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# How Brand Loyalty Affects Product Differentiation

John F.R. Harter*

**Abstract:** This paper examines the effects of brand loyalty on the amount of product differentiation. It presents three different methods of modeling brand loyalty in a spatial framework. Brand loyalty might be caused by switching costs, either constant or a function of how similar the product variety is to the consumer's most-preferred variety. These methods of modeling yield some (but not maximum) differentiation among the products in a duopoly. If the assumption of constant preferences is relaxed, the standard minimum differentiation result holds, and brand loyalty has no impact on varieties.

## I. Introduction

Brand loyalty can have great importance to a firm pioneering a market because it allows the firm to maintain market share as others enter to compete. It can even act as a barrier to entry [Bain, 1956]. Gabszewicz, Pepall, and Thisse [1992] point out that research seems to support the idea of brand loyalty as a first-mover advantage in markets. This paper models three alternatives of how brand loyalty might be exhibited in a product differentiation model and assesses the effects of these alternatives. Von der Fehr and Stevik [1998] looked at brand loyalty with product differentiation, but did not look at the firms' variety choices. This paper is an extension to their work by endogenizing the variety choices.

This paper uses Hotelling's [1929] line to show the effects of brand loyalty with product differentiation, developing three separate cases to show different ways of modeling brand loyalty. Case I examines the usual economic explanation of brand loyalty. This is the situation where there is a cost of switching from the incumbent's variety to the entrant's [see, *e.g.*, Klemperer, 1995]. In Case II, the disutility from consuming a variety that is not the consumer's most-preferred variety is lower for the incumbent's product than for the entrant's. This can be interpreted as a switching cost, but is different from

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Case I because the switching cost is different for each consumer. Case III explores the possibility that the consumers' most-preferred varieties might actually change.

Examples of switching costs are common. Others have examined switching costs for the banking [*e.g.*, Kim *et al*., 2003], telecommunication [*e.g.*, Burnham *et al*., 2003], health plan [*e.g.*, Strombom *et al*., 2002], and insurance industries [*e.g.*, Schlesinger and Schulenburg, 1991], among others. These switching costs can have a large impact on consumers' propensity to remain with a particular seller.

It is sometimes important that switching costs not be constant for all consumers. Popkowski Leszczyc and Gönül [1996] propose a measurement of brand loyalty and discover that it is important to include consumer heterogeneity. Their work looks at data for disposable diapers. Elzinga and Mills [1998] use data from generic cigarettes to show that the switching costs of buyers are different and that the difference is important. Chen and Hitt [2002], however, find that customer demographic characteristics have little effect on switching among online brokers. This suggests that online brokers might fit the case of the fixed switching cost in Case I and that disposable diapers and generic cigarettes are a better fit for Case II.

Examples of the situation where consumer preferences could change are not as easy to find, in part because consumer preferences are often a given to economists. Klemperer [1995] acknowledges that consumer preferences can change, using an acquired preference for one's mother's cooking as an example. He lists that as a switching cost, however. In this paper, a change in preferences is very different from a switching cost.

Most other works on brand loyalty focus on the pricing strategies that firms use [see, *e.g.*, Gabszewicz *et al.*, 1992]. To have brand loyalty, there must be some differentiation among products. Sometimes this is vertical differentiation [Schmalensee, 1982], and other times it is horizontal [von der Fehr and Stevik, 1998]. The extent of differentiation is generally ignored, however. This paper seeks to extend the literature by examining the amount of horizontal differentiation caused by brand loyalty and finds that differentiation will occur when brand loyalty is a result of switching costs or a decrease in transportation costs, but not when the brand loyalty is a result of a change in consumer preferences.

Von der Fehr and Stevik discussed the effects of advertising in the type of model used here. They saw three possible effects of persuasive advertising: changing the willingness to pay for a product, increasing perceived differentiation among goods, or actually changing the most-preferred variety of consumers. The three cases of brand loyalty in this paper were developed independently, but mirror their three effects of persuasive advertising. The cases of brand loyalty in this paper can easily be presented using the example of von der Fehr and Stevik – increasing a variable for one firm instead of decreasing that variable for another, for instance. However, the cases are presented the way they are here to help with intuition. There are two alterations to the von der Fehr and Stevik model. First, only one firm gains by having a lower transportation cost with brand loyalty; and, second, a minor modification of the case where consumer preferences actually change is necessary because the firms do not necessarily locate at the endpoints.

The rest of the paper is organized as follows: the next section discusses the model; the following section takes each of the three methods of modeling brand loyalty in turn; and a discussion of the results and possible extensions concludes.

## II. The Model

There are two profit-maximizing firms, *A* and *B*. *A* is the first entrant into the market, then *B* follows. Each firm chooses a single, permanent location on a product space given by the unit interval. Each location is interpreted as a product variety. Firm *A*'s location is denoted $a$, and Firm *B*'s by $b$. For ease of exposition, any result will be presented as $a \leq b$ (though the firms may not assume that). Firm *A* has a monopoly until Firm *B* also enters the market, allowing it to build the brand loyalty effects modeled here. Once both firms enter, they sell their products in a duopoly. The price, $p$, is given and equal for the two firms. For simplicity, the marginal cost of production is assumed to be zero.

The consumers are spread uniformly over the product space. That is, each point on the unit interval has a corresponding consumer for which that location represents the most-preferred product variety. Utility is measured in dollars, so a consumer with a most-preferred variety of $x$ who is purchasing a good from Firm *A* will lose $t|x-a|$ in utility where $t$ is some strictly positive coefficient. This loss in utility is also known as a "transportation cost." Each consumer has unit demand for this good up to a reservation price of $s$, where $s$ is assumed sufficiently high that all consumers purchase (*i.e.*, $s \geq p+t$). Formally, utility for the consumer at $x$ who is purchasing from Firm *A* is given by:

(1) $U(a) = s - (p + t|x - a|)$.

The full cost to the consumer of obtaining the good ($p+t|x-a|$) is known as the delivered price.

The outcome is defined by the firms' location decisions, ($a^*$, $b^*$). Because the consumers' reservation price is assumed high enough that all consumers purchase, the first firm to enter will have the same monopoly profits regardless of its location until the second firm enters. So, any monopoly profits will have no impact on the varieties produced and can be ignored in finding the equilibrium. Since the firms locate sequentially, the subgame-perfect Nash equilibrium in pure strategies will be the equilibrium concept used. For any equilibrium, ($a^*$, $b^*(a)$), there will also be a symmetric equilibrium, ($1-a^*$, $1-b^*(a)$).

Since costs are zero, the firms' profits are simply the revenues. When $a < b$, Firm $A$ will sell to those consumers whose preferences are defined by locations to the left of $\underline{x}$, where $\underline{x}$ is that location where the consumer is indifferent between the product of Firm $A$ and that of Firm $B$. Specifically, if the firms have the same transportation costs, then

(2) $$\underline{x} = \frac{b + a}{2}.$$

Firm $A$'s profits are then

(3) $$\pi_A = p\left(\frac{b + a}{2}\right).$$

Firm $A$ sells to those consumers between the left endpoint of the interval and the midpoint between its product variety and its competitor's product variety. Firm $B$ sells to the other consumers. This will imply that for any location $a \leq 1/2$, Firm $B$ will choose to locate $b$ arbitrarily close to $a$ so that $b > a$ in order to move that midpoint as far left as possible, increasing Firm $B$'s demand. Given Firm $B$'s response, Firm $A$ will choose to locate as far to the right as possible to increase its demand. If $a > 1/2$, however, Firm $B$ will locate left of Firm $A$. Therefore, Firm $A$ will choose the midpoint of consumer preferences, and the equilibrium outcome will be ($a^*$, $b^*$) = (1/2, 1/2) [see Hotelling, 1929].

