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Have Indonesian Rubber Processors Formed a Cartel? Analysis of Intertemporal Marketing Margin Manipulation

Thomas Kopp[1], Zulkifli Alamsyah[2], Raja Sharah Fatricia[3] and Bernhard Brümmer[4]

[1] Georg August Universität Göttingen, Agricultural Faculty, Chair for Agricultural Market Analysis, Platz der Göttinger Sieben 7, 37073 Göttingen, Germany. thomas.kopp@agr.uni-goettingen.de.

[2] Jambi University, Indonesia, Faculty of Agriculture, Department of Agricultural Economics, Mendalo Kampus, Jambi Kota, Jambi. zulkifli_uj@yahoo.com.

[3] Jambi University, Indonesia, Faculty of Economics, Marketing Department, Telanai Kampus, Jambi Kota, Jambi. eau_de_cherie@yahoo.com.

[4] Georg August Universität Göttingen, Agricultural Faculty, Chair for Agricultural Market Analysis, Platz der Göttinger Sieben 7, 37073 Göttingen, Germany. bbruemm@gwdg.de.

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Abstract

A high level of market-power within the rubber processing industry limits the spread of the wealth generated with exports in Indonesia's Jambi province. The market-power of the crumb rubber factories is based on a high level of concentration. With an Auto-Regressive Asymmetric Threshold Error Correction Model, we study the price transmission at these factories. The extent of the threshold effect is studied, as well as the rents that are redistributed from the farmers to the factories. This is the first paper to quantify the additional distributional consequences of intertemporal marketing margin manipulation based on cartelistic or oligopsonistic market power.

Keywords

Intertemporal marketing margin manipulation, rubber cartel, asymmetric price transmission, threshold error correction, Indonesia

1. Introduction

For Indonesia the agricultural sector is of great importance: in 2011 it contributed 15 % to the GDP and employed 36% of the workforce (World Bank Database). The most valuable export crop is natural rubber. More than 15 million people generate their main income with rubber cultivation (Fathoni 2009).

For the future, it is likely that the importance of rubber for Indonesia will even increase for two reasons. First: the total demand for any kind of rubber will increase, due to rapid economic growth in transition economies; and secondly the ever-rising crude oil price will make synthetic rubber more expensive and thus increases the demand for its substitute: natural rubber.

Rubber is predominately produced on the islands of Sumatra and West Kalimantan (Arifin 2005). The province of Jambi (Sumatra) is one example for a province that crucially depends on its agricultural sector, and is also one typical rubber production area: 52 % of the workforce is employed in the agricultural sector and 653 000 ha (out of 1354 000 ha) are dedicated to rubber production, of which 99.6% are cultivated by small-holders (Statistical Year Book of Estate Crops). Although Jambi is on average not an exceptionally poor province, the rural population is still at a disadvantage compared to the populations in other parts of Indonesia: the average income is 17.5 million RP/year (Jambi in Figures 2011 and Arifin 2005), which is far below the national average of 26.8 million RP/year (World Bank Database). Other development indicators show a similar picture: The life expectancy at birth for example is 70.80 years in Jambi, compared to 76.2 years in Jakarta (Jambi in Figures 2011).

As the most common production mode for rubber is small-scale plantation agriculture cultivated by smallholders, rubber does have the potential to be one key to economic and social development in the rural area, improving the socio economic situation of millions. In total, 250 000 Jambinese households (out of 619 000) depend on rubber cultivation (Statistical Year Book of Estate Crops). This means that roughly one million people in Jambi are affected. It follows that malfunctions in this market can have a tremendous effect on the livelihoods of small scale farmers and their families if these imperfections are disadvantageous for this group. Thus it should be a primary policy target to ensure that these markets function properly.

This does not seem to be the case. The Jambinese rubber sector is characterized by strong oligopsonistic market power. On the processing side a strong concentration of the demand for the produce of the farmers can be observed, as there are only nine rubber factories in Jambi, facing 250 000 farmers. These factories do not appear to be in tight competition, but are rather collaborating closely. All of them are organized in the association of the rubber processing sector, GAPKINDO (Gapkindo, 2013). Its main role is “the development of rubber processing industries” and to “network among members” (Peramune and Budiman, 2007: 32). There are strong indications that some individual firms exploit their network to behave in a way that resembles a classical cartel or oligopsony (ibid.)[1].

In order to shed light on the price formation process in the rubber value chain, we are employing a price transmission approach. In particular we study the vertical transmission between the output- and input prices of the five crumb rubber factories in Jambi City from 01 January 2009 until 31 December 2012 via an Asymmetric Threshold Error Correction Model (ATECM). To specify the error correction model, a set of candidate parametric models is estimated. The results are tested to determine which one represents the data best. Instead of stopping at this point and only proving the existence and extend of market power, we also

[1] Within the scope of this analysis it cannot clearly be distinguished between a cartel and an oligopoly since the data required for a game theoretical approach or the determination of the cartel price (cost structures of the factories, demand structure) are not available.

quantify a part of the resulting redistribution of welfare from the suppliers to the factories. These welfare implications are shown to be substantial.

