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# Import Prices and Hard Currency Constraints in Eastern Europe: Implications for Coarse Grain Imports and Production of Meat

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## ABSTRACT

The objectives of this study were (a) to determine the degree to which hard currency earnings constrained overall imports and coarse grain imports in command economies; (b) to measure the importance of import prices on grain imports and to trace the link of grain availability to meat production; and (c) to determine how economic and political reforms in the selected countries may have affected the hard currency constraint, the importance of import prices, and grain imports and meat production. The results indicate that import demand was constrained by earnings of hard currency, but was not responsive to world prices, and meat production was affected by total grain availability, including imports.

**Key Words:** coarse grain imports, Eastern Europe, hard currency, import prices, meat production, political reforms.

Under the planned economic system by which Eastern Europe and the former Soviet Union operated, most consumer prices were fixed, and production and marketing decisions were predominately centralized. Regional economic integration among these countries, formulated under the Council of Mutual Economic Assistance (CMEA), further insulated production and marketing decision making, and shielded intra-bloc trade from world market price signals. Intra-bloc trade consisted, in large part,

of the Soviet Union's willingness to offer member countries, under favorable terms (i.e., at prices that did not reflect opportunity costs), energy and raw materials in exchange for lower quality Eastern European goods that could otherwise be sold at a discount on the world market (Inotai). However, in spite of the tendency to fix domestic prices, to centralize control of internal markets, and to satisfy import demand through maximizing trade with CMEA-member countries, some researchers asserted that supplementary trade with the West affected internal production and marketing decisions through the world price mechanism and/or through the relative scarcity of hard currency that was available to finance these imports.

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The overall objectives of this study are threefold: (a) to determine the degree to which hard currency earnings are a constraint on

overall imports and coarse grain imports in command economies; (b) to measure the importance of import prices on coarse grain imports and to trace the link of coarse grain availability to meat production; and (c) to determine how economic and political reforms in the selected countries may have affected the hard currency constraint, the importance of import prices, and the coarse grain imports and total production of meat. To address these questions, the study estimates total hard currency imports, total meat production, and net coarse grain imports as a function of hard currency inflows and other economic variables for Bulgaria (1966–94), Czechoslovakia (1966–92), Poland (1966–94), and Romania (1966–94) using three-stage least squares.

The analysis builds on previous empirical work by extending the period of study and by providing a background into the transition to market economy in these countries, summarizing the important political, legislative, and economic reforms in the early 1990s which significantly altered the agricultural marketing system. The results should provide insights into the depressed state of the agricultural economy in these countries, particularly the meat sector, as a result of the economic reform in combination with the constraints of world prices and scarce hard currency resources.

Several empirical studies have examined import behavior as a function of foreign exchange constraints in less developed countries (LDCs) and in centrally planned economies (CPEs), taking into account constraints in world prices, hard currency resources, and government import intentions (Hemphill; Scobie; Jones et al.; Zeimetz, Jones, and Mohammadi; Cochrane). In addition, a recent body of literature describes the experience of the agricultural sector during the transition to market economy (Rembisz and Rosati; Wädekin; Szeleenyi and Szeleenyi; Due and Schmidt). This study employs a model with a specification similar to the earlier work of Cochrane, and draws upon the recent experiences in markets in transition to discuss the theoretical framework of the model, prior expectations, and the limitations of the study.

## **Literature Review**

Import demand analysis has evolved from modeling the import behavior of relatively market-oriented economies, i.e., economies in which the price mechanism, for the most part, determined import decisions. Import behavior was specified as a function of the price of imports relative to the price of the domestic import substitutes, real income as a proxy for the overall productive activity of an economy, some dummy variables for unusual periods or for seasonal variations, some relevant lagged variables, credit, and foreign exchange reserves (Leamer and Stern). Hemphill's model of import demand in LDCs included the effects of foreign exchange receipts as a means to measure hard currency constraints. This approach studied import behavior as a more calculated response of a government's macro and long-run economic development objectives.

Both Scobie and Jones et al. note that import studies at that time failed to give explicit recognition to competing uses of foreign exchange and did not provide an underlying behavioral model of the balance-of-payments (BOP) adjustment process. Scobie applied Hemphill's approach to study the effects of foreign exchange receipts on aggregate import behavior affecting wheat import policy objectives in Egypt.

Jones et al. reported that there was little understanding of how grain exports to the Soviet Bloc were affected by interactions between variations in world prices and the hard currency position in CPEs. They attempted to address the interplay between macro BOP adjustment processes and micro-oriented price and income relationships affecting imports. In CPEs, currency inconvertibility and a lack of hard currency had implications for the import capacity. Centrally planned production targets also directly affected intended imports. Rising incomes in Eastern Europe between the late 1960s and mid-1980s had demand implications for meat, which in turn affected coarse grain utilization and imports. Hence, shortfalls in agricultural production relative to production targets (for whatever reasons) resulted in increased pressure to import coarse grains

(Jones). Thus, hard currency allocations may have an explicit role in determining import response to world price movements and domestic crop shortfalls.

