Journal of Applied Economics and Policy

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TABLE OF CONTENTS

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Friday, September 24, 2010—Capital Plaza Hotel, Frankfort, KY
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PROGRAM:
Those interested in presenting or discussing papers, organizing a session or panel discussion, or serving as a session chair should submit their materials using our online submission form at kentuckyeconomicassociation.org or contact:

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The deadline for program submissions/abstracts is September 3, 2010. Completed manuscripts may be considered for publication in the *Journal of Applied Economics and Policy*. The JAEP is a publication of the Kentucky Economic Association. It is listed in Cabell's Directory of Publishing Opportunities and can be accessed online through EBSCOhost.

There will be a "Best Paper Award", as well as, undergraduate paper sessions and an award for "Best Undergraduate Paper." A completed paper must be submitted no later than September 3 to be considered for these awards.

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TABLE OF CONTENTS

MEASURING SOCIAL PREFERENCES IN GROUPS VERSUS AS INDIVIDUALS: INCOME INEQUALITY AVERSION USING THE LEAKY-BUCKET METHOD[1]

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Abstract

This paper contributes to the few empirical estimates of income inequality aversion as well as examining the effect of different decision-making situations on parameter estimates. Policy decisions are often made in groups via deliberation. Yet social preference information is typically obtained from individuals. Groups systematically differ from individuals in how they make decisions. Errors in forecasting group preferences can lead to inaccurate prediction and policy-making. Questionnaires were administered to two samples. In one sample, groups deliberated on their joint response. In the second sample, individuals provided responses anonymously. Responses were used to estimate the inequality aversion parameters for selected social welfare functions. Decisions made in group settings are significantly different from those made by individuals. Parameter values for both individuals and groups are lower than those usually assumed in the literature. Kernel density estimates indicate that for both individuals and groups the means of the inequality aversion parameters are poor representations of the distribution of social preferences.

[1] The authors would like to acknowledge Jim Unterschultz for providing helpful comments on earlier drafts and Natalie Zimmer for her assistance with the survey and data input. We would also like to thank the two referees for their suggestions. They appreciably improved the paper.

I. Introduction

Public projects often do not generate uniform benefits and costs, so understanding social preferences with respect to unequal distributions is important in policy development. A common assumption in social welfare analysis is that people are averse to inequality. This implies that social utility functions are concave where the degree of concavity represents the trade-off between equity and efficiency (Atkinson, 1970). Few studies have attempted to determine the extent of individuals' inequality aversion. One notable exception, Amiel et al. (1999), asked a sample of students a series of "leaky-bucket" questions. Responses were used to estimate the inequality aversion parameters for selected social welfare functions (SWF). Their results indicated that people are less averse to income inequality than the literature had previously hypothesized. This paper contributes to the few empirical estimates of inequality aversion and extends the Amiel et al. (1999) methodology by examining whether differing decision-making situations lead to divergent aversion to income inequality estimates. Policy decisions are often made in groups via deliberation (Sunstein, 2006) and there is substantial evidence that groups systematically differ from individuals in how they make decisions (Adamowicz et al., 2005). This paper empirically examines the size and nature of the differences between individual and group decision-making.

There is a burgeoning literature on group decision-making and social preferences. For example, Li (2001) and Li and Suen (2009) investigate the inefficiencies that can arise when decisions must be made by a committee of self-interested members. They establish that free-ridership among committee-members can lead groups to be too conservative in decision-making. Similarly, Fehr and Schmidt (1999) and Fehr and Fischbacher (2002) demonstrate that research which ignores social preferences will fail to adequately capture the processes that drive market outcomes. Despite the growth in this literature however, few empirical studies have been completed on how the preferences of individuals and groups differ in particular contexts.

This study measures aversion to income inequality using the leaky-bucket framework (see Appendix for a description of the leaky-bucket metaphor). Responses to a questionnaire are used to determine the socially preferred level of inequality aversion for the constant relative inequality averse (CRIA) SWF.[2] To assess how differing social contexts can affect aversion to income inequality, the questionnaire was administered in two distinct situations; one in which responses are from anonymous individuals and another in which group discussion precedes the determination of a final group decision. The latter is intended to mimic a deliberative context in which social decisions are often made. The primary objective is to establish whether attitudes which are stated in a social setting differ from those stated anonymously. While the theoretical background to inequality aversion has received extensive discussion, there are few attempts to actually ascertain public preferences (Amiel et al., 1999). By adding to the meager estimates of inequality aversion and by evaluating the

[2] All of the analysis in this paper was repeated using a constant absolute inequality averse functional form for the SWF. Using this alternative form, the main conclusions with respect to group versus individual estimates are identical to those presented in this paper. These results are available from the authors upon request.

impact of the decision-making context, this paper contributes to understanding the empirical measurement of preferences for equality.

II. Theoretical Framework

SWFs are typically employed to balance conflicting objectives. For a given project, a social planner maximizes a SWF to obtain an optimal outcome which implicitly entails a distribution of benefits and costs across individuals – this outcome may treat individuals unequally. Consequently, a desirable feature of a SWF is that it reflects social preferences with respect to alternative distributions.

Assume there is a well-behaved SWF:

$$W = \frac{1}{N}\sum_{i=1}^{N} U(y_i)$$

where W is per capita welfare, N is the total number of individuals, and $U(y_i)$ is the value put on y_i, income of person i, by the planner.[3] The planner must specify a functional form for $U(y_i)$which ideally reflects social attitudes with respect to inequality. If income is subject to diminishing marginal utility (i.e. W is concave), then costless transfers from higher income individuals to lower income individuals are welfare improving. In practice, transfers are not costless. That is, not all income taken from a high income individual will be received by the low income person – something is lost due to administrative costs or incentive effects. If the transfer were water, the money must be carried in a "leaky-bucket" (Okun, 1975) where the "leakage" represents inefficiency (Kakwani and Son, 2005). The leaky-bucket approach characterizes the equity-efficiency tradeoff within the SWF by making the efficiency loss explicit and permitting empirical measurement of inequality aversion (Amiel et al., 1999).

The CRIA SWF takes the form:

$$U(y_i) = \begin{cases} \dfrac{1}{1-\varepsilon} y_i^{1-\varepsilon}, \varepsilon \geq 0, \varepsilon \neq 1 \\ \log y_i, \varepsilon = 1 \end{cases}, i = 1, \ldots, N \qquad (2)$$

where ε is the parameter that measures aversion to income inequality. The CRIA depends on the ratio of incomes between two individuals. As income inequality aversion increases, ε increases (i.e.,$U(y_i)$ becomes more concave). This parameter is generally assumed to lie in the interval: 0.5 to 3.0 (Carlsson et al., 2005). Amiel et al. (1999) found values around 0.25.

[3] The social welfare function, $W = W(U_1, \ldots, U_n)$, is assumed to have the standard properties: it is increasing in individual utility, $W_{U_i} > 0$, but at a diminishing rate, $W_{U_i U_i} < 0$, and there is no altruism or envy, $W_{U_i U_j} = 0$ (single and double subscripts denote the first (single) or second (double) derivatives with respect to that variable).

III. Questionnaire and Data

A questionnaire with a set of leaky-bucket questions was administered to two university classes at the University of Alberta. In one group, students answered these questions individually. For the second class, respondents were randomly placed into groups of three within which internal discussions yielded a single group response to the same set of questions. These two sets are referred to as individual and group responses respectively.

The survey instrument contained five leaky-bucket questions. An introduction explained the choice task and provided information on the current Canadian income distribution. The wording of the five leaky-bucket questions was identical for all surveys:

> "Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of (high income) to transfer $1000 to an individual who has an annual income of (low income):" (**emphasis** in original)

and encompassed a broad range of high and low income values. The respondents were then presented a payment card with a predetermined matrix of potential transfer amounts. The payment card approach is designed to reduce cognitive challenges that may be associated with deciding on specific transfer values. Previous research and the literature (Amiel et al., 1999; Johansson-Stenman et al., 2002) provided information for determining the appropriate values to include in the matrix. The appendix contains a copy of the questionnaire. The individual response sample contains 115 data points[4] and there are 60 data points in the group sample.[5]

IV. Empirical Approach

Leaky-bucket questions ask individuals to act as the social planner. Respondents provide the *maximum* amount of money that each would be willing to take from a high income individual to provide a given amount to a low income person. At that *maximum leakage* point, the respondent's/planner's pre-transfer and post-transfer welfare are equal – the planner is indifferent between transferring and not transferring the money. Inequality aversion parameters can then be determined either via direct calculation or estimated within a parametric model. The direct calculation method is only exact for marginal transfers. Directly calculated values, however, can be used in nonparametric kernel density estimation which supplies a *distribution of preferences* across the sample. This implies that there is preference heterogeneity in the sample (i.e., in Eq.(2), each individual or group (m) has a different inequality aversion parameter (ε_m)). The parametric method uses a criterion function to estimate a population parameter. That is, it is a structural model which assumes that the population has a fundamental underlying preference for a degree of income equality. As the parametric approach requires numerical methods, its estimates are generally less stable than the nonparametric values.

[4] There were 23 individuals who answered five questions.

[5] There were 12 groups (38 students) who answered five questions.

a. Direct Calculation and Kernel Estimators Approach

Insert (2) into the SWF (Eq. (1)), hold social welfare constant and apply the implicit function theorem. The marginal change in income for individual *i* relative to the marginal change in income for person *j* provides a method to calculate ε_m:

$$-\left.\frac{dy_i}{dy_j}\right|_w = \left(\frac{y_i}{y_j}\right)^{\varepsilon_m} \tag{3}$$

If information is available for dy_i, dy_j, $y_i$and y_j, directly computing the inequality aversion parameters is straightforward.

A kernel density estimator is a nonparametric method that can be used to determine the distribution of a variable, smoothing the contribution of a data point in its local neighborhood (Davidson and MacKinnon, 2004).[6] The normal and Epanechnikov kernels are compared. The normal kernel takes the form:

$$k[z] = \frac{1}{\sqrt{2\pi}}\exp\left(-\frac{1}{2}z^2\right) \tag{4}$$

and involves all data points providing some weight when determining the density at each point (Davidson and MacKinnon, 2004). The Epanechnikov kernel is given by:

$$k[z] = \frac{3\left(1-z^2/5\right)}{4\sqrt{5}} \text{ for } |z| < \sqrt{5}, 0 \text{ otherwise.} \tag{5}$$

Density estimates from this kernel do not include all data points. While the Epanechnikov kernel is the most efficient density estimator in terms of mean squared error (Silverman, 1986), the normal kernel is better known.

[6] The general form for a kernel density estimator is: $f(x) = \frac{1}{Nh}\sum_{i=1}^{N} k\left[\frac{x-x_i}{h}\right]$ with $\int k[z]dz = 1$ where $f(x)$ is the density at a point *x* which depends on its distance from data point x_i and the bandwidth parameter *h*. The bandwidth parameter is given by the formula: $h = \hat{\sigma}\left\{\frac{4}{(3\cdot N)}\right\}^{-1/5}$, where $\hat{\sigma}$ is the standard deviation of the sample and *N* is the sample size.

b. Parametric Approach

The parametric approach allows for the inclusion of non-marginal transfers. Non-linear regression algorithms are needed to determine the inequality aversion coefficients. Estimates derived from these algorithms are often sensitive to the initialization values.[7] Let W^0 be pre-transfer welfare and W^1 be post-transfer welfare. A transfer from a high income individual, y_2, to a low income individual, y_1, keeping every other income in the population constant, implies that the two SWF's at the maximum leakage point, are equal – i.e., $W^0 = W^1$ – or on the same social indifference curve. For the CRIA function, this gives:

$$\frac{1}{1-\varepsilon}\left(y_1^{1-\varepsilon} + y_2^{1-\varepsilon}\right) = \frac{1}{1-\varepsilon}\left(\left(y_1+\theta\right)^{1-\varepsilon} + \left(y_2-\phi\right)^{1-\varepsilon}\right) \tag{6}$$

where θ is the amount transferred to the lower income individual and ϕ is the amount taken from the higher income individual. That is, for some y_1, y_2 and θ, ϕ is the value determined in the questionnaire. Dividing (6) by $y_2^{1-\varepsilon}$ and rearranging for ϕ gives:

$$\phi = y_2\left[1-\left(\delta^{1-\varepsilon}+1-\left(\delta+1000/y_2\right)^{1-\varepsilon}\right)^{1/1-\varepsilon}\right] \tag{7}$$

where $\delta = y_1/y_2$.

If we assume that $\phi_i = h_i(\cdot) + \eta_i$, where $h_i(\cdot)$ is the right-hand side of (7), η_i is a residual term (Greene, 2003) and the data across responses and questions are pooled, the following criterion function can be defined:

$$S = \frac{1}{2}\sum_{i=1}^{N}\sum_{q=1}^{Q}\left(\phi_{iq} - h_{iq}(\cdot)\right)^2 = \frac{1}{2}\sum_{1=1}^{N}\sum_{q=1}^{Q}\eta_{iq}^2 \tag{8}$$

Where N is the number of respondents and Q is the number of questions. A value for the income inequality aversion parameter, ε, can be obtained by minimizing (8).

V. Results and Discussion

Respondents provided values for the maximum amounts that they, acting as a social planner, would be willing to take from a high income individual to transfer $1000 to a low income person. These responses were used to estimate inequality aversion coefficients. Table 1 provides the means, standard deviations and 90% confidence intervals for the

[7] The parameter estimates using the CRIA formulation were robust to various starting values. However, noticeable sensitivity was shown by estimates derived from a constant absolute inequality averse social welfare (see footnote 1). As a consequence, these results are not included in the paper.

directly calculated parameter and estimated coefficient, standard error and 90% confidence interval on the estimate for the parametric approach.

For the direct calculation method, the mean of the individual responses is 0.433 and for the group responses it is 0.253. Using the parametric approach, the individual and group response means are 0.935 and 0.579 respectively. The parametric estimates are larger than the corresponding nonparametric coefficients. There is a tradeoff in assessing the two methods of estimation. While the direct calculation approach is intended for marginal income changes, it has more stable parameter estimates. The parametric method does account for discrete transfers but due to the numerical methods required the coefficients are less stable.

Comparing the directly calculated individual and group means offers a test of whether alternative social contexts yield different inequality aversion parameters. That these means are significantly different at the 5% of level suggests that varied choice circumstances influence social preferences.[8] Errors in forecasting group preferences can lead to inaccurate prediction and policy-making (Adamowicz et al., 2005). These results demonstrate that it is important to account for context when determining social preferences. While these tests are informative, it must be noted that the mean is a single point in the distribution. Examining the entire distribution of responses, under the assumption of preference heterogeneity, provides additional understanding of the differences between choice contexts.

Figure 1 displays the cumulative distribution functions (CDF) for the calculated inequality aversion parameters. The CDFs illustrate the total number of responses up to and including a given aversion parameter. If one curve sits to the right of another then the sample from which this distribution is derived exhibits greater aversion to income inequality. At low parameter values the group sample distributions are more averse to inequality than the individual sample responses. For most of the range however, the individual coefficients are larger. This suggests that decision-making context affects the distribution of results not just the mean. The group sample has a smaller variance than the individual sample.

There is a clear difference between the group and individual curves further supporting the hypothesis that diverse choice contexts lead to different outcomes. Also, when the size of the leakage is small, groups prefer more equality. Yet, as the losses increase, groups are less likely than individuals to accept the associated inefficiencies. There are several potential explanations for these results. First, groups were asked to make their selections collectively. Thus, it is possible that there is natural regression to the mean. Individuals with outlier responses may have had those tempered by discussion within the group or even overridden by the group's collective choice. While this may explain the difference in variance between the group and individual responses, it does not account for the statistically significant difference in the means. Moreover, Sunstein (2006) contests this regression to the mean explanation. He found that previous opinions were accentuated not tempered by group

[8] Two-tailed t-tests with unequal variances are used to examine the null hypotheses that i) the difference between means in the direct calculation approach and ii) the estimates coefficients using the parametric method are identical. All null hypotheses are rejected at a 5% level of significance.

deliberation. A second explanation has to do with the decision-making process. Requiring joint responses may act as a "time-to-think" calibration mechanism (Whittington et al., 1992) similar to "cheap talk" (Cummings and Taylor, 1999). Had the individual respondents faced a similar technique, their responses may have been less prone to hypothetical bias or strategic behavior – a common criticism of survey-based research.

The kernel density estimates are displayed in Figures 2 and 3. The kernel estimates provide a visual representation of the distribution of inequality aversion preferences. It is clear that the normal kernel is smoother than the Epanechnikov estimates – the latter does not decline smoothly as the aversion parameters increase. Also, it is important to note that the majority of responses are grouped around the lower parameter values.

These graphs raise an additional issue. Is it appropriate to use the mean inequality aversion coefficient in social welfare analysis if preference heterogeneity is expected? The bulk of the probability mass is located to the left of the mean – the nonparametric estimates of the median for the individual and groups samples are 0.399 and 0.177, respectively. Employing the mean value in cost-benefit analysis may lead to too great a concern for equity over efficiency. Indeed, the mean and variance do not appear to characterize these distributions very well. The public choice literature proposes that the median voter act as the effective decision-maker (Mueller, 2003). Perhaps, in public project appraisals the median aversion parameter should be used in place of the mean. Additional research is required to evaluate whether a single parameter SWF is a valid assessment tool.