To the best of our knowledge, this is the first paper combining the parametric analysis of asymmetric price transmission processes with a welfare perspective to quantify the distributional consequences of this intertemporal marketing margin manipulation. The dataset of daily prices on such a disaggregated and local level is also very unique.

The paper is organized as follows: chapter two provides the background of the rubber market in Jambi province and introduces the typical marketing chain for natural rubber originating from smallholder production in this area. In chapter three the intuition behind asymmetric price transmission is discussed. Chapter four is dedicated to the model development, and chapter five presents the statistical results. The subsequent chapter derives the resulting welfare implications before chapter seven concludes.

2. Background

The Jambinese rubber sector is displayed in figure 1: Most farmers sell to a village trader who has the choice between three different kinds of stakeholders to sell to: a factory, a warehouse or another trader, for example on the district level. This choice is influenced by various factors, including the remoteness of the trader, her capital, access to information, etc.[2] The percentages indicate which marketing channel is employed how often.

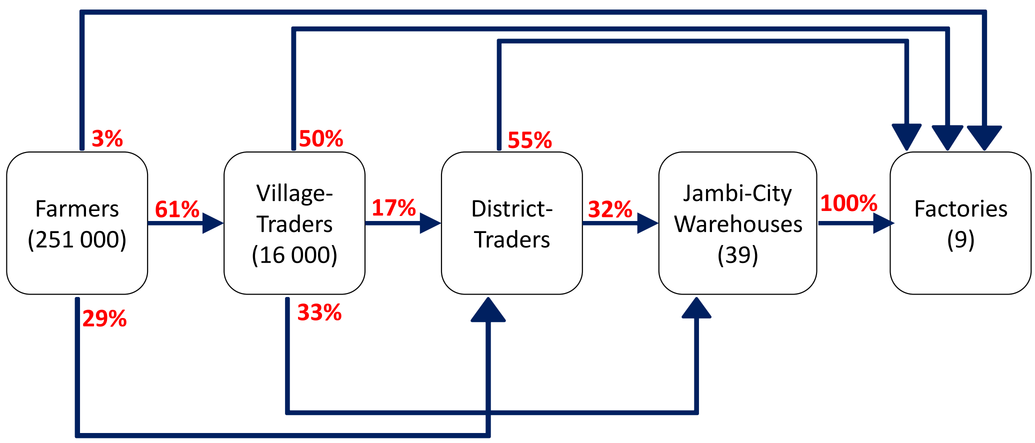

Figure 1. Marketing channels for rubber[3] (own calculations, based on survey data from Euler et al., 2012 and author's survey, 2012).

There are approximately 16 000 traders in Jambi province and nine factories of which five are located in the capital Jambi City (author's survey, 2012 and Jambi in Figures 2011). It appears likely that olygopsonistic market power occurs at several stages of this value chain. On the village-level the traders' market power seems to be based on the farmers' credit constraint as well as asymmetric information vis-à-vis the farmers. In this paper however, we are focusing on the market power at the next stage: the gates of the factories.

The incriminating indicators are strong: during the author's survey (2012) some respondents claimed that they were victims of market power of downstream stakeholders (other traders, warehouses and factories). It seems that the critique they are expressing is justified to at least

[2] Information stems from a representative survey with 335 traders from all over Jambi province, undertaken in 2012 by the author.

[3] Farmers' marketing channels do not add up to 100%, because they sell a minor share on auction markets (6%) where the buyer is unknown, as well as to farmers' associations (1%). The missing 13% of the district traders stem from the fact that they can also sell to another trader, which was omitted from this graph.

some extend: each of the five factories that are located in Jambi province reports the price that it is paying each day for their main input to one central agent (their association) and also has the option to get the information on its 'competitors'' prices from this agent. This makes it possible for each factory management to control its competitors' pricing. Another piece of evidence for the power of the factories is the standard procedure that follows if an external investor wants to construct a new crumb rubber factory: before getting the required permission by the government, the officials responsible will first consult with the rubber processors' association on whether to give the permission or not (source: interview with Jambi Provincial Government Office for Trade and Industry). Anwar (2004), cited in Arifin (2004) argues that the margin of Jambinese rubber factories is much higher than in other provinces. While Anwar argues this to be the result of the close geographic proximity of Jambi to one of the most important export market ports (Singapore), it is much more likely that this observed increased margin comes from the oligopsony of the rubber factories (Arifin 2004).

This market power has a tremendous effect on the distribution of welfare, both on the rubber farmers and the Jambinese society in general. The welfare loss that the farmers experience consists of the income that is redistributed from them to the factories due to the lower price and the general welfare loss that stems from the fact that at the free market price more rubber would be produced.[4] However, as the supply function of the rubber farmers is unknown, it is not possible to derive how much the supplied quantity and thus the total welfare loss would be in the case of a price change. So in the remainder of this article we will concentrate on the farmers' welfare loss due to the redistribution based on lower than free-market price in times of price hikes. We are going to show *that* and *how* this monopsonistic market power is exercised and *how large* the welfare loss to the farmers is which results from the intertemporal marketing margin manipulation.

