Resiko Project

Modelling, Ver 2

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Abstract

I model a vertically organized *palay* market to study the prevalent practice of *resiko* in the Philippine rice supply chain. *Resiko* is a markdown in the buying price of fresh palay, rationalized as compensation from the loss in volume due to rice production. This markdown is found to be levied consecutively accross the supply chain. In this vertical model of the palay market, I find that multiple *resiko*s will drive the farmgate price down. The effect on farmgate price depends on the elasticities of demand and supply. I find that traders benefit from imposing a *resiko*, and I find that the expression for an optimal markdown by a profit maximizing trader sector is equivalent to the monopsonist solution. From a policy perspective, the widespread practice of the second trader-level *resiko* gives traders monopsony power, even if they wouldn't otherwise have it. The paper ends with recommendations under the existing Philippine competition policy framework.

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Introduction

In an investigation of the *palay* market in the Bicol Region, the investigation team discovered that *resiko* across the segments of the palay supply chain. *Resiko* is a vertical pricing practice where the buyer buys fresh palay at a discount, due to the notion that only the *palay* that remains after the drying process will be paid. In practice, this markdown is set by the buyer who would declare that they would pay for X kilos per 50 kilos of fresh palay. This is tantamount to paying $\lambda = \frac{X}{50} < 1$ pesos per kg sold. We will hold to this convention in the modelling; that the buyer is setting a price of $\lambda < 1$ of peso price per kg of palay. The investigation has determined that *resiko* was applied (at least) twice in the supply chain stretching from farmers to millers.

This practice of marking down fresh (wet) palay is common practice in agricultural markets worldwide.[1] However, *resiko* should apply only once in the supply chain as the physical transformation of wet *palay* happens only once. In this paper, I model the effects of such multiple *resiko* being levied will have on the market using a model of a vertical industry.[2] I make analogies of the markdown to the economics of taxes and monopsony buying paper. Specifically, the markdown creates a wedge between the marginal revenue of the upstream seller and her demand curve. Such a wedge is analogous to the wedge formed by taxation, or by market power.

Intuitively, we will see that additional markdowns unrelated to the physical drying requirement will lead to lower prices for farmgate palay as the markdowns are simply passed down the supply chain. The more levels of the supply chain *resiko* is practiced, the lower the farmgate price will become. Recall that the process of drying occurs only once, hence the cost of the drying should be compensated by the *resiko* discount once. Perhaps less intuitively, but this is also derived from the model, is that the λ levied could be used to extract monopsony profits. A widespread practice like this that extends market power to buyers can be remedied by Philippine competition enforcement under the Philippine Competition Act.

1 Model

The vertical industry we are considering here includes three levels: Millers (M), Traders (W), and Farmers (F). The Millers face an industry demand curve for Rice, derived from higher in the supply chain, of a general linear form $P = a - bQ^R$. Rice is produced by Millers from a linear production function $Q^R = \alpha Q^P$, a process which includes drying and milling. We can think of the production coefficient as the the product of two coefficients for milling and drying separately: $\alpha = \tilde{\alpha}\tilde{\lambda}$, where $\tilde{\alpha}$ is the milling efficiency rate and the $\tilde{\lambda}$ is the drying conversion rate. Millers would spend resources to transform palay into rice, encapsulated by δ, and this is proportional to the quantity of palay processed: Cost of Processing $= \delta Q^P$. Thus δ, like α, incorporates the drying and the milling components in one parameter. It can

[1] See, for instance: https://www.uaex.edu/farm-ranch/crops-commercial-horticulture/Grain_drying_and_storage/rice_drying_and_storage.aspx

[2] As seen in textbooks such as (Pepall, Richards, and Norman 2008)'s discussion on double marginalization.

be thought of as a unit cost function of input prices to produce one kg of Rice arising from a standard cost minimization problem.[3]

1.1 Millers

Millers sell milled rice, buys palay and spends resources to process it. Its profit function can be represented by:

$$\Pi^M = P(\alpha Q^P)\alpha Q^P - \tilde{w}Q^P - \delta Q^P \tag{1}$$

A few notes on Equation (1): First, while milled rice is in the demand function, we can replace it as a function of palay with the rice production function. Second, we replace the trader price (palay wholesale) with $\tilde{w}$, to represent the *resiko* in action. I describe $\tilde{w}$ as the miller's percieved cost of palay, which describes the miller's pre-*resiko* marginal decision making.