VI. Conclusion

The objective of this paper was twofold: a) to provide additional estimates of inequality aversion and b) to ascertain whether varied social contexts affected social preferences for inequality. The inequality aversion values estimated here are similar to those reported by Amiel et al. (1999) but are lower than those reported by Johansson-Stenman et al. (2002) and those commonly assumed in the literature. The results also indicate that income inequality aversion is affected by differing decision-making circumstances – social context appears to matter. Eliciting preferences from groups leads to lower mean coefficient estimates than from surveying individuals. Further, when preference heterogeneity is assumed, density estimates of the directly calculated parameters reveal that inequality aversion parameters based on mean values appear to be poor representations of the distribution social preferences.

The question is still open with respect to who is more representative of the population's preferences, groups or individuals (Sunstein, 2006). The distribution of the costs and benefits of a policy's outcomes is important to most people in society. An enhanced understanding of public preferences for different distributions will assist in evaluating the efficacy of different project proposals.

Appendix: Questionnaire

Introduction

Many economists believe that, when considering public policy, there is the trade-off between two objectives: equity and efficiency. Further, they believe that governments must consider this trade-off when designing public programs. The purpose of this survey is to determine people's preferences for both equity and efficiency in society.

The basic problem is frequently characterized using the "leaky bucket" metaphor. Pretend that you have a leaky bucket and that you need to carry water from one place to another. Some of the water in the leaky bucket is inevitably lost in transit. It "leaks" out. The amount left in the bucket will always be less than the amount you started with. The need for water at the end of the trip will determine if it is even worthwhile to attempt the trip. For example, if water is desperately needed, then it may be worthwhile to carry water in a leaky-bucket even if 99% is lost. However, if the water is not truly required, maybe the trip is only worthwhile if only 10% of the water is lost.

This analogy is often used with reference to government programs and transfers, particularly when public services and transfers are paid for by individuals with higher incomes and then used by people with lower incomes. Due to administration costs, transfer costs or other such payments, some of the money taken from the wealthier individuals is unavoidably lost. Therefore, all the money originally slated to reach the lower income group does not. Equity is still improved through the provision of the public service or the transfer of money, although efficiency is reduced as some of the money disappeared during transit.

In this survey, an income transfer of $1000 will be made from a high income person to a low income person. During this transfer, a portion of the money will be lost due to the efficiency-equity trade-off. We are interested in *the maximum amount* money you (a detached, third party decision-maker) are willing to take away from the richer individual in order to give the poorer individual $1000. This transfer will be presented as five different circumstances, where the incomes of both the poor and rich person will change. For example, the rich household may have twenty times as much money as the poor household in one question while in the next question the difference may only be ten times as great.

We will present you with a list of income amounts. We ask you to circle *the maximum amount* that you would consider taking from the person with high income in order to provide the person with low income $1000 before you believe the transfer is no longer worth making. For example, if you were to circle the $1000, this would indicate that you are not willing to accept any loss with respect to this transfer. Similarly, if you were to circle $50,000, you would be indicating that you are willing to accept a loss of $49,000 in order to make a $1000 transfer. In other words, we are asking how much loss you will tolerate until the transfer is no longer worthwhile. Feel free to read these questions over once prior to answering.

The next set of figures and tables present some approximate information on the Canadian income distribution and low income cut-off line. This is provided as additional data only and is not required to answer the following questions. (These figures are available upon request.)

Question 1 Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of **$1,000,000** to transfer $1000 to an individual who has an annual income of **$10,000**:

Question 2 Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of **$500,000** to transfer $1000 to an individual who has an annual income of **$25,000**:

Question 3 Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of **$100,000** to transfer $1000 to an individual who has an annual income of **$5,000**:

Question 4 Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of **$200,000** to transfer $1000 to an individual who has an annual income of **$20,000**:

Question 5 Please circle the **maximum** amount of money you would be willing to take from an individual who has an annual income of **$750,000** to transfer $1000 to an individual who has an annual income of **$15,000**:

Sample Paycard (identical for all questions):

$1000	$1700	$4000	$7500
$1100	$2000	$4500	$10,000
$1200	$2300	$5000	$15,000
$1300	$2700	$5500	$20,000
$1400	$3200	$6000	$25,000
$1500	$3700	$7000	$50,000

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Table 1: Estimates of Income Inequality Aversion Parameter

Direct Calculation Method				
			90% Confidence Interval	
	Mean	Std Dev	Low	High
Individuals	0.433	0.356	0.378	0.487
Groups	0.253	0.263	0.197	0.309
Parametric Method				
			90% Confidence Interval	
	Coefficient Estimate	Std Err	Low	High
Individuals	0.935	0.084	0.796	1.073
Groups	0.579	0.070	0.465	0.715

Figure 1: Cumulative Distribution of the Directly Calculated Inequality Aversion Parameters

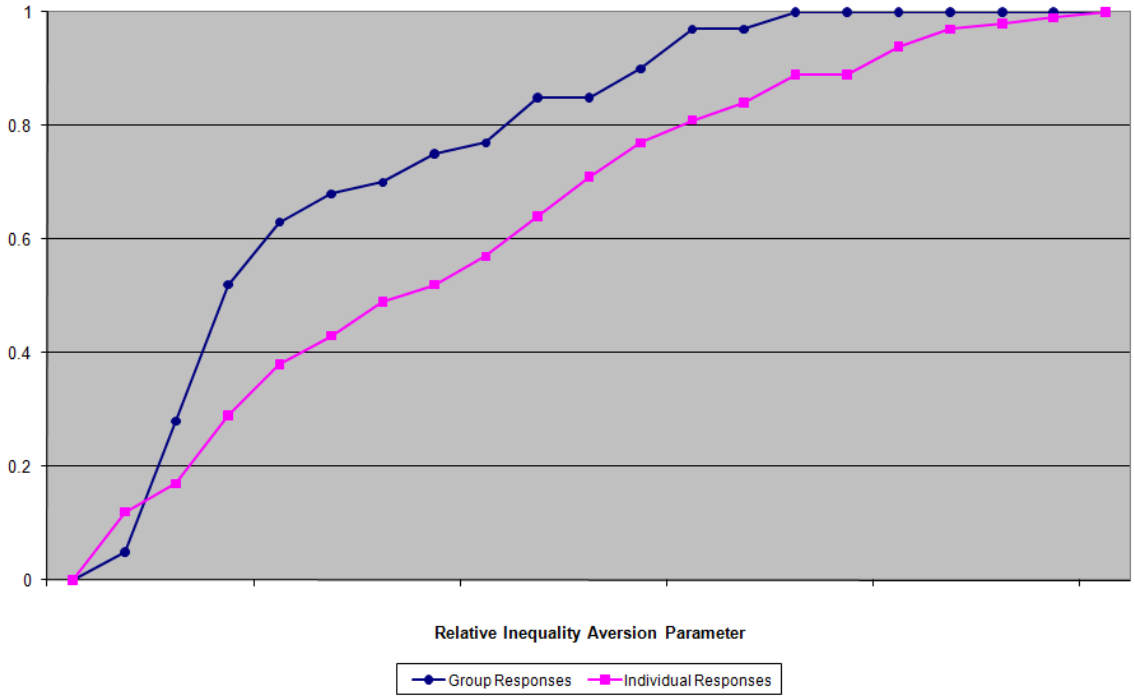


Figure 2: Density Estimates for Individual Responses

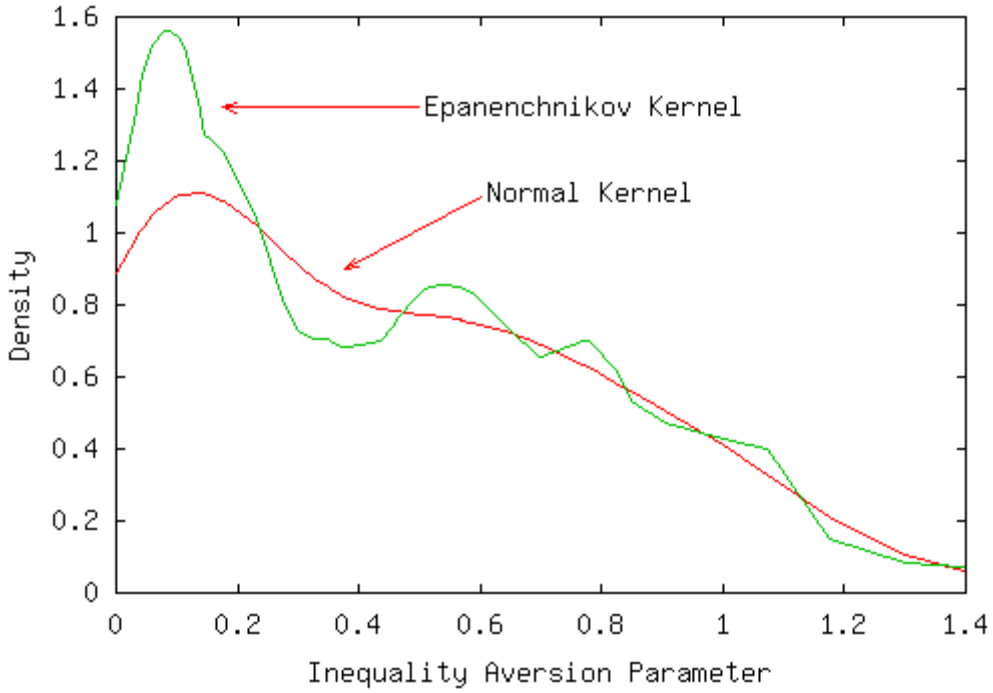
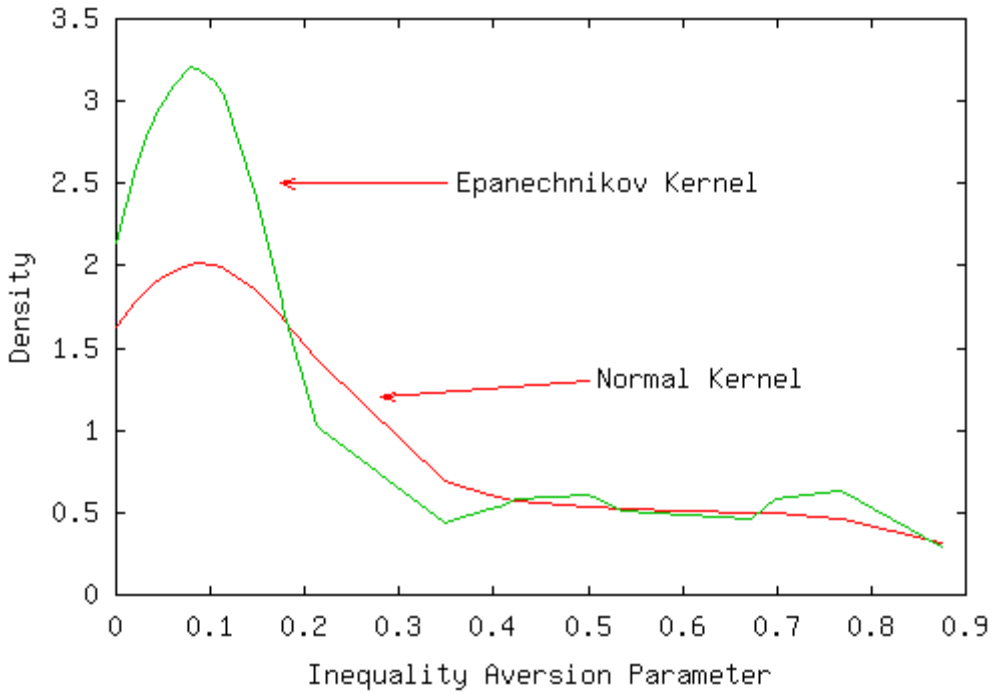


Figure 3: Density Estimates for Group Responses



TESTING FOR MARKET POWER IN THE U.S. CATFISH PROCESSING INDUSTRY: A DYNAMIC ERROR CORRECTION APPROACH

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Abstract

Concern over market power in the US catfish industry has prompted a series of research papers. Yet, virtually all the methods used are based solely on static oligopoly models. In this paper, we use a dynamic error correction model as an alternative approach to evaluate the degree of competitiveness of the US catfish processing industry. Econometric results indicate that the conduct of catfish processors is competitive both in the short and long run. The results also suggest that an adjustment of 31% of the supply of live catfish takes place each quarter after deviations from the long run equilibrium.

I. Introduction

Competition in the US catfish industry has been widely covered in the literature. Yet, virtually all the methods used are solely based on static oligopoly models. Static models, however, have some limitations in that they do not take into account dynamics, or the long-run relationships among variables included in the model. Maddala and Kim (1998) pointed out that the estimation of long run relationships using a static model is inappropriate when variables are co-integrated. This paper uses a dynamic error correction model as an alternative approach to test for market power in the catfish processing industry.

The appeal of the error correction model (ECM, hereafter) is its ability to disentangle the short-run dynamics from the long-run equilibrium condition of the series. In addition, ECM does not impose any restrictions on the nature of the dynamics. Because of its positive features, ECM has been extensively applied. Examples of its application include testing for aggregate consumption behavior (Anderson and Blundell, 1983), estimating factor demand (Friesen, 1992), and analyzing the adjustment of interest rates (Heffernan, 1997). Some of the few studies that used ECM to investigate the degree of competitiveness in aquaculture and fisheries sectors include that of Steen and Salvanes (1999) who tested for market power in the French market for fresh salmon, and that of Jaffry et al. (2003) who used the same technique to examine the degree of oligopoly power in the salmon retail market in the United Kingdom.

The structure of the US catfish processing industry is highly concentrated (Dillard, 1995). This highly concentrated structure is of particular concern because it can lead to market power thereby reducing welfare of catfish farmers. Dynamics are important in the catfish industry due to numerous factors. These factors include fluctuations in the supply of live catfish because of seasonality (Kouka and Engle, 1998), adjustment costs, and random shocks variations in real prices of both live and processed catfish. Because dynamism is particularly important in the catfish industry, it is appropriate to use a dynamic model when testing for market power. To do so, we adopt the dynamic oligopoly model developed by Steen and Salvanes (1999) to test for market power in the US catfish processing industry. Our focus in this paper is, however, on oligopsony power rather than oligopoly power because the former is of more concern than the latter.

The remainder of this paper proceeds as follows. The first section provides a brief overview of catfish industry. The subsequent section contains the empirical model. The third section discusses the econometric results. The last section concludes the paper.

II. An Overview of Catfish Industry

Catfish industry is one of the mainstays of the US aquaculture sector. The industry accounts for nearly 70% of all food fish sales (USDA, 2006). Catfish industry consists of two major components: catfish farming and catfish processing. Catfish farming generated more than $400 million in sales in 2008 (USDA, 2009). Catfish farms are concentrated in the southern states of Arkansas, Mississippi, Alabama and Louisiana. Over the past years, catfish farming has seen the emergence of large-scale and highly mechanized farms (Kazmierczak

and Solo, 2000). Catfish production is a risky and capital intensive enterprise (Tucker and Hargreaves, 2004). In addition, adjustment costs are particularly important in the catfish production because of the lengthy grow out period. According to Tucker and Robinson (1990), catfish require from 18 to 24 months to reach market size.

Catfish processing plants are mainly located in the Mississippi delta region, where more than 90% of total annual sales are produced. The number of catfish processors varied from 19 to 28since 1981 because of consolidations through mergers and acquisitions (Engle and Quagrinie, 2006). In general, catfish is processed into headed and gutted, fillets, steaks and nuggets, which can be in frozen or fresh form.

Prices in the catfish industry are relatively volatile because of two major factors. The first factor is related to the occurrence of off-flavor that restricts the supply of food size catfish. The second factor pertains to lack of adequate information about catfish processing industry. This lack of information resulted in periods of unbalanced supply and demand thereby leading to price variability (Zidack and Hatch, 2007).

III. Empirical Model

Consider a market composed of a set of *N* catfish processors. Catfish processors purchase live catfish in a non-competitive market, but sell processed catfish in a competitive market. The profit of the *i*th catfish processor is

$$\pi^{i} = Pq_{i}^{p} - w\left(Q^{L}\right)q_{i}^{L} - C_{i}\left(q_{i}^{L}, v\right), \tag{1}$$

where *P* is the price received by catfish processors; w is the price paid to catfish farmers; q_{i}^{L} and q_{i}^{p} are the quantity of live catfish processed and the quantity of processed catfish sold by the *i*th processor, respectively; $Q^{L} = \sum_{i=1}^{N} q_{i}^{L}$ is the industry total quantity of live catfish; C_i is the processing cost; and *v* is a vector of input prices.

Assuming live catfish is converted into processed catfish according to a fixed proportion technology; that is

$$q_{i}^{p} = hq_{i}^{L}, \tag{2}$$

where *h* is a conversion factor.[1]

Substituting Eq. (1) into Eq.(2), and rearranging results in

$$\pi^{i} = \left(hP - w\left(Q^{L}\right)\right)q_{i}^{L} - C_{i}\left(q_{i}^{L}, v\right). \tag{3}$$

[1] In general, conversion of one pound of live catfish into H&G (headed and gutted), fillet (nuggets attached), shrank fillet (nuggets removed) results in a yield of 62%, 42-45%, and 38-40%, respectively (Seafood handbook). Using a weighted average, the conversion factor, *h*, is 0.56.

