and Kenya. This has proved when demand for flowers in Germany market increases, the exporters from China will benefit the most, and it's also proved that, in Germany market, flowers from China could be further developed for the most potential.

From the perspective of Slutsky price elasticity, we can see that the own-price elasticity of the demand for flowers from China，Columbia，Kenya，Italy，Netherland，Ecuador，Colombia and other countries are all negative, which suggests that flowers in Germany market are normal commodities, and the price and demand are changing with opposite trend. Meanwhile, the absolute values of the own-price elasticity of the demand for flowers from Netherland, Kenya, Italy and Ecuador are less than 1 respectively, indicating the import demand for flowers from these countries to Germany market lacks of price elasticity, and the flowers from these countries have occupied steady shares; and the absolute values of the own-price elasticity of the demand for flowers from China and Colombia are more than 1, especially, that of the own-price of the flowers from China is the biggest, indicating the share of the flowers from China to Germany fluctuates frequently, and decreasing the prices of the flowers from these two countries will increase the shares of the flowers from China and Colombia to Germany.

From the perspective of Cournot un-compensation price elasticity, it's found when the income effect is not eliminated, the own-price demand for flowers from Netherland is highly elastic, it's quite different from the truth that the own-price demand for flowers from Netherland is inelastic when the income effect is eliminated, this may be caused by the income effect to great extent, which also can be verified by the higher expenditure elasticity.

From the perspective of cross-price elasticity, the absolute values of the cross-price elasticity of import demand for flowers from Netherland to that of the flowers from other source countries are all less than 1, which indicates the import demand for flowers from Netherland lacks price elasticity to the flowers from other source countries, it may be Germany and Netherland are all from Europe, Netherland has the absolute advantages to other countries exporting flowers to Germany in terms of Geographical position or trade barriers. Thus, prices of the flowers from other countries can not impact the flowers from Netherland occupying the share of Germany market. Table 4 also tells us that, in Germany market, import demand for flowers from Kenya lack of price elasticity, and import demand for flowers from Italy is positively and highly elastic to the prices of the flowers from Netherland, indicating they are substitutes, and the

flowers from other source countries are inelastic to the prices of the flowers from Netherland, indicating the fluctuation of the flowers from the source countries except Netherland will not impact on the share of the flowers from Italy in Germany market.

5. Conclusion and Discussion

The gross expenditure of demand for flowers from Netherland, Italy and China is highly elastic in Germany market, and that of the demand for flowers from Kenya, Ecuador and Colombia are inelastic, indicating flowers from Netherland, Italy and China are more popular in Germany market; And if the flowers from China can be promoted widely in Germany market, and brands and breeds can be constantly improved, flowers from China will surely occupy bigger share in Germany market.

In fact, the expenditure elasticity and price elasticity of any commodity has close relationship with the sum of the used data. The expenditure elasticity and price elasticity of demand for flowers in Germany market are estimated on the basis of annual data, and the quarterly and monthly fluctuation of demand are ignored, which may influence the estimation to some extent; What's more, considering small sample, Rotterdam is adopted in this paper, although the restraints meeting the model are strictly tested, Rotterdam may be not the perfect one to study such points, because these restraints also are satisfying other demand models, and the estimated elasticity values of different models may be significantly different, therefore, much more further researches must be continued in future.

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