3. Asymmetric price transmission

One way of empirically proofing the existence of market power is by testing for a non-constant transmission of price changes (Kinnuncan & Forker 1987, McCorriston 2002, Lloyd et al. 2003).[5] In the process of the kind of asymmetry that we are addressing here, positive changes of the price at which an agent sells (i.e. when the agent's margin increases) are passed on to the next upstream agent where the agent buys from at a lower speed than negative price changes (i.e. when her margin decreases).[6]

The assumption behind the asymmetric price transmission between the international rubber price and the Jambinese price for raw rubber is that the factories are price takers at the international market and price setters at the domestic market. One can thus understand the shocks that arise in the first one as exogenous and the ones in the latter as reactions to that shock. In figure 2, the two lines represent the input- and output-prices. The margin of the factory is the squared area. Negative shocks are transmitted faster than positive ones, which means that in the case of a negative shock the margin of the processor stays constant, while after a positive shock the margin increases (striped area).

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[4] In the long run it is reasonable to argue that the farmers have the possibility to increase their rubber output, for example by shifting their production from palm oil to rubber. After 20-25 years a palm oil plantation has to be replanted anyways and the investment required for replanting palm oil or establishing rubber are similar.

[5] We are aware that with structural models the literature around New Empirical Industrial Organization provides a more direct approach to the proof of market power (Bresnahan 1981). However, these approaches require detailed information on the firms' demand and supply structures, i.e. data on a level of detail that we don't have access to.

[6] If asymmetries in the short-run dynamics occur (not only in the adjustment parameter) it would also be interesting to analyse these dynamics via impulse response functions. As we will see however, there are no asymmetries in the short-run dynamics, so the generation of impulse response functions would not increase the quality of information.

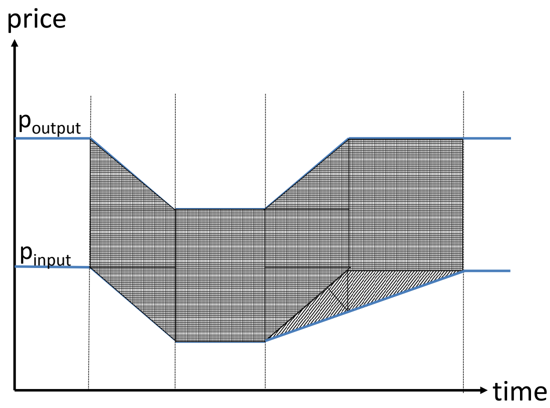

Figure 2. Intuition of asymmetric price transmission (own draft).

As Meyer and von Cramon-Taubadel (2004) show, asymmetric price transmission (APT) is not necessarily caused by market power. In their literature review, they present an overview of reasons for asymmetric price transmission other than market power, arguing that the proof of asymmetric price transmission is not necessarily equal to a proof of market power. For the case of our study however, all these alternative explanations that can lead to APT may be well-consciously ruled out, leaving only the conclusion of the APT to be caused by market power, based on cartelistic behavior.

(a) “Menu costs” or the costs associated with changing the price: the prices that the factories are paying to their suppliers are changing on every single day. There is no reason to believe that the costs of changing the price depend on the direction of the price change.
(b) Fixed costs forcing a firm to operate close to its production capacity: as the agricultural input, the slabs of coagulated rubber is extremely durable, the factories do always have a stock available, big enough to keep the factory running for more than a week.
(c) Perishability generates an incentive to sell the produce quickly: processed crumb rubber is not perishable.
(d) A strong Inflation in times of rising prices leads to data that exhibit asymmetry: while the inflation of the Indonesian Rupiah is greater than of the US Dollar, it is not great enough to have any impact on a daily basis which is the horizon of our data.
(e) Processing time: Though a delayed reaction (caused by processing time) in combination with high inflation can show misleading signs of APT[7], this does not apply here because of two reasons: 1.) Yes, inflation is high in Indonesia (4.3% in 2012[8]). However, we are working with daily data. During the typical reaction times the price hike due to inflation is close to zero. 2.) Secondly, we are observing a potentially monopsonistic setting, implying that the shock that hits the leading (selling) price occurs *after* the processing. If factories who set their buying price (and take their selling price) would want to set the buying price according to what they receive for that specific load of rubber after processing, they would have to anticipate the time after the processing already at the time of purchasing. This would be impossible.
(f) Non-cooperative game: there are cases which look like price-rigging has happened, while in fact there is no outspoken agreement. It occurs in situations in which firms possess a credible threat to punish another firm which deviates from the cartel-solution (Perloff et al., 2007). However, only very hardly could it be argued that these companies that are in other respects

[7] APT caused by delayed reaction to shock and high inflation.
[8] Inflation in 2009: 4.8%, 2010: 5.1%, 2011: 5.4%. All were drawn from World Bank development indicators, dataset “Inflation, consumer prices (annual %)”, accessed on 25.09.2013.

such close companions would have an agreement that is not the subject of debates. Besides, even if there is indeed no explicit agreement on pricing, the oligopsony-hypothesis would still hold.

