Import Demand for Dairy Products in Cote d'Ivoire

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, July 23-26, 2006

Joseph V. Balagtas[§]
Department of Agricultural Economics
Purdue University

Jeanne Coulibaly[†]
Department of Agricultural Economics
Purdue University

Ibrahim Diarra[‡]
Centre Ivoirien de Recherches Economiques et Sociales (CIRES)

This draft: June 1, 2006

Abstract

We estimate an LA/AIDS model of demand for imported dairy products for Cote d'Ivoire. We employ a unique set of Ivorian customs data, spanning seven dairy products observed monthly from January 1996 to December 2005. Demand for milk powder is found to be inelastic, as substitutes for milk powder in the domestic processing industry are scarce. Demand for fluid milk, yogurt, and cream are found to be elastic, as these domestic products produced from imported powder may substitute for the imports. With the exception of condensed milk, dairy products are found to be necessities.

[§] Corresponding Author: Department of Agricultural Economics, Purdue University, 403 W. State Street, West Lafayette, IN 47907-2056, USA. Phone: 765-494-4298. FAX: 765-494-9176. E-mail: balagtas@purdue.edu. Authors are listed alphabetically. Senior authorship is not assigned.
[†] Department of Agricultural Economics, Purdue University, 403 W. State Street, West Lafayette, IN 47907-2056, USA. Phone: 765-494-0187. FAX: 765-494-9176. E-mail: jcouliba@purdue.edu.
[‡] CIRES, Abidjan, Cote d'Ivoire. Phone: 00 225 21-56-03-86. E-mail: dibmam@yahoo.fr.

Import Demand for Dairy Products in Cote d'Ivoire

Population growth, income growth, and increasing urbanization are boosting the demand for food of animal origin, especially dairy products, in developing countries. According to the FAO Food Balance Sheet, per capital cereal consumption in developing countries declined from 164 to 158 kg/year between 1982 and 2002, while milk consumption increased from 25.8 to 45.6 liters/year for the same period (FAO 2004). Dairy product sales in Cote d'Ivoire were an estimated 11.9 billion F.CFA in 1998 (Ekberg 2001) (approximately US$ 23.2 million at current exchange rates).

Like many developing countries, Cote d'Ivoire relies almost entirely on imports to satisfy demand for dairy products. Indeed, dairy products represent the third-most imported food commodity after rice and fish (Gbongue 2002). In 2003, approximately 200,000 MT of dairy products were imported, compared to approximately 25,000 MT produced domestically (MIPARH/DPE 2004). Contributing to the heavy reliance on imports is slow growth of the local dairy sector, and relatively low international prices of milk powder in the international market. Trade policies in developed countries affect the world prices facing Cote d'Ivoire, a small player in the world market. Export subsidies and import barriers in countries such as the EU, the United States, Japan, Korea, and Canada distort trade flows and lower the world price of dairy commodities (OECD 2004; FAPRI 2002).

Dairy trade liberalization continues to be a topic of on-going negotiations in the Doha round of the World Trade Organization. Recent studies of dairy trade liberalization scenarios find that world dairy prices would rise significantly as a result of liberalized trade (OECD 2004; FAPRI 2002). Thus, it is not surprising that exporting countries such as Australia and New Zealand are pushing hard for trade policy reform. In addition to making exporters better off,

however, liberalized dairy trade would also end the days of low-priced, subsidized exports in countries such as Cote d'Ivoire. Thus, trade liberalization may offer some opportunities for increased prices and incomes for local dairy farmers. On the other hand, given the growing importance of dairy protein in the Ivorian diet, to the extent that price rise, dairy trade liberalization may also harm consumers in this and other poor nations that rely on dairy imports.

Little economic research exists on the markets for dairy in Cote d'Ivoire or on other African countries.[1] Because of a dearth of research, policy makers and economists are unable to analyze and quantify the potential impacts of dairy trade reform on African markets. Such analysis is necessary for considering the full welfare implications of potential WTO scenarios and would also be useful to African governments for planning purposes and to dairy exporters, as well. In this paper, we begin to develop the primary economic information necessary to evaluate the performance of Ivorian dairy markets by estimating Ivorian demand for imported dairy products.

