

UC Berkeley

CUDARE Working Papers

Title

A dynamic model of the food processing sector in the new market economies of Central Europe

Permalink

<https://escholarship.org/uc/item/79m6s9c5>

Authors

Lyons, Robert F.
Goodhue, Rachael E.
Rausser, Gordon C.

Publication Date

1998-05-01

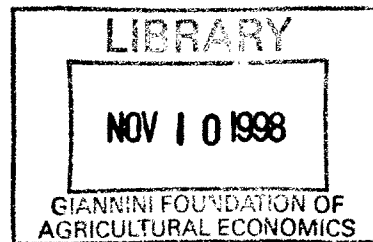
**DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS AND POLICY/
DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA AT BERKELEY,**

WORKING PAPER NO. 859

**A DYNAMIC MODEL OF THE FOOD PROCESSING SECTOR
IN THE NEW MARKET ECONOMIES OF CENTRAL EUROPE**

by

**Robert Lyons, Rachael Goodhue,
Gordon Rausser, and Leo Simon**



**California Agricultural Experiment Station
Giannini Foundation of Agricultural Economics
May 1998**

**A DYNAMIC MODEL OF
THE FOOD PROCESSING SECTOR IN
THE NEW MARKET ECONOMIES OF CENTRAL EUROPE**

ROBERT LYONS, RACHAEL GOODHUE, GORDON RAUSSER, AND LEO SIMON

May 15, 1998

1. INTRODUCTION

This paper describes a dynamic economic policy simulation model of the food processing industry in the new market economies of Central Europe (CE). Agricultural policy models, even those used to evaluate transition economies, traditionally have focussed on *commodity flows*. Our model focuses on *firm behavior*. This change in focus allows us to identify and evaluate the important interrelationships between trade liberalization, competitiveness policy, and credit policy in a dynamic, imperfectly competitive agricultural economy.

The model focuses in depth on the importance of imperfect competition and production inefficiencies in the food processing sector. This sector in CE countries is dominated in many product lines by a few large firms which act noncompetitively. Further, some of these firms appear to produce very inefficiently, using inferior technology and overly bureaucratic decision structures. As a consequence, the quality of processed output is typically below world market standards. The obvious solution—investing in new technology—is hindered in most cases by severe financial constraints arising from weak credit markets and overwhelming preexisting enterprise debt.

Many of the models that have been used for agricultural policy analysis in CE countries are reduced-forms that implicitly assume many of the institutional features of mature market economies—well functioning credit and investment markets, easy availability of technology, instantaneous market information, and stable market structures, to name a few. These market features are missing or changing so rapidly in CE countries that these reduced-form representations are likely to mislead policy-makers. Further, existing CE agricultural policy models are static, thus ignoring the complicated but important dynamic effects of transition economies. As we will demonstrate with our model, the intuition from static models rarely translates into a dynamic environment. The Lucas critique (Lucas 1976) provides another reason to mistrust these reduced-form models: in a policy model, the behavior of economic actors should not be assumed invariant to government actions. This suggests a model that focuses not on commodity markets but on the decision-making

structures of the economic agents affected by policy. Our model represents an important shift in the focus of agricultural policy models of transition economies *from commodities and prices in a static environment to people and incentives in a dynamic environment*. Some of our simulation results include a demonstration of why widespread cartelization of the CE food processing sector is unlikely, a reinforcement of the conventional wisdom that tariffs provide a cushion for inefficient firms and prevent restructuring and a variety of results concerning debt forgiveness and credit policies.

In the next section we provide a brief overview of some of the models that have been used recently to analyze CE agricultural policy. We then present our model in §3. In §4 we present the results of several policy simulations that illustrate the potential uses of our model. We conclude the paper in §5.

