Chukyo University Institute of Economics

Discussion Paper Series

January 2009

No. 0809

The Uncertainty of International Commodity
Price and Employment Stability

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The Uncertainty of International Commodity Price and Employment Stability

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Abstract

This paper examines whether the uncertainty of international commodity price affects farmers' employment stability. Farmers tend to abandon growing cash crops as uncertainty increases; they migrate to urban areas to make money, but it is difficult to find a job in formal sectors, given that most have previously worked in informal sectors or gone unemployed. This paper determines whether the supply of international commodities decreases when uncertainty rises, as the result of a lack of data *vis-à-vis* unemployment and informal sectors. If farmers leave the farms when uncertainty increases, cash-crop supplies will necessarily decrease.

Macro-level data rather than micro-level data is used, as the latter is limited to geographically specific areas; I, on the other hand, would like to examine universal trends. I apply corporate investment theory to farmers' investments in their own labour; the econometrical result of the fixed-effect model presents the coefficient of uncertainty as having a negative impact, even if time trends and country-specific effects are eliminated.

It is important to consider such issues of uncertainty and employment stability, as some countries concentrate on planting material crops that are used in bio ethanol, and there are presently violent fluctuations in commodity prices. In any case, these are concerns that are urgent for many developing countries.

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1. Introduction

Nowadays, many bio crops are growing in importance. Some countries tend to focus on planting such crops only. At the same time, international commodity prices are fluctuating violently, and those fluctuations are caused by such factors as weather, consumer demand and the provision of venture capital.

A few countries have previously suffered from fluctuations in the international commodity prices of, for example, coffee, sugar and cocoa, which they have planted only. Low international prices are not so much a problem as fierce price fluctuations. If prices were to remain low, farmers would eventually stop planting these crops, even if doing so is a difficult decision. However, prices are sometimes low and then high, making any sort of planning or decision-making difficult because farmers could not expect prices.

Although some countries have had such experiences, many have begun to focus on planting unique bio crops. Nonetheless, many questions arise: Does many countries planting unique crops at once affect the uncertainty of those crops' prices? How does doing so affect increasing uncertainty *vis-à-vis* employment stability? Do farmers decide to stop planting crops when the uncertainty is high—and if so, do they migrate to the city? For farmers who do decide to migrate, acquiring a job in the formal sector can be difficult; many eventually work in the informal sector or become unemployed. If this chain of events holds true, the high uncertainty of commodity prices extends its influence to the urban informal sector.

The purpose of this paper is to examine whether uncertainty *vis-à-vis* international commodity prices decreases the supply of commodity crops. If farmers abandon cash crops under conditions in which there is great uncertainty, the overall yields of those crops will decrease; concomitantly, farmers migrate to urban areas to earn money, where many of them find it difficult to acquire a formal-sector job. Ultimately, as mentioned, many will eventually work in the informal sector or become unemployed. However, I could not obtain informal-sector data that was precise and offered on an annual basis; unemployment data was also unavailable. Therefore, only farmers' decisions were examined, with the end-point of confirming whether farmers abandon commodity crops if the uncertainty of commodity prices increases, resulting in lower quantities of said cash crops.

1.1 Ghana and Cocoa-Planting

I especially focus on Ghanaian cocoa-planting, because there is a research demand for such data, and there is therefore detailed background information available. Zeitlin (2005) and Teal and Zeitlin (2006) analyse cocoa production during the 2001–2002 and 2003–2004 growing seasons; each chose a region in Ghana examined the corresponding individual data available. Teal and Zeitlin (2006) examined the effects of spray machines that influence government projects by affecting fertiliser application or input labour. They suggest the future work; "the long-term growth prospects in the cocoa sector are dependent on whether the increase in output represents the lifting of constraints on farmers' production possibilities or whether it simply reflects a short-term response to the windfall gains of strong cocoa prices". They also argue that their research is limited by the availability of geographically representative samples of the regions studied. My paper attempts to address these issues from a macro viewpoint rather than through the use of micro-level data, thus avoiding this region-based limitation.

There is extensive information available *vis-à-vis* Ghanaian cocoa production, from prior literature and surveys. Figure 1 lists international cocoa prices and producer prices in Ghana. International prices are decided by the New York or London markets. The cocoa market is a key one, followed by the oil and coffee markets. As seen in Figure 1, international prices have fluctuated greatly; the international cocoa agreement that had taken effect in 1981 was essentially abolished in 1993, but even with the international cocoa agreement, there were many problems. Indeed, the international agreement drafted for cocoa was not efficient, unlike the one devised for coffee. The most important cocoa export country, Ivory Coast, and the most important import country, the United States, were not affiliated; a buffer stock system was not sufficient to creating a surplus supply in the long term and the budget for this system was not enough.

With regards to the producer prices listed in Figure 1, they were stable until 1966, but saw fluctuations thereafter. There were connections between actual producer prices and international prices, even with the provision of a Ghanaian cocoa board. Between 1947 and 1966, producer prices were determined by the government, to protect producers. After the *coup d'état* in 1966, producer prices were immediately liberalised, but were once again controlled by the government in 1981, when the World Bank's Structural and Sectoral Adjustment was carried out. Even with the cocoa board, smuggling to neighbour countries was rampant, because payments to cocoa producers were late and producers were also being adversely affected by international cocoa prices.

Cocoa is a key export crop in Ghana, accounting for 50~70% of Ghana's exportation value during 1948–1989 and 20~30% during 1990–2006. In terms of the volume of exportation, it was two-fold as much as 1995 in 1965 and 1973, 2.5-fold in 2006.

In Ghana, small-scale farming operations produce cocoa in rural areas (Takane, 1999). In many households, women grow maize to sustain the family, while men plant cocoa to earn cash. In the 19th century, Europeans did not settle in western Africa and there were no local large landowners there, and so the growing of cash crops was introduced proactively by the local farmers, of their own volition (Mine, 1999).

1.2 Employment and Unemployment Trends in Ghana

In rural areas, 60% of men are farmers, 14% are wage-workers, and 13% are self-employed in non-agricultural areas; 41% of women are farmers, 28% are self-employed in non-agricultural areas, and 27% are unpaid household workers (Ghana Statistical Service, 2000). These numbers speak for themselves: Most work in these rural areas is of an agricultural nature. Furthermore, the Living Standards Measurement Study (LSMS) states that 88% of those households plant maize, 22% plant ground nuts, and 22% plant cocoa[1].

While verifying whether great uncertainty leads farmers to abandon growing cash crops, this paper assumes that farmers who do abandon those crops will often work in urban informal sectors or become unemployed. For this reason, it is important to review rural-to-urban immigration patterns. From the LSMS survey[2], it was found that the greatest influence on migration is driven by household needs: 30.4% of migrants move because of their employment, and 7.4% because of the spouse's employment. Generally, in Africa, workers move within their own social stratum (Mine, 1999), and it is difficult for rural, lower-class workers to acquire high-class jobs in the city (Mine, 1999). Unemployment is rampant in the city, with unemployment rates reaching 16% in Accra, about 12% in other cities, and 6% in rural areas. In terms of unemployment in the city, there is no difference between the genders, but women's unemployment (in terms of paid work) is higher in rural areas. Most unemployed individuals are young (i.e., 15–24 years old), as they comprise 30% of unemployed individuals in urban areas and about 10% in rural areas.