Since Firm *A* is the first firm to enter, it is assumed that *A* will gain the benefits of brand loyalty specified below. The underlying sources of brand loyalty have been much discussed in the marketing literature. For example, Patterson and Smith [2003] discuss six separate sources of switching costs for service providers. Their six sources of switching costs are: a loss of special treatment; perceptions of risk in switching; search costs for alternatives; availability and attractiveness of alternatives; a need to train new suppliers to idiosyncratic preferences; and sunk costs (psychological and social) with the current seller. Klemperer's [1995] list of the sources of switching costs is slightly different, including the need for compatibility (as with computer systems), for example. His example of frequent-flyer programs for airlines is an artificially-created switching cost, but mostly, the firm does not need to actually do anything to create these benefits other than entering first.

The benefits of brand loyalty are modeled in three distinct ways. First, the consumers perceive an additional loss of utility from purchases from the newer firm. Second, the rate at which the consumers lose utility from purchasing a different good than what they most want, *t*, is lower when purchasing from Firm *A* than from Firm *B*. Third, the locations of the consumers' most-preferred varieties move toward Firm *A*'s location as their preferences change.

## III. The Brand Loyalty Effects

Each of the following cases will examine the one of the possible methods of modeling brand loyalty outlined above.

### A. Case I: Switching Costs

For this case, assume that consumers have an additional quality that figures into their utility functions. Specifically, they prefer Firm *A*'s product simply because it was in the market first. There is a switching cost. This might arise because the product is more compatible with other purchases or because some learning has taken place. Here, there is an additional amount the consumers lose in utility from purchasing from Firm *B*, denoted *k*.

**Proposition 1**: Assume there exists a fixed switching cost, $k \in [0, t/2]$, for the consumer to purchase from Firm *B*. The subgame-perfect Nash equilibrium is $(a^*, b^*(a)) = (1/2, a+k/t)$.

For a given *a*, there exists a discontinuity in Firm *B*'s demand at location *b′* where

(4) $p + t(b' - a) = p + k$ .

For locations of $b$ closer to $a$ than $b'$, all consumers would prefer to purchase from Firm $A$ (see Figure 1). Thus, Firm $B$ would choose to locate at least as far as $b'$ from $a$. For any $b$ farther from $a$ than $b'$, however, there exists a closer location which increases Firm $B$'s area of demand and, hence, its profits. So, in the limit, Firm $B$ locates at $b'$. Firm $A$ still wishes to maximize the area it sells to by increasing its location to $a = 1/2$. Rearranging equation (4) gives the equilibrium outcome

(5) $$(a^*, b^*) = \left(\frac{1}{2}, \frac{1}{2} + \frac{k}{t}\right),$$

when $k \leq t/2$.

It should be noted that if the added cost of buying from Firm $B$ is high enough ($k > t/2$), then Firm $B$ would not sell to any consumer. This yields multiple equilibria as Firm $B$ can locate anywhere along the interval. As $k$ increases further, in fact, Firm $A$ can locate elsewhere than the midpoint without losing consumers to Firm $B$.

B. Case II: Different Transportation Costs

Instead of a fixed switching cost, brand loyalty might be exhibited by having the first mover face lower transportation costs. In this scenario, the consumers might be more tolerant of familiar products than of unfamiliar ones, implying lower transportation costs for the incumbent. Alternatively, this can be thought of as an example of switching costs. The entrant's product faces higher transportation costs because of a switching cost, but the switching cost increases as the product becomes more differentiated from the consumer's most-preferred good. Notice that this has a distinct effect on consumers from Case I. A consumer whose most-preferred variety is given by the location, $a$, is not affected. A third interpretation of this scenario is that the consumers' preferences change with respect to Firm $A$'s product, but not Firm $B$'s.

**Proposition 2**: Assume the consumer faces different transportation costs when buying from the incumbent firm, $t_A$, than when buying from the entrant, $t_B$, and assume $t_A \leq t_B$. The subgame-perfect Nash equilibrium is $(a^*, b^*(a)) = (1/2, 1 - t_A(1-a)/t_B)$.

If Firm *A* faces lower transportation costs, then it is no longer necessarily true that Firm *B* will locate as close to *a* as possible. This occurs because as Firm *B* locates closer to Firm *A*'s location, it will begin to lose consumers from its hinterland near the right edge of the interval.

Let $b'$ be the location at which the consumer at the far right of the production space is indifferent between purchasing from Firm *A* and Firm *B* (see Figure 2). Specifically,

(6) $$p + t_A(1-a) = p + t_B(1-b').$$

By the same argument applied earlier, $b^*$ will not be greater than $b'$, else Firm *B* can increase its demand by locating farther to the left.

If $b \in (a,b')$, then there exist $\underline{x}$ and $\bar{x}$ ($\underline{x}<b<\bar{x}$) where consumers are indifferent between purchasing from the two firms. Specifically,

(7) $$p + t_A(\underline{x}-a) = p + t_B(b-\underline{x}) \text{ and}$$

(8) $$p + t_A(\bar{x}-a) = p + t_B(\bar{x}-b).$$

Figure 2 shows that, for any location of $b$ to the left of $b'$, the consumer at the right endpoint will actually have a lower delivered price when buying from Firm *A* than from Firm *B*. Firm *B*'s demand will therefore be the interval, $[\underline{x}, \bar{x}]$. Simplifying equations (7) and (8) yields profits of

(9) $$\pi_B = p\left(\frac{t_B b - t_A a}{t_B - t_A} - \frac{t_B b + t_A a}{t_B + t_A}\right).$$

(10) $$\frac{\partial \pi_B}{\partial b} = p\left(\frac{t_B}{t_B - t_A} - \frac{t_B}{t_B + t_A}\right) = p\left(\frac{t_B^2 + t_B t_A - t_B^2 + t_B t_A}{(t_B - t_A)(t_B + t_A)}\right) = p\left(\frac{2t_B t_A}{t_B^2 - t_A^2}\right) > 0.$$

The partial derivative of Firm *B*'s profits with respect to $b$ is positive, implying that Firm *B* will locate $b^*$ at $b'$. This yields an equilibrium outcome of

(11) $$(a^*, b^*) = \left(\frac{1}{2}, 1 - \frac{t_A}{2t_B}\right).$$

Thus, the greater the difference between the coefficients on transportation costs, the farther from Firm *A* will Firm *B* locate. This equilibrium is unique for all specifications of $t_A$ and $t_B$ (except for the symmetric solution).

C. Case III: Preferences Change

Many people believe that firms can change consumers' preferences, or at least their perception of their preferences. Advertising, for example, might be geared towards giving information, but it might also be done in order to affect preferences. One possible method for brand loyalty to manifest itself is by changing the most-preferred variety of the consumers.

Assume that Firm *A*, being the first entrant, is successfully able to alter the consumers' preferences. The measure for how successful Firm *A* is in altering preferences is given by $\alpha \in [0,1]$. That is, each consumer's most-preferred good changes from $x$ to $x'$ where $x' = ((1-\alpha)x+\alpha(a))$. If α is zero, then there is no gain from brand loyalty. If α = 1, then all consumers consider Firm *A*'s product to be the most-preferred variety. As α increases, the movement of the consumers' preferences increases. Consumers would then have most-preferred varieties that are uniformly distributed over the interval $[\alpha a,(1-\alpha)+\alpha a]$ with density $f(x) = \frac{1}{(1-\alpha)}$.

**Proposition 3**: Assume brand loyalty changes consumer preferences towards the incumbent firm's variety so that each consumer has a new most-preferred good, $x' = ((1-\alpha)x+\alpha(a))$, where $\alpha \in [0,1]$. The subgame-perfect Nash equilibrium is $(a^*, b^*(a)) = (1/2, \lim_{\varepsilon \to 0}(a+\varepsilon))$ when $a \leq 1/2$.