2. REVIEW OF MODELING ALTERNATIVES

The success of agriculture and agricultural policy in the new market economies of Central Europe is most often evaluated in terms of the success of agricultural production policies, such as land reform and credit policies, the adjustment of the sector toward areas of comparative advantage, the movement of labor between the rural and urban sectors, and the development of robust transaction channels between agricultural producers and their input suppliers and output buyers. These criteria are largely derived from economists' experience in mature market economies, where institutions and players at all levels of the agrofood chain are established and change only slowly over time. Most agricultural policy models were designed with this traditional set of performance criteria in mind. Thus, these models are almost universally static, reduced-form, generally commodity-level, and are not well-suited to analyze structural change. In an economy in transition, however, the performance of agriculture can not be proxied by the performance of the agricultural production sector alone. The composition and competitiveness of agricultural input, processing and marketing firms will affect the ability of these countries to successfully compete on world agricultural markets and within regional trading areas, such as the European Union (EU). In particular, food processors will crucially determine a country's ability to market value-added agricultural products meeting the phytosanitary and quality standards of both domestic and international consumers.

Nonetheless, traditional agricultural policy models are commonly used to analyze transition environments. A popular model used among policy analysts has been USDA's Static World Policy Simulation (SWOPSIM) Model (Roningen 1991). Koopman (1994), for example, uses a variant of the SWOPSIM commodity marketing model to examine agriculture in the European transition

economies. He models the reform process as an exogenously specified gradual increase in supply and demand elasticities. Shifts in supply and demand are used to account for expected productivity increases and possible changes in excess demand. Tangermann (1994, 1995) also utilizes a SWOPSIM model to evaluate the effects of CE country accession on the EU's Common Agricultural Policy.

Gravity models comprise a second class of models that have been used to evaluate agricultural trade policy in CE countries (Hamilton & Winters 1992, Tyers & Anderson 1992). A gravity model considers three components in determining bilateral trade flows: importers' demand, exporters' supply, and the costs of doing business between the two. Gravity models are generally used to look at total trade, and are long-run equilibrium models. These characteristics make them poorly suited to evaluate the dynamic nature of transition economies.

Computable General Equilibrium (CGE) models are a third approach that has been used to evaluate CE agricultural policy. Orłowski (1995) uses the POLAGR model to examine alternative EU succession and integration scenarios in Poland. Another example is Weyerbrock (1994) who uses a six-region, thirteen-sector general equilibrium model to examine East-West European integration and the role of the CAP. Like the commodity and gravity models, CGE models are generally too aggregated to focus on the incentives facing individual economic actors, and how these incentives are altered by government policies and the restructuring process itself.

While each of these models and model types has strengths and contributes to the analysis of agriculture in the CE countries, they are unable to examine many issues that are important to policymakers such as the effects of restructuring and competitiveness policy and the importance of imperfect competition with respect to trade policy. Our policy model seeks to address some of these concerns within an analytical framework that explicitly models features of particular importance in a transition economy.

The analytical framework presented in this paper highlights the processing component of the agrofood chain.¹ The progress of the food processing sector in the Central European new market economies may be summarized in the following, extremely stylized fashion. A small number of very large state-owned firms has been supplemented or replaced by a large number of privately-owned firms and firms of mixed ownership. Large numbers of new firms, many quite small, continue to enter, and there are some state enterprises which have still not been privatized—ranging from 20% of the total in the Czech Republic to about 40% in Poland (Organisation for Economic Cooperation and Development 1996). Their continued existence affects the performance of newer and smaller

¹For broader applications, see Goodhue, Lyons, Rausser & Simon (1995a) and (1995b).

firms established during the liberalization period. Credit and investment policies, both formal and implicit, appear to have differential effects on firms based on their origin and size. While large and medium-sized firms may be able to attract foreign investors or obtain investment financing domestically, this is generally more difficult for small firms, which are dependent upon local banks for credit and often must pay higher rates.

These stylized facts have led us to construct a model that can be used to evaluate the importance of competitiveness and productive efficiency in the food processing sector under selected trade and credit policies. Our model is based on firm-level decisions, so that the effect of government policies on firms' incentives can be explicitly modeled. Consequently, interaction effects among different government policies and market structure and conduct are endogenously determined. Finally our model is dynamic, allowing us to capture an important class of incentive effects that are largely missing in the existing literature on transition agriculture.

