Chapter 15: Bundling of Annuities and Other Insurance Products

15.1 Introduction

It is well-known that monopolists who sell a number of products may find it profitable to 'bundle' the sale of some of these products, that is, to sell 'packages' of products with fixed quantity weights (see, for example, Pindyk and Rubinfeld, pp. 404-414). In contrast, in perfectly competitive equilibria (with no increasing returns to scale or scope), such bundling is not sustainable. The reason is that if some products are bundled by one or more firms at prices which deviate from marginal costs, other firms will find it profitable to offer the bundled products separately, at prices equal to marginal costs, and consumers will choose to purchase the unbundled products in proportions which suit their preferences. This conclusion has to be modified under asymmetric information. We shall demonstrate below that competitive pooling equilibria may include bundled products. This is particularly relevant for the market for annuities.

The reason for this outcome is that *bundling may reduce the extent of adverse-selection* and, consequently, tends to reduce prices. In the terminology of the previous chapter, consider two products, X_1 and X_2, whose unit costs when sold to an α-individual are $c_1(\alpha)$ and $c_2(\alpha)$, respectively. Suppose that $c_1(\alpha)$ increases while $c_2(\alpha)$ decreases in α. Examples of particular interest are *annuities, life insurance and health insurance.* The cost of an annuity rises with longevity. The cost of life insurance, on the other hand, typically depends negatively (under positive discounting) on longevity. Similarly, the costs of *medical care* are negatively correlated with health and longevity. Therefore, selling a 'package' composed of annuities with life insurance or with health insurance policies will tend to mitigate the effects of adverse selection, because, when bundled, the negative correlation between the costs of these products reduces the overall variation of the costs of the bundle with individual attributes (health and longevity), compared to the variation of each product separately. This, in turn, is reflected in lower equilibrium prices.

Based on the histories of a sample of people who died in 1986, Murtaugh, Spillman and Warshawsky (2001), simulated the costs of bundles of annuities and long-term care insurance (at ages 65 and 75) and found that the cost of the hypothetical bundle is lower by 3 to 5 percent from the cost of these products when purchased separately. They also found that bundling increases significantly the number of people who purchase the insurance, thereby reducing adverse selection. Bodie (2003) also suggested that bundling of annuities and long-term care would reduce costs of the elderly.

Currently, annuities and life insurance policies are jointly sold by many insurance companies though health insurance, at least in US, is sold by specialized firms. Consistent with the above studies, there is a discernible tendency in the insurance industry to offer plans that bundle these insurance products (for example, by offering discounts to those who purchase jointly a number of insurance policies).

We have been told that in the UK there are insurance companies who bundle annuities and long-term medical care, but could not find written references to this practice.

15.2 Example

Let utility of an α-individual be

$$u(x_1,\ x_2,\ y;\ \alpha) = \alpha \ln x_1 + (1-\alpha)\ln x_2 + y \tag{15.1}$$

where $x_1,\ x_2$, and y are the quantities consumed of goods $X_1\ X_2$ and the numeraire, Y. It is assumed that α has a uniform distribution in the population over $[0,\ 1]$. Assume further that the unit costs of X_1 and X_2 when purchased by an α-individual are $c_1(\alpha) = \alpha$ and $c_2(\alpha) = 1-\alpha$, respectively. The unit costs of Y are unity $(= 1)$.

Suppose that X_1 and X_2 are offered separately at prices p_1 and p_2, respectively. The individual's budget constraint is

$$p_1 x_1 + p_2 x_2 + y = R \tag{15.2}$$

where $R(> 1)$ is given income.