In the city, 42% of working males are wage-workers, 33% are self-employed in non-agricultural areas and 19% are farmers; 64% of women are self-employed in non-agricultural areas, 12% are wage-workers and 11% are farmers (Ghana Statistical Service, 2000). In terms of employer classifications, 35.5% of men work in the informal sector or are self-employed, 25% work in the private formal sector, 22% are farmers, and 17.5% work in the public sector. For women, 71% work in the private informal sector or are self-employed, 16% are farmers, and 6.5% work in the public sector. As one can see, most individuals,

[1] These statistics are based on the *Ghana Living Standards Survey Report on the Fourth Round (GLSS4)*, from 1998. In 1991, from the *GLSS3* (Third Round), it was found that 87% of households planted maize, 24% planted ground nuts and 19% planted cocoa.

[2] This survey includes rural-to-rural and urban-to-urban migrations; these particular statistics are from data pertaining to Accra in 1998.

regardless of gender, work in the informal sector or are self-employed. Therefore, if farmers abandon the growing of cash crops and migrate to the city, most will eventually work in the informal sector or become unemployed. In this paper, I verify whether fluctuations in speculative capital, as well as other factors, increase uncertainty and therefore decrease the supplies of international commodity crops, as a result of farmers deciding to stop growing them. If farmers migrate to urban areas after leaving their farming operation, it will necessarily affect employment stability, both individually and nationwide.

1.3 The Effects of Uncertainty on Employment

Chuma and Higuchi (1995), Price (1994) and Yasui (2005) have previously considered the effects of market uncertainties on employment. Chuma and Higuchi (1995) examine whether firms prefer short-term employers over long-term employers as uncertainty increases. They use variance in future demand of each firm's product as a surrogate for uncertainty. Ultimately, they argue that increasing uncertainty results in decreases trend of seniority wage system; however, the number of short-term employers increases with uncertainty—the opposite of the phenomenon predicted by the theoretical model. Yasui (2005), on the other hand, verifies the effect of uncertainty with regards to the speed of employment adjustment. The firms heist adjustment of employment in condition of the large uncertainty; it seems like financial investment theory. According to econometric analyses using firm-level data, decreasing uncertainty tends to increase the rate at which employment trends adjust. Studies such as these have debated the effect of uncertainty on a firm's labour investments. However, how do such arguments apply to agriculture, given that farmers invest in their own labour? This paper applies the theories used in prior studies regarding a firm's labour investments, to farmers' own labour investments.

Concerning fluctuations in international commodity prices, Minot (2002) analyses the effect of decreases in cotton price, rather than uncertainties in cotton price, to economic welfare and labour demand. According to his paper, a 40% cotton-price decrease (equivalent to the decrease in cotton price 2000 and 2002) decreases economic welfare 8% in the short term and 6~7% in the long term. However, the decrease in cotton price did not diminish labour demand greatly, because the labour-intensity of cotton is the same as that of other crops.

1.4 The supply function of cocoa

This paper examines the effect of uncertainty on cocoa supply; therefore, I examine the cocoa-supply function. Hattink, Heerink and Thijssen (1998) analyse the cocoa supply function and calculate the elasticity of price; they argue that the elasticity in prior studies has been 0.2 in the short term and less than 1 in the long term. They, themselves, calculate elasticity as being 0.13.

Price increases possibly affect quantity of supply in either direction (i.e., increasing or decreasing it), whereas price uncertainties only decrease cocoa supply. Price increases motivate farmers to plant cash crops, as they not only increase farmer incomes, but they also allow farming households the ability to make other choices, such as working in another sector or going to school.

As with any other variety of tree, the growth of cocoa trees requires time. When farmers note that the price of cocoa has been increasing and they therefore plan to the grow cocoa, the quantity of cocoa will increase only after a few years. Bateman (1965) notes that the quantity of harvested cocoa increases only five to six years after planting cocoa trees, and that the second period during which a yield increase is realised is 10 years after planting them.

This work contributes to the literature in three areas. First, I use macro-level data rather than micro data, corrected from specific geographical areas, because I look to understand universal trends with regards to fluctuating commodity prices. Second, I apply corporate investment theory to farmers' investments in their own labour. Finally, I raise the question about the trend of planting unique bio crops, even as the commodity prices thereof fluctuate widely; I do so, although data is often insufficient for econometric analyses. When the price is determined by the market in a market-based economy, I would like to assert that the uncertainty of international commodity prices affects producer employment as well as the supply quantity of those commodities—especially in developing countries.

I obtained the following results. First, I assess the quantity of cocoa in the face of market uncertainty—not only in the present, but also that from one to 10 years ago, because farmers' growing decisions are not made instantly, nor do they immediately manifest as marketable product. Uncertainty is calculated according to the following; price regress on past prices, using the auto-regression method and the standard error of that regression is uncertainty, as in Ogawa and Suzuki (2000) and Yasui (2005). I use panel data of the 13 countries that were the most important prolific cocoa producers in the period 1961–2002. As a result, the coefficient of uncertainty is negative.

Second, I use a time dummy to eliminate the time-trend wherein the quantity of cocoa increases as uncertainty decreases, despite the fact that uncertainty is increasing nowadays. I examine the uncertainty of five, six or 10 years ago, as a function of uncertainty from the more distant past. Each coefficient of uncertainty is also significant and negative.

Third, I use differences incurred by eliminating country-specific effects. As a result of the regression, the difference of uncertainty from six years ago is significantly negative.

Finally, I consider whether these results hold for other international commodity crops. Maize, coffee and sugar are important international commodities. Maize is an ingredient in bioethanol; however, it is also consumed as a staple diet, so it is a complicated commodity to analyse. I then examine the same econometric analysis using coffee and sugar data. In the case of coffee, the coefficients of uncertainty— which are two and seven years ago—are negative, but the others are positive and not significant. When the difference is used for estimation purposes, the differences of uncertainty two and seven years ago are negative but not significant.

Regarding sugar cane, present-day uncertainty is negative and significant, and it is consistent with required growing time. Sugar cane does not have a long growing time, whereas both cocoa and coffee do.

Section 2 presents a theoretical model that can be used to generate specific hypotheses. Then, section 3 presents an econometric model to which real-world data are applied. In section 4, I demonstrate the estimation result and, after discussing the limitations of the research in section 5, I conclude the paper in section 6.

2. The Theoretical Model

Women generally tend to grow staple diets, while men tend to grow cash crops like cocoa[3]. The reason why men plant cash crops is that they have money income although the cash crops are high risk. Therefore, the choice that garners cash tends to influence men's growing activities. In the city, there are formal jobs, such as those in public enterprise or large private companies; the informal sector, where people lacking high education skill or capital can seek employment; there is also unemployment. Thus, rural growers have choices in making money: grow cash crops or go to the city to make money. In such an examination, I follow the model of Kaen (1995).

Individuals can choose between being a farmer and a worker at any time. 'Farmer' means being a cash-crop producer, whereas 'workers' work in urban areas, often in the informal sector, or seek jobs therein. I deal with informal workers and unemployed individuals under

[3]Mine (1999) classifies export-type economies into three categories. The 'A' type is a small farm household that grows cash crops such as cocoa, the 'B' type is a mine or plantation type and the 'C' type is a farming zone to which white immigrants have moved. This paper considers only type A, because cash crops are mainly grown by type A nowadays and in future.

the same banner, because there is no expected difference therein, in terms of urban wage. Each individual has a potential working life of A periods, beginning at time $a = 0$.

Utility at any time a is given by

$$U(a) = \sum_{m=1}^{2} R_m(a) d_m(a) \quad , \tag{2-1}$$

where $d_m(a) = 1$ if m is chosen, (m = 1; farmer or 2; worker), at time a, and equal zero otherwise. $R_m(a)$ is the per-period reward associated with the two alternatives. These rewards consider all related benefits and costs.