The decision problem for the *i*th processor is to determine the optimal use of live catfish; that is, to choose q_i^L so as to maximize profit as given by Eq. (3). Differentiating Eq. (3)with respect to q_i^L yields the first order condition

$$hP - w - mpc_{\mathrm{i}} - \frac{dw}{dQ^{\mathrm{L}}} Q^{\mathrm{L}} \lambda_{\mathrm{i}} = 0, \tag{4}$$

where $\lambda_{\mathrm{i}} = \left[\frac{dQ^{\mathrm{L}}}{dq_{\mathrm{i}}^{\mathrm{L}}} \frac{q_{\mathrm{i}}^{\mathrm{L}}}{Q^{\mathrm{L}}} \right]$ is the *i*th processor conjectural variation elasticity; and $mpc_i$is the marginal processing cost.

In order to use aggregate data we assume that marginal processing cost is the same for all processors. Multiplying Eq. (4) by each processor's share of live catfish $\left[\frac{\mathrm{q}_{\mathrm{i}}^{\mathrm{L}}}{\mathrm{Q}^{\mathrm{L}}} \right]$, summing over the number of processors, and rearranging yields the marketing margin equation

$$M = mpc + \frac{dw}{dQ^{\mathrm{L}}} Q^{\mathrm{L}} \lambda, \tag{5}$$

where $M = \left(hP - w \right)$ is the marketing margin; and $\lambda = \left[\sum_{i=1}^{N} \frac{\lambda_{\mathrm{i}} q_{\mathrm{i}}^{\mathrm{L}}}{Q^{\mathrm{L}}} \right]$ is the industry weighted average conjectural variation elasticity, capturing the degree of competition in the live catfish market. Note that when $\lambda = 1$ the conduct is collusive and the marketing margin is larger than the marginal processing cost; when $\lambda = 0$ the conduct is competitive and the marketing margin is equal to the marginal processing cost; and when $0 < \lambda < 1$ we have intermediate levels of oligopsony power.

Following Bresnahan (1982) and Lau (1982) let the supply of live catfish takes the following form

$$\mathrm{Q}^{\mathrm{L}} = \alpha_0 + \alpha_w w + \alpha_z z + \alpha_{zw} w.z + u, \tag{6}$$

where *z* is a vector of exogenous variables that shift the supply function; *w.z* is the interaction term. This interaction term is added to the supply function to identify and empirically estimate the degree of market power as captured by the parameter λ.[2]

Differentiating Eq. (6) with respect to *w*, and inverting yields

[2] The inclusion of the interaction term, *w.z*, in the supply function allows the estimation of λ. To see this, let $Q^{\mathrm{g}} = \frac{\mathrm{Q}^{\mathrm{L}}}{\alpha_w + \alpha_{zw} z}$. The Eq. (10a) becomes: $M = \beta_0 + \beta_{Q^{\mathrm{L}}} Q^{\mathrm{L}} + \beta_{\mathrm{k}} VK + \beta_{\mathrm{e}} VE + \beta_{\mathrm{l}} VL + \lambda Q^{\mathrm{g}} + \varepsilon$. It is clear that λ is the coefficient of Q^{g}. Conversely, if the interaction term, *w.z*, is excluded from the supply function, this makes $Q^{\mathrm{g}} = \frac{\mathrm{Q}^{\mathrm{L}}}{\alpha_w}$, and hence Q^{g} is indistinguishable from Q^{L}. In such a case, the coefficient of Q^{L} is $\left(\beta_{Q^{\mathrm{L}}} + \frac{\lambda}{\alpha_w} \right)$. As a consequence, λ is not identified and therefore cannot be empirically estimated.

$$\frac{\mathrm{d}w}{\mathrm{dQ^L}} = \frac{1}{\alpha_w + \alpha_{zw} z}. \tag{7}$$

Eq. (7) is the inverse of the slope of the supply function, indicating change in price of live catfish for every one unit increase in quantity supplied of live catfish. Substituting Eq. (7) into Eq. (5) results in

$$M = mpc + \frac{\lambda Q^{\mathrm{L}}}{\alpha_w + \alpha_{zw} z}. \tag{8}$$

Because the industry marginal processing cost (*mpc*) in Eq. (8) is not known, for empirical implementation of the model, we assume that the marginal processing cost takes the following form

$$mpc = \beta_0 + \beta_{Q^{\mathrm{L}}} Q^{\mathrm{L}} + \beta_{\mathrm{k}} VK + \beta_{\mathrm{e}} VE + \beta_l VL, \tag{9}$$

where *VK* is the cost of capital; *VE* is the cost of energy; and *VL* is the cost of labor.

Substituting Eq. (9) into Eq. (8), and adding an error term, ε, yields

$$M = \beta_0 + \beta_{Q^{\mathrm{L}}} Q^{\mathrm{L}} + \beta_{\mathrm{k}} VK + \beta_{\mathrm{e}} VE + \beta_l VL + \frac{\lambda \mathrm{Q^L}}{\alpha_w + \alpha_{zw} z} + \varepsilon. \tag{10a}$$

For empirical implementation, we assume that the vector *z* consists of two variables: the price of feed *F*; and the farm worker average wage *L*. The supply function as given by Eq. (3) becomes

$$\mathrm{Q^L} = \alpha_0 + \alpha_w w + \alpha_{\mathrm{f}} F + \alpha_l L + \alpha_{\mathrm{wf}} w.F + \alpha_{\mathrm{wl}} w.L + u, \tag{10b}$$

where *u* is an error term. Other variables are as previously defined.

Given the supply function in Eq. (10b), the inverse of the slope of the supply function as given by Eq. (7) becomes

$$\frac{\mathrm{d}w}{\mathrm{dQ^L}} = \frac{1}{(\alpha_w + \alpha_{\mathrm{wf}} F + \alpha_{\mathrm{wl}} L)}. \tag{11}$$

The final forms of static models of live catfish supply and marketing margin functions are, respectively

$$\mathrm{Q^L} = \alpha_0 + \alpha_w w + \alpha_{\mathrm{f}} F + \alpha_l L + \alpha_{\mathrm{wf}} w.F + \alpha_{\mathrm{wl}} w.L + u, \text{ and} \tag{12a}$$

$$M = \beta_0 + \beta_{Q^{\mathrm{L}}} Q^{\mathrm{L}} + \beta_{\mathrm{k}} VK + \beta_{\mathrm{e}} VE + \beta_l VL + \lambda Q^{\mathrm{g}} + \varepsilon, \tag{12b}$$

where

$$Q^{\mathrm{g}} = Q^{\mathrm{L}} / (\alpha_w + \alpha_{\mathrm{wf}} F + \alpha_{\mathrm{wl}} L).$$

Eq. (12) serves as a basis for deriving the ECMs to test for market power. Detailed derivations of the supply and marketing margin functions in ECM forms are provided in

Appendix A. Because seasonality is important in the supply of live catfish (Kouka and Engle, 1998), we add three seasonal dummy variables to the supply function. We also add a time trend variable to the supply function to account for any technical change in the supply of live catfish.

The supply equation of live catfish in its dynamic form is formulated as

$$\begin{cases} \Delta Q_t^L = \alpha_0 + \sum_{i=1}^{3} \alpha_i D_i + \alpha_T T + \sum_{i=1}^{k-1} \alpha_{Q_i^L} \Delta Q_{t-1}^L + \sum_{i=0}^{k-1} \alpha_{wi} \Delta w_{t-1} + \sum_{i=0}^{k-1} \alpha_{fi} \Delta F_{t-i} + \sum_{i=0}^{k-1} \alpha_{li} \Delta L_{t-i} + \sum_{i=0}^{k-1} \alpha_{wli} \Delta w.L_{t-i} \\ \quad + \sum_{i=0}^{k-1} \alpha_{wfi} \Delta w.F_{t-i} + \gamma^* \left[Q_{t-k}^L - \theta_w w_{t-k} - \theta_f F_{t-k} - \theta_{wf} w.F_{t-k} - \theta_{wl} w.L_{t-k} \right] + u_t \end{cases} \quad (13a)$$

The marketing margin equation in its dynamic form is formulated as

$$\begin{cases} \Delta M_t = \beta_0 + \sum_{i=1}^{k-1} \beta_{M_i} \Delta M_{t-i} + \sum_{i=0}^{k-1} \beta_{Q_i^L} \Delta Q_{t-i}^L + \sum_{i=0}^{k-1} \beta_{ki} \Delta VK_{t-i} + \sum_{i=0}^{k-1} \beta_{ei} \Delta VE_{t-i} + \sum_{i=0}^{k-1} \beta_{li} \Delta VL_{t-i} \\ \quad + \sum_{i=0}^{k-1} \lambda_i \Delta Q_{t-i}^g + \psi^* \left[M_{t-k} - \varepsilon_{Q^L} Q_{t-k}^L - \varepsilon_k VK_{t-k} - \varepsilon_e VE_{t-k} - \varepsilon_l VL_{t-k} - \Lambda Q_{t-k}^g \right] + \varepsilon_t \end{cases} . \quad (13b)$$

As in Steen and Salvanes (1999), we compute Q_t^g using the long-run estimates of the parameters; that is, $Q_t^g = \dfrac{Q_t^L}{\theta_w + \theta_{wf} F_t + \theta_{wl} L_t}$.

IV. Results and Discussion

To estimate the dynamic model as given in Eq. (13), we use quarterly data from 1987.I to 2004.IV. We use quarterly data for two major reasons. First, quarterly data fit reasonably well the seasonal structure of catfish industry because of biological lags. Second, prior studies that estimated the supply of catfish used quarterly data (see, for example, Kouka and Engle, 1998). Data sources and a detailed description of each variable are in Appendix B. Descriptive statistics for the variables used in the model are in Table 1.

Prior to estimating the model, a number of statistical tests are undertaken. Unit root test is carried out both in levels and in first difference for each variable using augmented Dickey-Fuller (ADF) test. As reported in Table 2, the results show that the presence of unit root in levels cannot be rejected at the conventional significant levels. The ADF tests in first difference for each variable indicate the absence of unit root at least at the 10% significant level implying that all the variables are integrated of order one (I (1)).

Having established that all the variables are integrated of the same order I (1), the next step is to test for co-integration. To do that, we follow Johansen co-integrating rank approach (1988). Heffernan (1996) reported that Johansen test perform well compared to Engle and Granger's residual-based method (1987), and more so when there are multiple co-integrating vectors. A glance at the results in Table 3 confirms the existence of co-integrated relationships, thereby implying the existence of an error correction model of the variables in the form of Eq. 12. Prior to estimating the model, we use the Akaike Information Criterion as a guide to determine the lag-length. The results suggest that two lags (i.e., k=2) is the

appropriate lag-length for both the supply and marketing margin functions. The model is estimated econometrically using Non-Linear Three Stage-Least Square estimation method (NL3SLS).

The empirical results for the supply equation are reported in Table 4. The model fits reasonably well with R-square of 87% and most of the parameters are statistically significant.[3] The results confirm the importance of seasonality in the supply of live catfish (e.g., Kouka and Engle, 1998) as evidenced by the highly significance of the seasonal dummy variables. This result is consistent with industry practices. The estimate of the time trend parameter is positive and statistically significant suggesting that the catfish farming industry has experienced a tremendous technological progress over the past years. This result is in accord with that reported by Kazmierczak and Solo (2000) who found that catfish farming industry has undergone substantial structural changes from 1988 to 1998, leading to the emergence of large and highly mechanized farms. In addition, Kouka and Engle (1998) analyzed the supply in the catfish industry and highlighted the importance of technological change.

From Eq. (12a), the long-run supply elasticity for live catfish is given by $\eta_c = (dQ_{\mathrm{t}}^{\mathrm{L}}/dw_{\mathrm{t}})(w_{\mathrm{t}}/Q_{\mathrm{t}}^{\mathrm{L}}) = \left[\theta_{\mathrm{w}} + \theta_{\mathrm{wf}}F_{\mathrm{t}} + \theta_{\mathrm{w}l}L_t\right][w_{\mathrm{t}}/Q_{\mathrm{t}}^{\mathrm{L}}]$. Evaluated at the mean values of the variables and using the long-run estimates of the parameters, the long-run supply elasticity, η_c, is 0.02; implying that the supply for live catfish is inelastic. This result is consistent with that found by Kouka and Engle (1998). From a biological perspective, catfish requires from 18 to 24 months to reach market size (Tucker and Robinson, 1990).This lengthy grow out period largely explains the inelastic nature of the supply of catfish and thus making it difficult for catfish farmers to respond accordingly to any changes in the market environment such as an increase in price of live catfish (Engle and Quagrinie, 2006).

Theoretically, the adjustment parameter γ^* is bounded by –1 and 0. When it is –1, no error correction occurs. When it is 0, an instant adjustment takes place due to any deviation from the long run equilibrium. The estimate of the adjustment parameter, γ^*, is –0.31 and is highly significant suggesting that an adjustment of 31% of the supply of live catfish takes place each quarter after deviations from the long run equilibrium.

The empirical results for the marketing margin function are in Table 5. The main parameters of interest are: the short and long run conduct indices λ_0 and Λ, respectively. To test whether catfish processing plants are price-takers in the live catfish market in the short run is equivalent to testing whether $\lambda_0 = 0$. With a Wald Chi-Square Statistic of 0.10 E-02 and a p-value of 0.97 the hypothesis that $\lambda_0 = 0$ cannot be rejected, implying that catfish processing industry is competitive in the short run. Similarly, with a Wald Chi-Square Statistic of 0.85 E-01 and a p-value of 0.77 the hypothesis that $\Lambda = 0$ cannot be rejected, suggesting that processors are price-takers in the live catfish market in the long run. These

[3] Unlike static models, dynamic error correction models have some important features in that they take into account autocorrelation and non-stationarity (Steen and Salvanes, 1999).

results corroborate some of the previous studies that analyzed market power in the catfish industry. Along these lines, Bouras and Engle (2007) used a static conjectural variation model and found catfish industry to be competitive. Wiese and Quagrainie (2004) using a monopsony power model revealed that catfish processors did not exercise market power over catfish farmers. A similar result was reported by (Nyankori, 1991).

The competitive behavior of catfish processing industry can be explained by the trade-offs between market power and cost efficiencies arising from higher concentration (Williamson, 1968). Put differently, higher concentration may generate cost savings through economies of scale, but at the same time higher concentration may lead to market power. It is likely that the magnitude of cost efficiencies due to higher concentration in the catfish processing industry is larger than the magnitude of market power.

V. Conclusion

Although competition in the US catfish industry has been widely covered in the literature, the methodology used is solely based on static oligopoly models. This paper, however, used a dynamic error correction model, as an alternative method, to analyze the degree of competitiveness in the US catfish industry. The empirical results indicated that catfish processing plants are price-takers in the live catfish market both in the short and long run. The results suggest an adjustment of 31% of the supply of live catfish each quarter after deviations from the long run equilibrium. The empirical results also show that the catfish farming industry has experienced an important technological progress over the past years.

This paper can be extended in many ways. One way is to let the conduct parameter (i.e., the conjectural variation elasticity) vary with market characteristics such as concentration and advertising. Another way is to develop a dynamic model analogue of Azzam's model (1997) that decomposes the marketing margin into an oligopsony power component and a cost-efficiency component and then compare the magnitude of each component.

Appendix A

I. The supply function

The starting point of the derivation of the supply function in ECM form is equation (11a).