3. THE MODEL

Our model encompasses three levels of the agrofood chain including raw commodity production, processing, and final demand for the processed product. We model the supply of the raw commodity and demand for the processed product in reduced form in order to focus on the complexity of the processing sector. In our model, four types of processing firms compete in domestic markets for a low and high quality processed good. One of the four firm types is foreign, allowing us to incorporate trade considerations on the import side. The remaining three firm types represent the stylized structure of many CE food processing sectors. We refer to these domestic types as "small," "medium," and "large" in reference to their initial size in terms of capital stocks. However, these firms are differentiated in several important ways. The "large" firms represent formerly or still partially state-owned enterprises (SOE's). Firms of this type are characterized by a very large initial stock of low quality capital, little or no high quality capital, inefficient production and decision-making structures and high levels of preexisting debt. The "medium" firms have sizeable initial stocks of both low and high quality capital, are efficient and have reasonably low levels of preexisting debt. The "small" firms have very little capital, but are efficient and relatively debt-free.

We model the interaction of these heterogeneous players as a finite horizon, linear-quadratic dynamic game. The information structure is assumed Markovian—that is, the effect of past play on the current environment is captured entirely by a set of state variables that evolve under the strategies chosen by the firms. This information structure gives rise to equilibrium strategies—also called *feedback* or *closed-loop* strategies—which are subgame perfect. This means in any given

period it is optimal for a firm to follow its equilibrium strategy regardless of the history of past play. In other words, firms strategies are completely credible. This characteristic of equilibrium strategies is very important to understanding the quality of our results.

Linear-quadratic models are widely used, especially in the analysis of dynamic oligopoly situations (see for example Karp & Perloff (1993)). While the linear-quadratic structure restricts our modeling options, it has two important benefits that make it a very useful framework. First, it is computationally tractable. A similarly rich nonlinear model would be very difficult to solve and interpret. Second, we know the equilibrium strategies are subgame perfect.

We maintain the linear-quadratic structure through the following model specification. Domestic firms produce a low and high quality processed commodity according to the Leontief technologies

$$(1) \quad y_{imt} = \min(e_{im}k_{imt+1}, q_{imt})$$

where i indexes the firm, m indexes quality level, t indexes time, $e_{im} \in [0, 1]$ represents firm i 's productive efficiency, k_{imt+1} is firm i 's period t *post-investment* stock of m -quality capital, and q_{imt} is firm i 's demand for the domestic raw commodity used to produce the m -quality output y_{imt} . Note that quality of the final product is determined entirely by the type of capital used in the production process. The raw commodity is of a single quality. Firms sell both low and high quality products in domestic markets only. We do not allow for exports in the model.

The raw commodity is supplied affinely by domestic producers according to

$$(2) \quad w_t = a_t^0 + a_t^1 \sum_i \sum_m q_{imt}$$

where w_t is the time t price of the raw commodity as a function of all processors' demands. Final demand for the m -quality processed product is also linear:

$$(3) \quad p_{mt} = b_{mt}^0 + \sum_i \sum_n b_{mnt}^1 y_{int}$$

where \mathbf{b}^1 is a symmetric, negative definite matrix.

Each firm's objective is to maximize the sum of profits over a finite time horizon, $t = 1 \dots T$. We incorporate the possibility of collusion between firms by defining a firm's *perceived profits* as:

$$(4) \quad \Pi_i = \sum_t \left(\pi_{it} + \sum_{j \neq i} \lambda_{ij} \pi_{jt} \right)$$

where $\lambda_{ij} \in [0, 1]$ measures the degree of collusion between firms i and j . When $\lambda_{ij} = 0$ there is no collusion and the firms act as Cournot competitors. When $\lambda_{ij} = 1$ firms collude perfectly.

This formulation says that firms care about maximizing *perceived profits* Π_i even though what they actually receive is their own profits, π_i . We will assume that there is no collusion between domestic and foreign firms.

Foreign firms export both low and high quality goods to the country in question. These firms are presumed to have constant marginal costs, c_{fmt} . Their t period actual profits are given by

$$(5) \quad \pi_{ft} = \sum_m (p_{mt} - c_{fmt} - \tau_{fmt})y_{fmt} - \gamma_{fmt}y_{fmt}^2$$

where τ_{fmt} is an import tariff and γ_{fmt} represents a nonlinear import restriction. This quadratic term allows us to partially capture the effect of an import quota on foreign firms while maintaining the linear-quadratic structure of the game. The foreign firms choose output levels y_{fmt} recognizing their effect on domestic price p_{mt} .