We estimate Ivorian demand for imports of seven dairy products—yogurt, milk powder, butter, cream, milk, cheese, condensed milk, and fluid milk—using Ivorian customs data observed monthly from 1996 to 2005. We adopt the Linear Approximate Almost Ideal Demand System (LA/AIDS) model (Deaton and Muellbauer 1980) with imports aggregated over import sources and expenditure assumed to be exogenous. To correct for serially correlated errors, we impose a common AR(1) error structure to all equations.

The next section of this paper presents some background information on the dairy industry in Cote d'Ivoire. Next, we sketch the LA/AIDS model to be estimated, then present and

[1] Nwoko studies dairy markets in Nigeria, and Ahmed et al. focus on Ethiopia. These countries are unique in Africa in that they have susbstantial, growing domestic dairy industries.

discuss our regression results. We close the paper with concluding remarks and directions for further work.

Background information on Ivorian dairy industry

Ivorian dairy production and marketing

Little data exist on the Ivorian dairy sector. Based on estimates from the Ivorian Ministry of Animal Production and Fisheries Resources (MIPARH/DPP), domestic milk production accounts for 11 percent of total milk consumption in Cote d'Ivoire. Domestic production has been estimated to grow at an average annual rate of six percent, rising from an estimated 17,800 MT in 1990 to 25,000 MT in 2005. Approximately eighty percent of the total production is supplied by the traditional sector, which is comprised of smallholder operations focused mainly on consumption at home. The remaining 20 percent is supplied by the commercial sector (MIPARH/DPP 2004). While the lack of data prevents an empirical analysis of domestic production, here we provide some qualitative description of the sector.

Milk production in the traditional sector takes place mostly in the rural, northern part of the country under pastoral and agro pastoral systems. Average herd size in this region was 15 cows in 2002 (MIPARH/DPP 2002). In this region, cotton, cashew nuts, and mangoes represent the most important sources of revenue for farmers. Livestock is commonly used as draught power and organic fertilizer for the crop enterprise. Milk is considered as a livestock by-product and mostly consumed within the farm household (BDPA 2002). This traditional system relies mainly on local breeds with very low milk output. Typical milk production per cow is approximately one to two liters per day during eight months of lactation. The cows are dry the rest of the year.

Under the traditional system, surplus milk (i.e., milk not consumed at home) is marketed as fresh or fermented to consumers in nearby village markets. Marketing is either done directly by farmers or by traders. In either case, milk is delivered on foot or on bicycle. A lack of storage possibility and transportation technology limits the geographical size of the market for fresh milk to nearby consumers.

Prospects for greater and more market-oriented production from the traditional system are constrained by production and marketing challenges. Production challenges include poor genetics (low output per cow), animal disease, and insecure access to pasture. Marketing challenges include long distances to markets, poor transportation infrastructure, and a lack of proper milk sanitation practices. Access to financial capital is also a problem for farmers who might otherwise invest in increased capacity for milk production and marketing.

In contrast, an intensive, modern milk production system exists near the population centers of the urban south. The modern dairy sector uses dairy cows bred specifically for milk production, with milk production per cow in the range of 15 to 20 liters per day (Coulibaly 2004). The modern dairy farms are either private or small cooperative enterprises, but have received financial support from the Ivorian government, foreign governments, and international development organizations such as the African Development Bank.

Both private and cooperative commercial farms are integrated with small-scale, proprietary processing plants that pasteurize the milk and package fresh milk, sour milk, and yogurt. The processed dairy products are then distributed to consumers through small retail outlets.

Dairy Imports

The Ivorian dairy market is dominated by the imports of finished dairy products and milk powder which is subsequently reprocessed in Cote d'Ivoire. Eighty-nine percent of dairy consumption is supplied by imports (MIPARH/DPP 2004). Dairy processing in Cote d'Ivoire is dominated by large manufacturing plants that use imported milk powder as the main dairy ingredient due to the uncertain availability and quality of local milk. These large plants manufacture yogurt, cheese, condensed milk, and other dairy products, which are distributed to small retail outlets as well as large supermarkets. Manufacturers also import finished dairy products to supply directly to large supermarkets. Dairy products are also imported directly by supermarkets, or by importers who sell to supermarkets.

The main supplier of dairy imports is the European Union, with whom Cote d'Ivoire maintains a preferential trade agreement, and particularly with France through the strong historical, cultural, and economic links. E.U. countries supply almost 80 percent of Ivorian dairy consumption. Among E.U. countries, France and the Netherland are the biggest suppliers.