The millers maximize the profit by taking the derivative of profit with respect to Q^P. This gives us:

$$\alpha\left[a - 2b\alpha Q^P\theta_M\right] - \delta = \tilde{w} \tag{2}$$

The first order condition is most easily interpreted as a marginal benefit equal to marginal cost condition. On the left had side is the marginal benefit, being the marginal product with respect to Q^P net of processing costs. on the right hand side we have the per kg cost of palay, $\tilde{w}$, the marginal cost of purchasing palay perceived by the millers.

We also note the justification for apply resiko, which is embedded in the δ term.Millers produce rice using a linear production function of Q^P, and spending $\delta * Q^P$. In exchange, they will pay less for inputs, $\tilde{w}$. If the markdown is well calibrated to the costs of production, it must be that the portion of δ that comprises drying cost per kg is equivalent to $(1-\lambda)w$, the decrease in input price due to the *resiko* markdown.

We also included here a general θ_M term, which is an index of competition at the miller's output market. If its a monopoly, then $\theta_M = 1$; if its perfectly competitive, $\theta_M = 1/2$. In this exercise, we leave seller market power as a parameter, although we consider local geographic markets for wholesale milled rice have millers with some market power. However, we expect local dominant millers to exercise some buyer market power. We abstract away from buyer market power here to focus on the *resiko* effects; both would lower the price received by upstream firms.

From the perspective of the traders, the first order condition above is interpreted as a demand function by traders. But because of *resiko*, the demand perceived by traders is smaller by

[3]Rice production has constant returns to scale in this formulation.

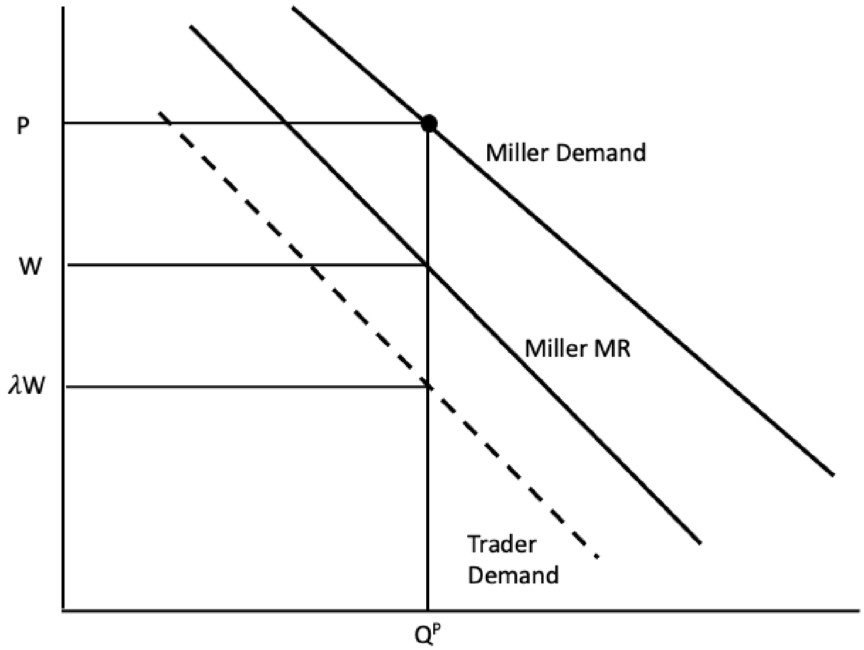

Figure 1: Miller and Trader Prices, given Quantity

λ_M, with $\lambda_M < 1$. The millers know that they will receive only $\lambda_M \tilde{w}$ to get Q^P of Palay, so they purchase palay according to $\tilde{w} = \frac{w}{\lambda_M}$ to get exactly Q^P from traders.

Figure 1 illustrates the pricing conditions for Millers and Traders. Given some market power, the miller MR is lower than demand at every Q. The effect of *resiko* is to create a *wedge* between the Miller's Marginal Revenue and Trader Demand. This is analogous to the economic effects of a tax, which shifts the demand perceived by a buyer in contrast to the seller. In this situation however, what might be tax revenue is captured by the miller as added profits. Of course, this is the reason why the trader, in turn, levies *resiko* as well; to regain its lost profits off of farmer surplus.