That is

$$Q_t^L = \alpha_0 + \alpha_w w_t + \alpha_f F_t + \alpha_l L_t + \alpha_{wf} w.F_t + \alpha_{wl} w.L_t + u_t . \quad (A1)$$

The dynamic pattern in the data is captured by adding lagged values of both Q_t^L and all the independent variables. For simplicity, we assume that the lag-length is one (i.e., k=1). Eq.(A1) becomes

$$Q_t^L = \alpha_0 + \alpha_{w0} w_t + \alpha_{w1} w_{t-1} + \alpha_{f0} F_t + \alpha_{f1} F_{t-1} + \alpha_{l0} L_t + \alpha_{l1} L_{t-1} + \alpha_{wf0} w.F_t + \alpha_{wf1} w.F_{t-1} + \alpha_{wl0} w.L_t + \alpha_{wl1} w.L_{t-1} + \alpha_{Q_t^L} Q_{t-1}^L + u_t \quad (A2)$$

Adding and deleting Q_{t-1}^L, $\alpha_{w0} w_{t-1}$, $\alpha_{f0} F_{t-1}$, $\alpha_{l0} L_{t-1}$, $\alpha_{wf0} w.F_{t-1}$, and $\alpha_{wl0} w.L_{t-1}$ in the right hand side of (A2), and rearranging yields

$$\begin{cases} Q_t^L = \alpha_0 + \alpha_{w0} w_t + \alpha_{w1} w_{t-1} + \alpha_{f0} F_t + \alpha_{f1} F_{t-1} + \alpha_{l0} L_t + \alpha_{l1} L_{t-1} + \alpha_{wf0} w.F_t + \alpha_{wf1} w.F_{t-1} \\ \quad + \alpha_{wl0} w.L_t + \alpha_{wl1} w.L_{t-1} + (\alpha_{w0} w_{t-1} - \alpha_{w0} w_{t-1}) + (\alpha_{f0} F_{t-1} - \alpha_{f0} F_{t-1}) + (\alpha_{l0} L_{t-1} - \alpha_{l0} L_{t-1}) \\ \quad + (\alpha_{wf0} w.F_{t-1} - \alpha_{wf0} w.F_{t-1}) + (\alpha_{wl0} w.L_{t-1} - \alpha_{wl0} w.L_{t-1}) + (Q_{t-1}^L - Q_{t-1}^L) + \alpha_{Q_t^L} Q_{t-1}^L + u_t \end{cases} \quad (A3)$$

Rearranging (A3) results in

$$\begin{cases} Q_t^L - Q_{t-1}^L = \alpha_0 + (\alpha_{w0} w_t - \alpha_{w0} w_{t-1}) + (\alpha_{w0} w_{t-1} + \alpha_{w1} w_{t-1}) + (\alpha_{f0} F_t - \alpha_{f0} F_{t-1}) + (\alpha_{f0} F_{t-1} + \alpha_{f1} F_{t-1}) \\ \quad + (\alpha_{l0} L_t - \alpha_{l0} L_{t-1}) + (\alpha_{l0} L_{t-1} + \alpha_{l1} L_{t-1}) + (\alpha_{wf0} w.F_t - \alpha_{wf0} w.F_{t-1}) + (\alpha_{wf0} w.F_{t-1} + \alpha_{wf1} w.F_{t-1}) \\ \quad + (\alpha_{wl0} w.L_t - \alpha_{wl0} w.L_{t-1}) + (\alpha_{wl0} w.L_{t-1} + \alpha_{wl1} w.L_{t-1}) + (\alpha_{Q_t^L} Q_{t-1}^L - Q_{t-1}^L) + u_t \end{cases} \quad (A4)$$

Using the difference operator (A4) becomes

$$\begin{cases} \Delta Q_t^L = \alpha_0 + \alpha_{w0} \Delta w_t + (\alpha_{w0} + \alpha_{w1}) w_{t-1} + \alpha_{f0} \Delta F + (\alpha_{f0} + \alpha_{f1}) F_{t-1} + \alpha_{l0} \Delta L_t + (\alpha_{l0} + \alpha_{l1}) L_{t-1} \\ \quad + \alpha_{wf0} \Delta w.F_t + (\alpha_{wf0} + \alpha_{wf1}) w.F_{t-1} + \alpha_{wl0} \Delta w.L_t + (\alpha_{wl0} + \alpha_{wl1}) w.L_{t-1} + (\alpha_{Q_t^L} - 1) Q_{t-1}^L + u_t \end{cases} \quad (A5)$$

Rearranging (A5) yields

$$\begin{cases} \Delta Q_t^L = \alpha_0 + \alpha_{w0} \Delta w_t + \alpha_{f0} \Delta F_t + \alpha_{l0} \Delta L_t + \alpha_{wf0} \Delta w.F_t + \alpha_{wl0} \Delta w.L_t + \\ (\alpha_{Q_t^L} - 1) \left[Q_{t-1}^L - \frac{(\alpha_{w0} + \alpha_{w1})}{(1 - \alpha_{Q_t^L})} w_{t-1} - \frac{(\alpha_{f0} + \alpha_{f1})}{(1 - \alpha_{Q_t^L})} F_{t-1} - \frac{(\alpha_{l0} + \alpha_{l1})}{(1 - \alpha_{Q_t^L})} L_{t-1} - \frac{(\alpha_{wf0} + \alpha_{wf1})}{(1 - \alpha_{Q_t^L})} w.F_{t-1} - \frac{(\alpha_{wl0} + \alpha_{wl1})}{(1 - \alpha_{Q_t^L})} w.L_{t-1} \right] + u_t \end{cases} \quad (A6)$$

Letting $\gamma^* = (\alpha_{Q_t^L} - 1)$, $\theta_w = \frac{(\alpha_{w0} + \alpha_{w1})}{(1 - \alpha_{Q_t^L})}$, $\theta_f = \frac{(\alpha_{f0} + \alpha_{f1})}{(1 - \alpha_{Q_t^L})}$, $\theta_l = \frac{(\alpha_{l0} + \alpha_{l1})}{(1 - \alpha_{Q_t^L})}$,

$\theta_{wf} = \frac{(\alpha_{wf0} + \alpha_{wf1})}{(1 - \alpha_{Q_t^L})}$

and $\theta_{wl} = \dfrac{\left(\alpha_{\mathrm{w}l0} + \alpha_{\mathrm{w}l1}\right)}{\left(1-\alpha_{\mathrm{Q}_\mathrm{t}^\mathrm{L}}\right)}$, (A6) becomes

$$\begin{cases} \Delta \mathrm{Q}_\mathrm{t}^\mathrm{L} = \alpha_0 + \alpha_{w0}\Delta w_\mathrm{t} + \alpha_{\mathrm{f}0}\Delta F + \alpha_{l0}\Delta L_\mathrm{t} + \alpha_{\mathrm{w}\mathrm{f}0}\Delta w.F_\mathrm{t} + \alpha_{\mathrm{w}l0}\Delta w.L_\mathrm{t} + \\ \qquad \gamma^*\left[Q_{\mathrm{t}\text{-}1}^\mathrm{L} - \theta_w w_{\mathrm{t}\text{-}1} - \theta_\mathrm{f} F_{\mathrm{t}\text{-}1} - \theta_l L_{\mathrm{t}\text{-}1} - \theta_{\mathrm{w}\mathrm{f}} w.F_{\mathrm{t}\text{-}1} - \theta_{\mathrm{w}l} w.L_{\mathrm{t}\text{-}1}\right] + u_\mathrm{t} \end{cases}. \tag{A7}$$

II. The marketing margin function

The starting point of the derivation of the marketing margin function in ECM form is equation (11b). That is

$$M_\mathrm{t} = \beta_0 + \beta_{\mathrm{Q}^\mathrm{L}} Q_\mathrm{t}^\mathrm{L} + \beta_\mathrm{k} VK_\mathrm{t} + \beta_\mathrm{e} VE_\mathrm{t} + \beta_l VL_\mathrm{t} + \lambda Q_\mathrm{t}^\mathrm{g} + \varepsilon_\mathrm{t} \tag{B1}$$

The dynamic pattern in the data is captured by adding lagged values of both M_t and all the independent variables. For simplicity, we assume that the lag-length is one (i.e., k=1). Eq.(B1) becomes

$$\begin{cases} M_\mathrm{t} = \beta_0 + \beta_{\mathrm{M}1} M_{\mathrm{t}\text{-}1} + \beta_{Q_0^\mathrm{L}} Q_\mathrm{t}^\mathrm{L} + \beta_{Q_1^\mathrm{L}} Q_{\mathrm{t}\text{-}1}^\mathrm{L} + \beta_{\mathrm{k}0} VK_\mathrm{t} + \beta_{\mathrm{k}1} VK_{\mathrm{t}\text{-}1} + \beta_{\mathrm{e}0} VE_\mathrm{t} + \beta_{\mathrm{e}1} VE_{\mathrm{t}\text{-}1} + \beta_{l0} VL_\mathrm{t} \\ \qquad + \beta_{l1} VL_{\mathrm{t}\text{-}1} + \lambda_0 Q_\mathrm{t}^\mathrm{g} + \lambda_1 Q_{\mathrm{t}\text{-}1}^\mathrm{g} + \varepsilon_\mathrm{t} \end{cases} \tag{B2}$$

Adding and deleting $M_{\mathrm{t}\text{-}1}$, $\beta_{Q_0^\mathrm{L}} Q_{\mathrm{t}\text{-}1}^\mathrm{L}$, $\beta_{\mathrm{k}0} VK_{\mathrm{t}-1}$, $\beta_{\mathrm{e}0} VE_{\mathrm{t}\text{-}1}$, $\beta_{l0} VL_{\mathrm{t}\text{-}1}$, $\lambda_0 Q_{\mathrm{t}\text{-}1}^\mathrm{g}$ in the right hand side of (B2), and rearranging yields

$$\begin{cases} M_\mathrm{t} = \beta_0 + \beta_{Q_0^\mathrm{L}} Q_\mathrm{t}^\mathrm{L} + \left(\beta_{Q_0^\mathrm{L}} Q_{\mathrm{t}\text{-}1}^\mathrm{L} - \beta_{Q_0^\mathrm{L}} Q_{\mathrm{t}\text{-}1}^\mathrm{L}\right) + \beta_{\mathrm{Q}_1^\mathrm{L}} Q_{\mathrm{t}\text{-}1}^\mathrm{L} + \beta_{\mathrm{k}0} VK_\mathrm{t} + \left(\beta_{\mathrm{k}0} VK_{\mathrm{t}\text{-}1} - \beta_{\mathrm{k}0} VK_{\mathrm{t}\text{-}1}\right) + \beta_{\mathrm{k}1} VK_{\mathrm{t}\text{-}1} \\ \qquad + \beta_{\mathrm{e}0} VE_\mathrm{t} + \left(\beta_{\mathrm{e}0} VE_{\mathrm{t}\text{-}1} - \beta_{\mathrm{e}0} VE_{\mathrm{t}\text{-}1}\right) + \beta_{\mathrm{e}1} VE_{\mathrm{t}\text{-}1} + \beta_{l0} VL_\mathrm{t} + \left(\beta_{l0} VL_{\mathrm{t}\text{-}1} - \beta_{l0} VL_{\mathrm{t}\text{-}1}\right) + \beta_{l1} VL_{\mathrm{t}\text{-}1} + \lambda_0 Q_\mathrm{t}^\mathrm{g} \\ \qquad + \left(\lambda_0 Q_{\mathrm{t}\text{-}1}^\mathrm{g} - \lambda_0 Q_{\mathrm{t}\text{-}1}^\mathrm{g}\right) + \lambda_1 Q_{\mathrm{t}\text{-}1}^\mathrm{g} + M_{\mathrm{t}\text{-}1} + \left(M_{\mathrm{t}\text{-}1} - M_{\mathrm{t}\text{-}1}\right) + \beta_{\mathrm{M}1} M_{\mathrm{t}\text{-}1} + \varepsilon_\mathrm{t} \end{cases} \tag{B3}$$

Rearranging (B3) results in

$$\begin{cases}(M_t - M_{t-1}) = \beta_0 + \left(\beta_{Q_0^L} Q_t^L - \beta_{Q_0^L} Q_{t-1}^L\right) + \left(\beta_{Q_i^L} Q_{t-1}^L + \beta_{Q_0^L} Q_{t-1}^L\right) + \left(\beta_{k0} VK_t - \beta_{k0} VK_{t-1}\right) \\ \quad + \left(\beta_{k1} VK_{t-1} + \beta_{k0} VK_{t-1}\right) + \left(\beta_{e0} VE_t - \beta_{e0} VE_{t-1}\right) + \left(\beta_{e0} VE_{t-1} + \beta_{e1} VE_{t-1}\right) \\ \quad + \left(\beta_{l0} VL_t - \beta_{l0} VL_{t-1}\right) + \left(\beta_{l0} VL_{t-1} + \beta_{l1} VL_{t-1}\right) + \left(\lambda_0 Q_t^g - \lambda_0 Q_{t-1}^g\right) \\ \quad + \left(\lambda_0 Q_{t-1}^g + \lambda_1 Q_{t-1}^g\right) + \left(\beta_{M1} M_{t-1} - M_{t-1}\right) + \varepsilon_t\end{cases} \tag{B4}$$

Using the difference operator (B4) becomes

$$\begin{cases}\Delta M_t = \beta_0 + \beta_{Q_0^L} \Delta Q_t^L + \left(\beta_{Q_i^L} + \beta_{Q_0^L}\right) Q_{t-1}^L + \beta_{k0} \Delta VK_t + \left(\beta_{k1} + \beta_{k0}\right) VK_{t-1} + \beta_{e0} \Delta VE_t \\ \quad + \left(\beta_{e0} + \beta_{e1}\right) VE_{t-1} + \beta_{l0} \Delta VL_t + \left(\beta_{l0} + \beta_{l1}\right) VL_{t-1} + \lambda_0 \Delta Q_t^g + \left(\lambda_0 + \lambda_1\right) Q_{t-1}^g \\ \quad + \left(\beta_{M1} - 1\right) M_{t-1} + \varepsilon_t\end{cases} \tag{B5}$$

Rearranging (B5) yields

$$\begin{cases}\Delta M_t = \beta_0 + \beta_{Q_0^L} \Delta Q_t^L + \beta_{k0} \Delta VK_t + \beta_{e0} \Delta VE_t + \beta_{l0} \Delta VL_t + \lambda_0 \Delta Q_t^g \\ + \left(\beta_{M1} - 1\right)\left[M_{t-1} - \dfrac{\left(\beta_{Q_i^L} + \beta_{Q_0^L}\right)}{\left(1 - \beta_{M1}\right)} Q_{t-1}^L - \dfrac{\left(\beta_{k1} + \beta_{k0}\right)}{\left(1 - \beta_{M1}\right)} VK_{t-1} - \dfrac{\left(\beta_{e0} + \beta_{e1}\right)}{\left(1 - \beta_{M1}\right)} VE_{t-1} - \dfrac{\left(\beta_{l0} + \beta_{l1}\right)}{\left(1 - \beta_{M1}\right)} VL_{t-1} - \dfrac{\left(\lambda_0 + \lambda_1\right)}{\left(1 - \beta_{M1}\right)} Q_{t-1}^g\right] + \varepsilon_t\end{cases} \tag{B6}$$

Letting $\psi^* = \left(\beta_{M1} - 1\right)$, $\varepsilon_{Q^L} = \dfrac{\left(\beta_{Q_i^L} + \beta_{Q_0^L}\right)}{\left(1 - \beta_{M1}\right)}$, $\varepsilon_k = \dfrac{\left(\beta_{k1} + \beta_{k0}\right)}{\left(1 - \beta_{M1}\right)}$, $\varepsilon_e = \dfrac{\left(\beta_{e0} + \beta_{e1}\right)}{\left(1 - \beta_{M1}\right)}$, $\varepsilon_l = \dfrac{\left(\beta_{l0} + \beta_{l1}\right)}{\left(1 - \beta_{M1}\right)}$, and $\Lambda = \dfrac{\left(\lambda_0 + \lambda_1\right)}{\left(1 - \beta_{M1}\right)}$, (B6) becomes

$$\begin{cases}\Delta M_t = \beta_0 + \beta_{Q_0^L} \Delta Q_t^L + \beta_{k0} \Delta VK_t + \beta_{e0} \Delta VE_t + \beta_{l0} \Delta VL_t + \lambda_0 \Delta Q_t^g \\ \quad + \psi^*\left[M_{t-1} - \varepsilon_{Q^L} Q_{t-1}^L - \varepsilon_k VK_{t-1} - \varepsilon_e VE_{t-1} - \varepsilon_l VL_{t-1} - \Lambda Q_{t-1}^g\right] + \varepsilon_t\end{cases} \tag{B7}$$

Appendix B

Definition of variables and list of data sources are as follows:

P	Real wholesale price of processed catfish (cent/lb). Source: various issues of the USDA: Aquaculture Situation and Outlook Report (US Department of Agriculture: Catfish and trout production, National Agricultural Statistics Service, 1987-2005).
Q^L	Industry total quantity of live catfish (1000 lbs). Source: various issues of the USDA: Aquaculture Situation and Outlook Report (US Department of Agriculture: Catfish and trout production, National Agricultural Statistics Service, 1987-2005).
w	Real price paid to catfish farmers (cent/lb). Source: various issues of the USDA: Aquaculture Situation and Outlook Report (US Department of Agriculture: Catfish and trout production, National Agricultural Statistics Service. 1987-2005).
F	Real feed price ($/ton). Source: publications of the Mississippi Cooperative Extension Service.
L	Hired farm workers real average wage ($/hour). Source: various issues of the USDA: Aquaculture Situation and Outlook Report (US Department of Agriculture: Catfish and trout production, National Agricultural Statistics Service, 1987-2005).
VL	Real minimum hourly wage ($/hour). Source: various issues of the United States Department of Labor: Bureau of Labor Statistics, Employment and Earnings (US Department of Labor, Bureau of Labor Statistics, Employment and Earnings, 1987-2004).
VE	Real average retail electricity prices, industrial customers (cent/kilowatt hour). Source: various issues of the United States Department of Energy: Energy Information Administration, Monthly Energy Review (US Department of Energy, Energy Information Administration, Monthly Energy Review. 1987-2004).
VK	Bank prime loan rate used as a proxy for the cost of the capital (%). Source: Economic Time Series database (Economic Time Series Data Base available at: http://www.economagic.com/em-cgi/data.exe/fedbog/prime).