Like many other countries in West Africa, Cote d'Ivoire's dairy development scheme was driven by food security. This policy called for dairy imports to supplement inadequate domestic supplies. Starting from independence in the 1960s, dairy imports entered the country with nominal tariffs and nonrestrictive quotas. Cheap dairy imports further discouraged domestic production.

In 1990, the government changed course and took some measures to regulate imports in order to promote domestic milk production and to increase the tariff revenue. These policies were pursued through instruments such as import licenses and higher import tariffs. The government increased the import tariff for products such as condensed milk. Moreover, during

the years 1990-1991, the government required that importers purchase 40 percent of their products from SIALIM (Ivorian Society for Food) a government-run enterprise that processed imported powder milk into final products such as condensed milk, yogurt, etc. This requirement in longer exists and SIALIM is out of business.

Despite these economic barriers implemented by the government in order to regulate dairy imports and develop the domestic industry, dairy imports continued to grow and the local production remained low. In 1993, the government set up some emergency measures to not only develop and modernize the local dairy industry but also to reduce imports. These programs relied mostly on programs aimed at improving the genetics of the national herd. In this context, many development projects for the dairy industry were implemented in the commercial sector, where low disease pressure, greater feed availability, and more reliable market outlets were more amenable to the improved breeds. However, efforts to improve the performance of the national dairy herd have shown little success so far, because of technical and financial mismanagement.

Import tariffs remain an important component of the dairy development programs, as well as a source of government revenue. Tariffs for various dairy products are reported in Table 1. In January 1994, in order to attenuate the effects of a currency devaluation, the tariffs on liquid milk, condensed milk, milk powder, and butter were decreased by five percent, and the tariff on cheese by 10 percent.

Theoretical framework

We adopt the linear approximate almost ideal demand system (LA/AIDS) proposed by Deaton and Muellbauer (1980), one of the most widely used models for empirical demand studies due to its flexible functional form (Eales and Unnevehr 1988; Green and Alston 1988; Fulponi 1989; Foster et al. 1990; Hayes et al. 1990). The LA/AIDS provides an arbitrary first order

approximation to any demand system, satisfies the axiom of choice, and under certain conditions, aggregates perfectly over consumers (Deaton and Muellbauer 1980). The LA/AIDS model has the following form:

(1) $$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \log(p_j) + \beta_i \ln(X / P)$$

where w_i denotes the budget share of commodity i, p_j is the price of commodity j, X is the total expenditure on all n commodities, and P is Stone's price index, defined as:

(2) $$\ln(P) = \sum_{i=1}^{n} w_i \ln(P_i)$$

Restrictions imposed by demand theory are expressed in terms of restrictions on the model's parameters:

(3) $$\sum_{i=1}^{n} \alpha_i = 1; \quad \sum_{i=1}^{n} \gamma_{ij} = 0; \quad \sum_{i=1}^{n} \beta_i = 0 \text{ (adding up)}$$

(4) $$\sum_{j=1}^{n} \gamma_{ij} = 0 \text{ (homogeneity)}$$

(5) $$\gamma_{ij} = \gamma_{ji} \text{ (symmetry).}$$

Marshallian (uncompensated) elasticity of demand is computed from the estimated parameters of the model. These elasticities are estimated as follows (see, for example, Green and Alston 1990; Hayes et al. 1990):

(6) $$\eta_{ij} = -\delta_{ij} + \gamma_{ij} / w_i - \beta_i w_j / w_i$$

where δ_{ij} is the Kronecker delta, δ_{ij} = 1for $i = j$ and zero otherwise.

Income elasticity of demand for each product is expressed as

(7) $$\varphi_i = \beta_i / w_i + 1.$$

Data and Estimation Procedures

Data description

We use monthly data over the period 1996-2005 to estimate the model. The data are from the Statistics Department of the Ivorian Customs Service (Service des Douanes Ivoirien/Department des Statistiques), and comprise import values and quantities for seven aggregate dairy commodities: milk powder, fluid milk, yogurt, butter, cheese, condensed milk and milk cream. These products include the vast majority of dairy products imported and consumed over the observed period. Summary statistics are reported in Table 2.

