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Article

Uncertainty of the Imported Products and Its Effect on the Income Distribution of Importer

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Abstract: This paper aims to test the uncertainty of the imported products and its effect on the income distribution of importers. This research firstly shows Korea as the risk preference. We show that the relationship between capital and labor has been evolved from when there is no uncertainty to when there is uncertainty, while the relationship between import and capital is complementary. This result proves that the lower uncertainty of imported products hampers the capital of the importing country while it benefits the labor market.

Keywords: Hicks q-Complementary, Substitution, Reverse Demand Elasticity

1. Introduction

When compared with domestic trade, international firms need to confront a lot of barriers and risks such as contract violation, political disruption, and military conflicts. Price uncertainty also plays an important role in the decision-making of domestic firms. According to Appelbaum and Kohli (1997, 1998), there are two uncertainties for imported products: the uncertainty of foreign exchange and price uncertainty due to the geographical and cultural barriers. Therefore, when importing decisions, the importers have difficulty in forecasting the price of the imported products.

Many researchers claimed that trade restriction is harmful to domestic welfare since the effect of trade restriction on income distribution is not fully analyzed. Appelbaum and Kohli (1997, 1998) pointed out that during past decades, the research on this topic has not been sufficient even with the dramatic change of international trade. Kohli (1978) regarded import and labor as variables to affect the domestic factor and international trade. On the contrary, Appelbaum and Kohli (1997) incorporated the existence of an imperfectly competitive market to test the existence of deviation of price-decision. Later, Appelbaum and Kohli (1997, 1998) analyzed the case of America and Switzerland. To verify their theory, Appelbaum and Ullah (1997) analyzed the case of the press, stone, and glass industry in America. Kumbhakar (2002) analyzed the cases in Norway, and Satyanarayan (1999) considered the case of the medical industry in England.

We adopt the method of Applelbaum and Kohli (1998) and extend the production theory to consider the price uncertainty of imported products of Korea. The purpose of this study is to understand whether a biased estimation is caused if the uncertainty is excluded in estimating the demand function and whether the uncertainty impacts the price of imported products and decreases international trade.

2. Theoretical Model

This study considers the following production equation as the theoretical model.

$$y = f(X, t) \tag{1}$$

where $X = \{X_M, X_K, X_L\}$ and X_M, X_K, X_L represents total import, domestic capital, and domestic labor, respectively, and t is the time variable. Equation (1) is a continuous and non-decreasing linear-homogenous function. The model assumes the following: (1) all markets are perfectly competitive and (2) when a production decision is made, the import price q_M is unknown while the price of output p, the rental price of capital w_K and labor wage w_L are known. Then, the import price q_M has the density function $g(q)$. The import price q_M is obtained with Equation (2).

$$q_M = \bar{q}_M + e \tag{2}$$

where e represent the random variable and satisfies $E(e) = 0$ and $Var(e) \equiv \sigma_M^2$. As a result, $E(q_M) = \bar{q}_M$, $Var(q_M) = Var(e) \equiv \sigma_M^2$. The output is then obtained by solving the following maximization problem.

$$Max_x E\{U[\pi]\} = Max_x E\{U[pf(x,t) - w_L x_L - w_K x_K - q_M x_M]\} \tag{3}$$

where $U$is a Von Neumann-Morgenstern utility function and $dU/d\pi > 0$. The first-order condition of Equation (3) yields

$$E\{U'[pf_M(x) - q_M]\} = 0 \tag{4}$$

$$E\{U'[pf_h(x) - w_h]\} = 0, h = L, K \tag{5}$$

where $U' = \frac{\partial U}{\partial \pi}$, $f_h(x) \equiv \frac{\partial f(x)}{\partial x_h}(h = L, K)$. Simple substitution rewrite the above (4) and (5) as

$$pf_M(x) = \bar{q}_M + \theta \tag{6}$$

$$pf_h(x) = w_h, h = L, K \tag{7}$$

where $\theta = \frac{Cov[U',e]}{E(U')}$. When firms are risk aversion, then $\theta > 0$, and i marginal risk premium or the "adjusted" import price are considered in the model. The existence of uncertainty causes the marginal production of imported products and derivates its expected marginal cost. For example, if $\theta < 0$, then the marginal value of imported products becomes lower than its market price.

