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Employment Implications of Exporting Processed U.S. Agricultural Products

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The importance of international trade in the U.S. economy has increased dramatically in recent years. Between 1970 and 1980, merchandise exports rose from 3.9 to 8.4% of Gross National Product (U.S. Department of Commerce, 1971, 1981). The growth in international markets has been particularly significant for agriculture. In 1970, exports accounted for 14.4% of the value of farm marketings, while by 1979, they had increased to 24.3% (U.S. Department of Agriculture, 1980).

Much of the interest in the recent growth in agricultural exports has focused on its implications for the balance of payments and farm incomes. Less attention has been given to the question of whether the U.S. is realizing the maximum gains for the economy as a whole from foreign market opportunities. One way to address this broader question is to examine the contribution of agricultural exports to national employment and income, recognizing that such exports generate economic activity throughout many different sectors of the economy. The nature and distribution of this activity depends not only on the total volume of commodities but on the form in which they are exported.

The current Administration has expressed a desire to increase the proportion of agricultural commodities exported in processed form and is intensifying its efforts to promote such products overseas (Washington Agricultural Record). Work has been initiated within the USDA to examine the potential for expanding processed exports and the employment implications

of such expansion (Schluter and Clayton). The purpose of this paper is to complement these efforts in order to assist policymakers in assessing the implications of expanding processed exports. The analysis is placed into perspective by first examining the recent historical importance of primary and processed agricultural exports and the nature and allocation of U.S. expenditure on foreign market development. Next, the employment contribution of major categories of processed exports is estimated and finally the major policy implications derived from this information are identified.

Trends in Agricultural Exports

Data on U.S. agricultural trade are readily available. In most cases, a useful distinction can be made among the primary commodity (or commodity group) and its first- and second-stage processed forms. For example, wheat can be exported in its primary form as grain, after "first-stage" processing in the form of flour, or after "second-stage" processing as a component in packaged food products. Corn, on the other hand, could be exported directly as grain, as part of a prepared feed mixture, or embodied in livestock.

Recent trends are examined for major commodity groups by aggregating available data in terms of primary agricultural commodities and their counterparts at a "first-stage" of processing. The aggregates in table 1 do not account for agricultural products which constitute a small proportion of the value of numerous manufactured exports. For example, the primary oilseeds category includes soybeans, cottonseed, and other oilseeds; the processed category includes vegetable oils, meals, and oilcake. Primary livestock includes exports of live animals, whereas the processed livestock category includes carcasses, meats and meat products, and animal by-products.

Table 1. Principal Exports of Primary and Processed Agricultural Products by the United States

Commodity Group	1973 Value of Exports				1980 Value of Exports				Average Annual Growth Rate of Value of Exports (1973-80)[c/]
	Total	Distribution[a/]			Total	Distribution[a/]			
		DC	LDC	CPC		DC	LDC	CPC	
	million 1972 $	- - - - - % - - - - -			million 1972 $	- - - - - % - - - - -			%
Primary									
Foodgrains	2,350	26	53	21	3,303	23	55	23	4.9
Feedgrains	2,287	72	16	12	4,716	56	28	16	11.8
Oilseeds	1,531	86	8	6	3,064	79	15	6	10.3
Livestock	125	80	18	2	93	76	24	0	-4.6
Poultry	13	48	52	0	25	36	62	2	9.1
Fruits & Vegetables	341	86	13	1	539	76	24	b/	5.1
Cotton	574	44	43	13	1,211	35	39	26	10.4
Tobacco	684	84	15	1	743	71	26	2	--
Subtotal	7,905	61	27	12	13,694	53	32	15	8.2
Processed									
Foodgrains	137	5	95	0	138	2	98	b/	--
Feedgrains	22	56	44	0	33	38	62	0	4.4
Oilseeds	809	64	17	18	1,576	44	41	15	9.1
Livestock	1,001	71	23	6	1,535	62	33	6	8.2
Poultry	64	65	35	b/	332	33	65	2	22.5
Fruits & Vegetables	468	75	24	1	815	53	45	1	6.1
Cotton	254	NA	NA	NA	298	NA	NA	NA	--
Tobacco	279	NA	NA	NA	518	NA	NA	NA	11.4
Subtotal	3,034	66	26	8	5,245	50	43	8	8.1
Total	10,939	62	27	11	18,939	52	35	13	8.2