Figure 1a plots total expenditure for imported dairy products over time. Import values reflect prices at the Ivorian port of Abidjan, including all relevant tariffs and fees (see Table 1). Total expenditure on dairy imports was variable over the observed time period, but did not display an obvious time trend. Figure 1b plots the expenditure shares for milk powder and condensed milk. These two products together accounted for, on average, 87 percent of total expenditure on dairy imports over the sample period (Table 2). While no data is available, it is believed that most of the imported milk powder and condensed milk is manufactured into final dairy products such as reconstituted milk and yogurt.

Data on prices and consumption of domestically produced milk are not available. Thus we assume separability between domestic and imported dairy. We discuss the implications of this assumption and directions for further work in the conclusion of this paper.

Estimation Procedures

We estimate the LA/AIDS model (equation (1)) by Zellner's Seemingly Unrelated Regressions (1962). Because of the adding up condition, the covariance matrix is singular, and therefore one equation was deleted from the system. Barten (1969) has shown that when the

disturbances are serially uncorrelated, the parameters estimate are the same regardless of which equation is omitted. Thus, we estimate the model with six share equations (milk powder, condensed milk, fluid milk, cheese, yogurt, butter), and impute the coefficients for the share equation for cream from the estimated coefficients of the other six share equations, together with homogeneity and symmetry restrictions. To avoid the problem of endogeneity, we use lagged shares in the calculation of Stone's price index (Eales and Unnevehr 1988).

To account for potential seasonality, we allow for monthly dummy variables in each share equation. On the basis of a likelihood ratio test, we are able to reject at the 5 percent level the null hypothesis that the monthly dummies are jointly equal to zero. Thus we include the monthly dummies.

We also test for homogeneity and symmetry restrictions. We fail to reject the null hypothesis of no homogeneity for all commodities, and no symmetry at a 5 percent level. Failure of these restrictions can be attributed to a number of possible causes such as the omission of some explanatory variables (Deaton and Muellbauer, 1980). We thus impose homogeneity and symmetry on the model.

Durbin-Watson statistics indicate serially correlated errors when the model is estimated by SUR. Thus, we also estimated a model with a single, first-order autoregressive structure imposed on the errors.

Results

Results from the model estimated by SUR without correction for serially correlated errors are reported in Table 3. Results from the model estimated with an AR(1) error structure imposed are reported in Table 4. The estimated autoregressive coefficient is 0.207, with a standard error of 0.046. The AR(1) error structure improves the R^2 for each equation. Estimated coefficients

very similar to those estimated by SUR without correcting for serially correlated errors, thus we calculate demand elasticities only for the model with AR(1) errors.

Substituting the estimates from Table 4 into equations (6) and (7) we calculate point estimates of the elasticities of demand with respect to prices and expenditure, which we evaluate at the means of the data. The resulting elasticities are reported in Table 5. Demand for milk powder is price-inelastic, with an own-price elasticity of demand of -0.535. This finding is consistent with the fact, discussed earlier, that the local Ivorian milk supply is of inadequate quantity and quality to substitute for milk powder in the manufacture of dairy products.

Moreover, an increase in the price of milk powder results in an increase in demand for all other products, with the exception of condensed milk. That is, imported cheese, fluid milk, butter, yogurt, and cheese substitute for imported milk powder. These findings are consistent with the stylized fact, described above, that milk powder is imported as an intermediate good then processed within Cote d'Ivoire into dairy products such as cheese, yogurt, and butter. Thus, as the price of milk powder rises, the prices of goods manufactured from milk powder also rise, and Ivorian consumers substitute imported cheese, yogurt, and butter.

Demand for imported fluid milk, yogurt, and cream is elastic. Again, this finding reflects the availability of substitute products manufactured locally from imported milk powder. In contrast, the demand for condensed milk is price inelastic, with an estimated own-price elasticity of -0.133. Further, condensed milk stands out from the other products in that it appears to complement other dairy products.

With the exception of condensed milk, expenditure elasticities are all less than one, indicating that these dairy products are necessities. This finding is somewhat surprising for the finished dairy products (cheese, fluid milk, butter, yogurt, cream), since dairy product imports in

other countries are often perceived as expensive, high-quality luxuries. Condensed milk is the only luxury good.

Implications and Directions for Further Research

Milk powder and condensed milk account for, on average, 87 percent of Ivorian expenditure on dairy imports. Our results indicate that Ivorian demand for imported milk powder and condensed milk are inelastic. Thus, liberalization of international trade in dairy products, which would likely result in higher prices for these and other dairy product prices, would cause substantial welfare losses in consumer surplus, as few substitutes for these products exist.