Assume Firm *A* locates at a location other than 1/2. The interval of consumer preferences will become shorter than the unit interval because of the brand loyalty. For α less than one, however, Firm *A*'s location will not be at the midpoint of the consumer preferences. The consumers at the farther endpoint will move their most-preferred varieties more than those at the nearer endpoint, but not enough to make *a* the middle of the new interval. Assuming *A*'s location is to the left of the new midpoint, then Firm *B* would locate arbitrarily close to *a* so that $b > a$, and Firm A would sell to fewer than half the consumers. As in the original model, Firm *A*'s profits could be increased if it instead chooses $a = 1/2$. *B* then locates at $b = 1/2$.

This manifestation of brand loyalty, then, does not change the observed equilibrium outcome. Both firms locate in the middle of consumer preferences. Those preferences do change, but the location of the firms is the midpoint both before and after the change in preferences. Thus, no actual loyalty to a particular brand is observed, but there is an increase in the consumer surplus. This is true regardless of whether Firm B may locate along the entire unit interval or only the new interval of consumer preferences.

$$(12) \qquad (a^*, b^*) = \left(\frac{1}{2}, \frac{1}{2}\right).$$

This is unique for $\alpha < 1$. Again, we might have multiple equilibria: if $\alpha = 1$, then Firm *A* can locate anywhere on the line, and it would become the most-preferred variety for all consumers.

## IV. Conclusion

This paper models brand loyalty in three different ways. The traditional model in economics assumes a fixed switching cost between two products. This paper includes that manifestation of brand loyalty, but also two less-traditional manifestations. One case involves a difference in the transportation costs (which is possibly interpreted as a type of switching cost), and the other allows consumer preferences to change. The results show more differentiation than would occur without brand loyalty for two of the three cases – the two with some form of switching cost. This signifies that a strategic effect results from brand loyalty, but that the nature and extent of that loyalty will alter the strategy.

The disutility from buying a product which is not the most-preferred variety, also known as the transportation costs, is often assumed to be quadratic in distance to illustrate an increasing marginal disutility from differentiation [see, *e.g.*, Neven, 1985]. Here, however, the transportation costs are linear in order to be a direct extension to von der Fehr and Stevik. With linear transportation costs, unfortunately, allowing price competition results in an existence-of-equilibrium problem [d'Aspremont *et al.*, 1979]. This preliminary look at this issue focuses solely on the location decisions as a result of brand loyalty and so assumes the firms charge the same price. An extension would make the changes necessary to allow price competition.

An additional extension would be to endogenize the amount of brand loyalty. The switching cost, $k$, the difference in transportation costs, $t–t'$, or the change in consumer preferences could all be a result of the incumbent firm's

expenditures on advertising. These two extensions would further develop the von der Fehr and Stevik paper since it would combine parts of their work with a choice of differentiation by the firms.

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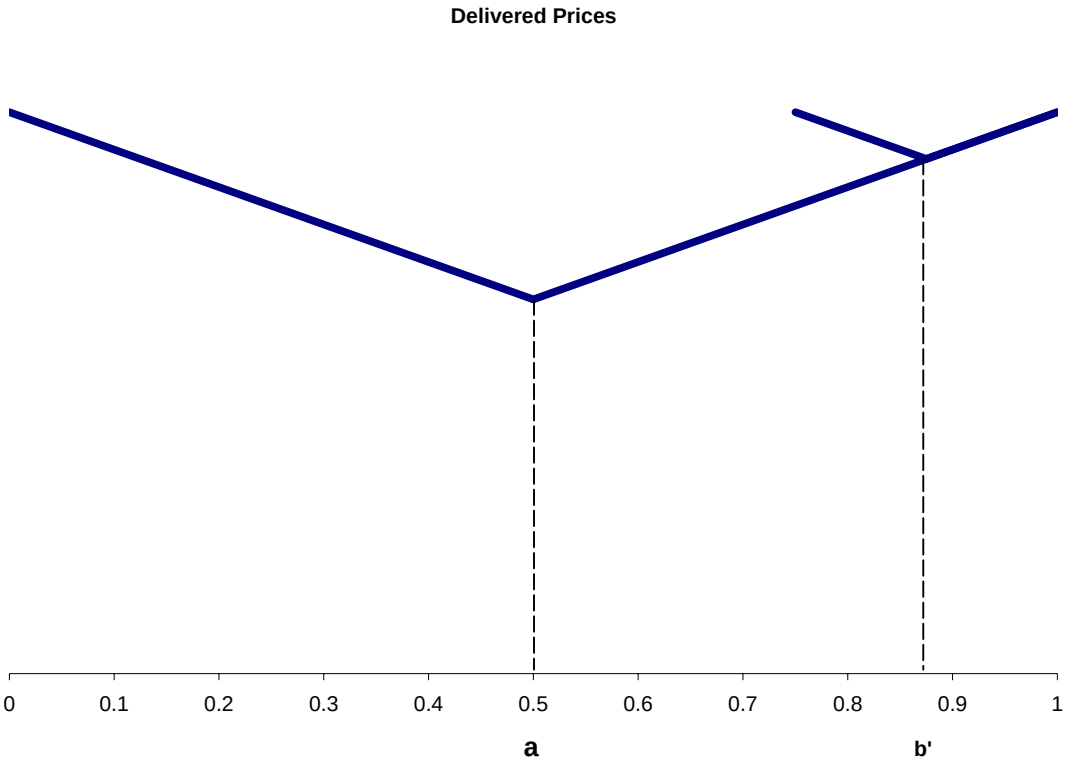


Figure 1: Switching Costs

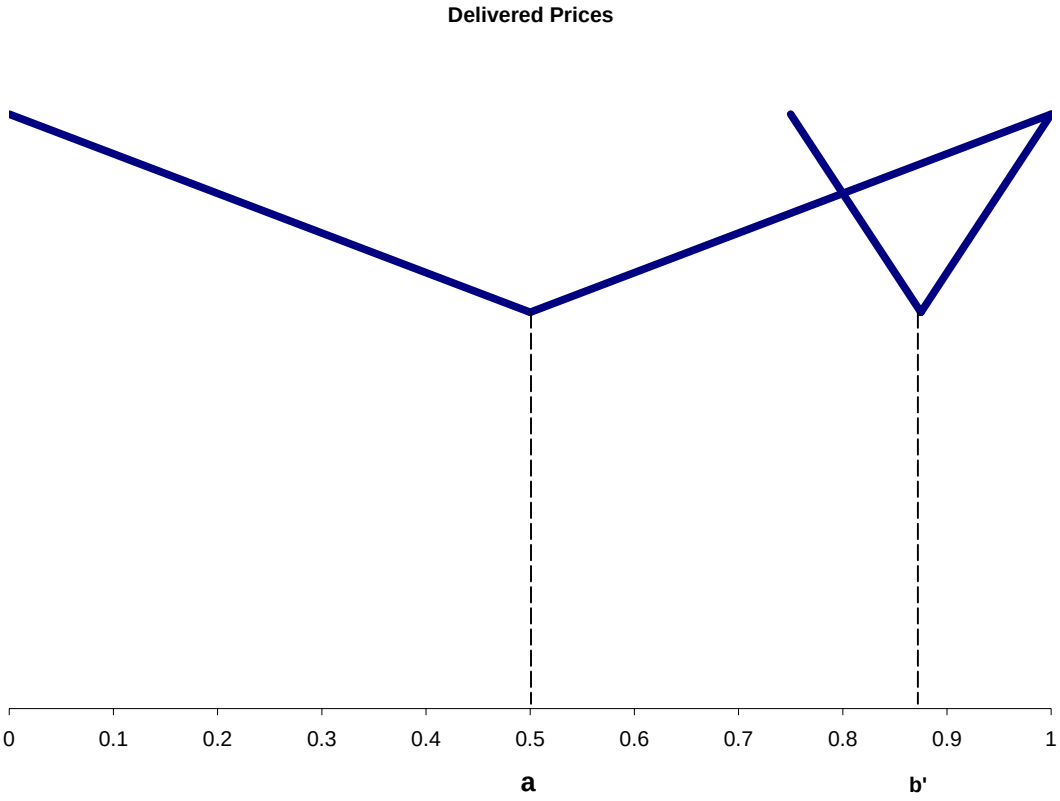


Figure 2: Different Transportation Costs

# Explaining Differences in Religiosity in Kentucky

Stephen E. Lile and Michelle W. Trawick*

**Abstract:** This paper estimates models of religious adherence by controlling for county-level income, education, elderly population, race, rural population, and two alternative measures of religious market concentration. We find that educational attainment has a negative impact on adherence and that both percentage of the population that is black and income level have a positive impact. Furthermore, counties with a more concentrated religious market have higher adherence rates. This finding is consistent with the hypothesis that a large number of competing religious groups results in lower adherence rates because of reduced plausibility of any one belief when the religious market offers many.

