THE IMPACT OF MARKET STRUCTURE ON AGRICULTURAL TECHNOLOGY TRANSFER

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ABSTRACT

An agribusiness focus has emerged in public discussions as way to enhance agricultural production in Indonesia and to improve sustainable income for farmers. The focus has led to increased attention on marketing. Marketing agricultural products via processing technologies can indeed address national objectives of rural poverty alleviation. REI-Indonesia observed that limited marketing alternatives are frequently mentioned by farmers as a significant constraint. In Indonesia, a significant amount of institutional support currently exists for the ideas presented in this paper. In particular, one should consider the multifaceted mission of agricultural development in Indonesia, which includes: (a) policies that encourage competition and, therefore, create welfare improvements; (b) the creation of new processing enterprises that increase competition; (c) the establishment of processing facilities that are owned and operated by farmer cooperatives; and (d) the utilization of government resources to assess processing technologies. Thus, the mission of agricultural development, as articulated by the Department of Agriculture, already encompasses in a broad way the specific agenda presented here. This paper provides the rationale behind a specific program that is directed toward mission goals.

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INTRODUCTION

An agribusiness focus has emerged in public discussions as way to enhance agricultural production in Indonesia and to improve sustainable income for farmers. Such a focus has motivated much research on farmer institutions and marketing. The agribusiness focus has led to increased attention on marketing, since marketing issues have a major impact on the incomes of agricultural households. In general, food processing of one sort or another has emerged as a possible marketing strategy that can improve agricultural household income. Indeed, processing agricultural produce creates added value, which, if captured by agricultural households, promises to raise living standards for a large segment of the rural population. Processing holds the additional benefit of potentially employing landless workers, who are isolated from any general improvements in agriculture. Thus, marketing agricultural products via processing technologies can indeed address national objectives of rural poverty alleviation.

At the household level as well, marketing issues represent a major concern. Utilizing an approach that invited farmer participation in agricultural training and technology transfer, REI-Indonesia observed that limited marketing alternatives are frequently mentioned by farmers as a significant constraint. Budianto and Zaini (2003) report results of a nationwide set of participatory rural appraisals among rice farmers that show that price issues are among the chief concerns for most of the participating farmers, earning the top ranking of all the mentioned issues. Price and profitability issues are prominent concerns among non-rice farmers, too. A thorough assessment of farmers' complaints of low output price levels requires an analysis of the downstream marketing channels for a given agricultural product in a particular area.

In West Java, a considerable amount of market power is wielded by retailers for a wide range of fresh produce commodities, including fruits and vegetables. In such markets, farmers typically receive only a third of the final marketed value (Kasryno, 2003). If the final product is marketed through a supermarket, the farmer's share of marketed value drops to 20%. These observations raise the suspicion that downstream market channels are characterized by imperfect competition.[2] Where imperfect competition exists in any stage of marketing, welfare losses will attenuate progress in agricultural development. As a preliminary response to farmers' marketing concerns, this paper will focus attention on the theoretical issues of imperfect competition and its impact on agricultural technology transfer.

An investigation of the way markets affect agricultural technology transfer will shed light on possible courses of action. In particular, the role of the regional AIAT offices can be enhanced by setting before them the task of improving competition in local agricultural markets. By utilizing AIAT the resources that are resident in the post-harvest and socio-economic departments, many market structure issues can be addressed. By successfully combating imperfect competition, strategies for agricultural technology transfer will be more fruitful.

The rest of the paper is organized as follows. Section A will discuss the basic elements of a theory of imperfect competition and the way in which agricultural technology transfer is affected by

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[2] The fact that processors enjoy a generous spread between the price they pay for the agricultural good and the price they obtain for the processed good does not, in itself, imply imperfect competition. As risk averse processors bear price risk they must exact a premium to compensate for the uncertainty. For instance, Schroeter and Azzam (1991) show that the marketing margins of U.S. meatpackers included a significant component that was due to price uncertainty. Contracts that shift risk-bearing of agricultural prices from the farmer to the processor must include an expected profit for the processor that at least covers processing costs and price uncertainty.

market structure. Section B will describe the practice of market analysis and point out specific instances where agricultural technology transfer has been adversely affected by imperfect competition. Section C will present general conclusions that suggest a research program, which focuses on the role of farmer processing cooperatives in enhancing competition in local agricultural markets and in generating additional rural income.

BASIC THEORY OF IMPERFECT COMPETITION

In environments where imperfect competition exists in the farmers' output market, the farmers' share of marketed value decreases relative to the competitive outcome. Where agricultural produce is marketed as fresh produce or where the agricultural produce is processed into a manufactured product, downstream market power reduces the farmers' share of the marketed value. A strategy that increases competition in the output market holds out the hope that the resulting welfare improvements will create more and better development, particularly in rural areas.