The hard currency effect of world price movements needs to be taken into account to demonstrate that imports in CPEs are something other than perfectly price inelastic. Zeimet, Jones, and Mohammadi applied the modeling framework to study the effects of foreign exchange rationing on the quantity of imported grain to the Soviet Union. They developed a system of four equations to examine import behavior affecting grains and the linkage to meat production for the 1960–83 period. Their results confirm that hard currency constraints do act as an import constraint and the import prices are ambiguous, i.e., feed grain import prices are perfectly inelastic, but wheat imports are relatively elastic with respect to import prices. Cochrane used a very similar specification and applied the model to the case of Eastern European countries for the 1970–84 period. In her results, foreign exchange constraints are a large factor explaining import capacity, but actual import prices also directly determine the capacity to import wheat and coarse grains. This finding was surprising in that it contradicted much of the literature reporting that imports in CPEs were perfectly price inelastic.

### The Transition to Market Economy

The political monopoly of the communist party in Bulgaria, Czechoslovakia, Poland, and Romania began to break down in the late 1980s, and ultimately ended in 1990 with (more or less) democratically contested elections in each country. Consequently, the centrally planned economic system slowly decentralized in the late 1980s as countries experimented with participation (or broader participation) by the private sector. As a result of the political changes in 1990, however, institutionalized changes (through decree or legislative action) were implemented between 1991 and 1993. In table 1, a list of various political, legislative, and economic events is

provided for a comparison of the four countries studied.

As a proxy to gauge the progress of each country's transition to market economy between 1990 and 1994, we use two indices to measure (or account for) governmental policy, the regulatory environment, economic freedom, and the political stability and risks. For the initial situation, the country credit ratings index for 1990 is used as a benchmark of the state of the overall political and economic environment. According to the investment index, a lower value implies greater risks. Hence, Czechoslovakia and Bulgaria were considered less risky relative to Poland and Romania in 1990 (*Institutional Investor*). The Heritage Foundation's "index for economic freedom" for 1994 is used to monitor the economic, political, and social progress (Holmes). This index is based on measures of policies affecting trade, taxation, and banking; regulations affecting investment regulation, property rights, and wage and price controls; and fiscal and monetary policy. The implication of this index is that there is a strong correlation between the degree of economic freedom and the economic performance of a country. By 1994, according to the economic freedom index, only the Czech and Slovak Republics had economies characterized as "mostly free" (Holmes). Furthermore, Poland's economic freedom index, relative to those of Bulgaria and Romania, suggests that by 1994 Poland's economy had become more market oriented, more open, and less risky.

Although some experimentation with privatization may have occurred in the 1980s, laws outlining the legitimized process of privatization were passed in Czechoslovakia and Poland in 1990, and two years later in Bulgaria and Romania. In most cases, privatization was introduced in phases with the sale or outright grants of smaller enterprises and/or housing. In the latter stages, medium- and large-scale enterprises and large-scale farms and agribusinesses were to be privatized. Typically it was during these stages that agricultural privatization stalled or was unsuccessful in the economies in transition, a situation that best describes the cases of Romania and Bul-

**Table 1.** Summary of Political and Economic Indicators and Implementation of Selected Political, Legislative, and Economic Reforms or Indicators, 1990–94

Indicators	Bulgaria	Czechoslovakia	Poland	Romania
Multiparty elections <sup>a</sup>	1990	1990	1990	1990
Investor credit index <sup>b</sup>	43.1	53.7	19.0	33.3
Economic freedom index <sup>c</sup>	MU	MF	MU	MU
General privatization law <sup>d</sup>				
year passed	1992	1990	1990	1992
progress	slow	fast	slow	slow
Farm land privately held <sup>e</sup>				
in 1990	16%	5%	75%	NA <sup>f</sup>
in 1994	43%	NA	NA	80%
Land reform legislation	1991	1991	1990	1992
Price liberalization <sup>g</sup>				
year started	1991	1991	1990	1993
year inflation peaked	1991	1991	1990	1993
IMF-stabilization loan	1991	1991	1990	1992
Gross domestic product (GDP)				
largest annual reduction	1990	1991	1990	1991
first year of growth	1994	1994	1992	1993
Budget deficit				
deficit $\geq$ 5% of GDP	1992	1990	1989	1992
deficit as % of GDP <sup>h</sup>	11%	7%	7%	7%
Convertible currency <sup>i</sup>	1992	1991	1990	1994
Trade liberalization <sup>j</sup>	1991	1991	1991	1991

Sources: Economist Intelligence Unit, *Country Report and Country Profile*; Holmes; *Institutional Investor*; IMF, *International Financial Statistics and World Economic Outlook*; Rembisz and Rosati.

<sup>a</sup> Year that post-communist, democratically contested elections were held.

<sup>b</sup> Country credit ratings for March 1990; lower values imply greater risk.

<sup>c</sup> Index of economic freedom for 1994; MF denotes mostly free, and MU denotes mostly unfree.

<sup>d</sup> Progress is judged to be slow/fast relative to the plan specified in the law. In some cases, privatization stalled or second phases have not been implemented or scheduled.

<sup>e</sup> Percent of arable land.

<sup>f</sup> NA = not available.