1.2 Traders

Traders face demand derived from millers. The demand they respond to is:

$$w = \lambda_M \left[\alpha \left[a - 2b\alpha\theta_M Q^P\right] - \delta\right] \tag{3}$$

Again, because of *resiko*, the demand traders respond to is less than the marginal product of rice. The trader demand is shifted down by λ_M, but the perceived miller wholesale price is $\tilde{(w)}$ is higher than w, and is equivalent to Miller marginal revenue. The wedge between miller marginal product and trader demand lowers the equilibrium Q^P, relative to a situation without *resiko*.

Trader's profit maximization problem gives us the following optimality condition:

$$\lambda_M \left[\alpha \left[a - 4b\alpha\theta_M\theta_W Q^P\right] - \delta\right] = \tilde{f} \tag{4}$$

The left hand side again is the marginal revenue at the trader level, which now includes market power components at the wholesale level, θ_W. The right hand side is the marginal cost of buying palay from farmers, which is the perceived price $\tilde{f}$. This is due to the second markdown the traders will apply to purchases from farmers, without incurring any further processing/drying cost (akin to δ in the miller's problem). To see the effect on farmers, we detail the demand function faced by farmers in the following section.

1.3 Farmers

The Farmers will percieve a shifted down demand for *palay*, in the same way the Traders faced a shifted down demand for *palay.* The farmer demand equation is below:

$$f = \lambda_W\lambda_M \left[\alpha \left[a - 4b\alpha\theta_W\theta_M Q^P\right] - \delta\right] \tag{5}$$

The *palay* farmers are the most upstream portion of our vertical model. We can now examine what happens in this instance. Again, we abstract from buyer power from traders, to focus on the *resiko* effect.[4] Equilibrium in this industry is found by equating demand and supply for *palay* at the farmer level. We further assume that farmer competition is closer to perfect competition; hence farmer demand is equivalent to farmer marginal revenue.

Figure 2 shows us the demand and supply curves for farmers, together with the pricing equations of traders. We note that if supply is inelastic, most of the adjustment of falling induced demand goes to prices instead of quantity. The effect of *resiko* would tend to decrease prices upstream along the supply chain, with more adjustment happening at its most upstream segment. Figure 2 connects with Figure 1 to form the vertical industry equilibrium. Demand and Supply at the Farmer level will determine Q^P, and this quantity will determine input prices going down the supply chain.

This model here has a double *resiko*, because the markdown is applied on two levels above the Farmer level. Indeed, the effect of double *resiko* comes from the multiplicative $\lambda_W\lambda_M$, where the double *resko* would reduce the demand perceived by farmers would fall by the product of the two λ terms. While this particular model has two levels above the Farmers, the more general lesson here is that the more levels of the chain levying *resiko* will mean the farmgate price will be depressed proportionately more.

[4] To preview results, I will find that these markdowns can allow traders to extract full monopsony profits.