Table 1: Descriptive statistics for the variables

Variable	Mean	CV[1]	Median	Max	Min
Price of processed catfish: P	1.8	16.0	1.8	2.4	1.3
Cost of electricity: VE	3.2	15.4	3.0	4.3	2.5
Cost of capital: VK	5.2	1.8	35.2	9.2	2.1
Feed price: F	154.6	21.9	156.0	245.2	110.5
Farm worker average wage: L	4.2	8.1	4.0	4.9	3.7
Margin: M	1.5	15.5	1.5	2.0	1.1
Quantity of live catfish processed: Q^L	40509.1	24.7	39636.2	58663.7	21331.7
Live catfish price: w	0.5	19.7	0.7	0.3	5.2
Cost of labor: VL	2.9	4.6	2.9	3.2	2.6

[1]Coefficient of variation (%).

Table 2: Unit Root Tests

	H_0 of Unit Root in levels		H_0 of Unit Root in 1st difference	
Variable	ADF without Trend	ADF with Trend	ADF without Trend	ADF with Trend
Cost of electricity: VE	-2.54 (4)	0.13 (7)	-2.78 (3)***	-4.29 (6)*
Feed price: F	-1.73 (1)	-2.90 (1)	-5.64 (0)*	-5.60 (0)*
Farm worker average wage: L	-0.15 (5)	-2.42 (5)	-2.82 (4)***	-2.91 (4)**
Margin: M	-2.28 (0)	-3.04 (1)	-8.00 (0)*	-8.08 (0)*
Feed price x live catfish price: F.w	-1.36 (2)	-3.08 (1)	-5.91 (0)**	-5.86 (0)**
Farm worker average wage x live catfish price: L.w	-1.48 (2)	-2.97 (0)	-7.78 (1)**	-7.72 (1)**
Cost of capital: VK	-1.47 (1)	-2.81 (2)	-4.41 (0)*	-4.34 (0)*
Quantity processed: Q^L	-1.64 (7)	-2.15 (7)	-4.37 (6)*	-4.54 (6)*
Live catfish price: w	-1.13 (11)	-3.20 (11)	-3.26 (9)**	-3.23 (9)***
Wage: VL	-3.08 (4)	-3.09 (4)	-3.46 (7)**	-3.55 (7)**
Q^g	-2.07 (4)	-1.74 (4)	-4.03 (3)***	-4.6 (3)***

Levels of statistical significance are represented by: *(10%), **(5%) and *** (1%).

Lag length in parentheses.

Table 3: Multivariate co-integration tests

	Max-Eigenvalue Statistic	Trace Statistic
	Supply Function	
1 cointegrating vector r=0	51.11**	110.95**
2 cointegrating vectors r=1	26.35	59.84
3 cointegrating vectors r=2	16.73	33.49
4 cointegrating vectors r=3	10.80	16.76
5 cointegrating vectors r=4	5.02	5.96
6 cointegrating vectors r=5	0.94	0.94
	Marketing Margin Function	
1 cointegrating vector r=0	44.02**	120.92**
2 cointegrating vectors r=1	36.62**	76.90**
3 cointegrating vectors r=2	20.85	40.27
4 cointegrating vectors r=3	11.66	19.42
5 cointegrating vectors r=4	5.28	7.75
6 cointegrating vectors r=5	2.47	2.47

** Indicate statistical significance at 5%

Table 4: Supply Function Estimates and Standard Errors

Parameter	Estimate	Standard Error
α_0	-1770.80	235.88*
α_1	4179.00	319.76*
α_2	-1332.90	198.71*
α_3	1056.00	126.71*
α_T	89.85	25.16**
$\alpha_{Q_l^L}$	-0.33	0.06*
α_{w0}	-2386.90	346.26*
α_{w1}	-329.95	1277.00
α_{f0}	83.22	5.67*
α_{f1}	-2.08	8.65
α_{l0}	4263.70	310.35*
α_{l1}	866.79	233.03*
α_{wf0}	18.56	8.13*
α_{wf1}	-31.05	11.81*
α_{wl0}	1482.00	262.28*
α_{wl1}	-1608.30	598.17**
γ^*	-0.31	0.06*
Long run parameters		
θ_w	49.70	14.95*
θ_f	4.74	2.03**
θ_l	220.70	69.39*
θ_{wl}	230.61	65.88*
θ_{wf}	3.19	1.67***
Long run supply elasticity	0.02	0.003*
R-square	0.87	
Degrees of Freedom	46	

Levels of statistical significance are represented by : *(10%), **(5%) and *** (1%).

Table 5: Marketing Margin Function Estimates and Standard Errors

Parameter	Estimate	Standard Error
β_0	0.38	0.04*
β_{M1}	-0.19	0.13***
$\beta_{Q_0^L}$	-0.65E-06	0.60E-03
$\beta_{Q_1^L}$	-0.23E-05	0.72E-03
β_{k0}	0.47E-02	0.49E-01***
β_{k1}	-0.12E-01	0.70E-01
β_{e0}	0.36E-01	0.90E-01
β_{e1}	-0.22E-01	0.11
β_{l0}	0.64	0.12*
β_{l1}	-0.19	0.14***
λ_0	-0.15E-02	0.45E-01
λ_1	-0.94E-03	0.46E-01
ψ^*	-0.25E-01	0.75E-01
Long run parameters		
ε_w	-1.37	0.00*
ε_{Q^L}	-0.38E-04	0.27E-02
β_k	-0.19	0.27
β_e	-1.53	0.76***
Λ	-0.92E-01	0.31
R-square	0.97	
Degrees of Freedom	50	

Levels of statistical significance are represented by : *(10%), **(5%) and *** (1%).

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PREDICTING PERFORMANCE FOR ONLINE STUDENTS: IS IT BETTER TO BE HOME ALONE?

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Abstract

The trend toward online higher education has been well documented in both the popular press and the education literature. Yet, the debate within higher education regarding the effectiveness of online education continues. Recent studies, Coates et al (2004), Farinella (2007) and Gratton-Lavoie and Stanley (2009), find that economics students in online courses perform worse overall. Our research is an experimental response to these studies. We take another look at the impact that course delivery has on student performance using what we believe is an improved, less biased study design. Like the aforementioned studies, we find that students in the online course perform worse than students in the face-to-face classes. In addition, we find that there is no selection bias for students choosing the online section and that the students who select into face-to-face classes perform better than they would have performed in an online class. University, college, and departmental administrators who are inclined to convert traditional face-to-face courses into online only sections should be aware that our findings suggest that not only does overall performance fall, but that performance declines even more for students who would have otherwise preferred the traditional classroom.

I. Introduction

The trend toward online higher education has been well documented in both the popular press and the education literature. Traditional publishing companies are even creating internet based solutions in response to the increased demand for online course delivery. Course management systems such as Blackboard and WebCT are continually updated to ease any barriers in creating and offering both fully online courses and hybrid online and face-to-face courses. A quick visit to elearners.com results in a list of 178 accredited "online" colleges and universities including Vanderbilt, Villanova, and Clemson. The same site also lists six online economics degree programs and nine colleges offering economics courses including UNC-Chapel Hill's distance learning Friday Center. Professors at some institutions are switching from traditional face-to-face to online only options for their students. For example, the computer information systems course that is required of all undergraduate business majors at our regional university has switched from face-to-face delivery to online only delivery.

Despite the continued trend in online delivery of courses, programs, and degree programs, faculty and administrators continue to debate the effectiveness of the online delivery method. Bernard et al (2004) produced a meta-analysis of the 235 empirical studies conducted between 1985 and 2002 on the effectiveness of distance education. Tallent-Runnels et al (2006) reviewed the literature specifically devoted to teaching online courses. Coates et al (2004) summarize the mixed results of effectiveness of online economics courses and recent empirical works on this subject include Farinella (2007) and Gratton-Lavoie and Stanley (2009). The questions remain. Do students who take online courses learn as much or perform as well as those in the traditional face-to-face courses? Furthermore, what learning advantage or disadvantage might exist for students forced to switch from one mode of delivery to the other?

Coates et al (2004) find using both 2SLS and an endogenous switching model that students in face-to-face classes performed better in terms of their test scores than students in online classes after controlling for self-selection bias. Farinella (2007) finds evidence "that students enrolled in an online introduction finance course earn an average of 21 points less on the final exam relative to students in a traditional course". Similarly, Gratton-Lavoie and Stanley (2009) find "a negative penalty associated with online teaching and that most students would have performed best in the hybrid class", i.e. face to face class. Our interest lies in these three works because they assess the impact of online versus face to face classes on student performance which is measured in terms of student exam scores. This differs from the vast majority of earlier studies which attempted to assess the impact of course type on more subjective measures of student performance which is measured in terms of student-teacher evaluations of the class or class dropouts. We take another look at the impact that course delivery has on student performance, i.e. student exam scores, using what we believe is an improved, less biased study design. Like Coates et al, Farinella (2007), and Gratton-Lavoie and Stanley (2009), we find that students in the online course perform worse than students in the face-to-face classes after controlling for self selection bias. However, unlike Coates et al, we find that there is no selection bias for students choosing the online section and that the students who select into face-to-face classes perform better than they would have

performed in an online class. Thus, any change in curriculum or university policy which forced these students into online course delivery would lower their performance.

The next section of the paper presents our study design. We follow with our data description and empirical model. The results and conclusion follow.

II. Study Design

The students in our study are from sections of principles of macroeconomics taught by the same professor at a single university. This course is required for all college of business majors and can be used to fulfill general education requirements for both business and non-business majors. Previous studies have compared online versus face-to-face delivery methods using student performance data derived from one or more of the following: different instructors with varying experience in teaching online courses (Brown and Liedholm, 2002 and Gratton-Lavoie and Stanley, 2009); online testing that was not proctored thus increasing the opportunity for cheating (Coates et al, 2004 and Farinella, 2007); and tests consisting of questions chosen by the instructor which could create an environment where the professor could "teach the test" (Coates et al; Anstine and Skidmore, 2005; Brown and Liedholm, 2002). The existence of each of these has the potential to introduce bias in the experiment.

Our study uses multiple safe-guards to address the above sources of bias. First, the same instructor, experienced in both types of course delivery, taught both the online and the face-to-face classes. Second, the instructor did not generate tests. A colleague selected 30 multiple-choice questions, for each of the four tests, at random from the test bank that accompanies *MacroEconomics for Today*, 4th edition by Irvin Tucker. This Tucker text was used for both online and face-to-face sections. On the day before each test was given, the instructor chose 25 questions. This procedure eliminated the possibility that the instructor would, either intentionally or unintentionally, "teach to the test" and also reduced the likelihood that tests included material that the instructor had not covered. Third, unlike other studies where online students were allowed to take tests at home or in some other unproctored environment, online students were required to come to campus and take the same test on the same day as students in the face-to-face classes. Admittedly, requiring online students to take tests on campus has the potential to introduce a negative bias in online student test results because such students are taking their tests outside their normal study environment. However, students knew prior to registering for the online class that testing would occur on campus. We view this negative bias as less severe than the positive bias associated with unproctored online testing. Fourth, lectures were not recorded for use by either group. However, written lecture notes were posted on Blackboard but only for online students. This eliminated the opportunity for face-to-face students to read class lectures after having attended class. Fifth, students in both classes were encouraged to submit homework and to post responses to discussion board topics; both groups knew that such participation, though not required, could influence "borderline" grades. Finally, both groups of students had access to the instructor through email, instructor-provided feedback to discussion board postings, as well as through "help-sessions" during office hours. Taken as a whole, we view these safe-guards as an improvement in study design relative to prior studies.

III. Data and Model

The approach taken in this paper is similar to that of Farinella (2007), Gratton-Lavoie and Stanley (2009) and Coates et al (2004) in that a production function approach is employed. Output, student performance, is dependent upon certain inputs, course delivery method and student and family characteristics. Student *Performance* is the average of the student's four exams scores during the semester. *Online* represents course delivery method which equals one if the student is in an online class, zero otherwise. Student and family characteristics include: *Gender* equals one for male, zero otherwise; *Race* equals one for white, zero otherwise; *Age* represents the age of the student; *ACT* represents the ACT score of the student; *Previous Econ Class* equals one if the student has had a previous economics class at the university level, zero otherwise; *GPA* represents the student's grade point average; *Load* is the number of credit hours that the student is taking during the current semester; *Total Credit Hours* is the number of credit hours the student has accumulated during their academic career; *Work Hours* is the number of hours per week that the student works; *Parent* equals 0 if neither parent has a college education, 1 if either parent has a college education, and 2 if both parents have a college education.[1] The empirical model for student performance is:

$$Performance = \beta_0 + \beta_1 Online + \beta_2 Gender + \beta_3 Race + \beta_4 Age + \beta_5 ACT + \beta_5 \Pr eviousEconClass + \beta_6 GPA + \beta_7 Load + \beta_8 TotalCreditHours + \beta_9 WorkHours + \beta_{10} Parent + \varepsilon$$

Due to self-selection sample bias, Greene (2003: 783-788) discusses why estimating the student performance equation by ordinary least squares would lead to biased and inconsistent parameter estimates. Therefore, in order to correct for the self-selection problem, one must estimate a self-selection equation which explains why some students prefer one type of class over the other. This equation is necessary because students are not assigned randomly to the two classes. Once the self-selection equation is estimated, the results will be used to correct for the self-selection problem in the student performance equation.

The self-selection equation's dependent variable is a dichotomous variable, *Online*, that equals one if a student is enrolled in an online class, zero otherwise. Independent variables related to the likelihood that someone would select into an online class include: student gender, *Gender;* student age, *Age;* number of hours worked per week, *Work Hours;* student cumulative hours earned, *Total Credit Hours*; student ACT score, *ACT*; student grade point average, *GPA*; student race, *Race*; and number of current credit hours that the student is taking during the current semester, *Load*. These variables are defined above. Additional variables in this specification include *Internet,* a student's self-reported evaluation of their internet ability; *Math,* a measure of the student's perception of his or her own math ability; and the following binary variables: *Campus*, which equals one if a student lives on campus;

[1] The student population is very racially homogeneous and was divided into white and nonwhite only. Note that the SAT score for some students were converted to ACT scores (the primary exam type in our region) using the university's standard conversion scale.

Friend which equals one if a student has a friend who has taken an online class; *Previous Web Class* which equals one if a student has taken a previous web class. Given the dichotomous nature of the dependent variable for the self-selection equation, the appropriate estimating technique is a probit model. The empirical model is described below. Please see Tables 1 and 2 for descriptive statistics of the full and subset samples.

$$\begin{aligned} Online = {} & \beta_0 + \beta_1 Gender + \beta_2 Age + \beta_3 WorkHours + \beta_4 TotalCreditHours + \beta_5 ACT + \beta_6 GPA + \\ & \beta_7 Race + \beta_8 Load + \beta_9 Internet + \beta_{10} Math + \beta_{11} Campus + \beta_{12} Friend + \\ & \beta_{13} \text{Pr} eviousWebClass + \varepsilon \end{aligned}$$

The variables employed in the self selection equation are similar to the variables employed in the aforementioned three studies. Females are more likely to sign up for online classes because of work and family duties, see Gratton-Lavoie and Stanley op cit. Older students and students who work more hours per week are less likely to have the time to commit to traditional class, thus, they are more likely to opt for a more flexible class schedule thereby enrolling in an online class. As cumulative hours earned increases, i.e. student transitions from freshman to sophomore to junior to senior status, one would expect that a student has greater confidence in their ability to handle an online class. Obviously, off campus students and students with greater confidence in their internet abilities are more likely to enroll in online classes. Thus, one would expect the signs on the coefficients for these two variables to be negative. One's own perception of math ability may have an influence on registering for an online class because math and economics are both analytical in nature. Thus, as student perception of his/her math ability increases, thereby providing them with the confidence to handle an online economic class, they may feel more inclined to enroll in an online economics class.

The expected signs on *GPA*, *ACT*, *Friend*, *Previous Web Class*, and *Load* variables are unknown. A student with a high grade point average and/or ACT score may be more likely to enroll in an online class because of the students' perception that they can handle the course online. It may also be true that individuals with high GPAs and ACTs have achieved those levels because of the ease and comfort associated with traditional classroom settings. Thus, they may be less likely to enroll in online courses. Students who have had a friend take a previous web class or a student who has taken a previous web class themselves may have had a positive or negative experience with an online class. One's willingness to register for an online course could be influenced by the number of credit hours that one is currently enrolled for the semester. Fewer current credit hours leave one with more time to devote to online class. Alternatively, a student with a larger number of current credit hours may need the time flexibility associated with online courses. Therefore, the influence of these two variables on class type is uncertain.

IV. Results

In this section we concentrate only on the effect that type of class has on student performance. Table 3 reports results for two initial forms of estimation: OLS and the selection corrected 2SLS. Using OLS, the coefficient on the online class variable has a negative sign but is statistically insignificant suggesting that class type has no statistically

significant impact on student performance. Unlike our finding, Farinella op cit. finds that students enrolled in an online class performed on average 21 points lower than students enrolled in a traditional class. Coates' OLS estimates find that face-to-face students answered correctly on average two more questions out of thirty-three than online students. Obviously, neither Coates, or Farinella nor our OLS estimations control for self-selection sample bias.

Following Coates, our first attempt to address self-selection is through 2SLS estimation. The first stage estimates the probability of taking an online course. The predicted probability is then used in our second stage specification. Our 2SLS results are similar to Coates' and Gratton-Lavoie and Stanley's results in that the coefficient on the predicted online class variable is negative and statistically significant. Our coefficient suggests that students enrolled in online classes perform on average about 6% worse than face-to-face students while Coates finds that online students perform on average 18% worse than those in face-to-face classes. Even though the magnitudes of the coefficients on the class variables appear to be somewhat different for the three studies, the direction of the effect is the same.