4. Statistical procedure

Given that we are working with prices, a non-stationarity nature of the data is expected which will be tested via the Augmented Dickey-Fuller (ADF) test with both variables of interest (ln_p^{Sell} and ln_p^{Buy}). As it will be shown, they are indeed non-stationary, which we address by taking the first differences. We will then test whether the two series are co-integrated which is done by employing both the Johansen test (Johansen, 1995) and the Engle-Granger Two-Step Method (Engle and Granger, 1987). For both tests we need to find the optimal lag-length. As we are using daily data, it is likely that the price of one day depends also on past shocks. To select the optimal number of lags we consider the Akaike's Information Criterion (AIC), Schwarz's Bayesian information criterion (SBIC) and Hannan and Quinn information criterion (HQIC).

Assume a multiplicative mark-up model.[9] p_t^B refers to the buying price at time t and p_t^S to the selling price. The long-run ("co-integrating") relationship in its logarithmic form is

$$\ln p_{\mathrm{t}}^{\mathrm{Buy}} = \beta_0 + \beta_1 \ln p_{\mathrm{t}}^{\mathrm{Sell}} + \varepsilon \qquad (1)$$

which we estimate with the Johansen method. The reason for doing so (despite our general approach of the Engle-Granger two-step method) is that it delivers better results when estimating the co-integrating relationship (Gonzalo, 1994). From the residuals of this relation we can generate the error correction term (*ect*) which is defined as follows:

$$ect_t := \ln p_{\mathrm{t}}^{\mathrm{Buy}} - \hat{\beta}_0 - \hat{\beta}_1 \ln p_{\mathrm{t}}^{\mathrm{Sell}} \qquad (2)$$

In the case of a positive price shock on the international level (i.e. a positive deviation from the long-run equilibrium in which the factories' margin increases) the *ect* will be < 0 and if the price is shocked negatively, the *ect* is > 0. The error correcting process (symmetric case) is expressed as

$$\Delta \ln p_{\mathrm{t}}^{\mathrm{Buy}} = \xi_0 + \alpha\, ect_{t-1} + \sum_{\text{ƀ}=1}^{\mathrm{M}} \left(\gamma_{\text{ƀ}} \Delta \ln p_{\mathrm{t}-\text{ƀ}}^{\mathrm{Buy}} + \lambda_{\text{ƀ}} \Delta \ln p_{\mathrm{t}-\text{ƀ}}^{\mathrm{Sell}}\right) + \varepsilon \qquad (3)$$

with M being the number of lags. Figure 3 (continuous line) illustrates the error correcting process by graphing the *ect* from the period before against the change of the buying price in the current period. In the 2nd quadrant we see the correction of positive price shocks while the correction of negative shocks is represented in the 4th quadrant.

For the thoughts laid out in the theoretical section above, the model is extended to a threshold error correction process, which is the generalization of a simple asymmetric adjustment. The existence of any threshold is tested for with a SupLM test as suggested by Hansen and Seo (2002). Based on model (4) the *ect* gets split up into N regimes by N-1 thresholds, which are located at ψ_λ with $\lambda \epsilon [1;N-1]$ and $ect_{\mathrm{t}}^{\varsigma} := ect_{\mathrm{t}} \;\; if \; \psi_{\varsigma-1} < ect_{\mathrm{t}} \leq \psi_{\varsigma} \quad \forall \varsigma \epsilon [1;N]$:

$$\Delta \ln p_{\mathrm{t}}^{\mathrm{Buy}} = \xi_0 + \sum_{\varsigma=1}^{\mathrm{N}} \alpha_{\varsigma} ect_{\mathrm{t}-1}^{\varsigma} + \sum_{\text{ƀ}=1}^{\mathrm{M}} \left(\gamma_{\text{ƀ}} \Delta \ln p_{\mathrm{t}-\text{ƀ}}^{\mathrm{Buy}} + \lambda_{\text{ƀ}} \Delta \ln p_{\mathrm{t}-\text{ƀ}}^{\mathrm{Sell}}\right) + \varepsilon \qquad (4)$$

[9] The intuition behind using a multiplicative instead of an additive model is that the margin is likely to be a percentage markup. This has been concluded from qualitative interviews with representatives of the rubber factories. We have tested both approaches anyways, and the results confirmed that taking the logarithm represents the data better.

For an "asymmetric" process, which is the simplest form of a threshold error correction (N=2 and ψ_1=0), the error correction is displayed in figure 3 (dotted line).

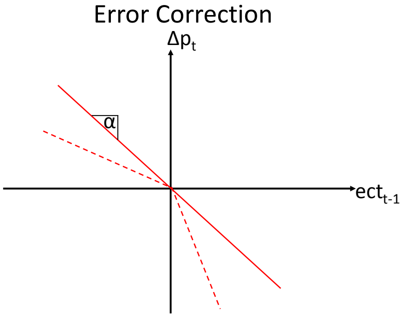

Figure 3. Symmetric, non-threshold error correction (continuous line) and asymmetric error correction (dotted line) (own draft).