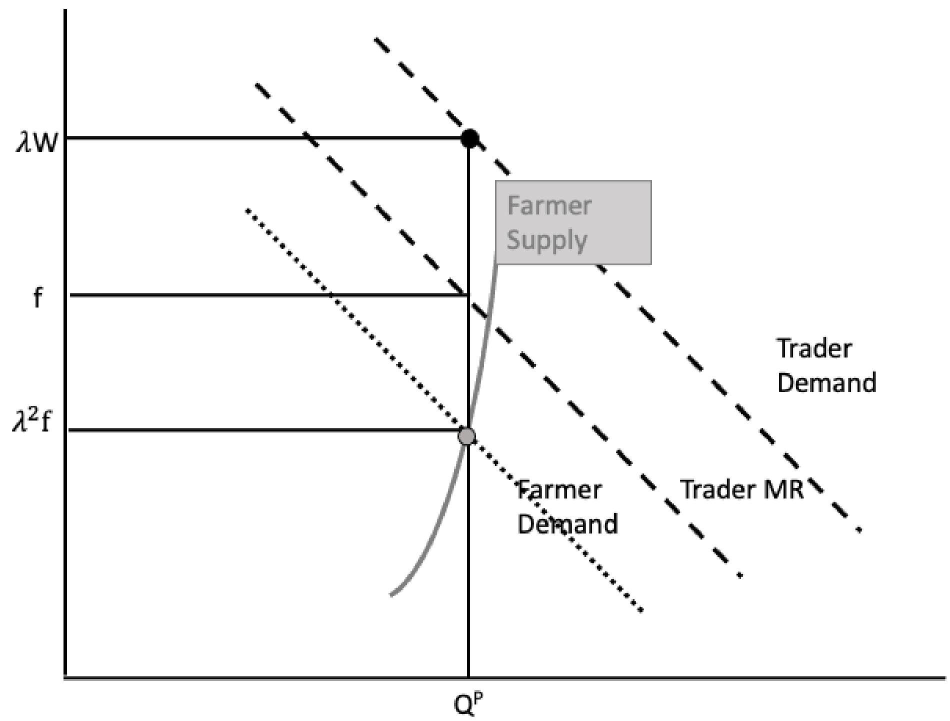

Figure 2: Farmer and Trader Prices, given Quantity

2 Extensions

We next explore two extensions to our vertical industry. First, I use published estimates of elasticities of demand and supply to estimate the price effect of the second *resiko* on farmgate prices. I observe that this practice has similar effects as a tax, and use the well-known result from public economics to estimate the effects of reducing a tax on the seller's price. Second, we relax the assumption that the *resiko* is a parameter. I ask if the trader would choose to impose a *resiko*. I find that traders would choose to do so, and find an expression for *resiko* for a profit maximizing trader.

2.1 Quantification

This next section will use the theoretical foundations built so far to compute some counterfactual farmgate prices. To do this, we need to have estimates for key demand and supply parameters at the farm level. Returning to the market facts in the Bicol Region, we have found that the predominant form of the supply chain is that farmers sell to traders/aggregators. Our counterfactual will be that the second resiko is not levied. How much will farmgate fresh palay prices rise?

We first note that the problem resembles a tax between the marginal revenue perceived by buyers and the demand percieved by sellers. There is a wedge imposed by the buyer, of size $0 < \lambda_i \leq 1$ where $i \in c(\text{M,T})$. We use the results from the economics of tax incidence, where a change in the tax wedge is expected to change the price received by sellers and paid by buyers. Suppose the change in the wedge is dt, we can show that the effect on sellers' price $\frac{dp}{dt}$, where $-1 \leq \frac{dp}{dt} \leq 0$, depends on the elasticities of demand and supply:

$$\frac{dp}{dt} = \frac{e_D}{e_S - e_D}$$

I refer to (Lantican, Sombilla, and Quilloy 2013) for our demand elasticity estimates nationally to be around -0.51, which we can take to be our elasticity estimate for this exercise. In this case, we have an elasticity of demand (e_D) of -0.5. Based on (Balié and Valera 2020), I find that estimates of supply elasticity, (e_S) of 0.1 in the CGE model they utilized. The ratio will be $\frac{-.5}{.1+.5} = 3 = 83$ or a 1% decrease in the wedge, will result in a .83% increase in the selling price of farmers. In general, and we will see this in the next section, that a larger e_S will lead to a smaller effect of the wedge, up to the limiting case case of a perfectly elastic supply curve, which will lead to no price adjustment and complete quantity adjustment. On the other hand, a smaller e_S will lead to a larger price adjustment, up to the limit of a perfectly inelastic supply curve where there is complete price adjust and no quantity adjustment.

2.2 Endogenous *Resiko*

We know look at the incentives facing each buyer in the palay chain to levy a *resiko*. We focus on the traders specifically, on their incentives to impose a $\lambda_W < 1$. Do traders have an incentive to do so?

On the one hand, they do not, because, they treat the *resiko* by millers as given. From the trader's point of view, the trader demand is fixed; all they need to do is optimize conditional on this demand. This means that as long as MR=MC at $Q*$, there is no incentive to change.

However, the effect of *resiko* is to lower the MR proportionately by λ. The question we have now is how a firm might set this fraction. A λ closer to 1 means that MR is unchanged, while (in the extreme and impossible case, as we will see) a $\lambda = 0$ would mean that MR would be effectively zero.