This model derives the demand function for imported products and tests the risk preference and the effect of uncertainty. By applying the envelope theorem, we obtain the import demand function. Together with the value of X, Y and W, the implicit function estimates the price.

3. Income Distribution

To describe the substitution and complement relation between the factors that are proposed by Appelbaum and Kohli (1997, 1998), we define the Hicksian elasticities of complementarity as

$$\Psi_{hn} = \frac{(f_{hn})}{(f_h f_n)}, h, n = M, L, K \tag{8}$$

where $f_{hn} \equiv \frac{\partial^2 f}{\partial X_h \partial X_n}$. The quasi-concave production function implies that $\Psi_{hn} < 0$. If the inputs h and n are Hicksian q-complements (substitutes), then $\Psi_{hn} > 0 (\Psi_{hn} < 0)$.

The comparative analysis of the model is described by the set of the reversed demand function. By taking a logarithm of Equations (1), (6), and (7), we have

$$\begin{bmatrix} \hat{y} \\ \hat{\tilde{q}}_M \\ \hat{w}_L \\ \hat{w}_M \end{bmatrix} = \begin{bmatrix} 0 & s_M & s_L & s_K \\ 1 & \eta_{MM} & \eta_{ML} & \eta_{MK} \\ 1 & \eta_{LM} & \eta_{LL} & \eta_{LK} \\ 1 & \eta_{KM} & \eta_{KL} & \eta_{KK} \end{bmatrix} \begin{bmatrix} \hat{p} \\ \hat{x}_M \\ \hat{x}_L \\ \hat{x}_K \end{bmatrix} \tag{9}$$

where the letters represent the relative change of each variable, s_M is the import share, s_K is share of domestic capital, and s_L is share of domestic labor. η_{hn} is the elasticity of the quantity of the reversed demand function and calculated by

$$\eta_{hn} = \frac{\partial \ln w_h(p, x_L, x_K, x_M, t)}{\partial \ln x_n}, \ h = L, K; n = L, K, M \tag{10}$$

$$\eta_{Mn} = \frac{\partial \widetilde{\ln q_M}(p, x_L, x_K, x_M, t)}{\partial \ln x_n}, \ n = L, K, M \tag{11}$$

Similarly, we obtain the Hicksian elasticities of complementarity as follows.

$$\eta_{hn} = \Psi_{hn} s_n, \quad h, n = L, K, M \tag{12}$$

According to Kohli (1995) and Appelbaum and Kohli (1997, 1998), the reverse demand elasticity is obtained by comparative analysis. By setting a GDP function, we obtain the following set of elasticity.

$$\begin{bmatrix} \hat{y} \\ \hat{x}_M \\ \hat{w}_L \\ \hat{w}_M \end{bmatrix} = \begin{bmatrix} \varepsilon_{YY} & \varepsilon_{YM} & \varepsilon_{YL} & \varepsilon_{YK} \\ \varepsilon_{MY} & \varepsilon_{MM} & \varepsilon_{ML} & \varepsilon_{MK} \\ \varepsilon_{LY} & \varepsilon_{LM} & \varepsilon_{LL} & \varepsilon_{LK} \\ \varepsilon_{KY} & \varepsilon_{KM} & \varepsilon_{KL} & \varepsilon_{KK} \end{bmatrix} \begin{bmatrix} \hat{p} \\ \hat{\tilde{q}}_M \\ \hat{x}_L \\ \hat{x}_K \end{bmatrix} \tag{13}$$

where $\varepsilon_{YY} = (\partial lny)/(\partial lnp)$. By starting from Equation (9), the elasticity of Equation (13) is expressed as follows.