Sources: U.S. Department of Agriculture (1974-81), U.S. Department of Commerce (1974-81), U.S. Department of Labor (1973-81).

a/ Destination of exports by region, DC = developed countries; LDC = less-developed countries; CPC = centrally-planned countries as defined by the USDA. Percentages for subtotals and total are weighted averages using export value shares. Processed cotton and tobacco are excluded.

b/ Less than 0.5 percent.

c/ For individual commodity groups, computed from semi-log trend line and only quoted if the null hypothesis of zero growth was rejected at the 10% level or above. For subtotals and total, computed as the compound growth rate implied by 1973 and 1980 values.

NA = not available. Detail may not add due to rounding.

Other categories are defined using parallel distinctions between primary and processed forms. There are two categories of processed agricultural exports in table 1 which are not reported in the agricultural export data, although they embody a substantial component of primary agricultural product and are therefore consistent with the above notion of first-stage processing. Yarn and cloth comprise the bulk of processed cotton exports, while processed tobacco includes cigarettes, pipe tobacco, and other manufactured tobacco products.

Table 1 contains the value of primary and processed exports in 1973 and 1980 for eight major commodity aggregates. Nominal values were deflated by the corresponding components of the U.S. wholesale price index to convert to 1972 constant dollars. The average annual growth rates reported in the table are also based on constant dollar values.

After accounting for inflation over the 1973-80 period, the total value of exports in the categories listed increased from $11 billion to $19 billion. This represents an average annual growth rate of just over 8%. The growth rates for primary and processed products were roughly the same. In each of the years, 72% of the total value was made up by primary products and 28% by processed products. The tremendous increase in U.S. exports of primary feedgrains and oilseeds during the 1970's is generally acknowledged; interestingly, processed exports as a group kept pace and continue to constitute a significant portion of the total.

In 1973, developed countries (DC's) absorbed 63% of all U.S. agricultural exports. By 1980, this proportion had dropped to 52%. While some of this change is explained by a small relative increase in exports to centrally-planned countries (CPC's), the major shift has been towards markets in less-developed countries (LDC's). This shift is particularly pronounced

for processed exports; in 1973, only 26% of processed exports were destined for LDC markets, whereas by 1980, this percentage had risen to 43%. There are several forces which have contributed to this marked expansion; rising incomes in many LDC's over the period, coupled with their lack of primary processing capacity, are certainly contributing factors. From a policy perspective, this change in the distribution of products across markets is as significant as the change in their total volume.

Market Promotion

Despite the fact that the rapid increase in agricultural exports is a relatively recent phenomenon, U.S. government activities to maintain or expand overseas markets date back at least to 1953, with the creation of the Foreign Agricultural Service (FAS). Since its inception, the FAS has undertaken a variety of programs to facilitate sales of U.S. agricultural commodities overseas. Many of the Agency's promotional activities are carried out jointly with market development co-operators. These are primarily farm-oriented groups representing specific commodity interests. Within the co-operator program, two basic approaches have been used. Trade servicing, the provision of information on price, availability, usage and technical application of U.S. products in overseas markets, is particularly well-adapted to bulk, unprocessed commodities. Consumer promotion, the use of media advertising and other techniques to promote generic or brand-name products, is generally used by co-operators representing producers of semi-processed and processed products.

In table 2, FAS co-operator program expenditures are allocated between primary and processed products. Unpublished data on expenditures by co-operator and by country were available on a fiscal year basis. Funds

Table 2. Foreign Agricultural Service Expenditures on Market Development Programs

	Fiscal 1974					Fiscal 1980				
	Expenditures		Market Distribution[a/]			Expenditures		Market Distribution[a/]		
			DC	LDC	CPC			DC	LDC	CPC
	1,000 $	%	- - - - % - - - -			1,000 $	%	- - - - % - - - -		
Co-operator Program										
Primary[b/]	7,213	67	77	23	0	13,619	66	70	30	0
Processed[b/]	2,421	23	90	10	0	3,378	16	92	8	0
Subtotal	9,634	90	80	20	0	16,997	82	74	26	0
Other Programs[c/]	1,104	10	94	4	2	3,689	18	72	23	5
Total[d/]	10,738	100	82	18	0	20,686	100	74	25	1