Current-period rewards are specified as follows:

$$\begin{aligned} R_1(a) &= P(\theta)Q(R, F, K, N) - \text{cost} \\ R_2(a) &= W \end{aligned} \tag{2-2}$$

θ is the uncertainty of cocoa price, R is rainfall, F is fertiliser, K is land and N is labour input (men × days). P is the expected cash crop international price, and it is a decreasing function of θ. For workers, m = 2, W is the expected wage in urban areas.

The individual's objective is to maximise the expected present value of remaining lifetime rewards at any time. Defining V(S(a),a), the value function, as the maximum expected present value of lifetime rewards at a given time, given the individual's state S(a), defined below, and given discount factor δ,

$$V(s(a), a) = \max E[\sum_{\tau=a}^{A} \delta^{\tau-a} \sum_{m=1}^{2} R_m(\tau) d_m(a) \mid S(a)]. \tag{2-3}$$

The value function can be written as the maximum over alternative-specific value functions, each of which obeys the Bellman equation:

$$V(s(a), a) = \max\{V_m(S(a), a)\}, \tag{2-4}$$

where $V_m(S(a), a)$, the alternative-specific value functions, are given by

$$\begin{aligned} V(s(a), a) &= R_m(S(a), a) + \delta E[V(S(a+1), a+1 \mid S(a) : d_m = 1], a < A, \\ V_m(S(A), A) &= R_m(S(A), A) \end{aligned} \tag{2-5}$$

The standard method for solving the individual's finite horizon optimisation problem is by backwards recursion. The optimal decision is given by the rule:

$$d^*(s(A), A) = \arg\max\{R_m(S(A), A)\}. \quad (2\text{-}6)$$

Thus, the mth alternative is chosen—$d_m(s(A), A) = 1$—iff $d^*(s(A), A) = m$.

The probability that each individual chooses to be a farmer decreases as uncertainty increases, because the rewards of equation (2) decrease. This paper assumes that farmers expect a profit decrease when uncertainty increases.

In all, the increasing probability of each individual choosing to be a farmer increases the number of farmers. Therefore, the labour input to the farm decreases at the macro level when uncertainty increases.

The cocoa supply is calculated as follows:

$$Q = f(R, F, K, N)$$

R is rainfall, F is fertiliser, K is land and N is labour input (men × days). As well, N is determined by individual decision. When the labour input decreases by increasing the uncertainty, the cocoa supply quantity decreases.

3. Statistical Model

3.1 Equation Structure

First, uncertainty is calculated by following the auto-regression equation, as in Ogawa and Suzuki (2000) and Ysui (2005). The standard error of regression is the uncertainty.

$$\Delta \ln P_t = \alpha_0 + \alpha_1 \Delta \ln P_{t-1} + u_t \quad (3\text{-}1)$$

$\Delta \ln P_t$ is the difference log of international cocoa (cash crop) price. Ten years of data is used, and so the uncertainty of 1969 refers to the standard error of regression using data from 1959 to 1968, inclusive. Each year’s uncertainty is determined by repeating this calculation.

Second, the cocoa supply equation is examined. I cannot use labour input data, so the uncertainty calculated above in (3-1) is used directly in the supply equation. If the uncertainty increases, some farmers decide to stop growing cocoa and migrate to the city.

Therefore, the quantity of cocoa decreases because of an increase in uncertainty.

$$\ln Q_t = \beta_0 + \beta_1 \ln Prov_t + \beta_2 \ln Rin_t + \beta_3 \ln Price_t + \beta_4 \ln Rain_t + \beta_{t,l} \sum_{l=0}^{10} Uncertan_{t,l} + \varepsilon_t \quad (3\text{-}2)$$

lnQ is the quantity of cocoa, and lnProv is the land productivity per section of land (i.e., quantity/harvest area). lnRin and lnRain refer to the consumption of phosphate fertilisers and rainfall at the capital, respectively. Each of these variables increases the quantity of cocoa. lnPrice is the international price of cocoa (cash crop), not the uncertainty of price. The price affects the quantity, in both negative and positive directions. If the income effect is important, prices increase and the farmers go to school or choose another career venue; in such cases, the price effect is negative. However, if the farmers would like to grow more cocoa as the price increases, the increasing price affects total yield in a positive direction.

The last term refers to uncertainty. As mentioned, cocoa trees require time before their first harvests are realised, so I use various uncertainties for estimation: present uncertainty alone (which means the standard error of regression using data from 11 years ago until last year); present uncertainty, plus last year's uncertainty; present uncertainty, plus last year's uncertainty, plus uncertainty of two years ago ..., until 10 years ago; and the uncertainty of five, six or 10 years ago. I compare the sizes of the estimation coefficients.

For the estimation of (3-2), I use the fixed-effect model, due to the elimination of country-specific effects. In this paper, I use 13 countries to satisfy the number of samples. When I use a number of countries, the number of samples studied is boosted, but I must consider factors unique to each country. For example, the policies of planting crops differ with each county. If I use the pooling model, I need a variable that controls for country-specific effects; it is represented by the 'country-specific effect term' when I use the fixed-effect model. When this model is used, the estimation coefficients are consistent.

Due to the elimination of time trends, I estimate (3-2) using a year dummy and again using the fixed-effect model. I also use differences in each term to estimate the cocoa supply function. Using differences is other way of eliminating country-specific effects.

$$d\ln Q_t = \gamma_0 + \gamma_1 d\ln Prov_t + \gamma_2 d\ln Rin_t + \gamma_3 d\ln Price_t + \gamma_4 d\ln Rain_t + \gamma_{t,l}\sum_{l=0}^{10} dUncertan_{t,l} + \mu_t \quad (3\text{-}3)$$

Finally, I expand upon the above analysis, into other international commodities—namely, coffee and sugar cane. Using international prices for coffee and sugar, I estimate each uncertainty. Then, I examine (3-2) and (3-3); if the uncertainty is found again to decrease the quantity of coffee and sugar supply, I can say that the uncertainty of international commodity price affects producer employment. It means also that uncertainty is one of the reasons why the informal sector has expanded, or why unemployment has increased in urban areas.

3.2 Data

International cocoa prices (as well as coffee and sugar prices, for robust estimations) were obtained from International Financial Statistics (IFS), which is the statistical data of the International Monetary Fund (IMF). Information from FAOSTAT by way of the Food and Agriculture Organization of the United Nations (FAO) was used for the quantities of cocoa, the harvest area of cocoa and the consumption of phosphate fertilisers. Productivity was also calculated using these data. Rainfall data was based on *Tropical Land-Surface Precipitation: Gridded Monthly and Annual Time Series 1950–1999.*

In the case of cocoa, I use 13 countries that are the most important cocoa producers[4], in terms of quantity, using the 1961–2002[5] time series, though when using rainfall data, the period is shortened to 1961–1999.

In the case of coffee, I use the 13 countries[6] that are the most important coffee producers,

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[4] Each country produces more than 30,000 tons, thus accounting for 96% of the world's total cocoa production. The 13 countries are Brazil, Cameroon, Colombia, Ivory Coast, Dominican Republic, Ecuador, Ghana, Indonesia, Mexico, Nigeria, Papua New Guinea and Togo.

[5] The uncertainties from 1961 to 1968 are extreme high, but there is no reason to eliminate this period. Even if this period is excluded, the results are the same although the significances of coefficient decrease.

[6] The 13 countries are Brazil, Colombia, Costa Rica, Ivory Coast, Ecuador, Guatemala, Honduras, India, Indonesia, Mexico, Peru, Philippines and Uganda.

and the periods used were 1974–1979 and 1990–2006. Until 1973 and during the 1980s, the International Coffee Agreement was in effect; therefore, I exclude these years from the estimation. Regarding sugar, 16 countries[7] are used and the time series is 1961–2006. Table 1 presents a summary of the statistics.