This research may be extended in several directions. Yang and Koo (1994) argued that source differentiation is important for import demand analysis. In the present context, historical cultural and economic links between Cote d'Ivoire and some E.U. countries might lead to a preference by Ivorian consumers for products from those countries. Indeed, a handful of European countries supply most of the dairy products imported into the country (Table 6). The model sketched above aggregates imports across source countries, and thus does not allow for differences in demand across countries. We are currently extending this research to estimate the source differentiated LS/AIDS model developed by Yang and Koo (1994).

The analysis presented here omits locally produced milk and dairy products made from locally produced milk. Thus, we have implicitly imposed an assumption of separability between imported and domestic milk. The main reason for this modeling choice is a lack of data on domestic milk production and prices. We have justified the omission of local milk from the model on the basis that domestic milk production is small, and a significant portion of the sector is isolated from the most consumers and oriented towards home consumption. Nonetheless, it is

likely that some substitution possibilities exist between domestic and imported milk. Therefore, omission of the domestic sector from the model likely results in biased estimates, although the magnitude and direction of the bias is not obvious. Current research efforts are under way to collect data on the domestic production and prices in order to include them in the demand system.

In a related point, it is likely that domestic production would benefit from and respond to higher prices resulting from, say, trade liberalization. Thus, in order to accurately estimate import demand elasticity, it is necessary also to estimate the supply elasticity for the domestic sector. An estimate of the domestic supply is also necessary to measure the full welfare implications of changes in world prices. We leave this task for future research.

References

Altson, J.M., C.A. Carter, R. Green and D. Pick. 1990. "Whither Armington Trade Models?" *American Journal of Agricultural Economics* 72:455-467.

Barten, A.P. 1969. "Maximum Likelihood Estimation of a Complete System of Demand Equations." *European Economic Review*, 1:7-73.

Bureau d'Etudes des Productions Agricoles (BDPA). 2002. *Evaluation à mi-parcours du Projet de Développement de l'Elevage phase II: Rapport définitif.*

Coulibaly, Y.J. 2004. "Analyse Econométrique de la Demande d'Importation des Produits Laitiers en Cote d'Ivoire." Mémoire de fin de cycle D.E.S.S. Université de Cocody, Abidjan, Côte d'Ivoire.

Deaton, A. and J. Muellbauer. 1980. "An Almost Ideal Demand System." *American Economic Review* 70:312-326.

Eales, J.S. and L.J. Unnevehr. 1988. "Demand for Beef and Chicken Products: Separability and Structural Change." *American Journal of Agricultural Economics* 70:521-532.

Edgerton, D. L. 1997. "Weak Separability and the Estimation of Elasticities in Multistage Demand Systems." *American Journal of Agricultural Economics* 79:62-79.

Ekberg, A. 2001. *Rapport de la Mission de Formulation du Projet Laitier Sud-Phase II*. Abidjan, Côte d'Ivoire, March.

FAO 2004. F.A.O Statistical Database, www.faostat.fao.org.

Food and Agricultural Policy Research Institute (FAPRI). 2002. "The Doha Round of the World Trade Organization: Appraising Further Liberalization of Agricultural Markets." Working Paper 02-WP 317. Center for Agricultural and Rural Development, Iowa State University, November.

Fulponi, L. 1989. "The Almost Ideal Demand System: an application to food and meat groups for France." *Journal of Agricultural Economics* 71:82-92.

Foster, K., R. Green and J. Alston. 1990. "Estimating Elasticities with Linear Approximate Almost Ideal Demand System: Some Monte Carlo Results." Department of Agricultural Economics, University of California, Davis, CA.

Gbongue, M. 2002. "Aspects Socio-économiques de la Performance Productive des Fermes Piscicoles en Etang: l'expérience du volet pisciculture du projet BAD-OUEST de la région forestière ouest de la Côte d'Ivoire." Mémoire de fin de cycle D.E.S.S. Université de Cocody, Abidjan, Côte d'Ivoire.

Green, R, and J.M Alston. 1990. “Elasticities in AIDS Models.” *American Journal of Agricultural Economics* 72:442-445.

Hayes, D. J., T.I. Wahl and G.W Williams. 1990. “Testing Restrictions on a Model of Japanese Meat Demand.” *American Journal of Agricultural Econ*omics 72:556-566.