In addition to the welfare losses of imperfect competition, further detrimental effects occur in the area of technical innovation. In this section, we will see that imperfect competition diminishes the benefits of agricultural technology transfer to farmers. In particular, we will consider the following question: How does the adoption of improved technology in a market environment that is characterized by imperfect competition impact aggregate rural incomes or aggregate rural output?

In order to shed light on this topic we will appeal to the two extreme cases of pure monopsony and perfect competition. Monopsony occurs when the demand of an agricultural product is used exclusively by a food manufacturer[3]. Figure 1 shows the demand of the agricultural product, which is derived from the food manufacturer's production function and represents the food manufacturer's marginal benefit of the agricultural good as it produces a processed good. The demand for the agricultural commodity is therefore the value of the marginal product (VMP) of the agricultural good. The supply of the agricultural good is derived from the growers' effort to minimize the cost of producing a specific quantity of the agricultural good. The supply of the agricultural good is the minimum cost incurred by the grower as his output increases one unit, i.e. the marginal cost (MC).
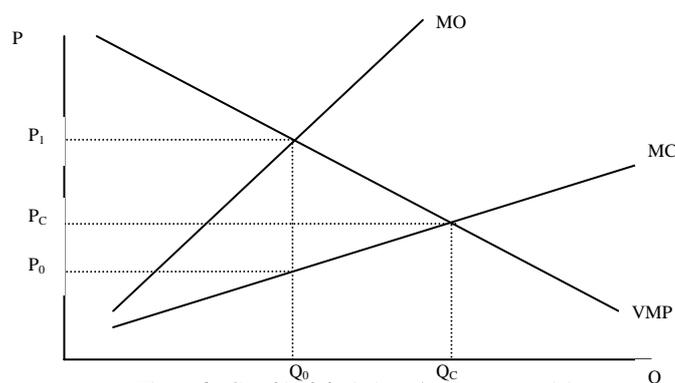

Figure 1. Graphical depiction of monopsony pricing

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[3] Although the comparative static effects of the oligopsony model differs from the pure monopsony model presented here, shifts in supply, which is the focus of this paper, give rise to effects that are qualitatively the same in both models. See Chen and Lent (1992) for a thorough analysis of the supply effects in the oligopsony model.

Under perfect competition, neither the food manufacturer(s) nor the growers can influence the market price of the agricultural good. A Walrasian market emerges and yields a price that clears the market where VMP=MC. The competitive equilibrium price is PC and the market output is QC. Total sales of the agricultural product will be PCQC, which represents the aggregate income earned by the farmers.

A different result emerges when the food manufacturer is the only buyer of the agricultural product and can, therefore, influence the market price. As the quantity purchased by the food manufacturer increases by one unit, the price that he pays for that extra unit also increases, according to the growers' supply schedule. Consequently, the food manufacturer's marginal expenditures (or marginal outlays, MO) on the agricultural good are not the same as the supply curve that is generated by the farmers' cost structure. As a result, the optimal amount of the agricultural good for the food manufacturer is much lower than the optimal amount under perfect competition. The food manufacturer will purchase an amount of the agricultural good, Q0, where VMP = MO. Note that the farmers' income has dropped to P0Q0 from the competitive outcome of PCQC.

Now consider what happens when the growers adopt a cost-reducing technology, which effectively shifts down their supply schedule. Figure 2 presents in graphical form the market outcome of agricultural technology transfer. Note that the competitive outcome includes higher output and lower price. For this outcome to imply an increase in rural income, the demand curve must be elastic. That is, an inelastic demand will result in lower aggregate sales. Now observe that under imperfect competition output also increases with an improvement in technology but by a lower amount, demonstrating that imperfect competition reduces the output effect of agricultural technology transfer. Note also that both P1 and P0 decrease but P0 decreases by a larger amount than P1, showing that the benefits of farmers' adoption of cost-reducing technologies accrues mainly to the processor, not the farmer.
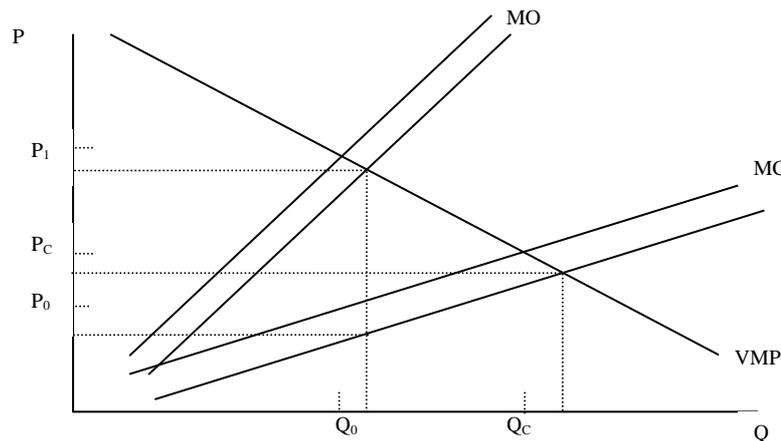

Figure 2. The effect of the adoption of a cost-reducing agricultural technology

When imperfect competition characterizes the market faced by agricultural producers, there will be relatively little increase in agricultural output after the adoption of effective agricultural technology. Consequently, farmers' incentives to adopt improved technologies are greatly reduced when their only marketing alternatives are those that are characterized by imperfect competition. In this way, market

characteristics can have a notable impact on agricultural technology transfer, as well as on poverty alleviation efforts.