In order to get to know the exact slope-coefficients which it is necessary to calculate the distributional effects, we will continue with a parametric regression approach. Several approaches are employed to model the error correction process before the model that represents the data best will be chosen via a testing procedure described below.

To start with, we estimate a simple linear error correction model (M1) which corresponds to the model described in equation (3). The second model (M2) is an asymmetric error correction model which corresponds to equation (4) with the specifications N=2 and ψ_1=0.

For the third model (M3) we assume a one-threshold model with no restriction on the location of the threshold. The intuition of model three (M3) is that the price gets corrected quickly during price drops (regime 3) and moderate hikes (regime 2) when the factories generate a normal margin. In times of large price increases (regime 1) however, the prices get corrected much slower: the factories generate a greater margin. M3 corresponds to equation (4) with N=2 and an unknown value of ψ_1).

The exact location of this threshold can be found via a grid search approach: we test each possible value of the *ect* as the threshold value ψ_1, estimate the model and save the log-likelihood value. We then select the model with the highest log-likelihood.

We find the threshold of model M3, which does not make any assumption about the location of the threshold, via the grid-search following the method laid out above.

After estimating the different models described (M1-M3), we will test which of them represents the data best. As we compare models with different specifications concerning the number of regimes (one and two), we rely on an information criterion again. We employ the AIC which is superior to other information criterion as suggested by Burnham & Anderson (2002).

5. Empirical results

The daily buying prices from the five factories in Jambi City were provided by GAPKINDO. There is one price for each factory available for each day from 1 January 2009 until 31 December 2012, except for Sundays and public holidays. Out of these five series, an unweighted average for the Jambi-buying price was generated. The selling prices were drawn from PT Kharisma (2013), a marketing company located in Jakarta. These prices represent the average results of the auctioning of Standard Indonesian Rubber (SIR20) on each day when rubber was sold (four or five days per week, except for two weeks of Christmas holidays and two weeks during Ramadan). In combination, this gives us 706 days for which we have both selling and buying prices. The price series is graphed in figure 4.[10]

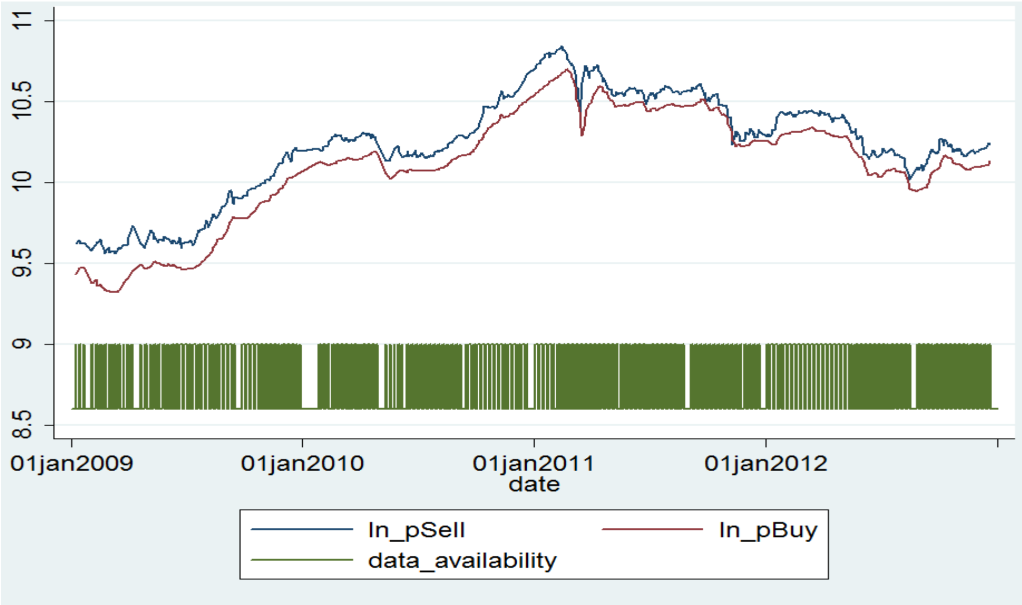

Figure 4. Time series of buying and selling prices, in ln(Rupiah).

The initial suspicion could be confirmed: the series are indeed both non-stationary (the H0 of non-stationarity cannot be rejected on a confidence level of 10%).[11] To avoid the problem of spurious regressions, we take the first differences. As the results of the ADF test show (H0 can be rejected at a 1% confidence level), which solves the problem.[12]

The SBIC suggests a lag-length of the order two, the HQIC three lags, and the AIC opts for four lags. Following Ivanov and Kilian (2005), who suggest to trust the AIC in situations of large sample sizes (>250) and data of relatively high frequency (>weekly), we use four lags. The second reason to chose the lag order suggested by AIC is the danger of biasing the results by under-parametrizing the model, while over-parametrizing does not cause too much damage (Gonzalo, 1994).