MIPARH/DPP. 2002. *Recensement National de l’Agriculture 2001. Rapport de l’Analyse Thématique*. Abidjan, Côte d’Ivoire

MIPARH/DPP. 2004. *Statistiques de Productions, Importations, Consommation de 1990 à 2001: Rapport Annuel*. Abidjan, Côte d’Ivoire

Organization for Economic Cooperation and Development (OECD). 2004. “An Analysis of Dairy Policy Reform and Trade Liberalization, An Analysis of International Dairy Trade Liberalization. Paris.” OECD Joint Working Party on Agriculture and Trade.

Service des Douanes Ivoirien/Departement des Statistiques. Unpublished customs data, 1991-2005.

Yang, S.R., and W.W. Koo, 1994. “Japanese Meat Import Demand Estimation with the Source Differentiated AIDS Model.” *Journal of Agricultural and Resource Economics* 19(2):396-408.

Zellner, A. 1962. “An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests of Aggregation Bias.” *Journal of the American Statistical Assoc*iation 57:348-368.

Table 1: Ivorian Import Duties for Dairy Products, 2001-2006

	Import tariff	V.A.T.	Other[a]	Cumulative total
			percent	
Dry milk powder	5.0	20.0	2.2	27.2
Condensed milk	20.0	20.0	5.2	45.2
Yogurt and cheese	20.0	20.0	5.2	45.2
Butter	20.0	20.0	5.2	45.2
Cream	5.0	0.0	1.0	6.0

Source: Service des Douanes Ivoirien/Departement des Statistiques

[a] "Other" includes fees for the Ivorian Customs Service, a common tax for the Economic Community of West Africa (ECOWAS), and a social security tax.

Table 2. Summary Statistics for Ivorian Dairy Imports, 1/1996-12/2005 (monthly)

NAME	Mean	Standard deviation	Minimum	Maximum
Quantities (1000 kg)				
Milk powder	1,037	385	266	2,151
Condensed milk	1,077	554	149	3,151
Cheese	39	17	2	81
Fluid milk	148	111	7	490
Butter	31	20	0	90
Yogurt	13	9	3	66
Cream milk	54	73	0	365
Prices (F.CFA/kg)				
Milk powder	1,483	213	921	2,115
Condensed milk	924	177	543	1,435
Cheese	3,665	564	2,345	6,919
Fluid milk	603	208	96	1,716
Butter	1,906	460	847	3,980
Yogurt	3,366	949	962	6,246
Cream milk	1,739	2,186	328	12,838
Total expenditure (Mil. F.CFA)	2,857	803	772	4,953
Expenditure shares				
Milk powder	0.532	0.131	0.230	0.802
Condensed milk	0.339	0.140	0.052	0.713
Cheese	0.053	0.026	0.006	0.153
Fluid milk	0.028	0.017	0.003	0.077
Butter	0.021	0.016	0.000	0.095
Yogurt	0.015	0.007	0.003	0.050
Cream milk	0.012	0.015	0.000	0.069

Source: Service des Douanes Ivoirien/Departement des Statistiques

Table 3: Regression Results for the LA/AIDS Model for Ivorian Demand for Dairy Imports, Without Correction for AR Error

		Price Coefficients									
Expenditure share for:	Constant	Milk powder	Condensed milk	Cheese	Fluid milk	Butter	Yogurt	Cream	Total Expenditure	R^2	DW
Milk powder	1.153*	0.242***	-0.259***	0.013	-0.004	0.002	-0.003**	0.010**	-0.037	0.36	1.41
	(0.648)	(0.053)	(0.046)	(0.012)	(0.009)	(0.009)	(0.003)	(0.005)	(0.030)		
Condensed milk	-1.916***	-0.259***	0.332***	-0.038***	-0.007	-0.014**	-0.002**	-0.012***	0.113***	0.46	1.47
	(0.629)	(0.046)	(0.046)	(0.009)	(0.006)	(0.007)	(0.002)	(0.005)	(0.029)		
Cheese	0.752***	0.013	-0.038***	0.008	0.014***	-0.000	0.003	0.001	-0.032***	0.41	1.51
	(0.125)	(0.012)	(0.009)	(0.008)	(0.004)	(0.005)	(0.002)	(0.001)	(0.006)		
Fluid milk	0.265***	-0.004	-0.007	0.014***	-0.011***	0.003	-0.000	0.005***	-0.012***	0.30	1.80
	(0.089)	(0.009)	(0.006)	(0.004)	(0.004)	(0.003)	(0.001)	(0.001)	(0.004)		
Butter	0.197**	0.002	-0.014**	-0.000	0.003	0.006	0.004**	0.000	-0.008*	0.14	1.93
	(0.091)	(0.009)	(0.007)	(0.005)	(0.003)	(0.005)	(0.002)	(0.001)	(0.004)		
Yogurt	0.315***	-0.003**	-0.002**	0.003	-0.000	0.004**	-0.002	0.000	-0.014***	0.55	1.52
	(0.030)	0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)		
Cream	0.235***	0.010**	-0.012***	0.001	0.005***	0.000	0.000	-0.003***	-0.010***	0.32	1.34
	(0.076)	(0.005)	(0.005)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.004)		