Domestic firms have a more complicated problem. Their Leontief production technology (1) implies each firm produces $y_{imt} = q_{imt} = e_{im}k_{imt+1}$ units of the m -quality product in period t , where $k_{imt+1} = (1 - \delta)k_{imt} + I_{imt}$ is firm i 's period t stock of m -quality capital *after* investment of I_{imt} units of new m -quality capital. A domestic firm's period t profits, then, are

$$(6) \quad \pi_{it} = \sum_m (p_{mt} - w_t + \tau_{imt})e_{im}k_{imt+1} - (r_{mt} + \rho_{imt})I_{imt} - (\phi_{imt}^0 + \phi_{imt}^1 I_{imt})I_{imt}$$

where τ_{imt} is a production subsidy, r_{mt} is the domestic price of m -quality capital, ρ_{imt} is a credit subsidy, and the ϕ parameters represent the "adjustment" cost of investment. Domestic firms choose investment I_{imt} recognizing the effect of their decisions on both output prices p_{mt} and the input price w_t —that is, they exercise market power on both margins. The state variables for the model are the capital stocks for all domestic firms.

The quadratic costs associated with investment can be interpreted literally as adjustment costs. However, we will also use them to partially capture the effects of credit constraints while maintaining the linear-quadratic structure of the game (Rausser & Hochman 1979). Under this interpretation, the ϕ parameters govern the additional marginal cost of investment above the subsidized price of capital. The more debt a firm has, the more costly investment should be at the margin. Under a standard credit constraint, firms would have access to capital at the subsidized price up to some limit determined by their debt and collateral, after which the marginal cost of investment would become infinite. The quadratic adjustment cost approach is a simplified, finite and smooth version of this constraint.

The model is solved using backwards induction to derive a set of Ricatti-like matrix equations. The linear-quadratic structure assures each firm's optimal strategy is a linear function of the current

state (i.e., the current capital stocks of all firms) and its total payoff in the game is a quadratic function of the initial state. For simplicity, in the simulations that follow we assume that all parameters are time invariant. However, it is possible and indeed straightforward to solve the model with time varying parameters. All Greek-symbol parameters in the model are either direct policy variables that we assume the government is able to choose or they are variables that can be affected by government policies. Our simulations involve altering one or more of these policy parameters and evaluating the comparative dynamic effects on the equilibrium strategies, the state, and a variety of performance measures.

4. SOME SIMULATION RESULTS

4.1. The Effect of Protection on Domestic Performance. One surprise of the transition process has been the negative agricultural trade balance realized by the CE countries. One explanation observers have offered for this outcome is that trade performance has been hindered by the presence of inefficient, large scale food processors and that governments have attempted to protect these large firms from external competition in an effort to stave off the short-term costs of massive layoffs. The conventional wisdom is that protection provides a cushion for the inefficient large firms, preventing restructuring and reducing domestic performance.

Our simulations support this conventional wisdom. We ran three types of scenarios to simulate different kinds of protective policies. The base case for these simulations allowed foreign firms to freely compete in the domestic market ($\tau_{fmt} = \gamma_{fmt} = 0$). The first simulation compared this scenario to a complete import ban (i.e., removing foreign players completely from the game). The second simulation allowed the foreign players to compete, but allowed some nonlinear import restrictions ($\tau_{fmt} = 0, \gamma_{fmt} > 0$). The third simulation considered the effects of positive tariffs ($\tau_{fmt} > 0, \gamma_{fmt} = 0$).

The results for all three simulations are similar: protection helps the large, inefficient firms at the expense of the medium and small efficient firms. While this is in accord with conventional wisdom, the conventional explanation is based on static intuition. Our result can only be fully explained by the dynamic effects of market power. The argument is easiest to explain for the case of an import ban versus free trade.

Under either scenario, large firms have too much low quality capital at the beginning of the game. In general, then, they find it optimal to reduce their low quality capital stocks in the early periods of the game until they reach an optimal profit rate. This means they are losing market power in the low quality good during the early periods of the game. Conversely, the large firms

start out the game with too little high quality capital and want to increase their stocks over the course of the game. This means they are gaining market power in the high quality good during the course of the game.