$$\begin{bmatrix} \hat{y} \\ \hat{x}_M \\ \hat{w}_L \\ \hat{w}_M \end{bmatrix} = \begin{bmatrix} -\frac{s_M}{\eta_{MM}} & \frac{s_M}{\eta_{MM}} & s_L - \frac{s_M \eta_{ML}}{\eta_{MM}} & s_K - \frac{s_M \eta_{MK}}{\eta_{MM}} \\ -\frac{1}{\eta_{MM}} & \frac{1}{\eta_{MM}} & -\frac{\eta_{ML}}{\eta_{MM}} & -\frac{\eta_{MK}}{\eta_{MM}} \\ 1 - \frac{\eta_{LM}}{\eta_{MM}} & \frac{\eta_{LM}}{\eta_{MM}} & \eta_{LL} - \frac{\eta_{LM}\eta_{ML}}{\eta_{MM}} & \eta_{LK} - \frac{\eta_{LM}\eta_{MK}}{\eta_{MM}} \\ 1 - \frac{\eta_{KM}}{\eta_{MM}} & \frac{\eta_{KM}}{\eta_{MM}} & \eta_{KL} - \frac{\eta_{KM}\eta_{ML}}{\eta_{MM}} & \eta_{KK} - \frac{\eta_{KM}\eta_{MK}}{\eta_{MM}} \end{bmatrix} \begin{bmatrix} \hat{p} \\ \hat{\tilde{q}}_M \\ \hat{x}_L \\ \hat{x}_K \end{bmatrix} \tag{14}$$

The $\varepsilon_{jM}(j = Y, K, L, M)$ in Equation (14) represent the effects of imported price on the output supply, import demand, and factor price. To deviate the effect of change in the risk premium on the expected import price, the definition of $\tilde{q}_M$ is rewritten as

$$\hat{\tilde{q}}_M = (1-\delta)\hat{\bar{q}}_M + \delta\hat{\theta} \tag{15}$$

where $\delta = \theta/\tilde{q}_M = \theta/(pf_M)$. (Appelbaum and Kohli, 1998). By defining $\varepsilon_{jq}$and $\varepsilon_{j\theta}(j = Y, K, L, M)$ as the partial derivative of output supply and import demand for $\bar{q}_M$and θ under the given value of p, x_L, x_M, it is found that $\varepsilon_{Yq} = (\partial lnY)/(\partial q^{-})$ and $\varepsilon_{Y\theta} = (\partial lnY)/(\partial ln\theta)$. Then, from Equations (9) and (15), we obtain

$$\varepsilon_{jq} = (1-\delta)\varepsilon_{jM}, \ j = Y, K, L, M \tag{16}$$

$$\varepsilon_{j\theta} = \delta\varepsilon_{jM}, \ j = Y, K, L, M \tag{17}$$

Therefore, ε_{jq}, $\varepsilon_{j\theta}$ and ε_{jM} have the same sign. This means that if there is a risk aversion, the increase of θ lowers w_j only when Ψ_{jM} is positive. In other words, the increase of uncertainty of import price decreases the factor price if the relationship between factor and import are Hick q-complementary with each other. On the contrary, when the relationship between factor and import are Hick q-substituting with each other, then the increase of uncertainty of import price increases the factor price.

4. Empirical Step

4.1. Expected Utility

As explained by Appelbaum and Kohli (1997, 1998), the production function with Equations (1), the expected price q_M, and marginal risk premium θ, the reverse demand function is estimated. Unfortunately, as both $\bar{q}_M$ and θ are dependent on the functional form and data, they are neither functions nor parameters. Thus, we use the method of Appelbaum (1991). When the density function g is tight enough, the expected utility function is estimated by second-order expansion as Equation (18).

$$E(U(\pi)) \approx U\left[\bar{\pi} - \frac{1}{2}\alpha Var(\pi)\right] = U\left(\bar{\pi} - \frac{1}{2}\alpha{\sigma_M}^2 x_M\right) \tag{18}$$

where $\bar{\pi} \equiv E(\pi)$ and $\alpha \equiv -\frac{U''}{U'}$ as the degree of risk aversion ($U' = \frac{\partial U}{\partial \pi}$, $U'' = \frac{\partial^2 U}{\partial \pi^2}$). With the condition in Equation (18), Equation (6) is rewritten as

$$p\frac{\partial f}{\partial x_M = \bar{q}_M +} \frac{\alpha\sigma_M^2 x_M}{1 - \frac{1}{2}var(\pi)(\partial\alpha/\partial\bar{\pi})} \tag{19}$$

and the marginal risk premium follows Equation (20).