<sup>g</sup> Price liberalization means market-determined terms of an exchange, i.e., prices not set by government through fixed pricing schemes, ceilings, or monitored or "recommended" prices.

<sup>h</sup> The deficit as a percent of GDP is given for the year when the deficit exceeded 5%.

<sup>i</sup> Currency convertible internally; some restrictions still may have existed affecting trade.

<sup>j</sup> Corresponds with the dissolution of the Council of Mutual Economic Assistance (CMEA).

garia (*The Economist*). By the time the enterprises were to be sold, they had accumulated large debts, much depreciated capital, and deteriorating physical structures, and, in the case of agribusinesses, the government could not maintain the social infrastructure (e.g., back wages, pensions, schooling, maintenance of roads, etc.) of the enterprise.

For the agricultural sector, only Poland had private farms to a significant extent in 1990 (Rembisz and Rosati). Agricultural land reform was introduced between 1990 and 1992, but by 1995 there was still no practical land

market available in any of the countries surveyed. Price liberalization, like privatization, usually occurred in stages, and prices of essential products, which included food, were among the last to be fully liberalized. Prices of inputs were fully liberalized before many food products, resulting in a price squeeze for agricultural producers and depressing the market for agribusinesses. Price controls and subsidies usually remained in place longer for state-owned enterprises (SOEs), further complicating the privatization of large state farms and agribusiness enterprises. In Bulgar-

**Table 2.** Comparison of Selected Macroeconomic Statistical Data, 1989–94

Description	1989	1990	1991	1992	1993	1994
Real GDP (1989 = 100)						
Bulgaria	100	90.9	83.9	79.1	76.2	77.9
Czechoslovakia	100	99.6	84.1	77.0	NA	NA
Czech Republic	100	98.8	84.7	79.3	78.6	80.7
Slovakia	100	97.5	83.4	77.6	74.4	78.0
Poland	100	88.4	82.3	84.3	87.6	91.9
Romania	100	91.8	80.0	72.9	73.9	76.5
Consumer Prices (% change from previous year)						
Bulgaria	NA	24	334	82	73	81
Czechoslovakia	1	11	59	11	NA	NA
Czech Republic	NA	NA	NA	NA	21	9
Slovakia	NA	NA	NA	NA	23	14
Poland	251	586	70	43	35	30
Romania	5	161	210	256	156	100
Balance of Trade (\$ mil)						
Bulgaria	NA	NA	NA	NA	NA	NA
Czechoslovakia	143	-1,422	-121	-1,834	NA	NA
Czech Republic	NA	NA	NA	NA	-302	-918
Slovakia	NA	NA	NA	NA	-912	109
Poland	47	3,589	-711	-131	-303	-1,809
Romania	2,050	-3,344	-1,106	-1,194	-593	NA

Sources: Economist Intelligence Unit, *Country Report* and *Country Profile*; World Bank; United Nations.

Note: NA = not available.

ia, and to a lesser extent Romania, price control and subsidies to agriculture still occur, resulting in continued budget deficits and higher rates of inflation in absolute terms during 1995–96, while rates for Poland and the Czech and Slovak Republics continued to decline (*The Economist*).

As a proxy for the country's ability and willingness to reform its economy, the year in which the International Monetary Fund (IMF) provided stabilization loans is reported. In the case of Romania, IMF loans were made in 1991, but the inability to stabilize the macro economy and implement privatization and price liberalization in a timely fashion resulted in withholding of some of the funds. In each country (for the period presented), the highest annual rates of inflation occurred as prices were liberalized. As measured by annual changes in gross domestic product (GDP), Poland was the first to experience economic growth, occurring three years after it cut its budget deficit as a percentage of GDP. Romania came out of recession in 1993, one year

before Bulgaria and the Czech and Slovak Republics, but its economy experienced the fastest and largest reduction in physical output.

The system of international exchange among these countries ended with the dissolution of the CMEA in 1991. Furthermore, the economic restructuring implemented between 1990 and 1993 affected production and the marketing channels linking these countries. Agriculture, which was typically one of the most heavily state-owned and controlled sectors in the planned economies, was expected to suffer disproportionately from the adverse consequences of such a transformation.

In table 2, selected statistical data are reported for the 1989–94 period to provide further macroeconomic evidence of the effects of the transformation. The data provide evidence that Romania, the country which was the slowest in adopting reforms, suffered the greatest reduction in total physical output relative to 1989, and more consecutive years of annual inflation rates in excess of 100%. Poland's shock therapy produced the highest