Both Coates and Gratton-Lavoie and Stanley utilized the endogenous switching model in an effort to adjust for the effects of self-selection bias on each of the sub-groups of students.[2] For example, this estimation technique allows researchers to estimate how a random student who chose a face-to-face course, would have performed had that student been placed in an online class. Table 4 reports our results from estimating the endogenous switching model for both the face-to-face and online classes.[3]

We first discuss the estimate of student performance for the online class. Though the overall model is statistically significant at the 0.10 level, few of the individual variables explaining student performance are statistically significant. We believe the lack of significance for many of the variables is a byproduct of multicollinearity resulting from the small sample size. The variable of most interest in this model is the lambda which is statistically insignificant (p=0.22) implying that there is no self-selection bias for the students in the online class. Thus the performance of students who choose online classes is not statistically different from that of a similar, random student in the population. This result differs from Coates et al and Gratton-Lavoie and Stanley in that they found this variable to be positive and statistically significant suggesting that those students who selected into the online class performed better in this type of class than would a similar student who had chosen a face-to-face class. Note, however, that if multicollinearity and small sample size are causing the lambda coefficient's standard error to be too large, then it is possible the online sample's lambda should be statistically significant. If so, the positive sign on the coefficient would indicate that a random student in the online course scores about 15% higher than a similar student in the face-to-face class. This result would then be consistent with the result and interpretation of online class lambda found in the Coates et al study.

[2] Coates provides a very thorough description of the endogenous switching model. For more review, please see chapters 8 and 9 in Maddala (1983).

[3] Note that both models were tested for heteroscedasticity using White's method. We failed to reject the null hypothesis of homoscedasticity with p-values of 0.62 and 0.60, respectively.

We have a dramatic improvement in overall explanatory power with the face-to-face student performance equation. Several variables are statistically significant and the R^2 is 0.53. The coefficient on the lambda variable is positive and statistically significant implying that those students who selected the face-to-face class performed better in this type of class than would a similar student who had chosen an online class. This result coincides with the finding of Gratton-Lavoie and Stanley. Alternatively, Coates et al found that there was no selection bias for the face-to-face students.[4] More specifically, using the lambda coefficient and the average lambda for this subset, our results indicate that if a student who had chosen the face-to-face class were to be compared to an otherwise similar student in an online class, the online student would score 2% less than their face-to-face peer.

When evaluating the switching model results using the parameter estimates from both models evaluated at the means from the entire sample, we find that choosing an online course lowers performance by approximately 23%. This result is larger than that found by Coates and a much stronger reduction than the 6% we found using 2SLS estimation. Ultimately, our results show that a random student in the population would produce a lower score in an online class than in a face-to-face class. Furthermore, if that random student had been given an opportunity to choose delivery method and had chosen face-to-face, that student would have performed even worse in the online course.

V. Conclusions

Empirical studies investigating the affect of online versus face-to-face classes on student academic performance involve complex phenomena. Due to self selection bias, OLS estimation is an inappropriate estimation technique. That is, when students are not randomly assigned into either an online or a face-to-face class, OLS estimation leads to biased estimates. For example, estimating our performance equation by OLS, we find that there is no statistically significant difference between the mode of class delivery and students' academic performance. After controlling for self selection, we find that students enrolled in face-to-face classes outperformed their counterparts, i.e. online classmates by approximately 6%.

In terms of the selection equation, our findings suggest that students who 1) work more hours, 2) have taken more cumulative hours, and 3) have a higher ACT score are more likely to enroll in an online class. Alternatively, students who 1) are male, 2) have a higher grade point average, and 3) are taking more current credit hours are more likely to enroll in a face-to-face class.

We created an experimental study that better controls for some sources of bias that may have been present in the Coates et al and Gratton-Lavoie and Stanley studies. Our results with the improved design support the overall implication found by Coates and

[4] A more restricted model was estimated over the entire sample (n = 109). The coefficient on lambda was positive and statistically significant, suggesting that there is positive self-selection bias for the online class binary variable in the performance equation. The estimated coefficient of -14, suggesting online students score about 19% lower, would have been even lower had correction for self-selection not taken place.

Gratton-Lavoie and Stanley. After controlling for self-selection bias, students in online classes perform statistically worse than they would in a face-to-face course. However, our results from the switching regression model differ slightly from Coates'. We find that self-selection bias has little or no effect on the students in the online courses, but has a positive statistically significant effect on the students who choose a face-to-face course. Specifically, students who choose a face-to-face course would have performed even worse than a randomly selected student from the population who had been placed in an online course. Gratton-Lavoie and Stanley find that most students would have performed best in the face to face class. University, college, and departmental administrators who are inclined to convert traditional face-to-face courses into online only sections should be aware that our findings suggest that not only does overall performance fall, but that student performance for those students who would have otherwise preferred the traditional classroom will decline even more.

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Table 1
Descriptive Statistics
Full Sample (n=109)

Variable	Mean	Std Dev	Max	Min
Performance	72.87	10.87	40.00	94.00
Online	0.28	0.45	0.00	1.00
Gender	0.48	0.50	0.00	1.00
Age	20.68	3.43	18.00	47.00
Work Hours	13.97	14.64	0.00	60.00
Total Credit Hours	54.43	25.12	19.00	143.00
ACT	22.40	3.70	15.00	34.00
GPA	3.01	0.58	1.70	4.00
RACE	0.88	0.33	0.00	1.00
Load	15.14	2.53	3.00	21.00
Previous Econ Class	0.72	0.45	0.00	1.00
Parent	0.95	0.83	0.00	2.00
Campus	0.47	0.50	0.00	1.00
Friend	0.91	0.29	0.00	1.00
Previous Web Class	0.38	0.49	0.00	1.00
Internet	4.33	0.68	3.00	5.00
Math	3.61	0.90	2.00	5.00

Table 2

Descriptive Statistics

	Face-to-Face Sample n = 78					Online Sample n = 31			
Variable	**Mean**	**Std Dev**	**Max**	**Min**		**Mean**	**Std Dev**	**Max**	**Min**
Performance	74.07	10.84	40.00	94.00		69.84	10.51	49.00	91.00
Gender	0.53	0.50	0.00	1.00		0.35	0.49	0.00	1.00
Age	19.92	1.70	18.00	28.00		22.58	5.46	19.00	47.00
Work Hours	10.35	12.64	0.00	40.00		23.10	15.54	0.00	60.00
Total Credit Hours	50.05	21.72	22.00	120.00		65.44	29.75	19.00	143.00
ACT	22.56	3.72	15.00	34.00		22.00	3.67	16.00	30.00
GPA	3.08	0.56	1.77	4.00		2.84	0.58	1.70	4.00
RACE	0.87	0.34	0.00	1.00		0.90	0.30	0.00	1.00
Load	15.45	1.64	12.00	19.00		14.35	3.91	3.00	12.00
Previous Econ Class	0.71	0.46	0.00	1.00		0.74	0.44	0.00	1.00
Parent	1.01	0.83	0.00	2.00		0.81	0.83	0.00	2.00
Campus	0.58	0.50	0.00	1.00		0.19	0.40	0.00	1.00
Friend	0.90	0.31	0.00	1.00		0.94	0.25	0.00	1.00
Previous Web Class	0.35	0.48	0.00	1.00		0.45	0.51	0.00	1.00
Internet	4.28	0.66	3.00	5.00		4.45	0.72	3.00	5.00
Math	3.69	0.89	2.00	5.00		3.40	0.92	2.00	5.10

Table 3

Performance Equations: OLS and 2SLS Estimations

	OLS			**2SLS**				
	Performance			**Selection: Online**			**Performance**	
Variable	**Coefficient**	**Std. Error**		**Coefficient**	**Std. Error**		**Coefficient**	**Std. Error**
Intercept	13.1434	10.8957		-4.0882	3.2771		-4.3736	13.2685
Online	-2.1171	2.1986						
Predicted Online							-4.1607*	1.8431
Gender	0.3281	1.7053		-1.1920*	0.4324		-4.0285	2.6544
Age	0.5338**	0.2942		0.1412	0.1072		1.1075*	0.3968
Work Hours	-0.0712	0.0617		0.0390*	0.4756		0.1150	0.1077
Total Credit Hours	0.0276	0.0351		0.0260*	0.0102		0.1546*	0.0691
ACT	1.0790*	0.2838		0.2309*	0.0787		1.8181*	0.4466
GPA	6.7646*	1.8961		-1.2767*	0.4617		1.8564	2.9969
Race	-1.7882	2.8188		1.0220	0.7926		3.5549	3.7545
Load	0.1477	0.3621		-0.1881*	0.0939		-0.6877	0.5301
Previous Econ Class	0.7332	1.8062					0.2767	1.7832
Parent	4.5580*	1.7042					4.1677*	1.6800
Campus				-0.7550	0.0102			
Friend				0.2837	0.7653			
Previous Web Class				-0.1243	0.3901			
Internet				0.1982	0.2629			
Math				-0.3784**	0.2190			
R2	0.45						0.47	
LLF				72.47				

*,**: significant at the 0.05 and 0.10 levels, respectively.

Table 4

Endogenous Switching Regressions for Student Performance

	Face-to-Face Class			Online Class	
Variable	**Coefficient**	**Std. Error**		**Coefficient**	**Std. Error**
Intercept	6.8255	16.9064		22.8078	35.5223
Gender	-.5902	2.2235		-4.5439	5.1056
Age	0.9235	0.7237		0.3998	0.6718
Work Hours	0.0010	0.0938		0.1109	0.2228
Total Credit Hours	0.0876	0.0611		0.1428**	0.0963
ACT	1.5763*	0.3592		1.1242**	0.7442
GPA	3.4437	2.7766		4.3021	4.7043
Race	4.4689	3.3180		-11.0630	10.8489
Load	-0.2719	0.6044		-0.8271	0.7940
Previous Econ Class	-2.2747	2.0155		3.4084	4.1286
Parent	2.2862*	1.1413		3.2329**	2.1804
Lambda	6.9892*	4.1433		11.4029	9.0668
R2	0.53			0.27	
N	78			31	

*,**: significant at the 0.05 and 0.08 (one tail) levels, respectively.

STRUCTURED WRITING ASSIGNMENTS AS PEDAGOGY: TEACHING CONTENT, ENHANCING SKILLS

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Abstract

In this paper we summarize the findings from a series of action research projects conducted by the authors beginning spring 2005. There are seven principal findings from this effort: (1) writing positively impacts student learning, (2) structured writing assignments positively impact student learning relative to unstructured writing assignments, and relative to no writing, (3) structured writing assignments positively impact student learning and can enhance student readiness for self-directed learning, especially for those students who are not ready for self-directed learning, (4) the more structured writing assignments completed the higher the score on the multiple-choice test, (5) most students in our sample are not ready for self-directed learning, (6) students who are not ready for self-directed learning perform better in a structured learning environment, and (7) students who are ready for self-directed learning perform better in an unstructured learning environment. Given these findings, coupled with what the authors believe to be the ultimate goal of a college education (to create a desire for, and skills to engage in, life-long learning), the authors recommend a modification in the pedagogy used to deliver course content. This modification is designed to improve student learning by making use of Guglielmino's Self-Directed Learning Readiness survey (an assessment tool), structured writing assignments, and Bloom's taxonomy of educational learning objectives.

I. Introduction

Teaching at its best strives to achieve two student-learning outcomes. The first student-learning goal is to increase students' knowledge with respect to particular course content. Using Bloom's taxonomy as one course design tool can be very helpful in achieving this goal. The second student learning goal is to become a self-directed learner, "…a process in which individuals take the initiative with or without the aid of others in diagnosing their learning needs, formulating learning goals, identifying human and material resources, choosing and implementing appropriate learning strategies, and evaluating learning outcomes." (Knowles, 1975, p. 18) This second student-learning goal is the subject of our inquiry.

In this paper we summarize the findings from a series of action research projects conducted by the authors beginning spring 2005. The action research projects were implemented in an economics course within an Association for the Advancement of Collegiate Schools of Business – International (AACSB) accredited college of business. The action research projects were a natural outgrowth of the "assurance of learning" (AOL) documentation required as part of the reaffirmation process and explored whether different pedagogical approaches would produce demonstrable differences in student learning.

Specifically, in spring 2005, we began the first in a series of action research projects in ECO 305, "The International Context for Business." ECO 305 is required for all business majors in the College of Business (COB). It is an economics course with sections offered each semester by both authors. The Economics and Finance department, housed in the COB, typically offers ten sections of this course per year with approximately 35 students per section.

As noted, to maintain accreditation, AACSB requires demonstration and documentation of student learning, known as AOL. Accordingly, to ensure demonstrable student learning we must determine how to deliver course content in the most pedagogically appropriate manner for our student body. Course content and pedagogy are regularly upgraded through continuous improvement activities based on our evaluation of student performance on AOL assessments.

In ECO 305 we use a 30 question multiple-choice examination (the MC test) as an AOL assessment tool. The MC test is designed to assess student mastery of a set of topics common to all sections of the course. Regardless of the textbooks and teaching materials used by an individual instructor – and instructors are encouraged to use non-standard textbooks – a set of common topics must be covered.[1]

[1] List of Common Topics: Principle of comparative advantage; exchange rates; domestic and international accounts; institutions and nongovernmental organizations that affect trade, economic growth and development; factors (cultural, economic, environmental, political, social) that affect trade and economic growth and development; general concepts from comparative economics (transitional economic systems), economic development and international trade; sustainable development; evidence of environmental degradation (rules of ecology, world environmental status, major sources of pollution); macroeconomic policies: fiscal policy, monetary policy, strategic trade policy; views of human rights; convergence hypothesis; cultural competency.

The initial action research project investigated the impact of writing on student learning as measured by student scores on the MC test. In this project we sought to verify and replicate the findings of other researchers in this field of study. As our knowledge of the existing literature increased, and as we investigated additional questions and hypotheses, we realized that, perhaps, new ground was being broken.

We summarize what we have learned from our multi-stage inquiry in what follows. First we highlight themes in the literature on writing in economics that we seek to explore and identify linkages in the literature across these themes. We next present the principal findings of our action research projects. (A detailed formal discussion of the action research projects and the associated literature review may be found in Dynan and Cate, 2009 and Dynan, Cate and Rhee, 2008.) We then propose a modification in the pedagogy used to deliver course content based on these finding. Some suggestions for future research conclude the paper.

II. The Literature on Writing in Economics

We identify and link three relevant themes in the literature on writing in economics. (See Table 1 for a meta-analysis of this body of literature.) The first theme is that writing assignments should be incorporated into the assessment activities of a course because writing may improve student learning. Emig (1977), the seminal paper from this part of the literature, articulates the principle that students must learn to write in order to write to learn. Becker (1997), Walvoord and Anderson (1998), and Walstad (2001) propose a variety of practical ways of implementing Emig's basic principle - using the "one-minute" paper and linking reading and writing assignments, for example.

The second theme within the literature provides some evidence that writing assignments improve student learning of economic principles. Crowe and Youga (1986) and Hamlin and Janssen (1987) suggest that students need to be "active learners," that is, to be actively engaged in the learning process. One way to actively engage learners is through the use of writing assignments. Simpson and Carroll (1999) support the findings and recommendations of these authors.

The third theme links the two themes above to a broader literature of writing as learning and writing as a tool to learn (Tynjala 2001; Tynjala, Mason and Lonka 2001). Hayes and Flower (1980) and Hayes (2000) explore the idea that writing is a cognitive process. Bangert-Drowns, et al (1991), Butler and Winne (1995), and Winne (1997, 2001) explore the idea that writing is an information-processing activity. Weinstein and Mayer (1996) identify four categories of cognitive learning strategies: rehearsal, elaboration, organization, and comprehension monitoring. They suggest that these strategies should be taught to students for the purpose of facilitating learning. Bereiter and Scadamalia (1987) explore the process of writing from two perspectives: knowledge telling (the skills of recall and comprehension) and knowledge transforming (the skills of analysis, synthesis and knowledge creation through self-directed or self-regulated learning). Hattie, Brigg and Purdie (1996) and Paris and Paris (2001) conclude that these cognitive learning strategies can improve academic success. Applebee (1984) reminds us that the acquisition of knowledge

(learning) may be influenced by the characteristics of the writing assignments (scope and frequency, mental operations, and interest of the writer). Langer and Applebee (1987) find that all types of written assignments improve student performance to a greater extent than reading without supplemental writing assignments.[2]

In our view, many of the topics discussed in the literature are quite similar, but use different terminology. Although we do not empirically test this contention, we have developed some linkages across the aforementioned readings to clarify the commonalities that we find. The table below presents these terms relative to Bloom's taxonomy of educational learning objectives (1956; see Dynan and Cate (2009) for a different version of this Table).