There are two extreme scenarios that can help us understand the trade-offs in setting λ. **Figure 3** shows two extreme values of the elasticity of supply. Figure 3 (A) shows an $e_S = \infty$, or the case of perfect competition on the supply side. *Resiko* shifts the marginal revenue curve down, but the input price remains constant and equilibrium quantity falls to Q^0. The choice of λ boils down to whether Q^0 is preferable to Q^E. It must be that profits are higher under Q^E because MR(Q^0)>MC; so there is an unambiguous incentive to purchase more at those input prices. Thus, λ^* must be 1.

Meanwhile, Figure 3 (B) shows the case with $e_S = 0$, or a fixed supply unaffected by input prices. In this situation, the input price falls proportionally to the value of the *resiko*, and all

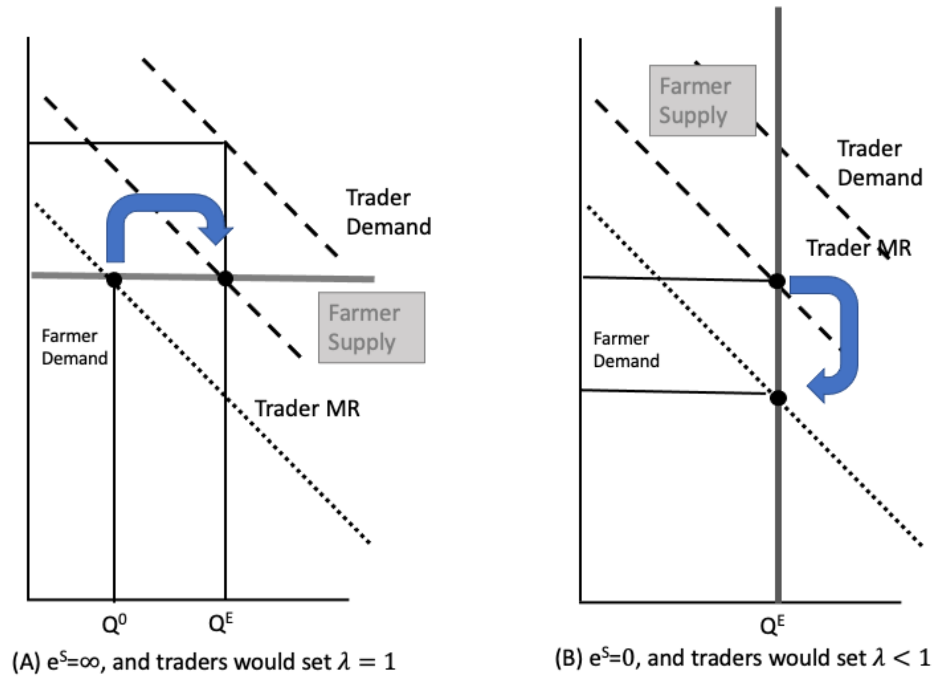

Figure 3: Desired Resiko markdown depends on Elasticity of Supply

of that is enjoyed as pure profit and prices don't fall because quantity doesn't change. In this situation, the trader would prefer a $lambda \approx 0$, as long as Q^E doesn't change.[5]

The equilbrium λ depends on the value of the elasticity of supply and elasticity of demand. Generally, a decrease in λ will result in (a) a lower input price, (b) lower quantity produced , and (c) higher selling price. The net result of these changes will depend entirely on the relative values of these elasticities. To get more general results, I focus our attention to the case of $\infty > e^S > 1$. I would also note here that it is more likely that the elasticity of palay supply is closer to zero than infinity given existing empirical research on the matter. See Section 2.1 for the estimates of elasticity of supply.

This problem is similar to the monopsonist's problem. In that situation, if the trader were a monopsonist, she would be aware that changing Q would change the input price, and thus this fact would factor into the optimal quantity being chosen. The monopsonist would use the farmer marginal factor cost (MFC) instead of farmer supply. The MFC would be higher than the cost/supply curve (at every $Q > 0$) because it incorporates the fact that as more output is produced, the cost of the marginal unit rises. This is analogous to the notion of marginal revenue for a monopolist, which is less than demand curve, because each marginal unit purchased will lower the price of the marginal unit. The monopsonist equilibrium will require **MFC=MR** to maximize profits.