From the test for a simple (i.e. non-threshold) AR-VECM with the Johansen method we can confirm our assumption that the factories are clearly price-takers on the international market and price setters on the domestic market: the selling price does not react significantly to the buying price, while the reaction of the buying price is strong and highly. Using the Engle-Granger two-step approach results in a very similar adjustment parameter for the buying price and is also highly significant. Hence, the use of the Engle-Granger two-step approach seems appropriate. We continue the analysis using the residuals of the co-integrating relationship generated with the Johansen method ($p^{Buy}=0.45 * (p^{Sell})^{1.07}$), following the results of Gonzalo (1994) who finds that the Johansen method delivers the best results when estimating long-run relationships.[13] Testing the residuals with the ADF test yields a test statistic of -6.980, with which we can reject the H0 of non-stationarity at the 1% level. The results of Hansen and Seo's (2002) SupLM test indicate the presence of a threshold, as the H0 of an error correction process without a threshold can be

[10] The green bar indicates the existence of data, so the holes in the green bar represent days without data. In the graph, the last point before a gap was connected with the first one after it. The values are the logarithm of the prices in Indonesian Rupiah.
[11] The lag length was specified as 4 in each case, following the Akaike's Information Criterion (see below), including a constant and without trend. Test results are available on request.
[12] Same specifications as above.
[13] An F-Test confirmed that the constant is significantly (1%-level) different from the value one.

rejected at a 10% level (robust SupLM), respectively 1% (standard SupLM) level of significance.

Table 1. Estimates of long-run relation.

dep. var: ln_pBuy	OLS	Johansen
ln_pSell	1.067***	1.067***
	(0.0071)	(0.0186)
Constant	-0.811***	-0.800
	(0.0723)	
Observations	706	702
R-squared	0.982	

Robust standard errors in parentheses[14]
*** p<0.01, ** p<0.05, * p<0.1

The specification of M3 stems from a one-dimensional Gridsearch. Its results are shown in figure 5. The display of the likelihood values shows two peaks which indicate possible locations for the threshold, one at the *ect* value of -0.0383844 (splitting up the *ect* in one regime of 135 observations and one of 571 observations) and one at the value of 0.052372 (662 and 44 observations per regime). Considering that the likelihood values are nearly identical (2226.714 with the threshold at the 135th observation vs. 2226.863 at the 662nd observation) but the latter one produces one regime of only 44 observations we chose the first possibility.[15]

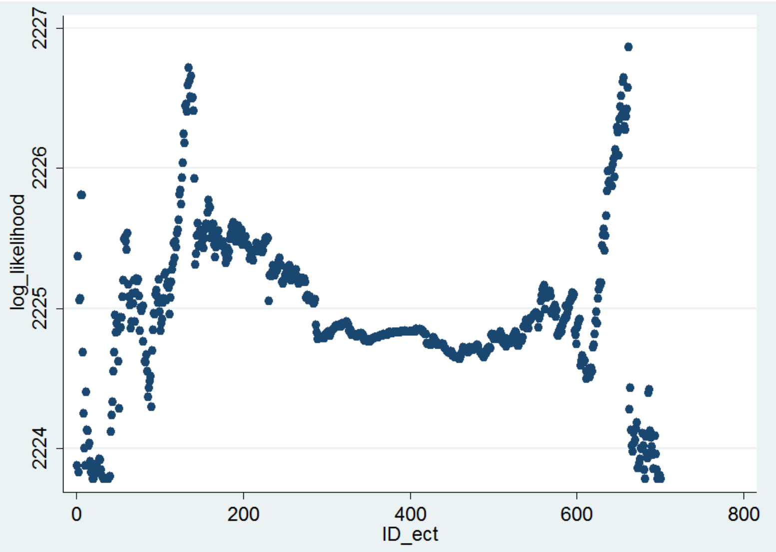

Figure 5. Results of one dimensional grid search.

Table 2. Results of all models discussed.

dep. var: d_ln_pBuy	(M1) Regular OLS	(M2) One Threshold (at zero)	(M3) One Threshold (at -0.0383844)
L.ect	-0.0583***		
	(-4.234)		
L.ect_pos		-0.0875***	-0.0935***
		(-2.954)	(-4.284)

[14] Since the VEC is not linear, it does not report t-statistics. The Johansen results have four observations less, because it includes lags, while the first step of the Engle-Granger method does not require the inclusion lags.

[15] For model tests see below. The results of the estimation that assumes the other threshold can be made available on demand.

L.ect_neg		-0.0473***	-0.0438**
		(-2.601)	(-2.561)
Constant	4.98e-05	0.000646	0.000529
	(0.125)	(1.112)	(1.260)

Robust t-statistics in parentheses[16]
*** p<0.01, ** p<0.05, * p<0.1

Table 3 presents the AIC values of the models M1-M3. Following this criterion, M3 represents the data best. Executing an F-Test proves that the two slope-coefficients of Model 3 are different from each other with a significance of 6.58%. The following discussion is thus based on the two regimes model with one threshold at -0.0383844 (M3).