Table 1
Making Linkages across the Literature

Lower-order learning objectives

Bloom	Weinstein and Mayer (1996)	Bereiter and Scadamalia (1987)
Knowledge	rehearsal	knowledge telling
Comprehension	elaboration	
Simple application	organization	

Higher-order learning objectives

Bloom	Weinstein and Mayer (1996)	Bereiter and Scadamalia (1987)
Analysis and Complex applications	comprehension monitoring	knowledge transforming
Synthesis		
Evaluation		

[2] Ackerman provides an alternative viewpoint on this portion of the literature. "This essay situates the phenomenon of writing and learning in historical, pedagogical, and theoretical frameworks to isolate write-to-learn methods derived from the "British model" of language and learning. Writing, as a mode of learning, has maintained its status partly because of the rise of rhetoric and composition as a specialized field, and because cross-curricular writing instruction has been offered as one answer to alleged "crises" of literate standards and competence in public and higher education." Generally, the author claims that typical accounts of writing as a unique tool for promoting learning ignore the complexities of cultures, classrooms, assignments, and other media that might equally facilitate learning. The author's reading of 35 studies of writing and learning is that they do not provide the long-sought empirical validation of writing as a mode of learning. He argues that this research is grounded in the same assumptions about language and learning as are common in the lore and practice of "writing across the curriculum" (WAC) and writing process approaches, and as a result, the issue of writing and learning has been framed wrongly. "The confounds within this body of research are many of the cognitive and situational variables that would support a model of writing and learning that is compatible with the diverse discourses and experiences within and across institutions" (Ackerman, 1993, p. 334).

III. The Seven Findings

The first question we explored was: Does writing affect student learning? In particular, could we replicate Greenlaw's (2003) results with our student population? Greenlaw incorporated writing assignments into one section of his Principles of Macroeconomics course and compared student learning in this section to student learning in non-writing sections. He concluded that writing positively impacts student learning.

To explore the impact of writing on student learning, in fall 2005 we conducted an action research project in ECO 305. Our measure of student learning was students' performance on the MC test. We found that students in the writing sections demonstrated statistically significantly improved learning – approximately ½ of a letter grade (p-value <.01; n = 70) – relative to students in the non-writing sections (Dynan and Cate, 2005). This finding is consistent with Greenlaw's (2003) results, and with the findings of Becker (1997), Emig (1977), Walvoord and Anderson (1998), and Walstad (2001).

We next expanded this simple inquiry to explore: What caused student performance on the MC test to differ between the writing and non-writing sections? Specifically, was the learning improvement from the activity of writing alone, or from the additional guidance provided by the professor in designing specific writing assignments? This inquiry led us to experiment with two different learning environments over the course of two semesters. In spring 2006 we conducted an action research project in ECO 305 in which students were given structured writing assignments (SWA), assignments with explicit and detailed instructions, which, if followed, would result in the successful completion of the assignment. SWA may be in the form of in-class assignments or homework assignments. The following is an example of a SWA:

> After reading the article on sustainable development answer the following questions:
>
> Define the term sustainable development.
> List and explain the three metrics used to assess sustainable development.
> Explain, in your own words, the concept of sustainable development and its three metrics to an Accounting major.

Given the types of questions in a SWA, the feedback provided by the instructor to the student is quite specific: either the student's response meets or exceeds the expectations of the target response (for example, providing the correct definition) or the student's response does not meet the expectations of the target response (for example, listing and explaining two of the three metrics). When the SWA is returned to the students, the instructor reviews the SWA and provides the students with the target response for each question. This feedback could be oral, or by way of a grading rubric.

In the fall 2006 we conducted another action research project in ECO 305 in which students were given unstructured writing assignments (USWA) with open-ended questions (based on a syllabus by Richard Locke of MIT) for their weekly assignments that addressed:

> Ideas and arguments in the reading that the student found important, interesting, or stimulating;
> Questions, concerns, or disagreements the student has with claims or ideas presented in the assigned material.
> Connections among the material, lectures, and experiences the class has explored for this course.

Students were given the freedom to self-define strategies, which, if implemented, could result in the successful completion of the assignments. USWA may be given as in-class assignments or homework assignments. The following is an example of an USWA:

> After reading the article on sustainable development, identify some ideas and arguments that you found important, interesting, or stimulating.

We used these two different student-learning environments to determine how the learning environment impacted student learning as measured on the MC test (lower order learning objectives of knowledge, comprehension, and simple application) and some intermediate level learning assessments of analysis and complex applications. We found that students who completed writing assignments (structured or unstructured) scored approximately 2.9 points higher on the MC test relative to those students who had no writing assignments ($p = .08$) (Dynan and Cate, 2009). We also found that SWA positively impact student learning and can enhance student readiness for self-directed learning, especially for those students who are not ready for self-directed learning. That is, students who completed SWA scored approximately 3.3 points higher on the MC test relative to students who had no writing ($p = .07$) (Ibid.). These findings suggest that a potential source of the additional learning as measured by the student's score on the MC test could be the additional guidance provided by the instructors in such activities as the SWA (Ibid.). As additional support to this hypothesis we also found that the more SWAs a student completed the higher the score on the MC test – approximately 0.46 points per completed assignment ($p = .02$) (Ibid.).

In addition to investigating the impact of the learning environment (structured and unstructured) on student learning, we investigated the impact of the learning environment on student readiness for self-directed learning. To assess whether our students are ready for self-direct learning (SDL), that is, ready to self-define strategies to answer open-ended questions, or identify and answer their own questions we incorporated Guglielmino's Self-Directed Learning Readiness survey (Guglielmino, 1977) into both the spring 2006 and fall 2006 action research projects. The survey was administered twice, once at the beginning of the semester and again at the end of the semester to assess which—SWA or USWA – improves students' ability to engage in self-directed learning to a greater extent.

Guglielmino and Associates sort the readiness scores into the following categories:

Low readiness	58-176
Below average readiness	177-201
Average readiness	202-226
Above average readiness	227-251
High readiness	252-290

In repeated sampling, Guglielmino and Associates found:

Adult mean	214
Standard deviation	25.59

We found first that approximately 60% of the students in our sample are not ready for SDL (Dynan, Cate and Rhee 2008) - having SDL scores at average or below.[3] When we estimated difference-in-means test between the pre – and post – experiment SDL readiness scores, the difference was positive and statistically significant for the structured learning environment (spring 2006: pre-score 222.82; post-score 225.71; p-value < .01) but although positive, was not statistically significant for the unstructured learning environment (fall 2006: pre-score 216.71; post-score 221.57) (Ibid.).

We hypothesized students who were not ready for self-directed learning would perform better in a structured environment. Likewise, we hypothesized that students who were ready for SDL would perform better in an unstructured environment. Thus, we say a match between the student and the learning environment exists when a student not ready for SDL (average, below average or low readiness for SDL scores) is in the structured class, or when a student ready for SDL (above average or high readiness for SDL) is in an unstructured class. With respect to these hypotheses we found that:

> Students whose initial scores matched the structured environment improved their scores by about 6.8 points (p = .01) relative to those students whose initial scores did not match them to the structured environment. The match in the unstructured environment improved scores by close to 13 points (p = .00) relative to those students who did not match. In the full sample, the match between students' initial score and their environment improved their scores by about 3.42 points (p = .03) (Dynan, Cate and Rhee, 2008 p.98).

The findings of our action research projects lead us to the practical conclusion that the use of SWAs (or other highly instructor-guided activities) enhance student learning on lower-order learning objectives for students who are not ready for SDL (the majority - 60% in our sample) relative to students who are not ready for SDL and are given USWAs, and relative to students who are given no writing assignments. Likewise, the structured environment supports the SDL skill enhancement of those who are less well prepared for SDL.

[3] If the reader finds some merit in four findings, and is interested in adopting our recommendation for a structured learning environment, then we urge the reader to assess student readiness for SDL at the beginning of the term and move forward from that initial benchmark.

At this point one could raise the question: Might we be mistaking weak writing and analytical skill with a lack of work ethic and tenacity? To such a question we respond – no! By definition students who are not ready for SDL – a majority of the students in our sample – possess weak analytical and writing skills. While we acknowledge that other classes at other institutions may not match ours in terms of the proportion of students ready for SDL, our finding that structure enhances the skill set of less prepared students should not be dismissed out of hand, and that student match to the environment matters.

As an observation we note that as students move through course work required for their chosen major we sense – and hear third-hand conversations about – the growing frustration on the part of students, especially those students who are not ready for SDL. We suspect that this sense of frustration stems from the fact that instructors who teach upper-level major courses have articulated student and course learning goals and objectives that are associated with the higher-order learning objectives of analysis and complex applications, synthesis, and evaluation. Students who are not ready for SDL will struggle with USWA that require students to use higher-order learning skills because they do not know how to tackle these assignments. Our thoughts on pedagogy strive to alleviate this sense of frustration, enhance students' ability to engage in higher-order learning activities, and ultimately become life-long self-directed learners using the evidence and insight we have gained from our experiments.

IV. Recommendation for Preparing Students to Become Life-long, Self-directed Learners

One of the goals we have for our students is to prepare them to become life-long or self-directed learners. Although our action research projects were conducted in a junior-level course (with almost entirely senior-level students) with a variety of majors, we found that 60% of the students in our sample were not ready for SDL. We are confident that if the majority of the students in our sample of mixed majors are not ready for SDL, then freshmen enrolled at our institution are also unlikely to be so. Based on our assumption that students newly entering our large, metropolitan-area, public university are not ready, or need to improve their skills, for SDL, we recommend a modification to the pedagogy used to deliver course content. If it is successful, by the end of their course of study, our students should be able to:

1. Ask an appropriate question to guide their inquiry
2. Identify the appropriate resources and tools
3. Use the resources and tools, with appropriate adjustments and modifications based on their specific needs, to satisfactorily answer the initial question
4. Identify and question the underlying assumptions and ideas that generated the initial question (Dynan, Cate and Rhee 2008)

Given the primary purpose of a college education is to acquire and/or hone the skill set associated with life-long, self-directed learning, earning a degree must not be confused

with being a life-long self-directed learner (intelligent). A diploma is not a guarantee that the individual has mastered more than the lower-order educational objectives of knowledge, comprehension, and simple application. Being an intelligent, thoughtful, life-long self-directed learner goes beyond earning a diploma, beyond the mastery of the lower-order educational objectives. Being intelligent means that one has acquired, honed, and uses the set of skills needed to master the higher-order educational objectives of analysis and complex applications, synthesis, and evaluation. In short, becoming a life-long self-directed learner implies one realizes that there is a moral obligation to be intelligent.

> If we do not know what questions their books (the Classics) hold out for admiration, then – let me say this as delicately as possible – our admiration is not discriminating; and if we neither have discrimination nor are disturbed by our lack of it, then perhaps (the) wise man could not list intelligence among our virtues. (Erskine, 1969, p. 12)

V. Translating Research into Practice

One way to identify students' readiness for life-long learning is to assess their readiness for self-directed learning using an instrument specifically designed to do so such as Guglielmino's Self-Directed Learning readiness survey instrument. When we assessed our students we found the majority of them were unprepared for life-long learning. Clearly, the level of preparedness will vary across student populations.

Our research projects have demonstrated that given our set of students and their measured level of preparedness for self-directed learning, teaching faculty can enhance unprepared students' ability to engage in self-directed learning by exposing them to a structured learning environment. We suggest that what is needed in this environment of relative lack of preparedness for self-directed learning is a structured approach to course and curriculum design - because the evidence suggests that this will enhance student preparedness for self-directed learning.

Concerning the design of the curriculum, there are three categories of courses:

1. Principles: These courses introduce students to a discipline/topic
2. Advanced: These courses build on the materials developed in principles
3. The capstone/Integrated: These courses integrate materials within a discipline or across disciplines

In Bloom's taxonomy of educational objective terms, the Principles category should focus on the lower-order educational learning objectives of knowledge, comprehension, and simple applications. Capstone/Integrative category should focus on the higher-order objectives of analysis and complex applications, synthesis, and evaluation. The Advanced category builds on student mastery of the content of a discipline's basic principles and provides transition to the higher-order objectives required by the Capstone/Integrative

category. Thus, the curriculum begins with a highly structured environment and transitions into an unstructured environment as the student progresses through the curriculum.

The same structured approach is used in the design of a course. Keeping in mind the course's ultimate goal is its contribution to the development of a life-long self-directed learner, the goal of SDL leads to the development of course learning goals that support the acquisition of the requisite skills for SDL. From the course learning goals flow specific student learning objectives that define what the student should know by the end of the course. From the student learning objectives flow concepts, ideas, principles and theories, and content (the hard facts) that the students must know by the end of the course. Having identified the hard facts, we then explicitly link them to the educational learning objectives in the following manner:

For lower-order educational learning objectives

> Knowledge: Can the student state the "textbook" definition of each hard fact?
>
> Comprehension: Can the student explain – in her/his own words – each hard fact to another individual, and does that individual understand the explanation?
>
> Simple applications: Can the student solve simple problems designed to assess her/his mastery of each hard fact?

A variety of activities should be used to assess student mastery of the hard facts including True/False, fill-in-the-blank, or multiple-choice type questions, SWA, and the information essay, in-class SWA given as quizzes or linked to the MC test.[4]

For higher-order educational learning objectives

> Analysis and complex applications: After reading a non-textbook assignment (newspaper, magazine, non-technical journal article passage from a book) can the student identify and explain the hard facts developed in the article?
>
> Synthesis: Using hard facts, can the student develop an opposing argument to the one developed in the assigned reading?
>
> Evaluation: Can the student identify the basis for stating that an argument is weak or strong, good or bad, right or wrong?

[4] The MC test is designed to assess student mastery of a set of topics common to all sections of the course. For fall 2005 research project the authors were interested in the impact of writing on student learning as measured by students' scores on the MC test. Beginning with the spring 2006 research project the authors began to explore the interrelationships among writing (SWA and USWA), learning environments (structured and unstructured), student's readiness for self-directed learning, and student learning as measured by their scores on the MC test. While the MC test still consisted of 30 questions, still assessed their mastery of the Common Topics, the MC questions were designed with Bloom's lower-order learning objectives as a benchmark.

At least four types of assessment activities are available: the SWA, the short paper, the term project, and exams with essays and analytical problems. The following is an example of a knowledge transforming oriented SWA.

> After reading Chapters 6-8 of *The Choice* and reviewing your class notes on our discussion of these chapters, answer the following questions:
>
> Define the terms tariff and quota.
> Identify the winners (benefits) and the losers (costs) of a tariff.
> Identify the winners (benefits) and the losers (costs) of a quota.
> Identify and explain the principal similarity and the principal difference between a tariff and a quota.

This SWA is linked explicitly to two knowledge telling learning objectives – knowledge (can the student define the terms tariff and quota) and comprehension (can the student explain these terms to the reader) and to two knowledge transforming learning objectives – analysis (can the student identify the winners and explain why the winners are winners) and evaluation (can the student explain the importance of the principal similarity).

Short papers may be linked together and given as an in-class activity or in the form of an essay examination. If, however, the short paper is given as a homework assignment – and this advice applies to the term project as well – a set of deadlines should accompany the assignment: the assignment is given day 1, the first draft is due on day 2, and the final draft is due day 3. Students must understand that writing is a process: papers go through multiple drafts, and unlike Mozart the final product is not the first draft. Students should be instructed on and given the opportunity to practice these assessment activities.

VI. Conclusion

Since spring 2005 we have conducted action research projects associated with writing and student learning. Seven findings have emerged from our projects: (1) writing positively impacts student learning, (2) structured writing assignments positively impact student learning relative to unstructured writing assignments, and relative to no writing, (3) structured writing assignments positively impact student learning and can enhance student readiness for self-directed learning, especially for those students who are not ready for self-directed learning, (4) the more structured writing assignments completed the higher the score on the MC test, (5) most students in our sample are not ready for self-directed learning, (6) students who are not ready for self-directed learning perform better in a structured learning environment, and (7) students who are ready for self-directed learning perform better in an unstructured learning environment.

Given these findings we recommend a modification of the pedagogy used to deliver course content. Our recommendation is designed to improve student learning through the use of Guglielmino's Self-Directed Learning Readiness survey, structured writing assignments, and Bloom's taxonomy of educational learning objectives. The goal of the revision in

curriculum design is to prepare our students for the real world of SDL. Furthermore, this proposal will also assist the COB and Northern Kentucky University in answering two of the five questions of postsecondary reform in the public agenda formulated by the Kentucky Council on Postsecondary Education:

> Are more Kentuckians ready for postsecondary education?
> Are college graduates prepared for life and work in Kentucky?

Finally, given the readiness composition of any particular class, a mixed strategy – having a mixture of SWA and USWA – may be necessary both to prepare Kentuckians for postsecondary education and for life and work in Kentucky.

VII. Future Areas of Research

Finally, we note that our research on creating self-directed learners has at least two potential shortcomings. First, it does not take into account the fact that individuals have eight individual components of intelligence: interpersonal, intrapersonal, logical-mathematical, musical, bodily-kinesthetic, visual-spatial, verbal-linguistic, and natural (Gardner 1983). How these multiple intelligences interrelate with the development of SDL skills has not yet been explored and may be an important source of new understanding. Likewise, investigating the impact of multitasking (Jackson 2008) in the "electronic age" on the ability of students to acquire and implement the skills associated with SDL, both in school and in the workplace, will enhance the ability of teaching faculty to develop best methods to prepare students for postsecondary education, and for life and work in Kentucky (or elsewhere).