**Table 3.** Comparison of Selected Agricultural Production Data, 1989–94

Description	1989	1990	1991	1992	1993	1994
Agricultural output (% change from previous year)						
Bulgaria	-0.4	-8.9	-17.0	-20.0	-18.1	-1.0
Czechoslovakia	1.1	NA	NA	NA	NA	NA
Poland	1.5	-2.2	-0.9	-11.9	3.6	-3.0
Romania	-5.1	-2.9	1.0	-13.8	12.4	0.8
Total Production of meat, incl. poultry (1,000 mt)						
Bulgaria	1,323	1,274	1,077	964	855	732
Czechoslovakia	2,946	2,936	2,464	2,435	—	—
Poland	5,799	5,750	5,555	5,254	4,924	4,546
Romania	2,289	2,479	2,354	2,293	2,299	2,334
Total production of grains <sup>a</sup> (1,000 mt)						
Bulgaria	9,421	8,013	8,811	6,455	5,778	6,356
Czechoslovakia	11,944	12,403	11,690	10,009	—	—
Poland	21,017	21,696	21,638	15,603	18,273	17,076
Romania	18,301	17,103	19,219	12,241	15,448	17,489
Total area for grain production <sup>a</sup> (1,000 ha)						
Bulgaria	2,124	2,006	2,204	2,182	2,294	2,270
Czechoslovakia	2,458	2,381	2,378	2,351	—	—
Poland	6,499	6,575	6,719	6,360	6,555	6,543
Romania	5,966	5,652	6,015	5,744	6,375	6,315
Yield for most important grain <sup>b</sup> (kg/ha)						
Bulgaria	4,766	4,551	3,753	3,107	2,903	2,870
Czechoslovakia	5,131	5,421	5,153	4,599	—	—
Poland	3,854	3,958	3,803	3,064	3,328	3,182
Romania	2,474	2,767	4,083	2,047	2,605	3,110

Sources: FAO, *Production Yearbook*; United Nations.

Notes: NA = not available, mt = metric tons, ha = hectare.

<sup>a</sup> Grains include corn, barley, rye, oats, and wheat.

<sup>b</sup> The importance of grain is based on the number of hectares harvested and production in each country: Bulgaria, wheat; Czechoslovakia, wheat; Poland, wheat; Romania, corn. The yield data provide a proxy for weather implications in crop production.

rates of inflation, but through an austerity program was able to reduce inflation to less than 100% in 1991, and to steadily reduce the rate of growth thereafter. Only Czechoslovakia (and later the Czech and Slovak Republics) did not experience annual inflation rates in excess of 100%, and was able to reduce inflation to around 10% annually.

In the agricultural sector, data on overall agricultural output, production of meat and grain, area harvested, and yield of most important grain are reported in table 3 for the 1989–94 period. The Bulgarian agricultural sector was most adversely affected, in percentage terms, by economic changes and by other factors such as weather. Production was

primarily affected by full price liberalization for inputs and limited price liberalization for outputs, and the reduction of agricultural subsidies and/or “soft loans” to agricultural SOEs by the government. In most cases, this process began in 1991–92, but a drought in 1992 also affected crop production in the region.

With the exception of Romania, meat production steadily declined in the region relative to 1989. In Romania, the meat sector showed signs of stability in the first half of the 1990s, perhaps reflecting a more gradual process of price liberalization and a reluctance to stick to an economic austerity program. The grain-producing sectors also signal an economic contraction since 1989. The lowest levels of pro-

duction are accompanied by the lowest yield per hectare (of the most important grain) which occurred in 1992 in each case except Bulgaria. In Bulgaria, grain production hit its lowest level in 1993 after another drought affected production, in spite of more land being brought into production. Of the countries studied, only Romania managed stable grain production relative to 1989. The relative stability in Romanian grain and meat production may be explained by the fact that at least one-third of the work force remained engaged in the sector and that higher levels of state assistance were provided to the sector compared with the other countries (*The Economist*). However, the incremental adoption of reform in Romania also corresponds with weaker overall economic performance.

### Model Specification and Data

Economic theory explaining decision making in production and marketing of a CPE focuses on two basic conditions: the centrally administered prices and production targets specified in annual and five-year plans (Cochrane). The economic problem of operating a state farm, from the perspective of the director of the farm, is to increase production in line with the specified production targets subject to the input subsidies provided to the operation. Inputs generally were supplied to state farms based on annual budget plans which reflected the historical productivity and previous year's input allocation (Garcia and Silvis). Directors who were best able to increase production relative to the targets were most able to convince regional administrators to provide them with more inputs in the future. As a result, most economists argue that production and marketing decisions in CPEs should not be directly affected by prices. Hard currency imports, however, are argued to be constrained on the availability of hard currency in each of the CPEs. Consequently, import demand that was not satisfied by the CMEA required imports originating from hard currency markets. Therefore, the link among world prices, hard currency constraints, the import of feed inputs, and meat production is established.

Cochrane developed a model to test the interaction of foreign exchange and variations in domestic production and domestic demand shifters in determining grain import demand. The model consists of four equations estimated as a system for five countries using annual data from 1970–84. The first equation is a foreign exchange equation to measure total hard currency import capacity; the second is a meat production equation linking the meat sector to the coarse grain and wheat sectors; and the third and fourth equations are coarse grain imports and wheat imports, respectively.

