Introduction

This report develops an economic model (the "WIC model") that examines supermarket retail prices for infant formula in a local market area, and identifies the theoretical effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and its infant formula rebate program (hereafter, "rebate program"). The foundation of the WIC model is a multi-firm Cournot oligopoly model, but the WIC model generalizes the Cournot model to a new setting. The WIC model features two differentiated products, heterogeneous consumers that are segmented by income, and the roles of WIC and its rebate program. The WIC model provides the theoretical framework for the specification and interpretation of the econometric model presented in this report's companion volume *WIC and the Retail Price of Infant Formula* (Oliveira et al., 2004).

This chapter describes background information on WIC and the rebate program. Chapter 2 presents the WIC model's assumptions and mathematical structure, and the model's solution is derived in Chapter 3. A central variable of the WIC model that captures the importance of WIC in a local market area is the *relative size of WIC*, measured by the ratio of WIC to non-WIC formula-fed infants. Chapter 4 uses the model to determine the theoretical effect on retail prices due to changes in the relative size of WIC and other WIC-related factors.[1] The WIC-related factors that are considered are:

- the presence of the WIC program (without rebates) relative to the absence of the WIC program;

- an increase in the relative size of WIC (without rebates);

- an increase in the relative size of WIC if WIC has rebates generated by open market contracts;

- the use of open market contracts relative to the absence of any rebate contracts;

- an increase in the relative size of WIC if WIC has rebates generated by sole-source contracts;

- the use of sole-source contracts relative to the use of open market contracts;

- the use of sole-source contracts relative to the absence of the WIC program; and

- the use of home delivery or direct distribution relative to the use of the retail food delivery system for distribution of WIC formula.

WIC safeguards the health of low-income pregnant, breastfeeding, and post-partum women, infants, and children up to age 5 who are at nutritional risk, by providing a package of supplemental foods, nutrition education, and health care referrals. Although WIC encourages mothers to breastfeed, a majority of participating infants receives infant formula through WIC. In the mid-1980s, infant formula accounted for nearly 40 percent of total WIC food costs, and infant formula retail prices were rising more quickly than prices for other foods. These factors led Tennessee and other States to look into cost containment practices to reduce infant formula costs. Tennessee

[1] The WIC model resembles nearly all other economic models in that it does not generate predictions of the *magnitudes* of price effects, but instead yields theoretical predictions of the *direction*—rise or fall—of price effects that result from changes in economic, demographic, and policy factors. The empirical analyses in the companion volume are designed to estimate the magnitudes of price effects.

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initiated a rebate contract system in 1987. In 1989, P.L. 100-147 required States to use competitive bidding—or an alternate method that would yield savings equal to or greater than those produced by competitive bidding—to procure infant formula. Indian State agencies with 1,000 or fewer WIC participants are exempt from this requirement.

Currently, WIC State agencies use competitive bidding to award a contract to a single manufacturer of infant formula for the exclusive right to provide its product to WIC participants in the State. The contract-winning manufacturer is then billed for the amount of the rebates on the formula issued to WIC participants. During the 1994-2000 study period covered by the empirical analyses in Oliveira et al., four manufacturers held one or more WIC State contracts (for at least part of the study period): Mead-Johnson, Ross, Carnation, and Wyeth. In fiscal year 2000, infant formula rebates totaled $1.4 billion, an amount that supported 27 percent of WIC participants (USDA, 2001).

WIC is an influential agent in the infant formula market: ERS estimates that infants participating in WIC consume about 54 percent of all formula sold in the United States. In most States, WIC participants use food vouchers or food checks to purchase their infant formula, free of charge, at participating retail grocery stores. WIC then reimburses the retail grocery stores for the amount of infant formula purchased. Some observers have hypothesized that WIC and its rebate program may significantly affect the retail infant formula prices faced by non-WIC consumers, either indirectly, through their impact on wholesale prices, or directly, through their effect on the retail markup (the difference between the retail price and the wholesale price). The WIC model focuses on the retail markup, with the model's structure and language developed to analyze supermarket pricing decisions. The manufacturers' wholesale prices for infant formula are exogenous in the model.

The WIC model focuses on supermarket infant formula retail prices as opposed to prices established by other retailers because the price data analyzed in Oliveira et al. are obtained from supermarket surveys. The retail price data cover many major U.S. market areas for the study period 1994-2000 and are used, in part, for price regressions for the separate national brands of each of the major manufacturers selling formula as of September 2000.