4. Results

Figure 2 presents the uncertainty estimated by equation (3-1) and international cocoa prices. After high uncertainty, the uncertainty increased between 1961 and 1983. It then decreased sharply for five years. During the 1990s, uncertainty was stabile; after 1999, it increased again.

I estimate equations (3-2) and (3-3) using this uncertainty. Table 2 presents the results of estimation (3-2). Column (1) uses only the present uncertainty. This uncertainty's affect on cocoa supply was significantly negative. The land productivity, ln_prov, and the consumption of phosphate fertilisers, ln_rin, both had significantly positive effects on the quantity of cocoa.

Regarding the price effect, ln_price was negative. Previous papers estimating a precise cocoa supply equation calculates price elasticity as approximately 0.2. In this paper, it is possible that the income effect—in which people can earn the same amount of money by generating less cocoa, which impacts farmers in such a way that they invest their own labour in other activities—appears, but the coefficient is not significant.

As mentioned previously, time is required for growing cocoa trees: five to six years for the first growing period and 10 years for the second growing period. Columns (2)–(10) are estimated using past uncertainty values; almost every estimate coefficient of uncertainty is negative. Especially, the oldest uncertainty value is negative and significant. I would like to compare the volumes of the coefficient between time series. The volume of coefficient is

[7] The 16 countries are Argentina, Australia, Brazil, China, Colombia, Cuba, Egypt, Guatemala, India, Indonesia, Mexico, Pakistan, Philippines, South Africa, Thailand and the United States.

different, especially, the present uncertainty, the uncertainty five or six years ago and the farthest uncertainty has strong negative impacts.

Table 3 presents the results of (3-2), with the rainfall variable. As mentioned, rainfall data is available only until 1999. The rainfall coefficient is positive; if the rainfall rises, the supply of cocoa increases, but the coefficient is not significant. The uncertainty has a negative impact and it is significant. The uncertainty and the other coefficients are almost of the same magnitude of importance, and in the same direction (see Table 2).

In Tables 2 and 3, every past and present uncertainty is used, to compare the volumes of the coefficient; however, it is possible that each coefficient of uncertainty has multicollinearity. Therefore, I estimate (3-2) using only the uncertainty of five, six or 10 years ago; these time-lengths are consistent with the cocoa tree growth argued by previous papers. I also use a year dummy to eliminate time trends. Uncertainty exhibits a decreasing trend—although it has increased nowadays, in opposition to the quantity of cocoa, which has seen an increasing trend. Table 4 presents these results. The uncertainties of five or six years ago were about –0.9, significantly and negatively affecting cocoa supply. Similarly, the uncertainty of 10 years ago also affected cocoa supply negatively and significant.

Table 5 presents the results of (3-3), which is the estimation using differences. Columns (1) and (2) are estimation results without the rainfall variable; columns (3) and (4) are those with the rainfall variable. In column (1), when I use the uncertainties from the present to 10 years ago, around the present, six years ago and the oldest uncertainty, the values are negative. Especially, the uncertainty from six years ago is both negative and significant; this time period is consistent with the cocoa tree-growing period. In column (2), when the uncertainty of six years ago is included by itself in the estimation equation, that coefficient is negative and significant, but the value diminishes. Column (3) presents the results of the estimation with the rainfall variable. The coefficients of uncertainty are negative, but not significant. In column (4), when I use only the uncertainty from six years ago with the rainfall data, the coefficient of uncertainty is both negative and significant. Both here and previously, uncertainty is found to affect cocoa supply negatively.

Next, I would like to confirm whether the uncertainty of other commodity prices affects farmers' planting decisions. If uncertainty increases and the farmers stop growing a commodity crop, will the supply of that commodity decrease? Table 6 presents the results in the case of coffee. The productivity, ln_prov, affects affect yield positively; the price, ln_price, has a negative impact. The uncertainty affect remains positive until four years previous; however, when the estimation includes uncertainties from before the four years previous, the coefficients are not significant. I also estimate using differences, as with the cocoa equation. Table 7 shows that the coefficients of uncertainty are not significant, even if the uncertainty is limited only to two and seven years ago, which are negative coefficients in Table 6 and column (1) of Table 7.

In turn, I examine the case of sugar; Table 8 presents the estimation results thereof. It is remarkable that the present uncertainty affects are negative *vis-à-vis* sugar supply quantity. This is likely a result of the fact that not much time is required between the time one decides to grow sugar cane, and when the first crop is harvested. Table 9 presents the estimation results, using differences. Productivity has a positive impact, and price affects are both negative and significant. The coefficient of uncertainty is negative, but not significant.

5. Limitations of the Research

I confirm whether a commodity's supply quantity decreases if there is uncertainty concerning price increases in that commodity. However, the following are the limitations of this study.

First, cocoa employment data (as well as that of other commodities) is not readily available, so equation (3-2) is not a precise supply function. However, previous papers that have estimated the supply function also lacked wage data. Additionally, this paper was not able to use data *vis-à-vis* unemployment or the number of informal-sector workers.

Second, I was not able to verify to the raising uncertainty increases the unemployment ratio or expand to the informal sector directly. The farmer also has the choice of planting other crops, rather than migrate to urban areas. Also, right and wrong of the informal sector expansion is beyond the scope of this paper.

Finally, followings remain in next study; using real price in place of nominal price in this paper and discriminating between the uncertainty in period of rising prices and that of decreasing prices.

6. Conclusions

A study of the international commodity price uncertainty effect on employment in developing countries is challenging, because data is lacking. However, the growing of bio crops is a hot issue today, and some countries tend to plant that crops unique even if some developing countries suffer from the commodity crop's price in last century.

There are no hard rules determining whether farmers will abandon certain crops in the face of uncertainty *vis-à-vis* international commodity prices, and migrate to the city. Surely, if they were to do so, the commodity supply would decrease and farmers would find it difficult to secure employment in urban areas, given that they are more likely to comprise informal-sector workers. In that case, it is clear that the uncertainty is one of the driving forces behind expansion in the informal sector or in the high unemployment rates seen in urban areas.

Data showing the number of informal-sector workers or unemployment ratios are lacking. I also could not obtain whole individual data that detail who is leaving the farms as a result of high uncertainty. Even if such data were available, most micro-level data is limited to specific geographical areas. I used macro-level data, because the purpose of this paper was to determine universal trends. While employment data is lacking, I analysed the supply function to determine whether farmers cease planting certain crops—resulting in a crop supply decrease—when uncertainty increases. Such uncertainty has been considered in financial studies. With regards to employment, most previous studies analyse firm investment; I apply this theory to the farmers' own labour investments.

First of all, I calculated the uncertainty, which is the standard error of the auto-regression of price. The uncertainty of international cocoa prices was high in the 1960s, after a sudden decrease; there was then an increase in uncertainty, until the mid-1980s, while it was stable in the 1990s. It again increased, from 1999 onwards.

Second, I assess the quantity of cocoa in the face of market uncertainty—using the result above. As a result, the uncertainty has negative impact to the supply of cocoa. Because cocoa trees do not grow immediately, I also estimated the supply function using past uncertainty. The coefficient is important about six years previous. This length of time is consistent with the growing period of cocoa.

The uncertainty has shown a decreasing trend against an increase in cocoa supply quantity. Therefore, I estimated the supply function using a time dummy. Even when including the time dummy, the uncertainty had a negative impact. In this estimation, I used the fixed-effect model to avoid country-specific effects. I also used differences to estimate and eliminate country-specific effects in other ways. As a result, uncertainty was found to affect cocoa supply negatively. As uncertainty increases, farmers decide to abandon growing cocoa, and the farmers who leave the farm migrate to the city to work in the informal sector or become unemployed. Nonetheless, this study could not fully verify this chain of events, because Ghanaian employment data was unavailable.