Figure 4 shows the optimal Q^* for a monposonist, which maximizes profit. The equilibrium quantity will be determined by the intersection of MFC and MR. Superimposed on this is the

[5]In the long run this will not be possible as all supply will disappear because no farmer would be willing to sell at zero, so its more likely that the value will be some positive value less than 1.

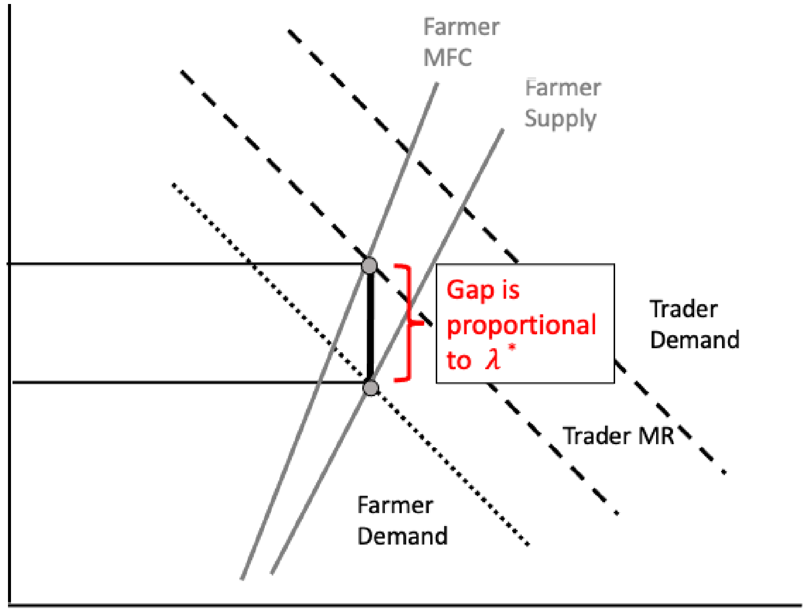

Figure 4: Traders' Profit Maximizing Markdown is equivalent to the Monopsonist's Solution

figure of vertical industry we have built so far. We note that the gap between the Trader MR and Farmer Demand is a function of λ. The figure therefore also shows show to obtain the optimal λ; the optimal λ creates a wedge with a vertical distance that is equivalent to the wedge between the farmer MFC and farmer supply at the optimal Q^*. In other words, even if the trader doesn't have an monopsonist buyer power, but has the opportunity to freely set a profit maximizing *resiko*, it would do so in a manner that would replicate the monopsonist equilibrium.

$$\frac{f^S(Q^*)}{MFC^S(Q^*)} = \lambda^* = \frac{f^D(Q^*)}{MR^W(Q^*)}$$

3 Summary

Resiko allows the traders to collectively replicate the monopsonist equilibrium, without necessarily having the market power to do so. From a policy perspective, the wide-spread practice of multiple *resiko* will grant downstream *palay* purchasers buyer market power. It is an open question whether any specific markdown λ is close to the monopsonist level, and can be explored in future work, with better estimates of the farm supply curve. With those estimates, we can compute the counterfactual gap and compare it to the actual *resiko* to test the buyer-side market power of the trader level. We have also found that, given the likely situation of elasticity of supply, we find that the markdown would be mostly passed down as lower farmgate prices.

Traders would likely rationalize that they levy a *resiko* based on the expectation of a *resiko* levied on it by millers downstream. It is an open question, and an important subject for further investigation, if traders in fact merely double the *resiko*. It is also important to note that the profit maximizing *resiko* can also be asked of millers downstream.

However, the model clearly indicates why additional markdowns unrelated to expenditures on processing are not justified as it makes clear that without the additional trader-level *resiko*, we would expect farmgate prices to rise as it lowers the trader-side buyer market power. A remedy for the situation would at the very least involve removing unwarranted *resiko*'s along the supply chain. From a competition policy enforcement framework, this practice may be pursued under either an Abuse of Dominance case or a Vertical Restraints case, depending on the other facts in each geographic market. Under either, the conduct can be approached with a theory of harm under either unfair pricing or a wide network of anticompetitive vertical restraints (see (European Commission 2010) for details).

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