Maximization of (15.1) s.t. (15.2) yields demands $\hat{x}_1(p_1;\alpha) = \dfrac{\alpha}{p_1}$, $\hat{x}_2(p_2;\alpha) = \dfrac{1-\alpha}{p_2}$ and $\hat{y} = R-1$. The indirect utility, $\hat{u}$, is therefore

$$\hat{u}(p_1, p_2; \alpha) = \ln\left[\left(\frac{\alpha}{p_1}\right)^{\alpha}\left(\frac{1-\alpha}{p_2}\right)^{1-\alpha}\right] + R - 1 \tag{15.3}$$

As shown in the previous chapters, the equilibrium pooling prices, $(\hat{p}_1,\ \hat{p}_2)$, are (for a uniform distribution of α):

$$\hat{p}_i = \frac{\int_0^1 c_i(\alpha)\hat{x}_i(\hat{p}_i;\alpha)d\alpha}{\int_0^1 \hat{x}_i(\hat{p}_i;\alpha)d\alpha} = \frac{2}{3}, \qquad i = 1, 2. \tag{15.4}$$

Now suppose that X_1 and X_2 are sold jointly in equal amounts. Denote the respective amounts by x_1^b and x_2^b, $x_1^b = x_2^b$. Denote the price of the bundle by q. The budget constraint is now

$$qx_1^b + y^b = R \tag{15.5}$$

Suppose that individuals purchase only bundles (we discuss this below). Maximization of (15.1), with $x_1^b = x_2^b$, s.t. (15.5) yields demands $\hat{x}_1^b = \frac{1}{q}$ and $\hat{y}^b = R - 1$. The equilibrium price of the bundle, $\hat{q}$, is

$$\hat{q} = \frac{\int_0^1 \left[c_1(\alpha) + c_2(\alpha)\right] \hat{x}_1^b(\hat{q};\alpha)d\alpha}{\int_0^1 \hat{x}_1^b(\hat{q};\alpha)d\alpha} = 1 \tag{15.6}$$

Thus, the level of the indirect utility of an individual who purchases the bundle, $\hat{u}^b$, is

$$\hat{u}^b = R - 1 \tag{15.7}$$

Comparing (15.3) with (15.7) we see that, with $p_1 = p_2 = \frac{2}{3}$, $\hat{u} \gtreqless \hat{u}^b \Leftrightarrow \frac{3}{2}\alpha^\alpha(1-\alpha)^{1-\alpha} \gtreqless 1$, $\alpha\epsilon[0,1]$. It is easy to verify that $\hat{u} < \hat{u}^b$, for all $\alpha\epsilon[0,1]$. *A pooling equilibrium in which X_1 and X_2 are sold as a bundle with equal amounts of both goods in each bundle is Pareto superior to a pooling equilibrium in which the goods are sold in stand-alone markets.*

It remains to be shown that in the bundling equilibrium no group of individuals has an incentive, when the goods are also offered separately in stand-alone markets, to choose to do so. In a bundling equilibrium, all individuals purchase one unit of the bundle, $\hat{x}_1^b = 1$. Hence, the α-individual's marginal utility of X_1 is $\hat{u}_1^b = \alpha$. This individual will purchase X_1 separately iff $\hat{u}_1^b = \alpha > p_1$.

Suppose that this inequality holds over some interval $\alpha\epsilon[\alpha_0, \alpha_1]$, $0 \leq \alpha_0 < \alpha_1 \leq 1$. so that individuals in this range purchase X_1 in the stand-alone market.

The pooling equilibrium price in this market, p_1, is a *weighted average* of the α's in this range: $\alpha\epsilon[\alpha_0, \alpha_1]$. Hence, for some α this inequality is necessarily violated, contrary to assumption. The same argument applies to X_2.

We conclude that the above bundling equilibrium is 'robust', that is, there is no group of individuals who purchase in equilibrium the bundle and also purchase X_1 and X_2 in stand-alone markets.

Typically, there are multiple pooling equilibria. The above example demonstrates that in some equilibria we may find bundling of products, exploiting the negative correlation between the costs of the components of the bundle. We have not explored the general conditions on costs and demands which lead to bundling in equilibrium, leaving this for future analysis.