Finally, I verified the robustness of the negative effect of uncertainty by examining the cases of other commodities. In the case of coffee, the uncertainties of two and seven years ago were negative but not significant. For sugar, the present uncertainty affect was strongly negative.

Uncertainty has a negative impact on the supply of international commodities. This phenomenon sees farmers deciding to stop growing international crops. Therefore, the uncertainty of international prices affects employment stability, which is an especial concern in developing countries. It is important to raise the issue of uncertainty *vis-à-vis* international commodity prices and employment stability, especially while some countries plant unique bio crops and commodity prices are fluctuating violently.

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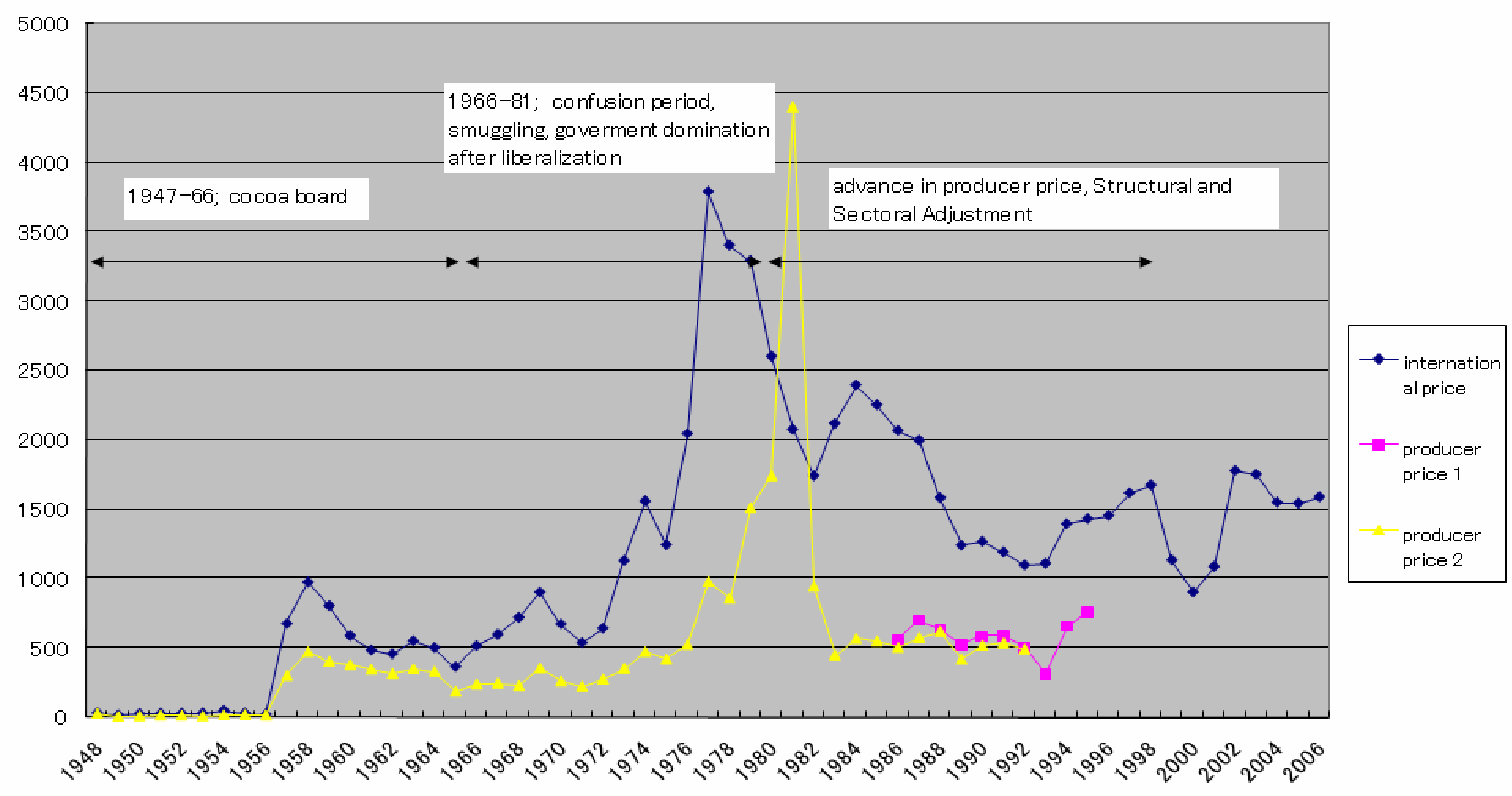
Figure 1　International Price and Producer Price



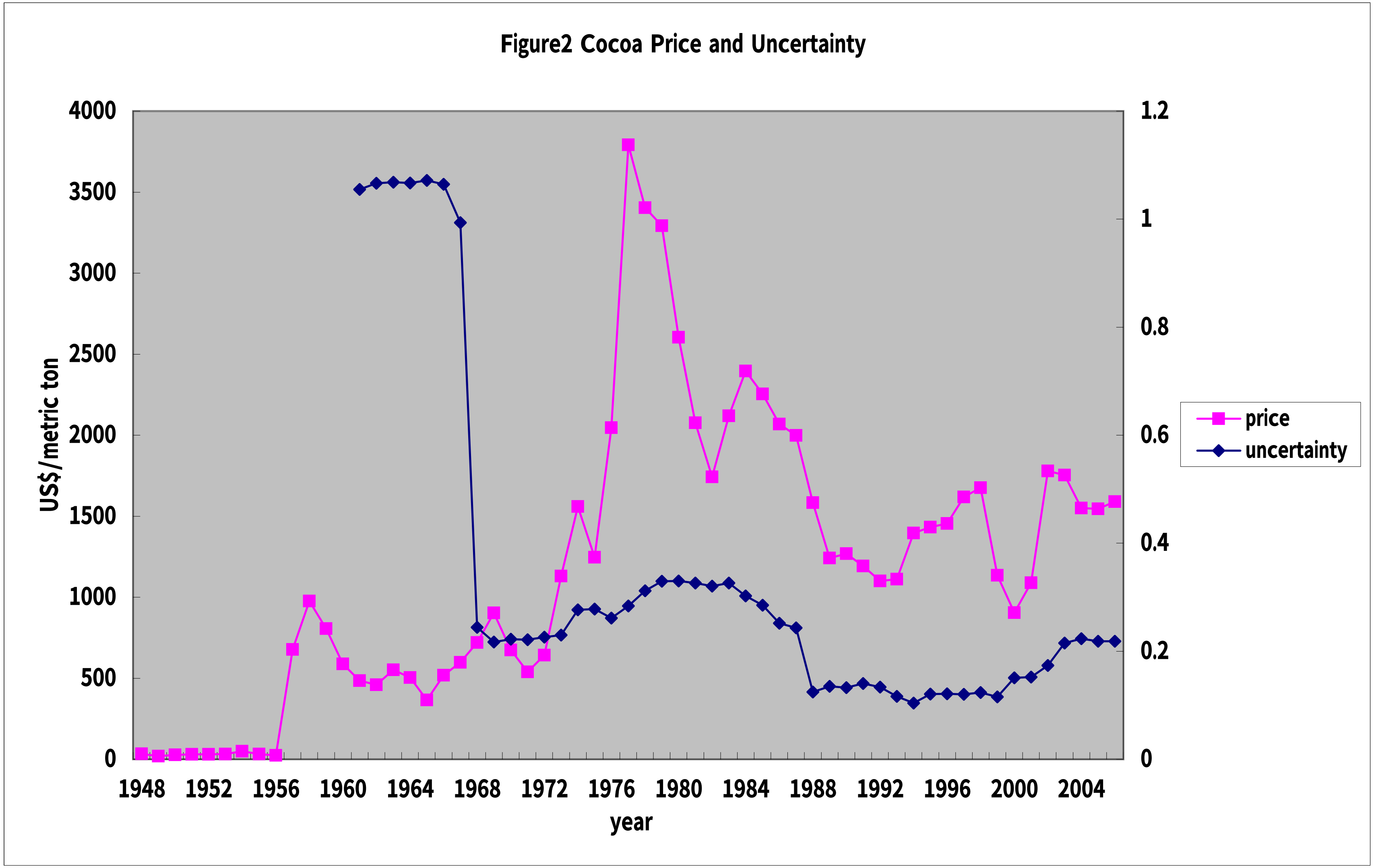


Figure2 Cocoa Price and Uncertainty
US$/metric ton
4000
3500
3000
2500
2000
1500
1000
500
0
1.2
1
0.8
0.6
0.4
0.2
0
1948 1952 1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004
year
price
uncertainty