## I. Introduction

National surveys suggest that religion plays an important role in the lives of Americans [Gallup and Lindsey, 1999]. Surveys indicate that Kentuckians exhibit a somewhat higher rate of religiosity than the national population. A 2001 survey, for example, shows that 45 percent of Kentuckians report attending church services either weekly or almost every week [University of Kentucky, Survey Research Center, 2001] which is somewhat higher than the national average of about 41 percent [Barna, 2004]. The rate of religiosity varies from county to county. This is not surprising given that income level, educational level, age distribution, and racial composition differ widely across Kentucky. However, what is surprising is the magnitude by which religious affiliation rates vary. For example, taking most Judeo-Christian religious groups or denominations into account, the number of persons affiliated with some religious group as a percent of population ranges from a low of 13 percent in Menifee County to approximately 100 percent in Caldwell, Fulton, and Washington counties. In some instances, the rate of religious affiliation varies dramatically between adjacent counties as in the case of Menifee County (13 percent) and neighboring Montgomery County (45 percent). To economists, an interesting question relates to why religiosity varies so widely across counties.

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This paper represents an effort to answer this question. We make no attempt to explain changes in religiosity over time, but rather focus on religiosity as of a given year. We utilize regression analysis and rely on socio-economic variables and measures of religious market competition to explain differences among counties in the proportion of the population that is affiliated with one of 133 Judeo-Christian religious groups**.**

## II. The Religious Market and Competition

Nobel laureate economist Fogel [2000] finds evidence suggesting that the U.S. is now in a religious revival and that one of the most intractable maldistributions in the U.S. is in the area of "immaterial and spiritual" assets. While the U.S. may be in a religious revival, research in the economics of religion is in the midst of its first dramatic stage of growth. Recent studies include Barro and McCleary [2003] whose research focuses on the relationship between economic development and measures of religiosity. A Canadian study by Jones [2003] examines measures of religiosity and how they vary by educational attainment.

The role of religious pluralism, another term for religious market competition, has also been studied. Adam Smith is responsible for perhaps the earliest attempt to apply economic principles of competition to the religious economy. He was the first to draw the analogy between a church and a business in his *Wealth of Nations* [[1776]1965] by focusing on the historic role of the Catholic Church as a state-sponsored monopoly. Anderson suggests that Smith was implicitly comparing the Catholic Church to the East India Company, an overwhelming monopoly at that time, which was considered "one of the most complex and sophisticated business organizations of the pre-twentieth-century period" [1988, 1080].

Studies of religious market competition include research by Zaleski and Zech [1995] that shows competition among churches is a statistically significant determinant of church giving. They find, for example, that Protestants give more to churches, other things equal, when their congregation faces substantial competition. Others have noted a connection between competition in religious output markets and clergy effort. Iannaccone [1998] found that every available measure of religious fervor is higher in countries with greater levels of religious pluralism. The traditional theory regarding the impact of increased church variety or competition on religiosity suggests that firms operating in a more competitive market tend to be more innovative and motivated in attracting customers and therefore, religiosity increases. Studies by Finke and Stark [1988], Finke, Guest,

and Stark [1996], Zaleski and Zech [1995], and Hamberg and Pettersen [1994] support this prediction.[1]

Contrary to the theory just presented, sociologist Peter Berger [[1967]1969] argues that increased competition, at least in the market for religion, may eventually lead to less consumption. He argues that as consumers observe increased options in their religious marketplace, i.e. as competition is increased, religion's "plausibility structure is weakened" [150]. The resulting skepticism leads to a decrease in religiosity. This same behavior is partially the basis for Hull and Bold's [1998] extension of Lancaster's [1975] socially optimal product variety theory to the religious sector. Lancaster argues that as competition increases the variety of products and total consumption within a market increase. Based on this theory Hull and Bold's empirical results were counterintuitive, i.e. the authors found that as pluralism in U.S. counties increased, religiosity decreased. Their conclusion was that Lancaster's theory should allow for the possibility that, in some markets, too many options may actually increase the costs associated with consuming a product, *ceteris paribus*. They showed this to be true in the case of religious market output in the United States. While the authors present four components of the increased costs of pluralism, one is the plausibility argument presented by Berger over twenty years earlier. As more religious options become available, the plausibility of any reliable doctrine is diminished. Thus, the cost of being religious, *ceteris paribus*, increases.

Competition in church output markets described above can result from any one of several motives: to increase the number of believers, to enlarge the congregation, to increase the budget, or just to have 'bragging rights' by virtue of being the largest church in the community. Whatever the motives leading churches to evangelize, engage in outreach, and fund raising for physical plant expansion, such efforts are manifestations of religious market competition. Other sources of competition are 'congregational splits' which lead to the creation of a new church. The Southern Baptist Convention (SBC), for example, promotes competition by encouraging the establishment of new congregations, known as 'church planting' [Lifeway Christian Resources, 2003].

## III. The Output of a Church

It seems reasonable to suppose that the rate of religious practice within a county depends in part on how residents perceive the benefits associated with church attendance and membership relative to the cost. If people place a high

[1] See Iannacconne (1998) and Hull and Bold (1998) for greater discussion of this literature.

value on religious services, it seems reasonable to predict that membership and regular attendance at services would be higher, other things the same. However, defining church output is not easy. Economists and sociologists have offered several conceptualizations of the product provided by churches. These include the promise of afterlife rewards, a range of supernatural commodities, and a set of beliefs and behaviors that give meaning to life [Azzi and Ehrenberg, 1975; Stark and Bainbridge, 1985]. Churches have the opportunity to choose the types of output they provide, perhaps more so in the case of churches characterized by congregational autonomy. The choices are many and encompass such things as theology (e.g. does the church treat the Bible as inerrant?), music (is instrumental music permitted and if so, is it traditional or contemporary?), the timing and number of worship services offered, whether services are "high" or "low" church in nature, and length and presentation of the sermon. Clearly data on attendance or church giving are more likely to be valid measures of church output than church affiliation rates. However, since attendance data at the county-level for all religious groups is not available, we measure religiosity by the proportion of the county population that is affiliated with some religious group.

## IV. Data and Theory

County-level church data come from *Churches and Church Membership* [Bradley, et. al., 1992]. These data show the number of churches and number of "members" for each of 133 Judeo-Christian church bodies by state and county in 1990.[2] Our dependent variable is the percentage of county population that is listed as an active participant of any religious group. The actual term used is church "adherent," a broader term than church member. As used by the Glenmary Research Center, adherents are defined as all members, including their children and the estimated number of other participants who are not considered members. For example, adherents includes the "baptized," "those not confirmed," "those not eligible for communion," "those regularly attending services," and the like.[3] As noted by the American Religion Data Archive, the last Census of Religious Groups conducted by the U.S. Bureau of the Census was the 1939 edition. Since

[2] The data related to the Jewish members are estimates that the Glenmary Research Center obtained from the *American Jewish Year Book* (Singer and Seldin, 1990).