Source: Unpublished USDA (FAS) data.

a/ See table 1.

b/ Funds used by FAS co-operators, allocated according to their major commodity focus.

c/ Expenditures on trade offices, projects initiated by FAS and Export Incentive Programs. (See McKinna for description.)

d/ Excludes expenditures which could not be allocated regionally, accounting for 1% of the total in 1974 and 4% in 1980.

provided to each co-operator were allocated entirely to the primary or processed product category corresponding to the co-operator's major commodity interest. The resulting distribution is approximate because some co-operators undertake activities relating to both the primary commodity and its processed counterpart. However, the allocation was applied consistently and the relative difference in expenditures by category and market between the two years is therefore less sensitive to errors in classification.

According to the table, FAS expenditures through the co-operator program totaled just over $9.6 million in fiscal 1974. By fiscal 1980, they had increased by 76%. Although it would be difficult to adjust this increase to reflect the change in the purchasing power of these dollars overseas, the U.S. wholesale price index increased by roughly 71% over the same period. This suggests that real expenditures have been relatively constant. Although the figures indicate the Federal government's contribution, they do not represent the total resources devoted to market promotion through the co-operator program. Unpublished data suggest that Federal funds are supplemented by approximately $2.5 of co-operator and foreign third party contributions in the form of cash or goods and services per dollar of FAS expenditure. These are not included in the table because their distribution by market was unavailable to the authors. Based on the figures for FAS expenditures alone, it appears that the share devoted to processed commodities has declined in recent years. On the other hand, the share allocated to product promotion in LDC's has increased.

The reduction in the proportion of FAS expenditures devoted to processed products through the co-operator program is explained by a shift to other promotional activities. These expenditures have increased from 10% to 18% of the total between fiscal 1974 and 1980 and support trade offices,

multi-commodity programs initiated by FAS and the Export Incentive Program designed to promote branded products. (See McKinna for details.) The distribution of these expenditures has also shifted towards LDC markets, but the shift has been more dramatic than in the co-operator program.

Exports and Employment

The rapid expansion of agricultural exports implies that overseas sales are of growing importance to U.S. agricultural producers. This direct linkage is the primary motivation underlying the market promotion activities of the FAS. However, it is also desirable to identify the returns to promotional activities for the nation as a whole. A complete evaluation is beyond the scope of this paper, but would involve two major components. One component is an assessment of the effectiveness of public expenditure in expanding overseas markets. The second is the determination of the benefits derived from such expansion by agriculture and other sectors of the economy. The remainder of the paper contributes to this second component.

In assessing the economy-wide benefits of export expansion, one would need to estimate the net returns to all factors of production attributable directly or indirectly to agricultural sales overseas. A major consideration is the implication for employment, particularly in light of recent increases in the unemployment rate. The number of jobs generated throughout the economy depends not only on the total volume of agricultural exports, but also on the degree to which they are processed prior to export.

An interindustry analysis for the U.S. economy is used to estimate the domestic employment attributable to agricultural exports. The analysis is based on the 1972 detailed input-output table, the most recent one available from the U.S. Department of Commerce. This table divides the U.S. economy

into nearly 500 sectors and delineates their purchases of individual commodities. Using procedures outlined by Su, transactions were estimated on a commodity-by-commodity basis. Based on this reformulation, it is possible to determine the direct input requirements per dollar of output on a commodity rather than an industry basis. This procedure eliminates the problems created by secondary products in the usual industry-by-industry delineation and facilitates an aggregation consistent with the primary and processed agricultural commodity distinction introduced above.

An aggregate table containing 45 sectors was constructed for the analysis. Eighteen sectors were designed to correspond as closely as possible to the agricultural commodity aggregates delineated in table 1. The remaining sectors were combined into 27 aggregates, containing one or more sectors of the economy defined by the two-digit SIC industrial classification (Executive Office of the President).