$$\theta = \frac{\alpha\sigma_M^2 x_M}{1-\frac{1}{2}var(\pi)(\partial\alpha/\partial\pi)} \tag{20}$$

To simplify the empirical analysis, we assume that the risk aversion parameter is constant, which means that the denominator of Equation (11) is equal to 1, i.e., $\theta = \alpha\sigma_M^2 x_M$. One of the benefits of this assumption is that we do not need to assume the functional form of the utility function. However, this may cause a biased result. If the absolute risk aversion parameter is decreasing, then the denominator of Equation (11) would be greater than 1. Therefore, the assumption of the constant risk aversion parameter does not weaken the effect of uncertainty.

4.2. Distribution of Import Price q

Before we estimate the reverse demand function, we need to know the rectangle of the distribution q_M. Thus, we assume that the expectation is rational to obtain the expectation of the rectangle q_M from the information of import price. Therefore, we suppose that the import price is given by

$$q = Q(z, e) \tag{21}$$

where z is import price and t is the time trend and other instrument variables. The consideration of the instrument variable and the endogeneity are expressed as

$$q_{Mt} = a_0 + a_1 q_{Mt-1} + a_2 t + \sum_i b_i z_{it} + e_t \tag{22}$$

where t represents time and z_{it} is the set of instrument variables, $\tilde{\bar{q}}_M$ and $\tilde{\sigma}_M^2$ represents the mean value and variance of q.

4.3. Production Function

We define the following trans-log production function with three inputs (Mohabbat *et al*. 1984).

$$ln(Y) = \beta_0 + \sum \beta_h\, ln(x_h) + \frac{1}{2}\sum_h \sum_n \phi_{hn}\, ln(x_h)\, ln(x_n) + \sum_h \phi_{ht}\, ln(x_h)\, t + \tau t + 0.5\mu t^2 \tag{23}$$

where $h, n = L, K, M$, $\sum \beta_h = 1$, $\phi_{hn} = \phi_{nh}$, $\sum_n \phi_{hn} = \sum_h \phi_{nh} = 0$, and $\sum_h \phi_{ht} = 0$. The parameters of this trans-log production function are indirectly estimated by using the reverse input demand function. By using the Envelope theorem, the reversed input demand function $s_h = \frac{\partial\, ln(Y)}{\partial\, ln(x_h)}$, $h = L, K, M$ is written as

$$s_h = \beta_h + \sum_h \phi_{ht}\, ln(x_h) + \phi_{ht} t, \quad h = L, K, M \tag{24}$$

Given the condition for the production function and the additional assumption of the homogeneous trans-log production function, the reversed input demand function is defined as

$$s_M = \beta_M + \phi_{MK}\, ln(x_K) + \phi_{ML}\, ln(x_L) + \phi_{MM}\, ln(x_M) + \phi_{Mt} t - \alpha \frac{\sigma_M^2 x_M^2}{py} \tag{25}$$

$$s_K = \beta_K + \phi_{KK}\, ln(x_K) + \phi_{KL}\, ln(x_L) + \phi_{KM}\, ln(x_M) + \phi_{Kt} t \tag{26}$$

$$s_L = \beta_L + \phi_{LK}\, ln(x_K) + \phi_{LL}\, ln(x_L) + \phi_{LM}\, ln(x_M) + \phi_{Lt} t \tag{27}$$

where $s_M \equiv \bar{q}_M \frac{x_M}{(py)}$, $s_K \equiv \frac{w_K x_K}{(py)}$ and $s_L \equiv \frac{w_L x_L}{(py)}$ are the share of import, capital, and labor. Based on the equation, we obtain the import function as

$$\tilde{s}_M = \beta_M + \phi_{MK}\, ln(x_K) + \phi_{ML}\, ln(x_L) + \phi_{MM}\, ln(x_M) + \phi_{MT} t - \alpha \frac{\tilde{\sigma}_M^2 x_M^2}{py} \tag{28}$$

where $\tilde{s}_M \equiv \tilde{\bar{q}}_M \frac{x_M}{(py)}$. Therefore, Equations (25)–(27) complete the whole model.