Now consider what happens when protection is removed and foreign firms are allowed into the market. Because foreign imports put downward pressure on prices, the large firms must use their market power (while they have it) to keep prices from dropping too low. But large firms have more market power early on in the low quality market, so the presence of imports tends to increase the rate at which the large firms disinvest in low quality capital. Foreign competition also reduces the rate at which large firms invest in high quality capital—the price of the high quality good drops and it is less attractive to large firms. The overall result is a major reduction in output by the large firms in both quality markets, especially in the early stages of the model. Because large firms also have market power in the raw commodity market, these drastic reductions seriously reduce input prices. While output prices drop due to imports, the reduction in input prices is even greater. This increased profit margin is enough to raise overall profits for small and medium sized firms whose output levels do not significantly change thanks to the drastic reductions in output by the large firms. This increased profit margin is insufficient to make up for the drastic reduction in output suffered by the large firms, and thus they do much worse under foreign competition.

It is interesting to consider how this result is affected by the efficiency of the large firms. The more inefficient the large firms are, the less drastically they need to disinvest in the low quality good to undergird prices in the face of foreign competition. This means small and medium firms benefit less from savings on input prices because (i) these savings are smaller per unit and (ii) they must reduce output relatively more to accommodate imports. If large firms are sufficiently inefficient, all domestic firms do worse by opening the market to foreign competition than in autarky.

4.2. Competitiveness Policy. We consider two categories of competitiveness policies. First, we examine the effect of the government forcibly breaking up the large firms. If the exiting firm's capital is removed from the model, for instance to payoff creditors, then all firms remaining in the model are unambiguously better off. However, consumers and raw commodity producers are worse off, as prices rise and output declines. This result is less forceful as the inefficiency of the removed firm rises.

Since we do not model entry endogenously, this experiment is somewhat artificial. Certainly, after removal of the large firms one would expect entry if industry profits are unambiguously higher. A more compelling experiment would allow entry after the removal of a large firm. We can approximate entry by increasing the number of small and medium firms while we reduce the

number of large firms. If we do so in a way that maintains the total stock of capital in the sector, we find that all incumbent firms remaining in the model after the removal of a large firm are unambiguously worse off. However, consumers and raw commodity producers are better off, as prices decline and output increases. In particular, the output composition shifts towards higher quality products. Note that now this result is *more* forceful as the inefficiency of the removed firm rises. This occurs because the same amount of capital in the hands of more efficient and smaller firms will increase output and reduce prices even more as the efficiency differential increases.

A second category of competitiveness policy involves the collusion matrix λ . Recall that λ_{ij} measures the degree of collusion between firms of type i and j . When $\lambda = 0$, all firms behave as Cournot competitors. When $\lambda = 1$ the industry is fully cartelized.² At first blush, λ can be viewed as an index of the strength of the government's anti-monopoly agency. If all firms benefit from collusion, one can view λ as an upper bound on the degree of collusion allowed by government policy. A reduction in the strictness of the government's competitiveness policy, then, could be implemented by increasing λ .

A stark result became clear, however, once we implemented this approach. For every parameter combination tested, increasing λ above zero led to an increase in profits for small and medium firms but a decline in profits for the large firms. Further, the loss to large firms always exceeds the total gain to the small and medium firms. Collusive behavior therefore can not be an equilibrium outcome under any profit sharing arrangement the cartel might devise.

The reason for the result is simple. There is a fundamental incentive compatibility problem due to the difference in size between the large firms and the smaller firms. A successful cartel reduces output to increase price. The smaller firms, however, have a strong incentive to cheat under any cartel arrangement since by definition each small firm has a negligible effect on price. The requirement that our equilibrium strategies be subgame perfect then implies small firms must cheat in equilibrium. But when all the smaller firms cheat, output prices decline and the cartel unravels. An analogous story holds for medium sized firms: while they have less incentive to cheat than the small firms do, the impact of any cheating they do is larger given their size. Again the cartel unravels. This story has more bite the larger the discrepancy between the size of the large firms and the smaller firms. In addition, the cost of collusion for the large players is magnified the more inefficient they are, as they wind up producing even less, thus strengthening the smaller firms' incentive to cheat and reducing prices even more. This result once again illustrates the importance of considering a dynamic model of oligopoly when asking questions about market power.