Standard deviations are in parentheses. * indicates statistical significance at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. A LR test of the joint significance of monthly dummy variables was rejected at the 5 percent level. Thus, monthly dummy variables were included in each share equation, but the coefficients are suppressed here.

Table 4: Regression Results for the LA/AIDS Model for Ivorian Demand for Dairy Imports, With AR(1) Errors

		Price Coefficients									
	Constant	Milk powder	Condensed milk	Cheese	Fluid milk	Butter	Yogurt	Cream	Total Expenditure	R^2	DW
Expenditure share for:											
Milk powder	1.143*	0.232***	-0.266***	0.019	0.001	0.000	-0.000	0.013**	-0.030	0.41	1.79
	(0.547)	(0.069)	(0.060)	(0.015)	(0.011)	(0.013)	(0.004)	(0.006)	(0.033)		
Condensed milk	-1.964***	-0.266***	0.339***	-0.038***	-0.053	-0.013*	-0.002	-0.015***	0.106***	0.50	1.87
	(0.679)	(0.060)	(0.062)	(0.012)	(0.009)	(0.009)	(0.003)	(0.006)	(0.032)		
Cheese	0.794***	0.019	-0.038***	0.006	0.011**	-0.001	0.002	0.000	-0.033***	0.44	1.91
	(0.136)	(0.015)	(0.012)	(0.010)	(0.005)	(0.006)	(0.002)	(0.001)	(0.006)		
Fluid milk	0.295***	0.001	-0.053	0.011**	-0.011**	0.001	-0.001	0.004***	-0.012**	0.35	2.27
	(0.101)	(0.011)	(0.009)	(0.005)	(0.005)	(0.004)	(0.002)	(0.001)	(0.005)		
Butter	0.168*	0.000	-0.013	-0.001	0.001	0.007	0.005***	0.000	-0.007*	0.12	2.30
	(0.104)	(0.013)	(0.009)	(0.006)	(0.004)	(0.007)	(0.002)	(0.001)	(0.005)		
Yogurt	0.315***	-0.000	-0.002	0.002	-0.001	0.005**	-0.003**	0.000	-0.014***	0.60	1.83
	(0.034)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)		
Cream	0.249***	0.013**	-0.015***	0.000	0.004***	0.000	0.000	-0.002**	-0.010***	0.41	1.81
	(0.089)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)		

Standard deviations are in parentheses. * indicates statistical significance at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Monthly dummy variables were included in each share equation, but the coefficients are suppressed here. The estimated autoregressive coefficient is 0.207, with a standard error of 0.046.

Table 5: Marshallian Elasticities of Ivorian Demand for Dairy Imports Using the LA/AIDS Model With AR(1) Errors

	Milk powder	Condensed milk	Cheese	Fluid milk	Butter	Yogurt	Cream	Total Expenditure
Milk powder	-0.535	-0.480	0.039	0.004	0.003	0.000	0.025	0.944
Condensed milk	-0.951	-0.107	-0.128	-0.024	-0.045	-0.011	-0.048	1.313
Cheese	0.696	-0.498	-0.845	0.228	-0.004	0.042	0.015	0.368
Fluid milk	0.272	-0.045	0.419	-1.390	0.056	-0.032	0.140	0.580
Butter	0.201	-0.502	-0.028	0.071	-0.666	0.254	-0.021	0.691
Yogurt	0.468	0.167	0.164	-0.046	0.378	-1.222	0.017	0.074
Cream	1.602	-0.943	0.081	0.344	-0.025	0.021	-1.155	0.074

Source: Authors' calculations based on equations (6) and (7) in the text, together with parameter estimates reported in Table 4. All elasticities are evaluated at the means of the data.