4.4. Random Assumption and Estimation Method

Since the empirical analysis requires the model to be random, we assume that the random property of Equations (25)–(27) stems from the bias during optimization. As the optimization of the function yields the error v_{ht}, $h = M, L, K$, we define $v_t = (v_{ht})'$ and at the same time, assume that the error vectors are independently identically distributed (IID) and have the property of the normal distribution of combination with zero mean value and covariance matric as follows.

$$E(v_t v_s) = \Omega \text{, if } s = t \text{ ; } E(v_t v_s) = 0 \text{, if } s \neq t \tag{29}$$

where Ω is a 3 × 3 positive definite matrix.

Since the summed share of proportion is equal to 1, the apportionment function is always linear. As a result, the sum of error terms is always equal to 1, and the covariance matrices are singular. However, the sum of the model is $1 - u_M \frac{x_M}{py}$, where $u_M = q_M - \tilde{\bar{q}}_M$. (Appelbaum and Kohli, 1997; 1998) As the collinearity exists and due to the consideration of uncertainty in the model, we apply the seemingly unrelated regression (SUR) for regression.

5. Data and the Empirical Results

5.1. Data Description

We use the annual data from 1975–2015 for the estimation of production function in the case of Korea. The variable includes the real GDP in constant terms (set the year 2005=100). The labor is measured by the total population employed by the economy. The import volume is also measured by setting 2005 as the base year. The private saving rate is the ratio between private saving and gross domestic product. The share of government expenditure is obtained by dividing the total government consumption by gross domestic product. The data for Korea, Japan, and America is obtained from the KOSIS and Korea National Statistic Office, Japan Statistic Bureau, and the Bureau of Economic Analysis, respecively.

5.2. Empirical Results

We firstly use the observed data to estimate Equations (16)–(18). The estimated results are listed in Table 1. The numbers in the brackets are t-values. Then, we use the expected import price to estimate Equations (16)–(18) again and the results are listed in Table 1. α is a significantly small negative value, which is different from the reulst of Appelbaum and Kohli (1997, 1998). This means that uncertainty does not play a significant role in production decisions.

Table 2 presents the estimation results with Hicksian elasticities of complementarity Ψ_{ij} by every ten years from 1975 to 2015. Table 2 shows that there are huge differences between years which are caused by the ignorance of uncertainty of imported price. When there is uncertainty regarding imported price, the relationship between labor and import and domestic capital changes from Hick q-complement to Hicks q-substitution. Furthermore, the relationship between domestic capitals follows Hick q-substitution. The substitution is stronger in the case of labor and import than in the case of labor and capital. The results are different from that obtained by Appelbaum and Kohli (1997; 1998) regarding the case of America and Switzerland. They found that oil and capital were substitutes to each other while the relationship of strong Hick q-complement between labor and import and capital was not supported.

Table 1. The estimation of the production function.

	$q_M(\alpha = 0)$	$\bar{q}_M(\alpha = 0)$	$\bar{q}_M(\alpha \neq 0)$
β_M	0.0984	0.0422	0.0643
	(9.9523)	(6.8979)	(5.7886)
β_K	0.5609	0.5566	0.5601
	(21.9438)	(26.7356)	(21.1879)
β_L	0.3407	0.4012	0.3756
	(7.6253)	(10.2347)	(5.0080)
ϕ_{MM}	0.0135	0.0976	0.0786
	(1.6667)	(10.7135)	(7.4151)