The model in the current study is a system of three equations estimated using annual data from 1966–94 for Bulgaria, Poland, and Romania, and from 1966–92 for Czechoslovakia. Yugoslavia is not included in this study because of the changes in its national and economic composition. The behavioral equations in the model are as follows:

- $$\begin{aligned}
 (1) \quad THCI_t &= \alpha_0 + \alpha_1 Earnings_t \\
 &\quad + \alpha_2 \Delta Earnings_t + \alpha_3 \Delta Debt_t \\
 &\quad + \alpha_4 Dummy + \epsilon_{1t}, \\
 (2) \quad Meat_t &= \beta_0 + \beta_1 Meat_{t-1} + \beta_2 GNP_t \\
 &\quad + \beta_3 TCGA_t + \beta_4 Dummy + \epsilon_{2t}, \\
 \text{and} \\
 (3) \quad CGM_t &= \gamma_0 + \gamma_1 DCGA_t + \gamma_2 Meat_t \\
 &\quad + \gamma_3 THCI_t + \gamma_4 Price_t \\
 &\quad + \gamma_5 Dummy + \gamma_6 Dum * P_t + \epsilon_{3t},
 \end{aligned}$$

where *THCI* is total hard currency import expenditures in real terms; *Earnings* are real foreign exchange earnings;  $\Delta Earnings$  is the change in foreign exchange earnings (from the previous year to the present year);  $\Delta Debt$  is the change in a country's real net external borrowing (the change in net hard currency external debt from the previous year to the present year); *Meat* is production of all meats (including eggs and milk, and converted into metric tons of meat equivalent); *GNP* (in constant prices) is a proxy for income; *TCGA* is total coarse grain availability in the country



(previous year's production in metric tons of corn, oats, barley, and rye less the present year's net imports); *CGM* is coarse grain imports in metric tons; *DCGA* is the domestic coarse grain availability (previous year's production minus the current year's exports); *Price* is the world price of corn (value of total world imports divided by total quantity imported) deflated by the world CPI; *Dummy* is a proxy to measure the effects of political and economic reforms (with a value of zero for all years prior to political and economic reform, a value of one the year reforms begin in 1991, and an increase of one for each year thereafter); *Dum\*P* is a proxy to capture the interactive effect of reforms and the increasing importance of prices in the economies (nonzero values for 1991 and beyond); and  $\epsilon_{it}$  are error terms. The endogenous variables in the system are *THCI*, *Meat*, *CGM*, and *TCGA*, and the lagged meat variable is considered to be predetermined.

Three modifications are made to Cochrane's specification: (a) because the sample period includes the economic transformation of the 1990s, dummy variables are included in each equation; (b) a lagged meat production variable is included in equation (2); and (c) an equation for net wheat imports (analogous to the coarse grain import equation without the dummy variables) is omitted from the system because wheat is not considered a particularly important feed ingredient for meat production. Otherwise, the specification is identical and the variables are defined and deflated as constructed by Cochrane.

In equation (1), the intention is to measure the country's capacity to import from hard currency markets. In modeling import capacity, there are two conflicting goals that motivate the central authorities: (a) to maintain some desired level of international reserves, and (b) to provide a smooth flow of imports, or to ensure imports can be procured as needed (Hemphill; Cochrane). The change in a country's capital inflows (loans and aid receipts) from the previous year (i.e., the variable  $\Delta Debt$ ) should reflect the country's capacity to import and should serve as a proxy for a country's expected expenditure on im-

ports. The variables *Earnings* and  $\Delta Earnings$  are also expected to explain the capacity to import and to provide insight into the formation of expectations related to import decisions. The dummy variable is an attempt to determine the effect of reforms on the economy's overall capacity to import. The dummy coincides with the liberalized trade regime after the CMEA regional bloc collapsed, i.e., 1991 and thereafter (see table 1).

The meat production equation (2) is intended to capture the linkages between general macroeconomic factors affecting import decisions, the factors affecting production (under a system of production targets), and the decision to import an important input—coarse grain. It is explicitly assumed that including a variable for internal prices under a system of controlled marketing (i.e., nonprice rationing) would be inappropriate. Information on domestic subsidies to the agricultural sector would be useful to determine the sensitivity of livestock (meat) production to government transfers. Unfortunately, such data are not available in public statistical publications. The dummy variable is an attempt to determine the effect of reforms on the agricultural sector's ability to maintain production of livestock and livestock products in an environment where subsidies declined and relative prices directly affected decision making.

In comparison to previous studies, one particularly important modification is the inclusion of a lagged meat production variable. Lagged meat production is expected to partially capture the effect of the longer production cycle involved with livestock production.<sup>1</sup> If production targets were binding on producers, then lagged livestock numbers (and therefore the production of meat) should have a

<sup>1</sup> The amount of meat that can be produced this year is related to past decisions on whether to delay slaughtering the animal and the amount of time it takes for the animal to be ready for market. The production of meat is lagged only one year to capture the production cycles associated with the production of smaller livestock (those other than cattle), and is expected to provide insight into the degree to which livestock production targets were binding. Lags of longer than one year were considered in earlier estimations, but were not statistically significant.

strong, positive effect on present meat production.

Last, national income and grain availability are included to capture demand-side and supply-side factors determining production of meat. Income is included with the expectation that meat production and consumption increase with increases in GNP. Even under central planning, the level of national income would have been a determinant of how high to set the meat production targets. Because input prices are not available, and did not reflect actual costs, coarse grain availability is expected to reflect the actual scarcity of inputs for livestock production.