Table1 Summary Statistics

summary statistics about cocoa

Variable	Obs	Mean	Std. Dev.	Min	Max
quantity of cacao(tons)	535	149639	199484	400	1401101
productivity tons/hectares	535	0.4392	0.1974	0.1166	1.1899
phosphate fertilizers(tons)	535	158479	381880	50	2807000
price($/metric ton)	535	1462.0610	816.0486	365.3050	3791.1200
ln_Q	535	11.1103	1.4606	5.9915	14.1528
ln_prov	535	-0.9151	0.4289	-2.1487	0.1739
ln_rin(log of phosphate fertilizers	535	9.9100	2.2660	3.9120	14.8476
ln_price	535	7.1286	0.5809	5.9007	8.2404
uncertainty	535	0.3403	0.3103	0.1041	1.0716

summary statistics about cocoa with rainfall variable

Variable	Obs	Mean	Std. Dev.	Min	Max
quantity of cacao(tons)	497	142250	182004	400	1235300
productivity tons/hectares	497	0.4360	0.1915	0.1166	1.1560
phosphate fertilizers(tons)	497	148750	347976	50	2022400
price($/metric ton)	497	1478.7820	838.1041	365.3050	3791.1200
rainfall(mm)	497	1548.4730	614.2948	475.5000	3445.2000
ln_Q	497	11.0740	1.4615	5.9915	14.0268
ln_prov	497	-0.9198	0.4247	-2.1487	0.1450
ln_rin	497	9.8492	2.2762	3.9120	14.5198
ln_price	497	7.1320	0.5975	5.9007	8.2404
ln_rain	497	7.2664	0.4008	6.1644	8.1447
uncertainty	497	0.3542	0.3177	0.1041	1.0716

summary statistics about coffee

Variable	Obs	Mean	Std. Dev.	Min	Max
quantity of coffee(tons)	296	128614	276765	100	1407213
productivity tons/hectares	296	0.1779	0.4088	0.0004	3.3789
price($/metric ton)	296	108.0007	52.6257	45.0300	267.1430
ln_Q	296	9.7314	2.2411	4.6052	14.1571
ln_prov	296	-3.0428	1.6615	-7.7134	1.2175
ln_price	296	4.5745	0.4600	3.8073	5.5878
uncertainty	296	0.2826	0.0667	0.1531	0.3913

summary statistics about sugar

Variable	Obs	Mean	Std. Dev.	Min	Max
quantity of sugar(tons)	735	48000000	68000000	1533000	457000000
productivity tons/hectares	735	68.1567	22.0397	22.4285	158.1254
price($/metric ton)	735	9.0973	5.8575	1.8670	29.9420
ln_Q	735	17.1371	0.9865	14.2427	19.9407
ln_prov	735	4.1700	0.3254	3.1103	5.0634
ln_price	735	2.0161	0.6424	0.6243	3.3993
uncertainty	735	0.3784	0.1483	0.1623	0.6261

Table2 Fixed Effect Model Estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ln_Q										
ln_prov	1.765***	1.736***	1.711***	1.670***	1.638***	1.638***	1.623***	1.597***	1.593***	1.569***	1.520***
	(0.092)	(0.092)	(0.092)	(0.092)	(0.093)	(0.093)	(0.093)	(0.094)	(0.097)	(0.098)	(0.100)
ln_rin	0.174***	0.186***	0.188***	0.191***	0.183***	0.175***	0.169***	0.161***	0.161***	0.151***	0.141***
	(0.041)	(0.042)	(0.043)	(0.043)	(0.045)	(0.046)	(0.047)	(0.049)	(0.050)	(0.051)	(0.052)
ln_price	-0.028	-0.052	-0.066	-0.099	-0.150**	-0.209***	-0.239***	0.010	-0.129	-0.143	-0.102
	(0.063)	(0.062)	(0.062)	(0.062)	(0.066)	(0.073)	(0.077)	(0.117)	(0.132)	(0.129)	(0.147)
uncertan	-0.335**	-0.016	-0.093	-0.125	-0.178	-0.272	-0.341	-1.849***	-1.718	-1.832*	-1.561
	(0.133)	(0.248)	(0.250)	(0.249)	(0.253)	(0.259)	(0.290)	(0.592)	(1.083)	(1.059)	(1.100)
uncertan_1		-0.350	0.055	-0.006	-0.019	-0.020	-0.031	0.056	0.526	0.093	-0.392
		(0.241)	(0.337)	(0.331)	(0.326)	(0.318)	(0.310)	(0.304)	(1.114)	(1.454)	(1.502)
uncertan_2			-0.377	0.076	0.040	0.061	0.078	-0.031	-0.025	0.681	0.085
			(0.239)	(0.332)	(0.328)	(0.319)	(0.310)	(0.303)	(0.297)	(1.089)	(1.444)
uncertan_3				-0.434*	0.053	0.002	0.011	-0.063	-0.017	-0.060	0.669
				(0.239)	(0.327)	(0.318)	(0.310)	(0.302)	(0.296)	(0.289)	(1.125)
uncertan_4					-0.512**	0.085	0.011	0.050	0.032	0.026	-0.005
					(0.249)	(0.316)	(0.309)	(0.300)	(0.294)	(0.286)	(0.282)
uncertan_5						-0.643***	-0.095	0.015	-0.079	-0.086	-0.056
						(0.243)	(0.311)	(0.310)	(0.306)	(0.298)	(0.295)
uncertan_6							-0.549**	-0.056	-0.161	-0.179	-0.150
							(0.222)	(0.300)	(0.304)	(0.296)	(0.292)
uncertan_7								-0.323	0.173	0.106	0.062
								(0.214)	(0.304)	(0.301)	(0.299)
uncertan_8									-0.495**	-0.100	-0.128
									(0.227)	(0.304)	(0.310)
uncertan_9										-0.345*	-0.126
										(0.198)	(0.318)
uncertan_10											-0.169
											(0.229)
Constant	11.315***	11.350***	11.426***	11.632***	12.094***	12.665***	12.974***	11.458***	12.412***	12.599***	12.369***
	(0.515)	(0.532)	(0.547)	(0.576)	(0.645)	(0.724)	(0.779)	(0.960)	(1.098)	(1.092)	(1.175)
Observations	535	524	513	502	491	480	467	454	441	428	415
Number of id	13	13	13	13	13	13	13	13	13	13	13
R-squared	0.53	0.53	0.52	0.52	0.51	0.51	0.51	0.52	0.51	0.51	0.50