[3] Some religious groups practice infant baptism while others, notably Baptists, do not. The American Religion Data Archive notes that the following formula was used in deriving number of adherents: The total county population was divided by the total county population less children 13 years and under (derived from census), and the resulting figure was multiplied by the confirmed members. Using adherents
allows for more meaningful comparisons between groups that count children as members (e.g. Catholics) and those that don't (e.g. Baptists).

then the best source of "membership" data by denomination has been The Glenmary Research Center.[4]

Per capita income is one of the explanatory variables in our model. However, we have no a priori hypothesis as to how income affects religiosity. On opportunity cost grounds, we would expect the adherence rate to be lower in higher income counties, assuming that income comes exclusively from earned income, i.e. wages. The opportunity cost argument is weakened, however, by the fact that much income, especially for elderly persons, comes from either financial investments and/or Social Security. In addition, one could argue that marginal utility of income diminishes as income increases allowing higher income persons to devote greater time to religious consumption. Supporting this view, there is some evidence that religiosity is positively correlated with economic growth [Barro and McCleary, 2003]. Our measure of educational attainment is the percent of adult population over age 25 with a college degree. Education is included in our analysis because past surveys have shown that religious belief is inversely related to educational attainment [The Harris Poll, 2003].[5]

As suggested earlier, competition may help explain rates of church adherence. We use two measures of competition. The first measure is share of churches affiliated with the Kentucky Baptist Convention (KBC). Almost all KBC churches are also affiliated with the Southern Baptist Convention. Southern Baptists are the dominant Protestant religious group in Kentucky with over 2,400 congregations and a total membership of over 786,000 [Kentucky Baptist Convention, 2003]. The Baptist-share variable ranges among Kentucky counties from about 3 percent in Johnson County to a high of 77 percent in Knox County. Our second measure of competition is an adherence rate Herfindahl index calculated using the 133 Judeo-Christian denominations found in the *Churches and Church Membership* data described above. Higher levels of the index suggest a more concentrated religious market in that county. If the traditional market model is appropriate for our county-level markets, then increased competition will result in higher levels of religiosity. On the other hand, if Hull and Bold's [1998] extended product variety model described above

[4] Adherence rates in Caldwell, Fulton, and Washington Counties are slightly in excess of 100 percent. We attribute this to inter-county commuting patterns.

[5] Strong correlations between income and education (0.73), rural and income (-0.63), and rural and education (-0.64) exist. The variance inflation factors (VIFs) for the equation described below range between 1.14 and 2.76. The correlations and VIFs suggest that while multicollinearity exists in this equation, it may not be an overwhelming problem. We believe that the variables are not redundant and that all three are needed to correctly specify the equation. Further, increasing the sample size for a study of Kentucky counties is not possible. Thus, the marginal effects for these variables may be slightly distorted.

is more appropriate, increased religious market competition should lead to lower levels of religiosity. Aside from these models, one might expect adherence rates to be higher in counties where the share of SBC churches is higher because SBC churches are generally perceived as being more evangelistic, outreach oriented, and in general focused more on making converts and new church "planting" as compared to either mainline Protestant or Catholic churches. This view is supported by a recent Canadian study [Jones, 2003], which found that measures of religiosity are highest among conservative Christians. According to this view, Baptist-share is a surrogate for church evangelism and outreach, which in turn leads to higher religiosity as measured by adherence rates.

In addition to the above considerations, any measure of religiosity is likely to be influenced by cultural differences among counties. For example, the religious practices and beliefs of parents and grandparents no doubt are often reflected in the beliefs and practices of children and grandchildren [Barna, 2001]. Unfortunately cultural differences are very difficult to quantify. We use three demographic variables to attempt to capture cultural differences. The first is the population's age distribution. Communities that are "older" likely have experienced less in-migration of persons from outside the Bible Belt. We expect, therefore, these communities to be more homogeneous in terms of religious tastes. In addition, a large elderly population could be expected to be more religious because it is more focused on the after-life rewards mentioned by Azzi and Ehrenberg[1975]. This expectation is supported by surveys that show that measures of religiosity, such as percent of respondents who read the Bible weekly and express belief in God, are highest among the elderly [The Harris Poll, 2003].

The percent of the county population that is black is another demographic or cultural characteristic that may contribute to our explanation of religiosity. Research in the field of health care economics, more specifically in the area of care giving, suggests that black families are more likely to live in multigenerational households and therefore children are more likely to be cared for by grandparents, and vice versa [Headen, 1992]. The U.S. Census reports that, relative to their white counterpart, a "considerably higher" proportion of the 30 years and over black population is multigenerational. Furthermore, the study reports that over half of black co-resident grandparents were considered the responsible caregiver for their grandchildren [Simmons and Dye, 2003]. Surveys by Barna show that adults who were taken to church as children are more likely to attend church themselves [2001]. Musick, Wilson, and Bynum [2000] state that "blacks are more likely than whites to be church members." Assuming that race is a proxy for multigenerational households and captures some preference for church membership, counties with a larger black population would have greater

religiosity. An ethnicity measure, such as Hispanic share of county population, could also be a relevant cultural descriptor in this model. Hispanic peoples are considered to be very family oriented. Their families are often enmeshed [Bulcroft, Carmody, and Bulcroft, 1996]. If, like blacks, Hispanics are relatively more devout than non-Hispanics, their immigration could impact the level of religiosity in the counties. Unfortunately, during the time period of our study, Kentucky counties were fairly homogenous with respect to ethnicity. Given the large influx of Hispanic peoples in the years following the 1990 data, we anticipate future studies to control for ethnicity variation among counties.

The percent of households that live in a rural area is also included as an independent variable. While we have no a priori hypotheses regarding this particular characteristic, we argue that it may capture some additional cultural differences across counties. Though not perfect, these three measures of cultural differences (age, race, and rural status) are the cross-county variables that we have available. Table 1 provides descriptive statistics.

## V. Model and Results

The following models were estimated over the 120 counties in Kentucky:

$$AdhRate_i = \alpha + \bar{\beta}_1 PColl_i + \stackrel{?}{\beta}_2 SBCShare_i + \stackrel{?}{\beta}_3 PCIncome_i + \stackrel{+}{\beta}_4 Pop65plus_i + \stackrel{+}{\beta}_5 PBlack_i + \stackrel{?}{\beta}_6 PRural_i + \varepsilon_i$$

$$AdhRate_i = \alpha + \bar{\beta}_1 PColl_i + \stackrel{?}{\beta}_2 ADHHerf_i + \stackrel{?}{\beta}_3 PCIncome_i + \stackrel{+}{\beta}_4 Pop65plus_i + \stackrel{+}{\beta}_5 PBlack_i + \stackrel{?}{\beta}_6 PRural_i + \varepsilon_i .$$

Our expected signs are based on the theoretical descriptions provided above.[6] Table 2 presents estimation results.[7]

Our model accounts for over 60 percent of differences in religiosity among Kentucky counties. We find a positive, and statistically significant, coefficient on the per capita income term suggesting that organized religion is a normal good. To the extent that our income variable is capturing earned income, this result supports the notion that there is a diminishing marginal utility to income resulting in more discretionary time spent on religion. A recent study by

[6] The regressions were also estimated using the log of AdhRate. The results were very similar to those presented in Table 2.

[7] The results have been tested and corrected for heteroscedasticity using White's method.