Table 1. *Cont.*

	$q_M(\alpha = 0)$	$\bar{q}_M(\alpha = 0)$	$\bar{q}_M(\alpha \neq 0)$
ϕ_{MK}	0.0096	0.0231	0.0399
	(1.1858)	(6.1872)	(5.3520)
ϕ_{ML}	−0.0231	−0.1207	−0.1185
	(−1.7550)	(−11.0015)	(−9.8471)
ϕ_{KK}	−0.0659	−0.0686	−0.0692
	(−3.2047)	(−3.8989)	(−3.3543)
ϕ_{KL}	0.0753	0.0726	0.0755
	(2.5578)	(2.6625)	(2.5688)
ϕ_{MT}	−0.0538	−0.0541	−0.0556
	(−2.1434)	(−2.0728)	(−2.0669)
ϕ_{KT}	−0.0019	−0.0084	−0.0105
	(−1.5028)	(−9.7622)	(−9.3075)
ϕ_{LT}	0.0059	0.0059	0.0061
	(1.9404)	(2.1839)	(2.0089)
α			−4.48E-05
			(−3.3256)
Log Likelihood	−296.9273	−293.6712	−297.8188
R^2			
s_M	0.7509	0.8233	0.8451
s_K	0.9658	0.9661	0.9657
s_L	0.9666	0.9665	0.9665

Note: the value within parentheses is t-value

The result shows that the uncertainty of imported price is a motivating factor rather than a hampering factor in the case of Korea and it stems from the import structure. The import data of Korea, from 1990s, revealed that nearly 40% of its import is used for export and only less than 10% of import is used for domestic consumption. In other words, most of the imported products are necessities that are required to be imported even with the price uncertainty. On the other hand, as oil and raw materials account for 50% of Korea's total export, the relationship between domestic capital and import is Hick q-complement with a coefficient of larger than 1. The original effect of labor is unfavorable mainly as the heavy industry tends to be capital-intensive. With the development of the economy, this situation between import and labor input changes.

As shown in Table 3, Equation (13) demonstrates the price and quantity elasticity of GDP which are calculated from Equations (12) and (14) by using the unconstrained model parameters in Table 1. When the price elasticity of demand changes from unit elasticity to inelasticity, which is different from the result of Appelbaum and Kohli (1997, 1998), the price elasticity of imported products is higher than unity.

The Rybczynski elasticity reveals that an increase of labor endowment has a positive impact on the total supply, while it has less influence on the imported demand. The change in the capital endowment has a large impact on total output and a negative impact on imported products, which leads to a decrease in imports. According to the Stolper-Samuelson elasticity, the increase of the price of imported products benefits the labor while it harms the capital holder.

Table 2. Hicks complementary elasticity.

			$q_M(\alpha = 0)$		
	1975	**1985**	**1995**	**2005**	**2015**
Ψ_{MM}	−8.3602	−6.2764	−6.9381	−5.9409	−6.2331
Ψ_{KK}	−0.6241	−0.9778	−1.3722	−1.5176	−1.6283
Ψ_{LL}	−2.5808	−1.8894	−1.2804	−1.1760	−1.0451
Ψ_{MK}	1.5019	1.4621	1.4673	1.2491	1.2048
Ψ_{ML}	0.1089	0.5857	0.6650	0.9591	0.9560
Ψ_{KL}	1.2746	1.4839	1.5282	1.7896	1.7981
			$\bar{q}_M(\alpha = 0)$		
	1975	**1985**	**1995**	**2005**	**2015**
Ψ_{MM}	−9.0876	−8.0155	−7.3551	−6.6980	−5.8027
Ψ_{KK}	−0.4953	−0.8107	−1.1785	−1.3131	−1.3988
Ψ_{LL}	−5.3366	−4.6295	−3.7102	−3.9104	−3.8678
Ψ_{MK}	1.9028	1.8664	1.9743	1.7207	1.7293
Ψ_{ML}	−5.9178	−4.2759	−3.8278	−3.6392	−3.8196
Ψ_{KL}	−1.4926	−1.2683	−0.9136	−0.9572	−1.0367
			$\bar{q}_M(\alpha \neq 0)$		
	1975	**1985**	**1995**	**2005**	**2015**
Ψ_{MM}	−11.4045	−9.1512	−8.7322	−7.5805	−6.9259
Ψ_{KK}	−0.1678	−0.3912	−0.6797	−0.7936	−0.8371
Ψ_{LL}	−5.3255	−4.5957	−3.6666	−3.8522	−3.8025
Ψ_{MK}	2.5603	2.5700	2.8486	2.5585	2.6436
Ψ_{ML}	−5.8195	−4.1840	−3.7305	−3.5310	−3.7030
Ψ_{KL}	−1.4531	−1.2091	−0.8485	−0.8761	−0.9496