Table 3. Akaike Information Critereon.

Model	ln(L)	k	AIC	Rank
M1	2223.7814	10	- 4427.5628	3
M2	2224.8331	11	- 4427.6662	2
M3	2226.7141	11	- 4431.4282	**1**

On average (M1), 5.83% of a price shock is corrected per day. If the buying price deviates from the long-run equilibrium price by 100% for example (i.e. it is half of what it should actually be), 5.83% of that shock are on average corrected at the following day. This is equivalent to an average half-life of a price shock of 11.4 days.

When accounting for the asymmetric price adjustment, the picture looks different: during the last four years, after 135 out of 390 price hikes (positive shocks to the price), the price was corrected significantly slower than during price declines. More specifically, these 135 cases were the times of extreme price hikes, i.e. *ect* < -0.0383844. It takes 16.5 days to correct half of a strong positive price change[17] and only 7.5 days in the case of a negative or small positive shock (see figure 6, in Indonesian Rupiah).[18] This means, more plainly, that when the international price sinks, the factories' buying prices decreases twice as quick as when the international price strongly rises. The time needed to correct 99% of a shock is 49 days in the case of a negative shock and 107 days in the case of a strong positive shock.

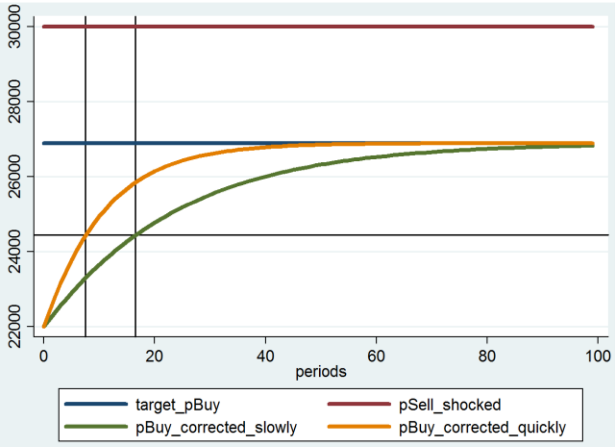

Figure 6. Correction of shocks over time (own calculations).

[16] 701 observations. Coefficients of lagged values are not reported, but can be made available upon request.

[17] The sign of the threshold is counterintuitive (negative *ects* referring to positive price changes) because the *ect* in the analysis was defined as the longrun equilibrium price minus the actual price in that period.

[18] The simulations are based on equations (7) and (8), see below.

The explanation why cartels do adjust (increase) their buying prices at all, i.e. why they not always pay a low price to the farmers is that even cartels face restrictions concerning their price setting. There is always one margin that cannot be exceeded without risking government interference. This is the margin that is realized in times of constant or falling prices but secretly increased when the prices rise.

6. Redistribution effect

The distribution effect of the asymmetric price transmission is based on the forgone profit for smallholders due to slower price transmission in times of tremendous price hikes, compared to a baseline scenario of the fastest adjustment possible which is assumed to be the adjustment that occurs in times of price decreases (see figure 7). As discussed above, we do not focus on the total welfare effect because the price elasticities of the supply and demand are unknown. The part of the welfare effect which stems from the intertemporal marketing margin manipulation is calculated as the difference between the price that is theoretically possible in times of price hikes and the price that is actually paid, multiplied with the quantity.[19]

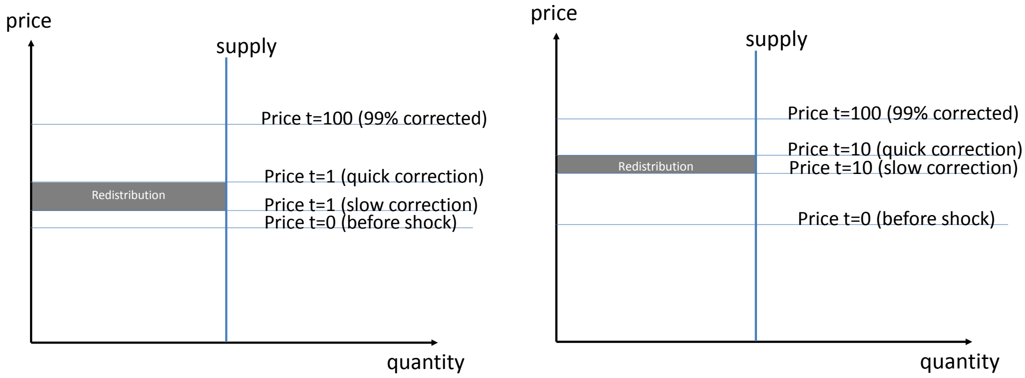

Figure 7. Welfare effect at time t+1 (Graph 1) and t+10 (Graph 2), after shock at t=0.