Table 5. Average Dairy Import Expenditure Shares by Source Country, 1/1996-12/2005

Products and Source Country	Share of Total Expenditure on Imported Dairy Products[a]	Source-country Share of Product Expenditure[a]
Milk powder	0.532	
United Kingdom		0.346
Ireland		0.177
France		0.157
Netherlands		0.144
Other countries		0.176
Condensed milk	0.339	
Netherlands		0.551
Germany		0.142
France		0.099
Malaysia		0.053
Other countries		0.156
Cheese	0.053	
France		0.720
Morocco		0.172
Other countries		0.108
Fluid milk	0.028	
France		0.935
Other countries		0.065
Butter	0.021	
France		0.657
Belgium		0.206
Other countries		0.137
Yogurt	0.015	
France		0.941
Other countries		0.059
Cream milk	0.012	
France		0.909
Other countries		0.091

Source: Authors' calculations using data from Ivorian Customs Service, Department of Statistics. Countries with less than 5 percent expenditure share for any product were grouped into "Other countries."

[a] For example, expenditure on milk powder accounted for 53.2 percent of total dairy expenditure over the sample period; milk powder imports from the United Kingdom accounted for 34.6 percent of total expenditure on milk powder imports.

Figure 1a. Ivorian Dairy Import Expenditure, 1/1996-10/2005 (Mil. F.CFA)
source: Ivorian Customs Service, Department of Statistics

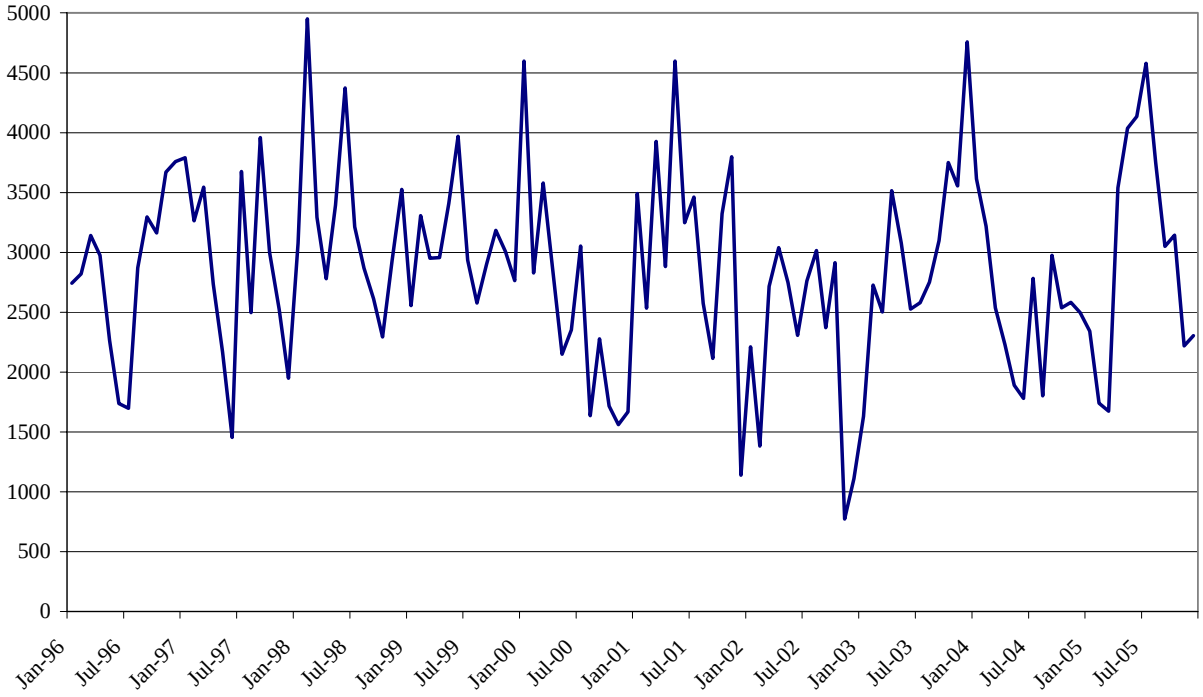

Figure 1b. Dairy Import Expenditure Shares for Milk Powder and Condensed Milk
source: Ivorian Customs Service, Department of Statistics