Now let's change the market structure in two important ways. First, assume that a marketing cooperative was organized among farmers, such that farmers became owner operators of a processing facility. Assume further that enough of these cooperatives formed to eradicate imperfect competition. Second, assume that technology transfer efforts included processing technologies so that the demand for the agricultural product shifted up. Figure 3 presents the theoretical effects of such a scenario.

Technical innovation at the processing level increases demand for agricultural products. If competition prevails in the market, both PC and QC increase, producing unambiguous increases in aggregate rural income. Now compare the new competitive outcome with the monopsony case, where the pre-shift outcome was P0 and Q0. It is apparent that the benefits are huge when increased competition is combined with technology transfer at the processing stage. In addition, landless workers can be included in processing, creating important employment opportunities. The scenario that was just described is consistent with a strategy that provides technical information regarding processing to farmer organizations as they organize at the processing stage.

Fostering farmer-operated food manufacturing can create a host of benefits. First, by placing an increased portion of the value added in the hands of farmers, the incomes of those households will increase. Second, by a deliberate attempt to increase competition, rural markets will become more efficient. Third, as markets become more efficient, development efforts, like technology transfer to growers and processors, will generate greater benefits. Thus, a strategy that aggressively confronts imperfect competition in agricultural markets, encourages grower involvement in food processing and develops efficient technologies of production and processing in those markets promises to make a significant impact on agricultural and rural development.
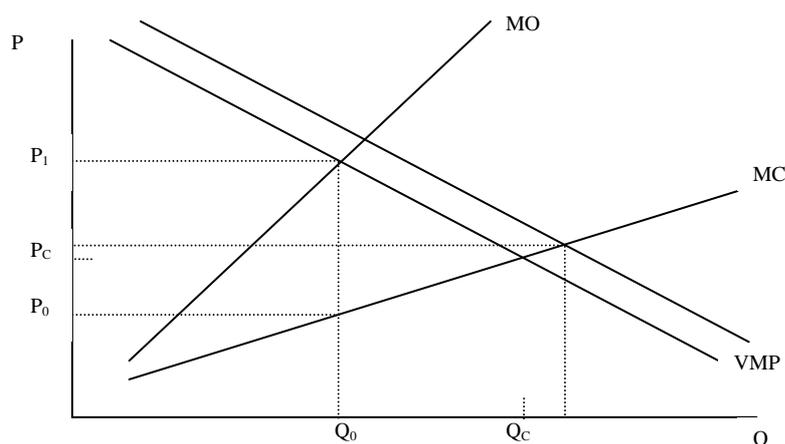

Figure 3. The effect of the adoption of a cost-reducing processor technology

ANALYSIS IN PRACTISE

In this section we consider ways to address issues of market structure so that multiple goals of development might be attained, including the enhancement of agricultural technology transfer, the

promotion of manufacturing in rural areas and the reduction of imperfect competition. All of these goals can be obtained with the resources and structures that are embodied in the agencies of the Indonesian Agency for Agricultural Research and Development.

Much previous work has been done that can provide direction for future analysis. In particular, the impact of market structure on technical innovations in agriculture has already received attention. For instance, by analyzing the impact of the adoption of mechanical harvesters in California from 1963 to 1967, Just and Chern (1980) provide evidence that imperfect competition existed in the market for California tomatoes. Moreover, they provided one of the earliest treatments of the effect of market structure on the potential impact of supply shifts, which include the impact of agricultural technology transfer. Huang and Sexton (1996) analyze a similar market in Taiwan, showing that adoption of the same technology (mechanical harvesters) created benefits mainly for processors, not farmers. They also showed that imperfect competition was the main culprit behind the eroded benefits of agricultural technology transfer. Previous work has demonstrated that the particular market environment can play a role in either enhancing or attenuating the benefits of agricultural technology transfer and innovation.

Aside from the impact on agricultural technology transfer, market structure also influences the potential of income-generation in rural areas. The literature exposes the detrimental welfare effects caused by imperfect competition. Specifically, in the processing tomato market in Taiwan, imperfect competition has resulted in large losses for farmers that amount to two-thirds of the benefits attainable under perfect competition (Huang and Sexton, 1996). Indeed, the verified existence of imperfect competition is identical to the verification of welfare losses.