Within the model, exports to foreign countries are treated as exogenous additions to final demand. Accordingly, one can calculate the level of sales of all commodities throughout the economy (s_j) generated by a particular dollar value of export sales of commodity j (x_j) from

$$(1) \quad s_j = \sum_{i=1}^{n} c_{ij} \, x_j \, ,$$

where c_{ij} is the i,jth element of the Leontief inverse $(I-A)^{-1}$, A being an nxn matrix of the dollar value of input i per dollar of output j.[1/] This information, combined with estimates of the direct employment generated per dollar of output for each commodity i (w_i), can be used to calculate the direct and indirect employment throughout the economy (e_j) attributable to a particular dollar value of export sales:

$$(2) \quad e_j = \sum_{i=1}^{n} w_i \, c_{ij} \, x_j \, .$$

Employment data for 1972 from County Business Patterns were used extensively to estimate direct employment coefficients (U.S. Department of Commerce, 1973). These data are organized on an industry basis rather than by commodity. To adjust the figures to reflect the commodity structure of the input-output table, the Commerce Department's data on the make of commodities by industry were used to reapportion total industry employment (U.S. Department of Commerce, 1979). In the case of primary agricultural products, employment figures are not available from County Business Patterns (CBP). Data from Merrill were used.

The employment coefficients generated in this fashion must be interpreted with some care. CBP figures cover 76% of all civilian wage and salary employment and are a count of employees during a single pay period. There is no way to determine how much of the employment recorded is full-time rather than part-time, or to assess how much seasonal employment is included. The implication of partial coverage is that the employment impact of exports will be understated. The inclusion of part-time employment may partially offset this understatement.

One way to assess the importance of agricultural exports from an employment perspective is to estimate the total number of jobs in the economy attributable to exports using equation (2). Table 3 contains such estimates for 1973 and 1980 exports, measured in constant 1972 dollars to be consistent with the valuation in the interindustry table. Between these two years, the estimated number of jobs due to agricultural exports increased from just under 0.9 million to roughly 1.4 million or by 68%. In both years, approximately three-quarters of these jobs were attributable to primary exports. This is close to the proportion that such exports represented of the total. As might be expected, the distribution of the jobs created by primary and

Table 3. U.S. Employment Generated by Major Agricultural Exports

Commodity Group	Direct Plus Indirect Employment[a/]				Employment Generated by Sector as Percent of Total[b/]			
	1973 Exports	1980 Exports	Percent of Total		Year	Agriculture		Other
			1973	1980		Primary	Processed	
	- - - - 1,000 Jobs - - - -							
Primary	652	1,074	75	74	1973	78	c/	21
					1980	77	c/	23
Processed	213	375	25	26	1973	45	23	33
					1980	46	21	33
Total	865	1,449	100	100				

a/ Derived from the 1972 Detailed Input-Output Table of the U.S. Economy, U.S. Department of Commerce, 1979, independent estimates of 1972 direct employment coefficients based on data from U.S. Department of Commerce, 1973, and Merrill, and the constant dollar export figures given in table 1. The input-output table was structured on a commodity-by-commodity basis and was reaggregated to reflect the 16 primary and processed agricultural sectors in table 1. The reaggregation was accomplished by an algorithm from Boisvert and Bills.

b/ Represents the percentage of direct and indirect employment that is generated in agriculture and other sectors of the economy.

c/ Less than 0.5 percent.

processed exports differs across sectors of the economy. For processed products, two-thirds of the total employment generated is in agriculture, whereas for primary products it is almost 80%. The difference reflects the value added from other sectors in processing.