In order to quantify the effect that the intertemporal marketing margin manipulation had on all Jambinese farmers (figure 7), we calculate the differences between two hypothetical scenarios of the local price development after 14 periods (the time after which a farmer sells his/her produce is around two weeks) following each shock to the global price during 2009-2012. The two scenarios differ in the assumed adjustment parameter, following the results from the asymmetric error correction model. We start with the following equation

$$\ln p_{\mathrm{t}}^{\mathrm{Buy}} = \ln p_{\mathrm{t-1}}^{\mathrm{Buy}} + \Delta \ln p_{\mathrm{t}}^{\mathrm{Buy}} + \varepsilon_t \qquad (5)$$

in which we substitute $\Delta \ln \mathrm{p}_{\mathrm{t}}^{\mathrm{Buy}}$ from a simplified version (without lagged prices)[20] of equation (4) and then ect_{t} from equation (2) in order to calculate the adjusted price after one period[21]:

$$\ln p_{\mathrm{t}}^{\mathrm{Buy}} = \ln p_{\mathrm{t-1}}^{\mathrm{Buy}} + \hat{\alpha}\left(\ln p_{\mathrm{t-1}}^{\mathrm{Buy}} - \hat{\beta}_0 - \hat{\beta}_1 \ln p_{\mathrm{t-1}}^{\mathrm{Sell}}\right) + \varepsilon_t \qquad (6)$$

[19] The generation of impulse response functions would not increase the quality of information, since the short run dynamics were not proven to be asymmetric.

[20] We can make this simplification of equation (4) since the short run dynamics were not proven to be asymmetric.

[21] The adjustment of p^{Sell} to p^{Buy} can be abstracted from, as p^{Sell} was proven above to be clearly the leading price, not reacting at all to p^{Buy}.

Iterating this procedure 14 times generates the price after 14 periods after the shock in period 1.[22] The difference between the two scenarios is given as

$$p_{t+13}^{diff} = \ln p_{\text{t+14}}^{\text{Buy}\ (\alpha+)} - \ln p_{\text{t+14}}^{\text{Buy}\ (\alpha-)} \quad (7)$$

The total redistribution (*RED*) based on intertemporal marketing margin manipulation is then the sum of all price differences, multiplied by the quantity sold at time t+14:

$$RED = \sum_{t=1}^{T} \{ p_{t+14}^{diff} * q_t \} \quad (8)$$

The 250 000 Jambinese rubber producing smallholders produce 281 000 tons of rubber per year on average (Jambi in Figures 2011) and we assume them to sell on average the same amount on every day they sell. Entering all numbers into the formulas above yields a forgone revenue of 31.7 billion IDR (2.9 billion US$)[23] for the Jambinese rubber farmers in times of rising prices in every year.[24] For a single farmer, this amount represents 2.25% of his/her annual revenue. Considering that around 32% of the revenue turn into profit (calculation based on Euler et al. 2012), the calculation of the forgone profit is based on the following: profit π is equal to $s * r$ and also $\pi = r - c$ with *r* being the revenue, *s* the profit share of the revenue (32%) and *c* the costs. The possible increased revenue (if the price transmission was symmetrical) r' is equal to $r * (1 + x)$ with x being the percentage share of the possible increase of the revenue (2.25%). Then $\pi' = r' - c$. The potential increase of profit can be calculated as

$$(\pi' - \pi)/\pi = \left(r * (1 + x) - c - (r + c)\right)/ (r * s) \quad (9)$$

Increasing the revenue by 2.25% would have lead to an increased profit of 7.03%. So effectively each farmer could have generated 7.03% more profit when the prices were increasing.[25]

7. Conclusions

The indications that the five rubber processing businesses in Jambi City, Sumatra have some over proportional market power and use it to rig the prices which they are paying to their suppliers are strong. This has led to a tremendous redistribution of revenue from the farmers to the processors during the last four years: compared to a non-monopsonistic market situation, the farmers have missed out revenue of 2.25%. The net welfare loss that has been generated in the process could not be quantified in this analysis (due to missing information on the price elasticities on the supply and demand sides), but can be assumed to be substantial, too. It is likely that these kinds of processes occur all over Indonesia.

The group has achieved its advantage by correcting price changes on the international market (where its members act as price takers) asymmetrically: if the international price drops, the buying price decreases much quicker than in times of great price hikes.

One topic that has not been addressed in this analysis is the behavior *between* the Jambinese rubber processors: it would be interesting to know if there is a rather random selection of the stakeholder who applies price changes first or one clear Stackelberg leader

[22] In the computation we omit the error term, assuming it to be zero.
[23] Exchange rate from Oanda (2013).
[24] This is only the amount that is redistributed from farmers all over Jambi to the factories, due to the asymmetric price transmission of the factories' cartel. The total welfare loss due to the lower-than-market prices can be assumed to be substantial, too.
[25] Only periods were accounted for in which the deviation from the long-run equilibrium was below the threshold.

determining the price and others are following. With this sort of game-theoretical approach one would be able to get an even more detailed picture on the roles of the different stakeholders within the group, and the functioning of it on the whole. This calls for research on a more disaggregated level.

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