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table3 Fixed Effect Model Estimation with Rainfall Variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ln_Q										
ln_prov	1.678***	1.650***	1.626***	1.585***	1.552***	1.556***	1.541***	1.522***	1.520***	1.501***	1.456***
	(0.097)	(0.096)	(0.096)	(0.096)	(0.098)	(0.098)	(0.098)	(0.099)	(0.101)	(0.103)	(0.105)
ln_rin	0.171***	0.187***	0.192***	0.200***	0.197***	0.194***	0.192***	0.189***	0.193***	0.185***	0.179***
	(0.044)	(0.044)	(0.045)	(0.046)	(0.047)	(0.048)	(0.050)	(0.051)	(0.053)	(0.054)	(0.055)
ln_price	0.001	-0.026	-0.043	-0.080	-0.135*	-0.205**	-0.249***	0.058	-0.127	-0.139	-0.095
	(0.066)	(0.066)	(0.065)	(0.066)	(0.071)	(0.080)	(0.086)	(0.138)	(0.162)	(0.157)	(0.186)
ln_rain	0.170	0.199	0.162	0.167	0.162	0.080	0.106	0.160	0.149	0.127	0.109
	(0.173)	(0.172)	(0.170)	(0.169)	(0.168)	(0.165)	(0.163)	(0.161)	(0.163)	(0.160)	(0.159)
uncertan	-0.308**	-0.005	-0.075	-0.098	-0.150	-0.244	-0.302	-1.975***	-1.598	-1.691	-1.484
	(0.136)	(0.252)	(0.254)	(0.253)	(0.256)	(0.263)	(0.294)	(0.631)	(1.206)	(1.173)	(1.197)
uncertan_1		-0.331	0.024	-0.036	-0.051	-0.040	-0.066	0.042	0.368	0.053	-0.389
		(0.246)	(0.342)	(0.336)	(0.331)	(0.323)	(0.314)	(0.309)	(1.173)	(1.507)	(1.547)
uncertan_2			-0.329	0.083	0.052	0.067	0.095	-0.027	-0.001	0.548	-0.026
			(0.242)	(0.336)	(0.331)	(0.322)	(0.312)	(0.305)	(0.300)	(1.132)	(1.505)
uncertan_3				-0.396	0.050	0.004	0.019	-0.076	-0.015	-0.053	0.677
				(0.243)	(0.330)	(0.321)	(0.312)	(0.303)	(0.297)	(0.291)	(1.184)
uncertan_4					-0.478*	0.073	-0.004	0.037	0.013	0.013	-0.013
					(0.256)	(0.320)	(0.312)	(0.302)	(0.295)	(0.286)	(0.283)
uncertan_5						-0.605**	-0.078	0.074	-0.049	-0.056	-0.027
						(0.251)	(0.314)	(0.314)	(0.312)	(0.303)	(0.302)
uncertan_6							-0.549**	-0.051	-0.156	-0.171	-0.141
							(0.228)	(0.301)	(0.305)	(0.296)	(0.292)
uncertan_7								-0.280	0.173	0.115	0.072
								(0.219)	(0.304)	(0.301)	(0.300)
uncertan_8									-0.488**	-0.121	-0.140
									(0.242)	(0.314)	(0.324)
uncertan_9										-0.323	-0.120
										(0.198)	(0.324)
uncertan_10											-0.150
											(0.238)
Constant	9.796***	9.612***	9.946***	10.091***	10.578***	11.770***	11.969***	9.594***	10.933***	11.241***	11.080***
	(1.416)	(1.402)	(1.401)	(1.396)	(1.404)	(1.443)	(1.460)	(1.653)	(1.800)	(1.779)	(1.835)
Observatic	497	486	475	464	453	442	429	416	403	390	377
Number of	13	13	13	13	13	13	13	13	13	13	13
R-squared	0.51	0.51	0.50	0.50	0.49	0.49	0.50	0.51	0.50	0.50	0.50

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table4 Fixed Effect Model Estimation with Year Dummy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln_Q							
ln_prov	1.706***	1.592***	1.597***	1.533***	1.613***	1.506***	1.515***	1.470***
	(0.092)	(0.094)	(0.094)	(0.103)	(0.097)	(0.098)	(0.099)	(0.108)
ln_rin	-0.028	0.069	0.091*	0.134**	-0.023	0.082	0.110**	0.170***
	(0.049)	(0.050)	(0.051)	(0.054)	(0.051)	(0.053)	(0.054)	(0.057)
ln_price	-0.112	-0.173	-0.165	-0.194	0.159	-0.236	-0.247	0.033
	(0.346)	(0.329)	(0.317)	(0.296)	(0.124)	(0.165)	(0.166)	(0.105)
ln_rain					0.338*	0.206	0.206	0.165
					(0.181)	(0.174)	(0.172)	(0.171)
uncertan	-1.133***				-0.111			
	(0.437)				(0.326)			
uncertan_5		-0.986***				-0.934***		
		(0.372)				(0.351)		
uncertan_6			-0.816**				-0.776**	
			(0.317)				(0.331)	
uncertan_10				-0.741**				-0.455**
				(0.321)				(0.211)
Constant	14.324***	13.540***	13.229***	12.926***	8.980***	12.193***	11.977***	9.601***
	(2.532)	(2.404)	(2.307)	(2.176)	(1.741)	(2.067)	(2.080)	(1.631)
year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	535	480	467	415	497	442	429	377
Number of id	13	13	13	13	13	13	13	13
R-squared	0.59	0.55	0.54	0.51	0.57	0.53	0.53	0.50

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table5 Fixed Effect Model Estimation using Differences

	(1)	(2)	(3)	(4)
	dln_Q			
dln_prov	0.891***	0.887***	0.893***	0.890***
	(0.028)	(0.027)	(0.029)	(0.028)
dln_rin	0.013	0.012	0.013	0.012
	(0.015)	(0.013)	(0.015)	(0.014)
dln_price	-0.025	-0.028	0.033	-0.007
	(0.037)	(0.022)	(0.047)	(0.024)
dln_rain			0.006	0.007
			(0.009)	(0.007)
duncertan	-0.341		-0.303	
	(0.252)		(0.254)	
duncertan_1	-0.111		-0.020	
	(0.242)		(0.252)	
duncertan_2	-0.052		0.051	
	(0.234)		(0.246)	
duncertan_3	0.105		0.128	
	(0.239)		(0.242)	
duncertan_4	0.032		0.048	
	(0.044)		(0.046)	
duncertan_5	0.033		0.079	
	(0.050)		(0.055)	
duncertan_6	-0.120**	-0.087**	-0.082	-0.073*
	(0.048)	(0.043)	(0.052)	(0.044)
duncertan_7	0.039		0.032	
	(0.048)		(0.049)	
duncertan_8	-0.010		0.037	
	(0.053)		(0.058)	
duncertan_9	-0.058		-0.002	
	(0.057)		(0.063)	
duncertan_10	-0.006		0.002	
	(0.047)		(0.048)	
Constant	0.020***	0.024***	0.005	0.001
	(0.007)	(0.006)	(0.039)	(0.029)
Observations	402	454	377	429
Number of id	13	13	13	13
R-squared	0.73	0.71	0.74	0.72

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table6 Fixed Effect Model Estimation in the case of Coffee