The coarse grain import equation (3) represents two linkages: (a) the link between the central authority's overall hard currency import intentions (or planned imports) and the import behavior when domestic grain production expectations (or targets) were not met, and (b) the link between meat production and the decision to supplement coarse grain with imported grain from the West. Each of the countries considered are net importers of coarse grain, although there are a few years in which each country did export grain. In the more common situation, grain was imported and the payments tended to be made in hard currency (Cochrane). This implies that the overall capacity to import goods from hard currency markets affected the decision to import grain. In addition, since imported grain is purchased on the world market where international supply and demand considerations matter, international prices may have affected the decision to import grain.

Conversely, if the production targets for livestock were binding (i.e., the directors of state farms did try to meet the specified targets), then grain imports may have been relatively insensitive to short-run changes in prices because grain needed to be imported to avoid larger than expected slaughter rates. In general, production targets for grain were more difficult to meet because of the uncertainty with respect to weather. Hence, the more demanding the livestock targets, the more likely grain imports would be required to supplement shortfalls in domestic grain

availability (relative to the grain production targets). If livestock production targets were not strictly binding, then in periods of domestic grain shortages and/or higher world prices, livestock numbers would have been reduced rather than spending scarce hard currency resources to maintain targeted numbers.

Coarse grain imports are expected to be affected by the domestic availability of feed grains, the production targets of meat, and the ability to supplement grain production with imports (which is captured by the country's overall ability to import). Import prices are included to determine whether import decisions were sensitive to international factors rather than centralized decision making of planners. The dummy variable is included to measure the effect of the reforms on capacity to import coarse grain. To support the hypothesis that prices began to matter (i.e., that the price elasticity was something other than perfectly inelastic) once the structural changes were implemented, the interaction dummy ( $Dum*P$ ) was introduced.

The data sets for each country were compiled using the same sources to ensure consistency and comparability across countries. Total hard currency import payments and export earnings, and hard currency debt are taken from the Central Intelligence Agency's *Handbook of International Economics Statistics* through 1992, and from the Economist Intelligence Unit's *Country Profile 1994-95* for the 1992-94 period for each of the respective countries. The GNP data are taken from the International Monetary Fund's (IMF's) *International Financial Statistics, 1995 Yearbook*. All crop and meat production data are obtained from various issues of the Food and Agriculture Organization's (FAO's) *Production Yearbook*, and the trade data are taken from various issues of the *FAO Trade Yearbook*. The world price of corn and the world consumer price index are also drawn from the *FAO Trade Yearbook*. Meat production, including eggs and milk equivalents, is aggregated using the method followed by Cochrane: one kilogram (kg) of meat equals one kg of eggs (where 18.188 eggs equals one kg), and one kg of meat equals 6.7 liters of milk.

## Estimation Results

Three-stage least squares (3SLS) is used to estimate the system of equations for each country under consideration (Kmenta; Johnston). Once the economic considerations are made to justify the specification of the model, the next theoretical issue to be addressed when using time-series analysis is that all variables in the model must be tested for stationarity or stochastic trends. The augmented Dickey-Fuller test is used to determine the order of integration of each variable. If all variables in the model are not stationary, it is suggested that they should be differenced, and the differences used instead of the original variables (Harvey; Enders). If the variables are integrated of different orders, the largest order of integration should be applied on all variables in the entire system, including any lagged dependent variables. This will further decrease the number of observations and may lead to fewer reliable inferences. Every variable is differenced twice in the system to accommodate the highest order of integration suggested by the augmented Dickey-Fuller test.

Diagnostics to check for the presence of heteroskedasticity and autocorrelation in the model are performed equation by equation. The appropriate test for heteroskedasticity in time-series analysis is the autoregressive conditional heteroskedasticity (ARCH) procedure, which is asymptotically distributed as  $\chi^2$  with one degree of freedom (Engle). In testing for autocorrelation, the Durbin-Watson (DW) test statistic is used for equations that do not have a lagged dependent variable, i.e., equations (1) and (3). When a lagged dependent variable is included in the equation, the DW statistic is biased toward rejecting the presence of autocorrelation; therefore, for equation (2) the appropriate test is to compute the Durbin  $h$ -statistic (Johnston; Kmenta).

The diagnostics provided by the regression output permitted tests for autocorrelation and heteroskedasticity. The regression results do not provide any evidence of autocorrelation in any of the equations. With respect to heteroskedasticity, only in equation (3) for Romania (coarse grain imports) is a presence of hetero-

skedasticity detected. A means to correct for this problem would be to reestimate using full-information maximum likelihood. Since heteroskedasticity adversely affects the efficiency of the estimated coefficients but does not result in bias, and since heteroskedasticity was detected in just one of the 12 regression equations, the decision was made to not correct for heteroskedasticity. Furthermore, the nature of the dependent variable in the coarse grain import equation is fairly different from the more ARCH-prone variables such as the futures prices for financial instruments, inflation related to macroeconomic variables, etc. (Myers).

The estimation results of the model for each country are reported in table 4, with  $R^2$ ,  $\chi^2$ , and degrees of freedom reported for the system as a whole. The  $R^2$  statistics imply that the model is able to explain more than 95% of the variation in the dependent variables for each country. The  $\chi^2$  statistics suggest that the model specification is appropriate. However, these statistics must be used with caution because some, such as  $R^2$ , are not strictly valid when 3SLS is used (Johnston). The estimation of the model using 3SLS also requires the econometrician to be fairly certain of the model specification, because parameter estimates are asymptotically efficient if and only if the model is correctly specified.