Table 3 provides an important historical perspective on the contribution of primary and processed agricultural exports to employment. However, given the Administration's interest in the expansion of processed exports, it is necessary to compare the net employment effects of expanding the eight categories of such exports. The net effect is computed by estimating the total employment attributable to one million dollars of processed exports and then by netting out the employment contribution of the primary commodity embodied in the processed export. That is, the total employment effect is reduced by the number of jobs that would have been generated had the embodied primary commodity been exported in unprocessed form. Algebraically, the net employment effect (e_p*) is

$$(3) \quad e_p^* = [(\sum_{i=1}^{n} w_i \, c_{ip}) - (\sum_{i=1}^{n} w_i \, c_{iu})(c_{up}/c_{uu})]x_p$$

where w, c and x are defined as in equations (1) and (2), the subscript p denotes an agricultural processing sector and the subscript u denotes its corresponding primary sector. The term $\sum w_i \, c_{ip}$ is the direct plus indirect employment per dollar of processed exports, the term $\sum w_i \, c_{iu}$ is a similar expression per dollar of primary exports and c_{up}/c_{uu}, the ratio of two elements of the Leontief inverse, estimates the equivalent dollar value of unprocessed exports per dollar of processed exports.[2/]

The data in table 4 demonstrate that the total number of jobs created by an expansion of processed exports by one million 1972 dollars differs substantially across commodity groups. It ranges from a low of 56 for feedgrains

Table 4. Change in Employment from Processing Agricultural Exports

Commodity Group	Processed Agricultural Exports		Equivalent Primary Agricultural Exports		Net Change in Employment			
						Distribution[d]		
	Value	Direct and Indirect Employment[a]	Value[b]	Direct and Indirect Employment[a]	Total[c]	Agriculture		Other
						Primary	Processed	
	1,000 $	Jobs	1,000 $	Jobs	Jobs	%		
Foodgrains	1,000	57	128	8	49	8	55	37
Feedgrains	1,000	56	198	13	43	20	29	51
Oilseeds	1,000	58	513	27	31	28	25	47
Livestock[e]	1,000	75	287	18	57	51	20	29
Poultry[e]	1,000	102	186	11	91	41	31	28
Fruits & Vegetables	1,000	71	110	15	56	8	40	52
Cotton	1,000	90	63	9	81	1	68	31
Tobacco	1,000	64	203	44	20	1	49	50

a/ Derived from the 1972 Detailed Input-Output Table of the U.S. Economy. (See table 3 for details.)

b/ Dollar value of unprocessed agricultural exports embodied in 1 million dollars of processed agricultural exports. It is calculated from the ratio of two elements of the Leontief Inverse (c_{up}/c_{uu}) where u refers to the unprocessed sector and p refers to the processed sector.

c/ Column 2 - column 4.

d/ Represents the percentage of the net change in employment generated in agriculture and other sectors of the economy.

e/ The primary export component is feedgrains and oilseeds rather than primary livestock or poultry. Thus, the net employment is attributable to the livestock and poultry producers as well as processors.

to a high of 102 for poultry. The total employment effects are lowest for processed grains and oilseeds. The net effects differ in terms of their relative ranking, although poultry still ranks highest. The smallest total effect is in feedgrains, but the smallest net effect is in tobacco. Much of this difference is due to the relative values of the primary agricultural commodities that would be exported in unprocessed form. In general, where the equivalent value is low (as it is in foodgrains), the net effect tends to be closer to the gross effect. A contributing factor to the high net effects in poultry and livestock is the way in which their primary agricultural component is defined. For these commodities, the appropriate comparison is not the export of live animals versus processed meats and poultry. Rather, the relevant alternatives are the export of feed directly or feed embodied in livestock products, because exports of live animals are dominated by breeding stock. Thus, the equivalent primary agricultural export (e.g. $287,000 in the case of livestock) is the value of embodied feedgrains and oilseeds.[3/] Because exporting processed rather than primary feedgrains is also an alternative, a category for processed feedgrains was included in the analysis.

The treatment of livestock and poultry partially explains why the proportion of the net change in employment going to primary agriculture is considerably higher than for other commodities. For example, over 40% of the net effect for poultry is in primary agriculture because raising poultry is viewed as the first stage in the indirect export of feed. However, the proportion of the net change in employment going to primary agriculture varies across the other commodity groups as well and appears to be inversely proportional to the degree of processing involved.