²We assume that foreign firms can not collude with each other or with domestic firms.

4.3. Credit, Debt and Investment Policies. Trade performance, investment, and the treatment of enterprise debt are all important policy concerns in transition economies. These policies are likely to interact in ways that are not immediately apparent, especially in the presence of strategic behavior.

Debt forgiveness could cause processors to be more successful, and might affect their speed of modernization. There is a tradeoff between enhancing the performance of existing enterprises, which may currently be struggling to survive and hence performing badly, and revitalizing the sector with new entry. The source of the tradeoff is that new entry will be inhibited by the persistence of weak incumbents. The nature of the relationship between investment and quality seems to suggest that tradeoffs such as these will have significant effects on product quality. The relative size and market behavior of the incumbents, who tend to be large and indebted, and of potential entrants, who tend to be small and competitive and not incur significant debt, suggests that debt forgiveness policies may have significant effects on the degree to which market power is exercised by the sector as well.

Unfortunately, it is difficult to accurately model debt within the linear-quadratic structure. Ideally we would like to model debt as a state variable; however, the linear-quadratic structure requires a linear state equation which is not entirely sensible in the context of debt. The alternative is to consider a permanent reduction in one or both of the ϕ parameters that determine the adjustment costs of investment as defined in equation (6). The logic behind this approach is that debt forgiveness should reduce the marginal cost of obtaining investment. Firms with high initial debt will find it difficult to obtain investment credit since they will be considered a risky prospect by investors. In this context, the ϕ parameters capture the risk premium investors associate with the heavily indebted firm. There are two limitations to this interpretation. First, a permanent reduction in ϕ^0 is indistinguishable in our model from a credit subsidy. The main difference between these policies is, of course, the difference in their costs to the government, something we don't explicitly evaluate in our model. Second, a change in ϕ^1 is symmetric vis-a-vis investment and disinvestment. While it make sense that debt forgiveness should reduce the marginal cost of investment, it is not clear why debt forgiveness should make *disinvestment* cheaper as well.

When we reduce ϕ^0 for the large heavily indebted firms (with the interpretation either as a form of debt forgiveness or a credit subsidy), the large firms do better at the expense of the small, medium and foreign firms. The subsidy causes the large firms to invest more in both types of capital, increasing their output, increasing the price of the raw commodity and reducing the price of both types of processed goods. Despite the reduction in the profit margin, the large firms benefit by producing relatively more of the high quality good. This crowds out investment by the smaller

firms in both types of capital, reducing their output and their profits in both markets. Consumers and producers of the raw commodity are both better off under the subsidy. These effects are magnified for more inefficient large firms.

When we reduce ϕ^1 for the large heavily indebted firms (with the interpretation either as a form of debt forgiveness or some kind of reduction of adjustment costs), we get exactly the opposite results. The large firms disinvest faster from low quality capital and slow their rate of investment in high quality capital. The overall effect is a drop in their output in both markets, which reduces the price of the raw commodity and increases the price of both quality goods. The small, medium and foreign firms are able to take advantage of this increase in their profit margins, keeping their output relatively stable. However, the reduction in output by the large firms leads to lower overall profits for them. Consumers and producers of the raw commodity are both worse off under lower adjustment costs. These effects are magnified for more inefficient large firms. These results indicate the effects of debt forgiveness depend on how it is implemented.

Instead of reducing the debt of, or subsidizing credit for, the large firms, the government could focus its energies on integrating national financial markets with world financial markets. This would allow any firms meeting world credit standards to borrow as much money as they desired while meeting the external market standard for credit.

Financial market integration is modeled as a reduction in the cost of capital for the efficient small and medium firms (i.e., increasing ρ for these types). This policy increases the total payoff to small and medium firms while reducing payoffs to the large and foreign firms. The policy has the intended effect of increasing investment by small and medium sized firms in both quality levels. The expansion of output by small and medium sized firms forces the large and foreign firms to reduce output in an exercise of market power to maintain prices. The resultant increase in output prices and reduction in the raw commodity price is insufficient to maintain the prepolicy payoffs to the large and foreign firms. This policy also reduces the average quality level of output as the large firms choose to exercise their relatively more effective market power in the high quality market late in the game.