Note: the values are estimated base on the parameter from Table 1.

Table 4 shows the estimated values of the demand elasticity of imported products, supply elasticity of output, and the returning elasticity of factors over years. Those values are defined according to Equation (14). The result in Table 4 presents that the impact of the price of imported products on total output, import, and factor return increase with the change of time. The higher values from 1994–1996 imply that the influence in recent years is larger than before. It is closely related to the series of shocks in recent years, such as the bursting of Japanese bubbles, the Asian financial crisis in 1997, and the financial crisis since 2007.

It is worth noting all factors except labor benefit from uncertainty. Although the value of α is very small, it is not equal to zero and positive, which is different from the normal thought that countries tend to be risk-aversion and uncertainty weaken the welfare. This paradoxical result owes to the Korean export-oriented policy. Korea imports a large number of raw materials such as oil and iron ore to export manufactured products. As mentioned earlier, the heavy industry generally requires more capital and capital factors that are benefited from the uncertainty than labor factors that lose the benefit.

It is interesting to estimate the effect of α. The estimation result is listed in Table 5, which gives the estimation of all effects from uncertainty. Since Korea is viewed as a risk-preference country, the total output and import demand are negatively affected by uncertainty, while they have a positive impact on labor wage. The above result is significantly different from that by Appelbaum and Kohli (1997, 1998). The effect of uncertainty on the quantity of imports has been increasing over past years, reaching its peak in 2015 at the level of 0.5%. This increasing effect of uncertainty also affects other variables. For example, when there is no uncertainty, the output in 2015 decreased by 0.1%, and the profit and labor wage decreases by 0.2% and 0.3% respectively.

Table 3. Price elasticity and quantity elasticity (based on GDP function).

	1975	1985	1995	2005	2015
(1) Price elasticity of import demand					
ε_{YY}	0.0877	0.1093	0.1145	0.1319	0.1444
ε_{YM}	−0.0877	−0.1093	−0.1145	−0.1319	−0.1444
ε_{MY}	1.0150	1.0981	0.8994	0.9097	0.7618
ε_{MM}	−1.0150	−1.0981	−0.8994	−0.9097	−0.7618
(2) Elasticity of demand of factor demand					
ε_{LL}	−0.7892	−1.0275	−0.9514	−0.9624	−0.8275
ε_{LK}	0.7892	1.0275	0.9514	0.9624	0.8275
ε_{KL}	−0.2340	−0.1643	−0.1093	−0.0310	−0.0751
ε_{KK}	0.2340	0.1643	0.1093	0.0310	0.0751
(3) Rybczynski elasticity					
ε_{YL}	0.2959	0.3634	0.4191	0.4061	0.3962
ε_{YK}	0.7041	0.6366	0.5809	0.5939	0.6038
ε_{ML}	2.4504	2.1631	2.3872	2.2488	2.5164
ε_{MK}	−1.4504	−1.1631	−1.3872	−1.2488	−1.5164
(4) Stolper−Samuelson elasticity					
ε_{LY}	0.4897	0.5428	0.5728	0.5342	0.4653
ε_{LM}	0.5103	0.4572	0.4272	0.4658	0.5347
ε_{KY}	1.2245	1.2808	1.3262	1.3375	1.3817
ε_{KM}	−0.2245	−0.2808	−0.3262	−0.3375	−0.3817

Note: All estimations are obtained under the condition that import price and output price and factor endowment are given. The estimations are based on the value of Table 1.

Table 4. The elasticity with uncertainty.