It is important to note, however, that market structures can change. Public policy that encourages competition can effectively address welfare losses due to imperfect competition. In the California processing tomato market, for instance, no significant level of imperfect competition was observed during the 1980's (Durham and Sexton, 1992), which was two decades after the Just and Chern study, which provided evidence of imperfect competition. Indeed, public policy that stimulates competition (eg. reducing barriers to entry) will create a dynamic market environment that can reduce imperfect competition (Durham, et al, 1996). An evolving market structure that becomes more competitive over time offers hope that in Indonesia, too, agricultural and industrial policies that promote competition in all stages of marketing can successfully create environments where technology transfer efforts bolster national welfare.

In practice, then, a synergy exists between agricultural market assessment and agricultural technology assessment. Analysis that focuses on specific local markets and specific local technologies represents an area of endeavour that is particularly suitable for the regional Assessment Institute for Agricultural Technology (AIAT) offices. In particular, the post-harvest department of the AIAT offices can play an important role in the assessment of processing technologies. Similarly, the socio-economic department of the AIAT offices can play a role in the assessment of market structure, while the agricultural production department can play a role in agricultural technology assessment. By combining resources in this way the AIAT offices can perform a more thorough analysis that recommends cost-reducing agricultural technology, cost-reducing processing technology and pro-competition measures.

THE ROLE OF FARMER COOPERATIVES

Having uncovered the detrimental effects of imperfect competition and having considered ways to conduct analysis, we turn our attention to possible solutions that could either solve the problem of imperfect competition or provide additional direction in the analysis stage. Both as a potential solution and as a research direction, collective action among farmers offers hopeful prospects.

In an environment of imperfect competition, farmers have incentive to act collectively to secure more value. Such collective action represents a special case of vertical coordination that captures lost efficiency while it generates procompetitive influences. Specifically, if farmers realize that their agricultural good is underutilized because of imperfect competition, there is incentive for vertical coordination between growers and processors (Azzam, 1996). Collectively negotiated contracts are one way to create more vertical coordination and seize greater benefits for both the growers and the processors.[4]

Alternatively, farmers can form marketing collectives that process their own produce. Sexton (1990) shows that farmer cooperatives can provide a procompetitive influence on markets that are characterized by imperfect competition. Therefore, public policies that are favourable toward cooperatives can indirectly enhance competition and, therefore, bolster the impact of farmers' adoption of cost-reducing agricultural technologies. When a processing farmer cooperative enters the market, imperfect competition is reduced, allowing the efficiency gains of competition to be realized.[5] Thus, an effort to organize farmers around a processing enterprise promises to create at least 3 benefits of increased competition, namely increased rural income through increased product sales, increased rural income through the capture of additional value added in the processing stage and enhanced welfare effects of agricultural technology transfer to farmers.

In Indonesia, a significant amount of institutional support currently exists for the ideas presented in this paper. In particular, one should consider the multifaceted mission of agricultural development in Indonesia [6], which includes

1. "synchronizing policy to encourage the development of every agribusiness sub-system to develop strongly and harmoniously"
2. "facilitating and stimulating the development of agribusiness enterprises . . . both on-farm and off-farm (i.e. cultivation, processing and marketing) and stimulating the development of business partnerships"
3. "promoting the development of farmers' economic organizations and business networks in agricultural upstream and downstream industries"
4. "developing location specific and environment friendly technology innovation, either on upstream industry, on-farm business or agricultural downstream industry"

Note that number 1 presumably includes policies that encourage competition and, therefore, create welfare improvements. Number 2 includes the creation of new processing enterprises that increase competition. Number 3 includes the establishment of processing facilities that are owned and operated by farmer cooperatives. Number 4 includes the utilization of government resources to assess processing technologies. Thus, the mission of agricultural development, as articulated by the Department of Agriculture, already encompasses in a broad way the specific agenda presented here. This paper provides the rationale behind a specific program that is directed toward mission goals.

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4 Note that the existence of contracts between growers and processors does not prove the existence of imperfect competition. Vertical coordination can arise for a host of reasons, including specialized assets (Williamson, 1985), uncertain supply (Carlton, 1979) and information asymmetry (Hennessy, 1996). Frank and Henderson (1992) show that vertical coordination arises mainly from the effort to reduce transaction costs, which only partly refer to the internalization of production and processing inefficiencies, like those that occur under imperfect competition.

5 Although one study found that "increases in the share of product handled by marketing cooperatives did not appear to increase competitiveness in the raw product market." (p. 990, Wann and Sexton, 1992), it is certainly the case that an increase in the number of marketing cooperatives will increase competitiveness.

6 Taken from Budianto and Zaini (2003)

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