Table 1
Descriptive Statistics
n=120

| Variable (county level) | Min | Max | Mean | Std. Dev. |
|---|---|---|---|---|
| Adherence Rate (*Adhrate*) | 0.13 | 1.08 | 0.60 | 0.19 |
| Percent with College Degree (*PColl)* | 4.60 | 30.58 | 9.22 | 4.46 |
| Share of SBC Churches (*SBCShare*) | 0.03 | 0.77 | 0.32 | 0.16 |
| Adherence Herfindahl (*ADHHerf*) | 0.11 | 0.77 | 0.35 | 0.15 |
| Per capita Income (000s) (*PCIncome*) | 7.94 | 22.91 | 12.99 | 2.88 |
| Percent of Population 65+ (*Pop65plus*) | 6.80 | 20.90 | 13.63 | 2.83 |
| Percent Black (PBlack) | 0.02 | 24.56 | 3.75 | 4.37 |
| Percent Rural (PRural) | 2.68 | 100.00 | 74.93 | 25.74 |

Barro and McCleary [2004] also found, after analyzing data collected in 59 countries between 1981 and 1999, that measures of religiosity increased along with increases in economic indicators such as real gross domestic product.

Our results suggest that the percentage of adults with a college degree is negatively related to religiosity. Even though Jones [2003] found that the percent of the population that is religious varied relatively little by educational attainment, we find that higher levels of education (as measured by the proportion of the county population with a college degree) result in decreased levels of religiosity. The opposite signs on the income and education variables are not theoretically inconsistent. Rather, our results show that for two counties with equal per capita income but unequal educational attainment, the religious adherence rate tends to be lower in the county with higher educational attainment. And for two counties with equal educational attainment, but unequal incomes, religiosity is greater in the county with higher income. As expected, we find that the percentage of the population that is age 65 or over has a positive and statistically significant impact on religiosity along with percent of population that is black. The percent of a

Table 2
Estimations of Adherence Rate
n=120

| | Coefficient<br>Std Error | Coefficient<br>Std Error |
|---|---|---|
| (Constant) | -0.1972*<br>(0.1035) | -0.2872*<br>(0.1088) |
| PColl | -0.0090*<br>(0.0033) | -0.0094*<br>(0.0033) |
| SBCShare | 0.5101*<br>(0.0768) | - |
| ADHHerf | - | 0.5058*<br>(0.0810) |
| PCIncome | 0.0279*<br>(0.0053) | 0.0341*<br>(0.0050) |
| Pop65plus | 0.0242*<br>(0.0035) | 0.0248*<br>(0.0034) |
| PBlack | 0.0083*<br>(0.0029) | 0.0098*<br>(0.0027) |
| PRural | -0.0001<br>(0.0005) | -0.0003<br>(0.0005) |
| $R^2$ | 0.6403 | 0.6193 |

* significant at 1%

community's households that live in a rural area does not have a statistically significant impact on adherence rates.

Finally, our estimated coefficients for the competition variables deserve extended comment. The coefficients for share of SBC churches and the adherence Herfindahl are positive and statistically significant. These results suggest that as the religious market becomes more pluralistic, the level of religiosity actually decreases. While counterintuitive to the traditional economic theory regarding market competition and total consumption, our results support hypotheses of Berger [[1967],1969] and Hull and Bold [1998] that increased choice in the religious market actually results in higher costs of being religious and therefore in lower rates of religiosity. Furthermore, when considering *SBCShare*, an additional explanation is that Baptist churches, relative to Catholic and mainline Protestant churches, provide religious goods that are more likely to result in greater religiosity as evidenced, at a minimum, by higher church membership rates. Another interpretation is that *SBCShare* is simply a surrogate

for evangelism and outreach that over time produces higher adherence rates. Findings by Jones [2003, Table 8.5] support this interpretation. Jones found that, Baptists, among all Canadian groups, displayed the highest measures of religiosity.

## VI. Summary and Conclusions

We develop a model utilizing data on income, educational attainment, percent of population that is elderly, racial composition, percent of population that is rural, and alternative measures of religious output market competition that explains over 60 percent of the differences among Kentucky counties in church adherence rates. Educational attainment has a negative impact on religiosity, whereas income level has a positive impact. Counties with a more elderly population show higher rates of religiosity. Racial composition has a positive and statistically significant influence whereas a county's rural or urban characteristic does not. Perhaps the most interesting results are those associated with our measures of competition. We find that increased choice for consumers in the form of a more pluralistic religious market actually leads to a decrease in religiosity. This result suggests that increased product differentiation through competition may not always lead to an increase in total consumption of a product. Future research might include the concept of an optimal level of product variety in the religious market. There is reason to suspect that the optimal level of competition in religious markets may be less than the optimal level of competition in, say, breakfast cereal markets, assuming the goal is increased consumption.

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# An Empirical Investigation of the Impact of Exchange Rates and Foreign National Incomes on Kentucky's Exports

Samanta Thapa* and Dharmendra Dhakal**

**Abstract:** Kentucky exported over $10 billion of goods worldwide in 2000 and ranked 22nd among the 50 states in the U.S. This represents about 10% of Kentucky's Gross State Product. The average annual growth rate of Kentucky's exports from 1990 to 1999 was 10.5% compared to growth rate of 7.1% for the U.S. This study investigates the impact of exchange rates and foreign national incomes on Kentucky's exports. We find both of these variables statistically significant. With exports playing such a significant role in the state's economy, the findings of this study should be highly relevant to Kentucky's economic policymakers if they seek an export-led growth strategy.

## I. Introduction

The objective of this study is to analyze the impact of exchange rates and national incomes of foreign importing countries on Kentucky's exports. Kentucky exported over $10 billion of goods worldwide in 2000 and ranked 22nd among the 50 states in the U.S. This represents about 10% of Kentucky's Gross State Product. The average annual growth rate of Kentucky's exports from 1990 to 1999 was 10.5% compared to a growth rate of 7.1% for the U.S. With exports contributing so much to Kentucky's Gross State Product, any increase/decrease in exports will have a significant impact on the state's economy. This issue should be highly relevant to Kentucky's economic policymakers and businesses if they seek to promote growth and development through foreign exports. Despite being such an important issue, no studies on the determinants of Kentucky's exports have appeared in the literature to date. The present study fills this gap in the literature.

This study also contributes to the economics/finance literature, as this is the first one, to the best of our knowledge, to investigate the impact of exchange rates and foreign incomes on exports of a particular state. There is extensive literature on exports and exchange rates at national and international levels [see for example Arize, Osang, and Stottje (2000), Mahadavi (2000), Nilsson and Nilsson (2000), Sauer and Bohara (2001)]. At the regional level there are a few studies on exchange rates and exports [see Erickson and Hayward (1991)]. There is, however, a paucity of studies on this issue at the state

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level. The reason for this may be a lack of reliable data at the state level. Researchers may also attach less importance to this type of research at the state level. The study that comes closest to what we are doing is Cronovich and Gazel (1998). They attempt to explain cross-sectional variations in exports across 50 states of the U.S. by regressing state exports on the weighted average of their trading partners' GDP and the exchange rate. They report a negative relationship between exports and exchange rates and a positive relationship between exports and trading partners' GDP. Both variables are statistically significant. Our study focuses only on the state of Kentucky and its contributions are twofold: i) no study of this type (for Kentucky) has appeared in the literature to- date despite the fact that exports accounts for almost 10% of Kentucky's gross state product, and ii) it provides one more piece of evidence in support of the argument in the literature that exchange rates also affect exports at sub-national level.

## II. Kentucky's Exports

Kentucky is located in the center of eastern U.S. bordered by seven states. Its land area is 39,732 square miles and the population is approximately 3.7 million. Kentucky has a diverse economic base and ranks as the eighteenth fastest growing economy in the U.S., as measured by the percentage change in Gross State Product (GSP). Its Gross State Product (GSP) in 1999 was $113.539 billion. Table 1 shows different industrial sectors contributing to the 1999 GSP. Of all the industries adding value to the state's economy, motor vehicle production was the most significant one between 1992 and 1999. Motor vehicle production more than doubled over the period, 1992 to 1999.

In 2000, Kentucky's exports worldwide totaled over $10 billion. This represents about 10% of Kentucky's Gross State Product. It ranked 22nd among the 50 states in the United States. Table 2 shows the distribution of Kentucky's exports worldwide.