In principle, WIC-related factors that could affect retail prices in a local market area—for any given levels of manufacturers' wholesale prices—include:

- the relative size of WIC

- the presence of a WIC rebate contract, and the type of contract (i.e., whether the contract is a sole-source contract or an open market contract)

- the delivery system used to provide infant formula to WIC households.

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The WIC model predicts that, holding other factors constant, profit-maximizing supermarkets establish a higher retail price if the relative size of WIC is larger. Economic reasoning suggests that WIC lowers the price sensitivity of demand in the infant formula market. WIC provides food checks or food vouchers (hereafter, "vouchers") to WIC households, thus taking a group of (low-income) households that would otherwise be price-sensitive and enabling them to obtain infant formula without bearing the retail price themselves. WIC makes these households insensitive to the retail price, and retail prices are higher when a price-insensitive component of the local market is larger. In the WIC model it turns out that retail prices are affected not by the *absolute* size of the WIC program, as measured by the number of WIC formula-fed infants, but rather the *relative* sizes of the WIC and non-WIC market segments.

The second set of WIC-related factors listed above concerns the presence and type of WIC contract. As of September 2000, each of the 50 WIC State agencies used a single manufacturer as a supplier of formula for WIC households. In contrast, under an open market contract—a form of contract that some WIC State agencies used in the early 1990s—any and all infant formula manufacturers could voluntarily participate in a State's rebate program. A participating manufacturer would pay a rebate, chosen by the manufacturer, when its particular formula was provided to a WIC household. Under the open market contract, WIC households themselves chose which brand of formula to obtain and each manufacturer's national brand receives at least *some* of the infant formula demand of WIC households (hereafter, "WIC demand"). In contrast, under sole-source procurement, the formula provided by the contract-winning manufacturer receives *all* of the WIC demand and all other national brands receive *none* of the WIC demand.[2] The WIC model predicts that retail prices depend on the type of contract. Most notably, under a sole-source contract, the prices of the contract and noncontract brands can be expected to respond differently to a change in WIC demand.

The bulk of the analysis of the WIC model is devoted to the retail food delivery system inasmuch as 48 of the 50 States utilized that system during the study period in Oliveira et al. Under the home distribution system, which Vermont uses, infant formula is delivered to the WIC participant's home. Under the direct distribution system, which Mississippi uses, WIC participants pick up infant formula from storage facilities operated by a State or local agency. The WIC model identifies how retail price depends on the type of delivery system used by a WIC State agency.

The list of WIC-related factors that may affect the retail prices (for given wholesale prices) does *not* include the amount of the rebates (on either a per-can basis or in total). Infant formula manufacturers—not retailers—bear the legal incidence for the rebate payments. If a manufacturer increases its wholesale price in response to its rebate payments or other WIC-related factors, then retail prices would be affected in turn (assuming retail markups are unchanged). This economic mechanism is discussed briefly in this report, but it is excluded from the formal WIC model so that the model can isolate retailer behavior. Manufacturers' wholesale prices are included in the

[2] An exception to this general statement is that the WIC State agency can issue formula provided by a different manufacturer when medical documentation supports the use of another infant formula product or a noncontract brand of formula is needed for religious reasons.

econometric analysis in Oliveira et al. as independent variables in brand-specific regressions for retail prices.

In addition to its examination of WIC-related factors and the wholesale price, the WIC model identifies various socioeconomic factors and market-structure conditions that can affect retail prices in a local market area. These other factors include median household income; the poverty rate; the degree of competition faced by the supermarket *sector* (inclusive of all supermarkets) due to the presence of discount stores; and the degree of competition faced by a supermarket *chain* (which may own one or more stores) due to the presence of other supermarket chains.

Oliveira et al. found that, within market areas, there is not a clear and consistent relationship between a formula's being the WIC contract brand and its being sold at the highest average retail price. However, comparing the retail prices of contract and noncontract brands of formula may not identify WIC-related price effects since, as just noted, *other factors may affect retail prices too*. The WIC model identifies conditions under which, theoretically, the retail price of the contract brand would be higher than the prices for noncontract brands. It also identifies alternative conditions under which that expectation would not be met.