Equation (1), total hard currency imports, provides the most consistent results across countries (table 4). In each case, hard currency earnings has a positive coefficient and is statistically significant at the 1% level. This implies that the country imports more hard currency items as its hard currency exports increase, i.e., an increase in two-way hard currency trade. The coefficient on the change in external debt is also positive and statistically significant at the 1% level in two cases. This is also an expected result because international loans and aid are likely to result in greater imports of intermediate and final products, especially from the countries providing the funds.

Finally, the coefficient on the change in hard currency earnings is significant at the 1% level only in the case of Bulgaria. There is no

Table 4. Results from the Estimation of a System of Three Equations Using 3SLS

Variables	Bulgaria (1966–94)		Czechoslovakia (1966–92)		Poland (1966–94)		Romania (1966–94)	
	Estimate	t-Ratio	Estimate	t-Ratio	Estimate	t-Ratio	Estimate	t-Ratio
Equation (1). Dependent variable: total hard currency imports (THCI)								
Earnings <sub>t</sub>	1.563	10.900***	1.097	11.390***	1.697	7.789***	0.760	3.225***
ΔEarnings <sub>t</sub>	−0.540	−3.604***	−0.202	−1.070	−0.817	−1.216	0.850	1.149
ΔDebt <sub>t</sub>	0.612	6.697***	0.540	4.220***	0.421	2.150**	0.489	1.328*
Dummy	−161.910	−1.954**	−74.042	−0.414	−1,298.900	−3.575***	369.390	1.191
Constant	96.079	1.169	51.246	0.772	676.930	2.108	−171.630	−0.634
Equation (2). Dependent variable: production of meat, including eggs and milk (Meat)								
Meat <sub>t−1</sub>	0.151	1.086	0.034	0.193	−0.002	−0.049	0.139	0.946
GNP <sub>t</sub>	8.385	2.208**	4.078	9.022***	−0.534	−0.363	14.805	5.212***
TCGA <sub>t</sub>	0.079	2.843***	0.367	1.882**	0.325	11.770***	−0.004	−0.321
Dummy	47.059	1.735**	27.790	0.769	112.500	1.224	18.579	0.369
Constant	−36.095	−1.367	−31.145	−0.223	−190.140	−1.959	−162.660	−2.765
Equation (3). Dependent variable: net coarse grain imports (CGM)								
DCGA <sub>t</sub>	−0.065	−0.409	−0.233	−1.312*	−0.994	−7.748***	−0.009	−0.299
Meat <sub>t</sub>	−1.780	−0.961	0.535	2.534***	3.247	6.649***	0.380	0.804
THCI <sub>t</sub>	0.186	1.653*	0.280	1.495*	−0.017	−0.216	0.193	3.067***
Price <sub>t</sub>	3.688	1.445*	−0.994	−0.402	−2.238	−0.637	−1.957	−1.067
Dummy	−50.213	−0.321	251.650	0.489	−461.180	−1.291	392.500	2.391**
Dum*P	119.720	1.736**	−40.215	−0.516	7.590	0.245	−85.690	−2.472***
Constant	−217.570	−1.248	92.352	0.729	659.400	1.931	105.590	0.665
R <sup>2</sup>	0.974		0.961		0.999		0.938	
χ <sup>2</sup>	105.420		87.266		261.220		80.488	
DF	14		14		14		14	

Notes: Single, double, and triple asterisks (\*) denote statistical significance at the 10%, 5%, and 1% levels, respectively; the respective critical values are 1.310, 1.699, and 2.462.

prior expectation for the sign of  $\Delta Earnings$  because it will depend on the willingness and intentions of the policy makers to spend hard currency earnings on imports from the West. Only in the case where a government has clear import regulations that do not change over time is the coefficient on  $\Delta Earnings$  expected to be positive. Hence, a negative sign might imply that trade with the West was more a reflection of short-run disequilibrium in trade among socialist countries, thereby necessitating increased trade with the West to an extent greater than expected (or planned). The insignificance of the variable at even the 10% level in the other cases may be an indication of equality of foreign exchange earnings to the planned levels of imports—a result consistent with previous findings (Zeimet, Jones, and Mohammadi; Cochrane).

The *Dummy* variable is negative and significant in the cases of Bulgaria and Poland. The result for Poland would seem to confirm that the shock therapy approach to economic reform would have very severe short-run consequences for the country's overall capacity to import. For Bulgaria, the case is not so clear because the reform program that was implemented occurred at a slower pace, and the state was not timid about reversing its policies. Unfortunately, no balance-of-trade data exist for Bulgaria to help shed some light on this issue.

In the estimation of the meat production equation (2), the lagged dependent variable is not statistically significant. This result might suggest that short-run (annual) production decisions did not deviate too much from the targeted levels specified in the five-year plans.