Kentucky exports to more than 100 countries worldwide. The top ten leading countries of Kentucky exports are: Canada, U.K., France, Japan, Mexico, Germany, Netherlands, Brazil, Belgium and Australia. Table 3 shows the top 10 leading countries of Kentucky exports and export values for 2000.

Kentucky exported over $10 billion worth of goods to various parts of the world. The goods exported cover various industries. The top ten exports by industry sectors are: transportation equipment, industrial machinery and computer equipment, chemicals, electronic and electric equipment, fabricated metals, primary metals, livestock, rubber and plastics, stone, clay and glass products, and food and kindred products. Table 4 shows the top ten export industries and the export values for 2000. The average annual growth rate of Kentucky's exports from 1990 to 1999 was 10.5% compared to a growth rate of 7.1% for the United States.

## III. Literature Review

There are many studies related to exports and exchange rates at the national level. Here, only a few of the most recent ones will be reviewed. Sauer and Bohara (2001) use a large panel of industrialized and developing countries to investigate the impact of exchange rate volatility on exports. They report a negative impact for less-developed countries' exports but not for industrialized countries. Mahadavi (2000) investigates the response of export price index to exchange rate fluctuations for Japan, Germany and the U.S. The study reports that Japan, more than other countries, tends to adjust the home currency prices to lessen the impact of exchange rate fluctuations on foreign currency export prices. Nilsson and Nilsson (2000) analyze the impact of various exchange rate regimes on developing countries' exports. They report that the more flexible the exchange rate regime, the greater the exports of developing countries. Arize, Osang and Stottje (2000) investigate the impact of real exchange-rate volatility on the exports of 13 less-developed countries and report a negative relationship.

A number of studies have also attempted to explain export performance at regional levels. Markueson, Noponen and Driesson (1993) and Hayward & Erickson (1995) focus on the supply side and relate state foreign exports to total state employment as a subset of regional growth models. Carlino, Voith, and Cody (1994) focus on demand factors and investigate the determinants of growth rates of Gross State Product (GSP) for all 50 states. Their hypothesis is that foreign incomes and exchange rates affect GSP growth through their impact on exports. Their empirical results, however, indicate these variables have no effect on GSP growth. Erickson and Hayward (1991) do a cross-sectional analysis of the exports of U.S. regions and report that regional exports are positively correlated with the destination country's GDP and negatively correlated with the distance to the country. They, however, do not include exchange rates in their analysis. Cronovich and Gazel (1998) investigate the impact of foreign incomes and exchange rates on exports at the state level. They do a cross-sectional regression analysis of 50 states' exports and destination countries' GDP and exchange rates. They argue that standard use of national trade weights in the construction of sub-national trade weighted average of foreign incomes and exchange rates is inappropriate and they use state-specific trade weights to construct these variables. They regress exports on these weighted average variables and find that foreign incomes and exchange rates do explain the cross-sectional variations in states' exports. To the best of our knowledge, no empirical analysis relating Kentucky's exports to foreign incomes and exchange rates has appeared in the literature to date.

## IV. Methodology and Data

This section describes the methodology and data used to estimate the impact of foreign exchange rates on Kentucky's total exports in a panel data set. There is a large body of literature on a country's exports and exchange rates and the models used in estimating the export demand function vary from relatively simple to quite complex. Ideally, we would like to include some other variables such as export price, trade policy orientation, and terms of trade. Because of the lack of available data for these variables

that impact exports at the state level, this paper simply examines the impact of exchange rates and importing countries' national incomes on the volume of Kentucky's exports. However, omitting important variables from the model might produce a biased estimate. Therefore we should accept the result with caution. With this note we use,

$$EXP = f(Y,ER) \qquad (1)$$

where total exports (EXP) is a function of national income (Y) of importing countries, and exchange rates (ER). Export prices could not be included as one of the independent variables in (1) because of the unavailability of data on export prices at the state level.

For estimation purpose, this paper follows Krugman and Baldwin (1987), and specifies the following pooled cross-sectional and time series export demand function in a log-linear form:

$$\log EXP_{it} = C_1 + C_2 \log Y_{it} + C_3 \log ER_{it} + C_4 \log ER_{(i,t-1)} + u_{it} \quad (2)$$

In this model total export ($EXP_{it}$) to country i in year t is a function of the foreign income represented by GDP of the importing country ($Y_{it}$) and the currency exchange rate ($ER_{(it)}$) between the importing countries and the United States as measured by the units of foreign currency per special drawing rights (SDR). Past studies have indicated that export volume responds to changes in exchange rates with a lag. Therefore, a lagged exchange rate variable $ER_{(i,t-1)}$ is added in the model. Since the exchange rate is defined as the units of foreign currency per SDR, a depreciation of currencies in these countries (an increase in ER) is expected to decrease the demand for imports in country i. When the currency of an importing country depreciates, imports in terms of SDR will become more expensive and demand will decline. The reverse will be true for local currency appreciation. Thus the coefficients for current and lagged exchange rates (ER) are expected to be negative. Instead of the real exchange rate, we have used the nominal exchange rate in this study because we believe that the directional impact of real and nominal exchange rates should be similar on exports for the following reason. A depreciation of domestic currency has important effects on domestic price. The greater the depreciation of currency the greater is its inflationary effects on economy via an increase in import price. This causes producers to shift resources from non- tradable production to the production of import substitutes, which in turn decrease the exports of the trading partner. Therefore, it is logical to believe that the directional impacts of real and nominal exchange rates will be the same on exports. An increase in the GDP of importing countries is expected to increase the demand for imports, thus the coefficient of Y should be positive. The coefficients are interpreted as the elasticities of export demand with respect to income (C2) and exchange rates (C3 and C4), measuring responsiveness of export demand to a change in foreign national income and exchange rates.

## V. Data

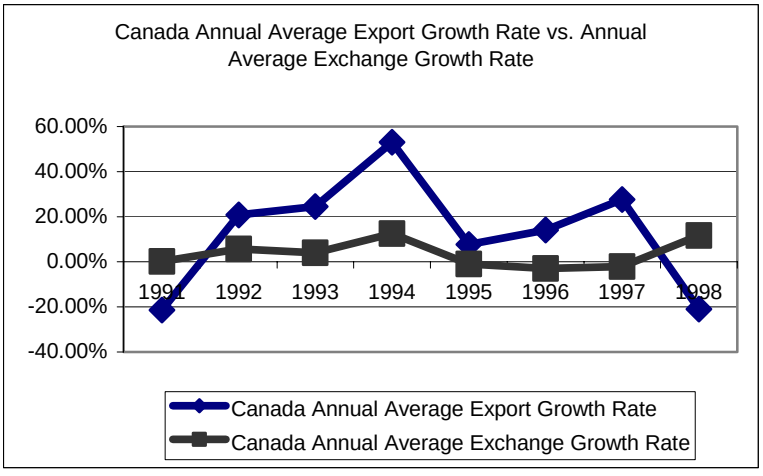
The sample consists of the top ten importing countries of Kentucky's goods as shown in Table 3. The time period under study is from 1990 to 1998. The data for the

dependent variable, total annual exports of Kentucky to the ten countries, are obtained from the Kentucky Desk Book of Economic Statistics (2000). The data for foreign income represented by the GDP of importing countries and exchange rates (foreign currency per SDR) are obtained from several issues of the International Financial Statistic published by the International Monetary Fund. In this study, we have used units of foreign currency per SDR for the exchange rate, because the SDR represents a basket of currencies. If a nation's trade is diversified across a number of countries (as is the case for countries importing from Kentucky) using the units of foreign currency per SDR will reflect the impact of trade activities (from a number of countries) on currency value better than using the units of foreign currency per dollar**.** Before estimating the reduced form export demand equation, we normalized exchange rates and the GDP of importing countries with each country to a value of 100 in 1990 to avoid the influence of arbitrary difference in units of foreign currencies.