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ln_Q										
ln_prov	1.038***	1.032***	1.028***	1.024***	1.022***	1.020***	1.017***	1.014***	1.013***	1.011***	1.010***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
ln_price	-0.090***	-0.064**	-0.053*	-0.030	-0.005	0.016	0.052	0.071	0.041	0.028	0.008
	(0.030)	(0.031)	(0.031)	(0.032)	(0.034)	(0.037)	(0.043)	(0.044)	(0.050)	(0.052)	(0.055)
uncert_cf	1.331***	0.505	0.570	0.598*	0.350	0.284	0.201	0.100	0.425	0.419	0.511
	(0.214)	(0.351)	(0.348)	(0.346)	(0.364)	(0.365)	(0.367)	(0.373)	(0.444)	(0.444)	(0.452)
uncert_cf_1		0.998***	0.230	0.285	0.486	0.398	0.437	0.487	0.183	0.354	0.168
		(0.338)	(0.456)	(0.454)	(0.461)	(0.463)	(0.462)	(0.462)	(0.514)	(0.545)	(0.572)
uncert_cf_2			0.848**	0.032	-0.003	0.032	-0.197	-0.279	-0.160	-0.288	-0.022
			(0.341)	(0.506)	(0.503)	(0.502)	(0.520)	(0.522)	(0.528)	(0.546)	(0.600)
uncert_cf_3				0.883**	0.189	0.234	0.369	0.274	0.286	0.283	0.127
				(0.407)	(0.522)	(0.521)	(0.526)	(0.529)	(0.528)	(0.528)	(0.548)
uncert_cf_4					0.851**	0.357	0.405	0.521	0.316	0.325	0.263
					(0.405)	(0.506)	(0.505)	(0.511)	(0.532)	(0.532)	(0.535)
uncert_cf_5						0.653	0.150	0.173	0.289	0.194	0.312
						(0.403)	(0.505)	(0.504)	(0.511)	(0.521)	(0.532)
uncert_cf_6							0.720	0.294	0.264	0.291	0.069
							(0.438)	(0.525)	(0.524)	(0.525)	(0.565)
uncert_cf_7								0.589	-0.071	-0.090	-0.126
								(0.400)	(0.632)	(0.633)	(0.634)
uncert_cf_8									0.631	0.282	0.433
									(0.468)	(0.596)	(0.613)
uncert_cf_9										0.410	-0.074
										(0.434)	(0.629)
uncert_cf_10											0.529
											(0.499)
Constant	12.928***	12.749***	12.643***	12.495***	12.355***	12.236***	12.035***	11.921***	12.054***	12.101***	12.186***
	(0.163)	(0.171)	(0.175)	(0.187)	(0.197)	(0.210)	(0.242)	(0.254)	(0.272)	(0.277)	(0.288)
Observatic	296	296	296	296	296	296	296	296	296	296	296
Number of	13	13	13	13	13	13	13	13	13	13	13
R-squared	0.93	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table7 Estimation using Differences in the case of Coffee

	(1)	(2)
	dln_Q	
dln_prov	0.889***	0.895***
	(0.022)	(0.022)
dln_price	0.004	0.003
	(0.025)	(0.020)
duncert_cf	0.398**	
	(0.176)	
duncert_cf_1	0.288	
	(0.177)	
duncert_cf_2	-0.058	-0.175
	(0.200)	(0.163)
duncert_cf_3	0.263	
	(0.175)	
duncert_cf_4	0.251	
	(0.194)	
duncert_cf_5	0.200	
	(0.176)	
duncert_cf_6	0.182	
	(0.196)	
duncert_cf_7	-0.132	-0.158
	(0.233)	(0.175)
duncert_cf_8	0.250	
	(0.186)	
duncert_cf_9	0.205	
	(0.197)	
duncert_cf_10	0.150	
	(0.226)	
Constant	0.003	0.010*
	(0.006)	(0.006)
Observations	295	295
Number of id	13	13
R-squared	0.86	0.85

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table8 Fixed Effect Model Estimation in the case of Sugar

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ln_Q										
ln_prov	1.307***	1.267***	1.233***	1.151***	1.107***	1.101***	1.089***	1.070***	1.017***	1.014***	1.011***
	(0.079)	(0.079)	(0.079)	(0.075)	(0.075)	(0.075)	(0.074)	(0.073)	(0.070)	(0.068)	(0.066)
ln_price	0.235***	0.203***	0.149***	0.144***	0.132***	0.092***	0.042	-0.014	-0.086***	-0.093***	-0.083***
	(0.023)	(0.023)	(0.024)	(0.024)	(0.024)	(0.026)	(0.028)	(0.029)	(0.030)	(0.030)	(0.030)
uncert_su	-0.612***	-1.075***	-1.344***	-1.514***	-0.945***	-0.967***	-0.768***	-0.373	-0.298	-0.735***	-0.634***
	(0.097)	(0.232)	(0.233)	(0.225)	(0.239)	(0.237)	(0.238)	(0.251)	(0.239)	(0.254)	(0.244)
uncert_su_1		0.392*	0.075	0.048	-0.456	-0.154	-0.423	-0.504*	-0.144	0.178	-0.253
		(0.230)	(0.278)	(0.280)	(0.293)	(0.296)	(0.296)	(0.293)	(0.286)	(0.291)	(0.305)
uncert_su_2			0.480**	0.394	0.019	-0.268	-0.011	-0.377	-0.360	0.309	0.511*
			(0.241)	(0.274)	(0.284)	(0.307)	(0.305)	(0.305)	(0.299)	(0.317)	(0.310)
uncert_su_3				0.109	0.037	-0.230	-0.316	0.025	-0.455	-0.550*	0.032
				(0.234)	(0.275)	(0.287)	(0.303)	(0.300)	(0.295)	(0.297)	(0.318)
uncert_su_4					0.365*	0.236	-0.179	-0.391	-0.079	-0.625**	-0.672**
					(0.220)	(0.269)	(0.286)	(0.300)	(0.289)	(0.290)	(0.286)
uncert_su_5						0.422*	0.165	-0.187	-0.303	0.242	-0.239
						(0.234)	(0.271)	(0.281)	(0.285)	(0.286)	(0.294)
uncert_su_6							0.662***	0.377	-0.097	-0.146	0.267
							(0.219)	(0.262)	(0.272)	(0.285)	(0.284)
uncert_su_7								0.689***	0.379	-0.259	-0.241
								(0.227)	(0.255)	(0.290)	(0.302)
uncert_su_8									0.789***	0.333	-0.190
									(0.218)	(0.275)	(0.304)
uncert_su_9										0.740***	0.320
										(0.230)	(0.271)
uncert_su_10											0.617***
											(0.223)
Constant	11.445***	11.714***	12.020***	12.460***	12.687***	12.796***	12.919***	13.078***	13.404***	13.422***	13.413***
	(0.332)	(0.335)	(0.334)	(0.321)	(0.319)	(0.321)	(0.321)	(0.316)	(0.307)	(0.299)	(0.292)
Observations	735	719	703	687	671	655	639	623	607	591	575
Number of id	16	16	16	16	16	16	16	16	16	16	16
R-squared	0.42	0.42	0.43	0.47	0.48	0.48	0.48	0.48	0.49	0.51	0.52

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table9 Estimation using Differences in the case of Sugar

	(1)	(2)
	dln_Q	
dln_prov	0.874***	0.909***
	(0.032)	(0.031)
dln_price	-0.030***	-0.017**
	(0.010)	(0.008)
duncert_su	-0.049	-0.027
	(0.080)	(0.055)
duncert_su_1	0.024	
	(0.076)	
duncert_su_2	-0.003	
	(0.078)	
duncert_su_3	-0.057	
	(0.075)	
duncert_su_4	-0.057	
	(0.075)	
duncert_su_5	-0.050	
	(0.071)	
duncert_su_6	0.014	
	(0.070)	
duncert_su_7	0.074	
	(0.071)	
duncert_su_8	0.138*	
	(0.074)	
duncert_su_9	0.144**	
	(0.064)	
duncert_su_10	0.117*	
	(0.067)	
Constant	0.018***	0.022***
	(0.004)	(0.003)
Observations	558	718
Number of id	16	16
R-squared	0.60	0.55

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%