The coefficient on *GNP* is positive and statistically significant in three cases. The positive signs on the coefficient are as expected, implying that meat is a normal good. The production targets are expected to have been increased by planners over time, in part because as the wealth of the nation increased, citizens would have been willing and able to spend more of their income on meat products. The coefficients on total coarse grain availability (*TCGA*) are positive and statistically significant in three cases. The positive sign reflects

that grain is an important input for livestock production and its availability affects production decisions. This might also be an important indicator that input availability was the key to satisfying the production targets for livestock and livestock products. The *Dummy* variable is significant in the case of Bulgaria only. The positive sign is curious because production of meat in Bulgaria declined dramatically in the 1990s when reforms were introduced.

In equation (3), the net coarse grain imports equation, *DCGA* is significant at the 1% level for Poland and 10% level for Czechoslovakia, confirming that imports occurred when the supply of feed grains was tight. The positive coefficients on meat production imply that the larger the size of the herd, the more likely imports of feed grains were needed to augment domestic supplies. The coefficients on meat production are significant in the cases of Czechoslovakia and Poland. The coefficient on *THCI* is positive and significant at the 1% level in the case of Romania, and at the 10% level for Bulgaria and Czechoslovakia. The link between grain imports and the capacity to import is measured through the overall import value of hard currency items; hence, the result implies that the overall constraint to import affected important decisions regarding feed grains only in the case of Romania.

An important departure from the results of some previous work (Cochrane) is with the coefficient on the import price of corn. The coefficient on price is not significant at the 1% or 5% levels in any case. These results support those economists who have argued that import prices (i.e., world price of corn) did not matter. In Cochrane's study, the coefficient on price (using the same definition and deflator) was significant in all cases. The signs were as expected in all cases except for Bulgaria, which was positive. The elasticities computed at the mean implied that coarse grain import prices, while mostly inelastic, were significantly different from perfectly inelastic. These results could not be replicated when using larger sample sizes, i.e., including the decade before or after the period of Cochrane's study. The estimation results of smaller samples using the data set for this study were very similar (in

coefficient estimate and sign) to the full-period model results reported in table 4.

The perfectly inelastic price response seems to imply that either central planners considered the livestock production targets to be binding and the decision to import grain a matter of meeting the targets, or that the price effect on the import decision was factored into the overall currency constraint. Hence, either livestock numbers were reduced through slaughter or grain imports continued to enter despite the higher prices. In the cases of Czechoslovakia and Poland, the significance of the meat production coefficient may be evidence to suggest that grain imports could be managed through reduction in livestock numbers.

The dummy variables in the grain import equation are used to test the hypothesis about the implications of the period of reform on the agricultural sector's reliance on imports, and whether the price mechanism became a more direct factor affecting the import decision. The coefficient on the dummy variable denoting the period of reform is statistically significant only in the case of Romania. For Romania, the period of reform made the country increasingly reliant on general imports (as noted by the extent of the balance-of-trade deficit, table 2) which also included import of grain. The interactive dummy with price ( $Dum*P$ ) is significant in the case of Bulgaria and Romania, but the positive sign in the case of Bulgaria is unexpected. According to the results for Romania, import prices begin to matter during the period of reform and adversely affect the country's ability and willingness to import.

### Implications and Concluding Comments

This study set out to examine the behavior of import demand in Eastern European countries with respect to hard currency constraints and world prices during the 1966–94 period. The study links hard currency allocation decisions to the import of coarse grain and traces this effect to the production of meat. The results generally support the findings of previous research that overall import demand was constrained by earnings of hard currencies. Coarse

grain imports, however, were unresponsive to international prices, suggesting that producers either tried to achieve the meat production targets even when domestic coarse grain supplies were limited or that animals were slaughtered in response to decreasing domestic grain availability. This finding contradicts the results from a previous study by Cochrane which used a similar method and the same countries as cases. However, the results from her study must be used with caution because the sample period covered only 12–15 years of observation, ranging between 1971 and 1984. The results from the current work support the hypothesis that world prices were mostly irrelevant for countries with binding production targets and controlled internal prices. As anecdotal evidence to support the empirical results, consider the transition to market economy beginning in 1990. Since the reforms, price liberalization only occurred in stages, particularly for food products. Even when state farms were allowed to make their own production decisions regarding mix of livestock or grain production, farm managers still admitted difficulty understanding the relative prices of goods and inputs. Unfortunately, this study does not go beyond the transition period—that is, when prices appear to be sending the appropriate signals to producers in Poland and the Czech and Slovak Republics. In Bulgaria and Romania it is debatable whether, in 1994, internal prices for agricultural commodities and food products fully reflected costs of production and their opportunity costs.

Future studies should make an effort to determine when internal prices in these emerging market economies directly affect production, marketing, and trade decisions. This will be further evidence of the success of political and economic reform. Another limitation of this study was the inability to incorporate input prices into the production of meat. This could have provided some insight into whether (and the degree to which) production decisions reflected changes in the price of inputs. Furthermore, government transfers could not be included. Government support to producers would have made it easier for (and probably would have required) directors of farms to

continue to produce the commodity mix that existed prior to the reforms. Nevertheless, hard currency constraints will force even the most reluctant policy makers to accept that market-oriented reforms are necessary and inevitable.

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