5. CONCLUSION

Market structure, market conduct, and unanticipated interaction effects among policies are widely recognized to affect policy outcomes at both a practical and theoretical level. These considerations, however, are exactly those which have been missing in the reduced-form commodity-level models commonly used for analyzing agricultural policy in the new market economies of Central

Europe. In a mature market economy, these omissions are relatively less important, due to the stable institutional structure and long-established record of market outcomes. The behavior of market participants may be taken as a given, and policy interaction effects may be insignificant compared to their direct effects. In a transition economy, however, the institutional structure and the nature of market participants are changing rapidly. Under economic liberalization, market structure and firms' market conduct are key determinants of internal and trade performance. These market features underlie any reduced-form depiction of market responses, such as market demand and supply elasticities. When these features are expected to be changing substantially, this reduced-form representation is likely to prove to be inadequate for explaining and predicting market responses. Accordingly, we focus on the incentives facing economic actors, rather than on reduced-form representations of commodity markets.

Our analytical framework highlights the processing component of the agrofood chain. In Central Europe, many product lines are dominated by a few large firms, often formerly state-owned. Additionally, in some cases these firms are inefficient producers, whose losses are implicitly funded by governments who fear the effects of large-scale companies shutting down. Their continued existence, however, affects the performance of newer, often smaller, firms established during the liberalization period. We evaluate the importance of the competitiveness and productive efficiency of the food processing sector for predicting policy outcomes, and evaluate the performance of a sector under selected trade policies and other government interventions.

We model a finite-horizon, linear-quadratic dynamic game between foreign firms and domestic firms of various sizes, efficiencies and debt levels. The firms' equilibrium strategies are required to be subgame perfect. This requirement is an important determining factor in many of our simulation results. We use it to show, for instance, that processing firms will not want to collude with each other. Other results include a confirmation and extension of the conventional wisdom regarding protecting inefficient firms and an indication that credit and debt policies have highly differential effects depending on how they are devised and applied.

REFERENCES

- Goodhue, R., Lyons, R., Rausser, G. & Simon, L. (1995a). The analytical framework for the TAPD project, *Working Paper 762*, Department of Agricultural and Resource Economics, University of California, Berkeley.
- Goodhue, R., Lyons, R., Rausser, G. & Simon, L. (1995b). A computable model of Eastern European food processing, *Working Paper 838*, Department of Agricultural and Resource Economics, University of California, Berkeley.
- Hamilton, C. B. & Winters, L. A. (1992). Trade with eastern europe, *Economic Policy* pp. 77–116.
- Karp, L. S. & Perloff, J. M. (1993). A dynamic model of oligopoly in the coffee export market, *American Journal of Agricultural Economics* **75**: 448–457.
- Koopman, R. B. (1994). Agriculture's role during the transition from planning to market, *Economic Statistics for Economies in Transition*.
- Lucas, R. E. (1976). Econometric policy evaluation: A critique, *Carnegie-Rochester Conference Series on Public Policy* **1**: 19–46.
- Organisation for Economic Cooperation and Development (1996). Agricultural policies, markets and trade in transition economies, *Technical report*, OECD, Paris.
- Orlowski, W. M. (1995). Price support at any price? costs and benefits of alternative agricultural policies for poland. World Bank.
- Rausser, G. C. & Hochman, E. (1979). *Dynamics of Agricultural Systems: Economic Prediction and Control*, North-Holland, Amsterdam.
- Roningen, V. (1991). Overview of the static world policy simulation (swopsim) modeling framework, *Staff Report AGES 9114*, USDA ERS.
- Tangermann, S. (1994). Ec membership by the year 2000: A realistic objective?, *Technical report*, Paper presented at the Agra Europe Conference entitled "Towards 2000: Agriculture, Agribusiness and the Food Industry in Central and Eastern Europe", Budapest.
- Tangermann, S. (1995). EU accession: A challenge for agricultural policies, *Proceedings of the Conference on Trade Analysis and Policy Design*, Prague.
- Tyers, R. & Anderson, K. (1992). *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge University Press, Cambridge.
- Weyerbrock, S. (1994). *Integration in Europe: A General Equilibrium Analysis of East-West Migration and Agricultural Policies*, PhD thesis, University of California at Berkeley.