Policy Implications

The policy implications of this analysis follow from the observations made above regarding export trends, promotional expenditures, and employment. The first observation is that in recent years, processed agricultural commodities have made a significant contribution to the total value of U.S. agricultural exports. Despite the rapid growth in primary exports since 1973, processed exports have kept pace, maintaining a share of roughly 28%. The principal factor sustaining the 8% annual growth rate in processed exports has been a tremendous expansion in sales to LDC's. Second, during the same period, Federal government market promotion expenditures through the FAS have shifted towards LDC markets but preliminary estimates suggest that the share of expenditures allocated to processed products has tended to decline. Third, processed products account for roughly 25% of the total number of jobs generated by agricultural exports in the U.S. economy. Because of the additional value added in processing, there would be a net increase in employment if for each agricultural commodity, a larger proportion of its total exports were in processed form. The magnitude of the net increase differs by commodity as does its distribution between production agriculture and other sectors of the economy.

From a policy perspective, recent experience demonstrates that opportunities for expanding processed agricultural exports have been realized. Rates of export expansion equal to or above the average for all primary commodities have been experienced for several processed products: poultry, tobacco, oilseeds, and livestock. It is difficult to assess whether historical growth rates will be sustained in the future, or the extent to which market promotion programs could increase them. Nevertheless, these commodities deserve careful examination. For example, processed poultry exports grew at

an average annual rate of over 22% between 1973 and 1980. Furthermore, the export of feed embodied in poultry rather than in its raw form generates the highest net employment effect per million dollars of processed exports of all the commodities considered. Efforts to sustain or expand overseas markets for processed poultry would clearly merit close consideration. On the other hand, processed tobacco, whose exports grew at an annual rate of over 11% between 1973 and 1980, has the lowest net employment impact by far of all the commodities examined. It is less than one-fourth of that for poultry. From a national employment perspective, efforts to expand processed tobacco exports seem to be of lower priority than other commodities where the net employment effects are higher.

In evaluating the relative merits of export expansion for processed products, the distribution of the net change in employment may be an important consideration. The distribution among the agricultural processing sector, primary agriculture, and other sectors of the economy differs considerably across commodities. For example, if one were particularly concerned with job creation in primary agriculture, the expansion of livestock exports would rank high in that an estimated 51% of the net increase in employment accrues to primary agriculture (table 4). On the other hand, only 8% of the net increase in jobs for fruits and vegetables is generated in primary agriculture. Yet in terms of their net impact on national employment, the two commodity groups are virtually identical. This comparison suggests that the promotion of processed agricultural exports based solely on their contribution to employment in production agriculture may not be the best strategy for maximizing the net increase in employment nationally.

In conclusion, the analysis in this paper has been designed to provide information useful in evaluating the desirability of promoting exports of

broad categories of processed agricultural commodities. Its focus is on how to utilize net employment information in evaluating export expansion, recognizing that there are numerous other considerations involved in formulating policy. The interindustry methodology used in the paper does not incorporate resource constraints on production for export. Historical growth rates are only partial indicators of future market potential. A more complete evaluation of export promotion strategy would have to include an in-depth assessment of the numerous economic and institutional factors which affect the prospects for growth in overseas markets for processed agricultural products. It is particularly important to identify the effectiveness of promotional expenditures in expanding the demand for both primary and processed products. With this information, it would be possible to determine the extent to which the net employment contribution of processed export expansion could be increased through the allocation of promotional expenditures.

Footnotes

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1/ The model assumes that the household sector is exogenous, that is consumer final demand is unaffected by changes in household income. This is an unrealistic assumption for a national model and implies that the sales attributed to exports are understated. Data were not available to the authors to close the system with respect to households. However, the underestimation of total sales is proportional across sectors (Bradley and Gardner) and an intersectoral comparison of the relative impact of exports on employment is unaffected.

2/ Schluter and Clayton calculate the net employment from exporting a million dollars of primary product in processed form. Their approach, although logically consistent with the one above, was not used in this paper because it makes the direct comparison of the expansion of different categories of processed exports more difficult.

3/ This procedure entailed a slight modification of equation (3) by subtracting the employment attributable to the equivalent dollar value of two primary inputs. This more complicated calculation could have been used generally to net out all embodied primary agricultural commodities in processed exports. In the majority of cases, primary inputs other than those corresponding to the major commodity group were insignificant and were therefore ignored.

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