## VI. Estimation and Results

Before estimating equation 2, we plotted graphs between export growth rates and exchange rate changes for all the countries to get a feel for the correlation of these two variables. Figure 1 shows the graph between annual Export growth rates and annual exchange rate changes for Canada (to save space, we have reported only one such graph, for interested readers graphs for other countries are available from the authors). Overall, the graph indicates a negative relationship between the two variables for most of the years except 1993 and 1994.

Figure 1




For estimating equation 2, first we use ordinary least squares method. The estimated results are as follows:

$$\log EXP_{it} = -20.84 + 5.43 \log Y_{it} - 0.04 \log ER_{it} - 0.02 \log ER_{(i,t-1)} \quad (3)$$

(10.69)* (1.36) (0.76)

$R^2 = 0.67$ F = 58.46 DW=1.36 N = 89

*Figures in parenthesis are t values

As expected, the coefficient of foreign national income (Y) is positive and highly significant. The coefficients of contemporaneous and one year lag of foreign exchange rates (ER) are negative, consistent with a priori expectations but statistically insignificant. These insignificant coefficients on exchange rates are not consistent with other empirical studies of this nature.

These estimates, however, are not reliable because of the likelihood of the presence of heteroscedasticity and auto-correlation in a pooled cross-section and time series data. Hence, this paper tests for heteroscedasticity using the White (1980) test. Briefly, the steps for the White (1980) test for heteroscedasticity are as follows: obtain the residuals, $e_i$, from equation (2) and then square $e_i$ and regress it on all the original variables, their squared and cross-products. The number of observations times the estimated $R^2$ from the auxiliary regression is the White's test statistic, which is asymptotically distributed as a Chi-square with degrees of freedom equal to the number of independent variables excluding the constant term in (2). The White test gave a large and highly significant test statistic, [$n*R^2 = 69.89$, where n = number of observations] confirming the presence of heteroskedasticity in the model.

To correct for the problems of heteroskedasticity and autocorrelation, this paper uses Newey and West heteroskedasticity autocorrelation consistent method (NWHAC) [Newey and West (1987)]. This method proposes a more general covariance matrix estimator in the presence of both heteroskedasticity and autocorrelation of unknown form. NWHAC allows for a general covariance matrix estimator that takes into account both the possibility of serially correlated and heteroskedastic residuals in the pooled time series and cross section data.

The NWHAC adjusted parameter estimates are given in equation (4)

$$\log EXP_{it} = -20.84 + 5.43 \log Y_{it} - 0.04 \log ER_{it} - 0.02 \log ER_{(i,t-1)} \quad (4)$$

(13.27)* (-4.48) (-3.99)

$R^2 = 0.67$ F = 58.46 N = 89 Truncation lag =3

* Figures in parenthesis are t values

As can be seen, when corrected for the problems of heteroskedasticity and serial correlation all the independent variables (importing countries' national incomes, contemporaneous and lagged exchange rates) are statistically significant with the expected signs. The F statistic is large and significant indicating estimated coefficients are significantly different than zero. The $R^2$ indicates significant correlation between Kentucky's exports and foreign national incomes and exchange rates. These results are similar to the ones reported by Cronovich and Gazel (1998).

The results presented reveal that national incomes of importing countries contribute positively and significantly to the exports of Kentucky and are largely responsible for export demand creation. As expected, the impact of contemporaneous and lagged exchange rates are negative and significant, implying both short and long term effects of exchange rates are negative. The impact, however, seems relatively small. Even if the effect is small, Kentucky's exports are not immune from changes in exchange rates.

## VII. Policy Implications:

With exports accounting for almost 10% of Gross state product, state economic planners must pay attention to factors that impact Kentucky's exports. As a matter of policy, state government must encourage and keep such studies on record so that planners are aware of the impact of various factors on Kentucky exports. For the state of Kentucky, this is the first empirical study establishing a negative relationship between Kentucky exports and exchange rates and a positive relationship between importing countries' GDPs and Kentucky exports. This information may be useful for the economic planners in various ways. For example, if an economic slump is predicted for some geographical region of the world, where some of Kentucky's trading partners are located, then Kentucky exports may decline, which has the potential to decrease the state's tax revenue and expenditures. The fluctuations in exchange rates may also impact the state's economy in a similar way. With such knowledge, the economic planners may formulate a policy of export diversification across different regions of the world. Since exchange rates and economies of different countries are not perfectly correlated,

diversification will smooth out the fluctuations in Kentucky exports, thus minimizing the negative impacts on the state's budget.

## VIII. Conclusions

This paper examines empirically the impact of national incomes of importing countries and foreign exchange rates on the exports of Kentucky. Using the Newey and West heteroskedasticity autocorrelation consistent method in a panel data set, this paper finds that Kentucky's exports are positively correlated with importing countries' national incomes and negatively correlated with current and lagged foreign exchange rates. These results are statistically significant and are consistent with international trade theory. The impact of foreign national income is substantial on Kentucky's exports and hence on its economic growth. The impact of exchange rates however seems relatively small. Even if the effect of exchange rates is small, Kentucky's exports are not immune from changes in exchange rates. Thus policymakers must consider the negative impact of exchange rates on export promotion policy.

Table 1. Kentucky's Gross State Product (GSP)-1999

(Current Dollars in Millions)

| 1999 GSP | Percent of 1999 GSP | Industry Sector |
|---|---|---|
| $113,539 | 100% | Total Gross State Product |
| $4,874 | 4.3% | Transportation |
| $5,064 | 4.5% | Construction |
| $6,964 | 6.1% | Wholesale trade |
| $18,122 | 16.0% | Services |
| $10,861 | 9.6% | Retail trade |
| $31,275 | 27.5% | Manufacturing |
| $12,404 | 10.9% | F.I.R.E |
| $15,306 | 13.5% | Government |
| $2,433 | 2.1% | Mining |
| $2,002 | 1.8% | Agriculture, forest, fish etc |

Source: U.S. Bureau of Economic Analysis

Table 2. Distribution of Kentucky exports (2000)

| Region | Percentage |
|---|---|
| Canada | 36% |
| Western Europe | 29% |
| Far East | 19% |
| Latin America | 6% |
| Other | 10% |

Source: Massachusetts Institute of Social and Economic Research (MISER)

Table 3. Ten Leading Countries of Kentucky Exports (2000)

| Rank | Country | Total Export Value |
|---|---|---|
| 1 | Canada | $3,682,603,091 |
| 2 | Japan | 984,357,934 |
| 3 | United Kingdom | 830,403,051 |
| 4 | France | 756,837,354 |
| 5 | Mexico | 534,154,062 |
| 6 | Germany | 327,977,949 |
| 7 | Netherlands | 316,496,259 |
| 8 | Brazil | 305.167,024 |
| 9 | Belgium | 224,757,560 |
| 10 | Australia | 183,114,386 |

Source: Massachusetts Institute of Social and Economic Research (MISER)

Table 4. Kentucky Exports by Industry Group (2000)

| Industries | $ Value | Annual Average % Change (1990-2000) |
|---|---|---|
| All Industries | $10,275,510,698 | 10.46 |
| Transportation equipment | 3,532,619,617 | 14.75 |
| Industrial Machinery & Computer Equipment | 2,056,760,001 | 10.14 |
| Chemicals | 1,215,885,571 | 8.39 |
| Electronic & Electric Equipment | 612,846,209 | 12.91 |
| Fabricated Metals | 427,469,318 | 17.89 |
| Primary Metals | 324,416,769 | 17.89 |
| Livestock | 305,609,715 | 5.10 |
| Rubber & Misc. Plastics | 298,451,963 | 15.77 |
| Stone, Clay & Glass Products | 228,126,564 | 8.36 |
| Food & Kindred Products | 211,721,989 | 2.01 |

Source: Massachusetts Institute of Social and Economic Research (MISER)

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