	1975	1985	1995	2005	2015
$\varepsilon_{Y\theta} \cdot 10^2$	0.0205	0.0902	0.1761	0.4287	1.1356
$\varepsilon_{YM\theta} \cdot 10^2$	0.2371	0.9059	1.3830	2.9559	5.9921
$\varepsilon_{L\theta} \cdot 10^2$	−0.1192	−0.3772	−0.6569	−1.5136	−4.2052
$\varepsilon_{K\theta} \cdot 10^2$	0.0524	0.2317	0.5016	1.0967	3.0021

Table 5. The impact of import price uncertainty.

	1975	1985	1995	2005	2015
Output	−0.00001	−0.00579	−0.00857	0.01936	−0.09235
Import	−0.00011	−0.05814	−0.06729	0.13351	−0.48730
Wage	0.00006	0.02421	0.03196	−0.06837	0.34199
Profit	−0.00002	−0.01487	−0.02440	0.04954	−0.24415

6. Conclusion

By applying the method of Appelbaum (1997) and Kohl (1998), we analyze the effect of price uncertainty of imports on the distribution of domestic incomes. During past decades, the price uncertainty of imported products has had a huge effect on the import demand of a country with the development of international trade. The case of Korea is investigated, and the result proves the assumption that Korea is a risk-preference country, and the price uncertainty of imported products stimulates rather than decreases its import demand. The estimation shows that the relationship between import and use of domestic factors in Korea is significantly different from the case in America (Appelbaum and Kohli, 1997) and in Switzerland (Appelbaum and Kohli, 1998). The difference is explained by the economic structure of Korea, that is, labor and import in Korea are substitutions while the capital and import in Korea are supplements. Thirdly, the result shows that the capital factor benefits from the price uncertainty of imported products while the labor factor suffers from it. This leads to the conclusion that the uncertainty of imported products is preferable to labor factors.

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References

1. Appelbaum, E., & Kohli, U. (1997). Import Price Uncertainty and the Distribution of Income. *Review of Economics and Statistics*, 79(4): 620–630.
2. Appelbaum, E., & Ullah, A. (1997). Estimation of Moments and Production Decisions under Uncertainty. *Review of Economics and Statistics*, 79(4): 631–637.
3. Appelbaum, E., & Kohli, U. (1998). Import-Price Uncertainty, Production Decisions and Relative Factor Share. *Review of International Economics*, 6(3): 345–360.
4. Kohli, U., & Ulrich, A. (1978). A Gross National Product Function and the Derived Demand for Imports and Supply of Exports. *Canadian Journal of Economics*, 11(2): 167–182.
5. Kohli, U., & Ulrich, A. (1979). Simultaneous Technologies and Demand and Supply Conditions in International Trade. *Empirical Economics*, 4(4): 235–246.
6. Kohli, U., & Ulrich, A. (1982). Production Theory, Technological Change, and the Demand for Imports: Switzerland, 1948-1976. *European Economic Review*, 18(2): 369–386.
7. Kohli, U. (1993). A Symmetric Normalized Quadratic GNP Function and the U.S. Demand for Imports and Supply of Exports. *International Economic Review*, 34(1): 243–255.
8. Kohli, U. (1995). Technology, Duality, and Foreign Trade: The GNP Function Approach to Modeling Imports and Exports. *Asean Economic Bulletin*, 14(2): 150–158.
9. Kumbhakar, S.C. (2002). Risk Preference and Productivity Measurement under Output Price Uncertainty. *Empirical Economics*, 27(3): 461–472.
10. Mohabbat, K.A., Dalal, A.J., & Williams, M. (1984). Import Demand for India: A Translog Cost Function Approach. *Economics Development and Cultural Change*, 32(3): 593–605.
11. Sato, R., & Koizumi, T. (1973). On the Elasticities of Substitution and Complementarity. *Oxford Economic Papers*, 25(1): 44–56.
12. Satyanarayan, S. (1999). Econometric Tests of Firm Decision Making under Dual Sources of Uncertainty. *Journal of Economics and Business*, 51(4): 315–325.