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ON FAIRNESS AND NEEDS IN A FREE ENTERPRISE ECONOMY

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Abstract

Fairness is notoriously hard to define, but many think it is captured by the socialist/Marxian phrase, "From each according to his ability, to each according to his needs." Free enterprise is often thought to fail in this regard and that this provides a rationale for government intervention in markets. This paper argues that, even if one accepts this definition of fairness, the private sector is greatly underestimated in this regard and the converse for the public sector. The private sector is comprised of not just profit-maximizing firms and self-serving individuals, but also of many formal and informal nonprofit organizations, such as charities, clubs, churches, circles of friends, and families. These organizations regularly allocate goods and services according to perceived "needs" of others. To successfully do so, they assess needs in close, face-to-face relationships and establish quid pro quos, i.e., there are expectations placed upon recipients of the goods and services. It is shown how this can be analyzed in a supply-and-demand framework as implicit, non-monetary exchanges. Large, governmental organizations do not engage in these types of activities and so are expected to have less success in allocating according to "needs." The supply-and-demand framework is used to show how government programs' failures in these respects can create greater dependency on the program, reduce private charity, and expand the government budget.

I. Introduction

Fairness is notoriously difficult to define and yet volumes have been written about it. Regardless of political views, many seem to think that important aspects of fairness are captured by the socialist/Marxian phrase, "From each according to his ability, to each according to his needs." Free enterprise is often thought to fail in this regard, where it is claimed that the needs of the less fortunate are ignored and where profit and self interest triumph. Proponents of this viewpoint contend that this implies a role for government intervention to temper, limit, or "provide a conscious" for market outcomes, thereby improving the fairness of the allocation of resources. This is usually thought to entail some sort of government tax and expenditure program, where the relatively wealthy are taxed in order to provide resources to the poor, or other interventions to control the private sector.

This paper takes the converse view. It may be debated whether the above phrase appropriately captures fairness. But even granting that it does, it is argued here that governmental organizations will have a difficult time implementing this notion of fairness and that there are a set of market-based organizations that are likely to have better success at doing so.

The above Marxian phrase suggests that in order to be fair, we ought to redistribute toward those with the greatest needs from those of higher ability. At the outset, let us note that economists often find the term "need" to be vacuous. For example, one can ask whether water is a need. In most times and places, it is not a need on the margin. Much of the water we consume – e.g., washing dishes, bathing, lawn watering, industrial processes – has nothing to do with sustaining life. The same applies to other "needs" such as food, clothing, and shelter. Additionally, people often trade off one of these "needs" for other "non-needs," e.g., forgoing the purchase of a shirt (clothing) in order to spend more on movies. In using the term "need," this paper will depart from technical economics and adopt the more common usage that need refers to something important in one's life.

For most of the paper, we consider fairness, at least in part, as being related to how well resources are allocated to those in need. Before turning to that line of analysis, though, we consider one other concept of fairness: that rewards should be related to merit. This discussion is in section II of the paper. On the metric of merit, markets are quite fair since high productivity is highly rewarded. Section III of the paper returns to considering the "needs" concept of fairness. The usual model of the profit-seeking firm and self-serving consumers is reviewed in this light.

Section IV of the paper observes that free enterprise economies are comprised of various types of organizations, many of which do not seek to maximize profits. These include nonprofit charities, clubs, churches, civic groups, circles of friends, and families. Thus, "free enterprise" encompasses many organizations beyond the profit-maximizing firm and the self-serving consumer. The goals of the multitude of nonprofit organizations reflect the heterogeneity of the individuals that comprise them, but most involve a concern for the needs of others. These various nonprofit organizations supplant or exist alongside for-profits

in many sectors of the economy, including the provision of religious services, the arts, hospital services, and child rearing.[1]

A fundamental difficulty of any organization, private or public, in trying to allocate according to need and inducing payment according to ability is to identify those individuals who are of greater need and those who are of higher ability. Failure to adequately do so results in many errors in making allocations and defeats the purpose of the organization. This problem is especially acute where needs are complex and involve more than income and when recipients may try to falsify their need. Also, when allocating goods to recipients without payment, one encounters the moral hazard problem of overuse of the good. This may lead to a dependency by recipients on organization; something the latter may wish to discourage. These issues are discussed in section V.

Section VI turns to an analysis of how private organizations deal with these problems. It is noted that in most cases, these organization engage in close interactions with potential recipients in order to assess their needs. For example, from a close relationship to their children, parents determine whether their child really benefits from having the latest fashion in shoes or is better served by doing without. From repeated contact with a homeless man, workers at a shelter can assess whether the man needs a meal or some counseling. Charitable health clinics, through personal knowledge of their clients, can assess whether a patient needs a motorized wheelchair or can do with an alternative device. Also, nonprofits frequently require a quid pro quo for their services, so that the recipients of a meal at a shelter may be required to attend a religious service and children who get an iPod are expected to behave. Thus, there is a nonmonetary price that recipients pay for what they receive and providers of the service presumably gain utility from this. This establishes a market for nonmonetary exchange, where recipients undertake actions that providers value (e.g., attending a religious service) in exchange for receiving a good or service. This is one way that overuse and dependence by recipients is limited. A supply and demand analysis of this market is introduced in this section.

Government organizations that attempt to allocate according to need face the same problems but are unlikely to address them as successfully as the private sector. Public organizations typically do not engage in the close, personal interactions with potential recipients to assess complex needs and do not expect a quid pro quo for services provided. Moreover, they are unlikely to have strong incentives to do so. Funding by tax dollars insulates public organizations from the competition for financial support that serves as an incentive for private organizations. This is discussed in section VII of the paper. Using supply and demand analysis, it is shown how a government program that effectively lowers the nonmonetary price to recipients increases the quantity demanded and reduces private sector supply. Because long run elasticities are larger than those in the short run, these effects are smaller in the short run than the long run. Thus, any presumably negative effects of the program on creating dependency, reducing private charity, and expanding the government budget are initially small, but larger in the future. If there is any political

[1] The term "nonprofit" organization is used in this paper to refer to the type of organization discussed in this paragraph and not in its legal sense.

shortsightedness, this may make these programs quite politically popular but difficult to undo once in place.

Section VIII concludes the paper. There are conditions under which government provision on the basis of need may not be as problematic as in others, for example, where the assessment of needs is obvious and where the elasticity of demand by recipients is low. However, the private sector in a free enterprise economy normally has advantages over public organizations. It is underrated regarding its efficacy in providing for the needs of individuals and in its fairness while the public sector is overrated in these respects.

II. Does Fairness Involve Merit?

Before considering the needs criteria of fairness, consider the following issue concerning markets and fairness.[2] Should merit be accounted for regarding fairness and rewards? Casual empiricism strongly suggests that it is widely held that it should. Is it fair that the individual who works hard to produce more goods and services be rewarded the same as one who is slothful and produces little? Most probably would not think so.

Thus, if a strong correlation of rewards and productive effort is an important aspect of fairness, then free enterprise does very well regarding fairness. There are market-generated incentives, e.g., reputational effects, to limit this though it does not eliminate it entirely. To be sure, luck and raw ability can play roles in monetary payments received in the marketplace. For example, without any effort, owners of Anaheim, California real estate reaped great rewards when Disney decided to locate there. But it is equally sure that effort, training, conscientiousness, and similar exertions are important in supplying marketplace consumers with goods they value. The rewards that come with this are therefore merit based.

Some might also argue that one can get ahead in the marketplace by cheating buyers or engaging in related fraudulent activity. There are market-generated incentives, e.g., reputational effects, to limit this, but they do occur. But this fraudlent activity really is outside the delineation of free enterprise. Free enterprise involves voluntary actions and exchange. Fraud is a deliberate failure by one party to follow through on his/her part of the exchange, going counter to what the other party agreed to. Proponents of markets understand this and advocate market-supporting legal infrastructure – e.g., contract law, anti-fraud statutes – that seeks to prevent it.

III. Profit-Maximizing Firms and Self-Serving Consumers

The profit-seeking firm is sometimes regarded as one of the hallmarks of free enterprise. This model of supplier behavior is long-ensconced in the economics profession's teaching of principles and advanced microeconomics. The sole pursuit of profit, presumed to be the goal of these firms and an accurate predictor of their behavior, is thought by some as leading to unfairness. Firms charge the same prices to individuals regardless of income,

[2] Also considered by Heyne (2008).

need, or any other characteristic. Any resulting profit is kept by the firm's owners, presumably used to further their own interests.

Another alleged hallmark of free enterprise is the self-interested consumer. In many of our models, consumers are entirely self serving, buying goods only of the basis of their own desires. Goods end up being allocated to those who are willing to pay. The result seems to be an allocation that is devoid of concern for the needy.

However, even the case of totally self-interested parties, this is not necessarily the case. One reason is that pricing and property rights require that we implicitly pay attention to the desires of others. In competitive equilibrium, prices provide information about others' wants. The market price represents the marginal valuation of the good to consumers. In deciding whether to acquire a good, a consumer compares his/her valuation to the market price, so is implicitly comparing to other individuals' valuations. The concerns of others, as reflected in the market price, are accounted for. Those who have a greater "need" for certain goods will have a higher valuation and be more likely to acquire the good. For example, those who jog for their health have a greater valuation for running shoes, those with colds value decongestants more, and those with larger families value bigger homes more. Of course, these purchases are constrained by income, but "needs" still matter in the allocation of goods and services. However, it is the income constraint and lack of income by some individuals – so their "needs" are not reflected in the marketplace as much as others – that generates concern with fairness.

It remains the case that the above-noted and widely-used assumptions of the underlying motivations of demanders and suppliers in the market generate much unease about the fairness of free enterprise outcomes.

IV. A Broader View of Humans and Other Private-Sector Organizations

The typical model of the competitive market discussed in the previous section is an abstraction intended to understand and explain certain market phenomena. However, it is well recognized – by economists as well as others – that human beings have broader concerns than profit, money, and their own selves. Self interest and a desire for money should not be neglected as parts of the human character, but overwhelming evidence shows that people value other things, too, including the "needs" of others. Many of our behaviors illustrate this, such as charitable donations, care for our children and friends, and volunteer efforts for various causes. A wide variety of organizations and institutions have developed in conjunction with these types of activities. These include nonprofit charities, clubs, churches, civic groups, circles of friends, and families. The goals of these organizations reflect the variety of the individuals that comprise them, but most involve a concern for the needs of others.

Each of the above named organizations is as much a part of a free enterprise economy as are for-profit firms. For-profits firms assist consumers, for a fee, in obtaining the goods and services that they wish to purchase. They emerge without diktat in response to consumer demand. Similar comments apply to other organizations. For example, nonprofit homeless

shelters arrange for the shelter of homeless because, in part, there are a large number of individuals wish to donate money to see that this occurs. Clubs form because of people's desire to gather for the purpose of interaction centered on a commonly shared interest. Families form in part from a desire to procreate, but also to have close, intimate relationships with mutual caring and assistance.

Each of these emerges on its own in a free enterprise economy where organizations are free to start up and will survive if they serve their stakeholders' interests adequately well. In fact, nonprofit and for-profit organizations can (and do) compete for serving the same objective. The nonprofit form of organization has "won" this competition and attains a dominating presence in many settings and shares the marketplace with for-profit organizations in others. For example, the provision of religious services is almost entirely composed of nonprofit organizations. Many art museums and other art-related organizations are nonprofits. Hospitals are a mix of nonprofit and for-profit institutions. In the market for childcare services, there are a large number of both for-profit and nonprofit providers, and a great deal of child rearing occurs within a different sort of nonprofit institution – the family.

The circumstances under which various forms of organizations, including nonprofits, are likely to occur is the subject of a significant literature. Important examples are the work of Fama and Jensen (1983a), Hansmann (1996), and Glaeser and Shleifer (2001). Delving into the details of this literature is beyond the scope of this paper. For our purposes, however, it is important to note that the nonprofit organizations discussed above frequently allocate goods *not* based on their users' willingness to pay. They often attempt to allocate based on users' "needs." Similarly, nonprofits organizations often try to gain payment from those who have a greater "ability to pay." The market selects these types of organizations over for-profit institutions in many situations.

V. Some Fundamental Problems

When an organization attempts to allocate its goods and services based on "need" and induce payment according to "ability," it encounters several fundamental problems. These apply to private organizations, as well as to government efforts along similar lines.

The Information Problem

The basic information problem faced by this type of organization is how to assess the needs of potential recipients and the ability of potential payers. Failure to adequately do so puts outcomes at odds with the objective of the organization, i.e., those obtaining the goods are unlikely to be the most "needy" and those paying may not be the most able. Allocation by some other rule may actually serve the organization better.

To illustrate this issue regarding needs, consider an example from Heyne (2008). A bus driver pulls up to a bus stop, takes on passengers and begins to pull away with a near capacity load of riders. As the bus moves off, someone runs up and waves wildly for the driver to stop and let him/her board. Is it fair for the driver to do so? Is the driver helping a needy person? To adequately assess this, the driver would have to know many details of

the tardy person's and the passengers' lives. What are the consequences for the late arriver if s/he has to wait until the next bus relative to catching this bus? Suppose that if the driver stops for the late party and there is a two-minute delay. This is two minute delay for the numerous other riders. What are the consequences for them? This may cause missed connections and/or late arrivals to meetings, appointments, or other engagements. Stopping for the late party is not necessarily helping the neediest person. To make a "fair" decision on whether to stop for the late party, the driver ought to consider all the consequences for each passenger and weigh them against each other. Not having detailed knowledge of the parties involved, this is an impossible task. A simple anonymous rule may work better. In this example, the anonymous rule is that one acquires a ride by arriving at the bus stop on time.

The analogous situation in a more traditional market setting is in the following example. Suppose an altruistic grocery store owner would like to allocate the food to those most in need. To do so, s/he would have to evaluate the life situations of the thousands of customers, determine who is most needy then allocate the groceries accordingly. Knowing the details of the lives of the customers simply is infeasible. This problem is compounded by the fact that some potential recipients of low priced food may try to falsify their need. Rather than attempting to allocate on the basis of some mistaken assessment of need, the grocer may find it more appropriate to use a simple rule: those willing to pay the going price obtain the food.

Similar comments apply to any attempt by the grocer to induce payment according to ability. Assessing the ability to pay of each of the thousands of customer is a task at which the grocer is not likely to succeed. Attempting to base payment on erroneous determinations of ability would be self defeating.

Income, Need, and Ability

A simple way to assess needs and ability is to use income as a proxy and rely on its presumed positive association to ability and its negative relationship to need. Income is easier to measure than underlying need and ability. Indeed, this presumably is the reasoning behind many government tax and expenditure programs where high income people are taxed and the low income are subsidized. Using income as a proxy for ability, or an inverse one for need, leads to another set of problems, however. Though the above noted relationships of income to need and ability may hold, they are far from perfect. As is well known, income does not necessarily correspond to ability or, inversely, with need. Those with high income may have achieved it through hard work despite modest ability. Some with low income may be highly able but still be low earners due to a desire for leisure, nonmonetary rewards, or to laziness. Redistribution based only on earned income does not redistribute carefully on the basis of ability and need. In addition, there is the well-known incentive problem. Those who earn high incomes who are taxed have less incentive to work; those with low income who are subsidized have less incentive to work.[3] Lower overall wealth is the outcome, with less to redistribute to the needy.

[3] The incentives for each group depend on the interplay of income and substitution effects, but as long as the amount taxed equals the amount of the subsidies, the income effect, on average, is absent and one is left with the substitution effect to work less.

The Complexity of Need

There is another set of problems related to the first two. Human needs often extend well beyond cash assistance or the purchase of goods and services. Very often, those in unfortunate situations may not simply need some cash or groceries, but are best served by emotional support, spiritual guidance, advice, having a sounding board, someone to commiserate with, or someone to be accountable to. Similarly, those most able to give are not necessarily those with the highest incomes. Personality traits such as the ability to offer sympathy, to engage in nurturing, to provide discipline, leadership, or inspiration can matter much more than earning ability when giving emotional support to those who need it.

Judging needs and abilities regarding the above traits is well beyond observing cash income. Because these traits are often very difficult to ascertain, we are back to the original issue discussed above: the difficulty in assessing needs and abilities makes it very hard to allocate and induce payment on those bases.

Moral Hazard and Dependence

When good and services are given away, this invariability induces consumption beyond what it otherwise would be. Naturally, those who "do not need" the good will be tempted to acquire it at the zero price. This is the familiar moral hazard problem. It creates two issues.

One is that the greater use of the good or service increases the required resources to support the enterprise. For these organizations to survive, there must be a way to limit this additional use. Second, the additional use may create a dependence that is counter to the goals of the organization. For example, free meals at a shelter may induce some people to come to rely on them and reduce efforts to become self supporting in this regard. Free medical care at a healthcare clinic may encourage extraneous visits. Those providing the support to shelters or medical facilities most likely do not wish to encourage this type of behavior.

In an ordinary market setting, a dollar price is charged for the good, generating funds for its provision and establishing a disincentive for overuse. However, in the setting of the nonprofit organizations we are discussing, requiring dollar payments is no longer allocating by "need" and is anathema to the goal of the organization. Other means to deal with this problem are required.

VI. Assessing Needs, Quid Pro Quos, and the Market for Nonmonetary Exchange

It seems clear that many of the nonprofit institutions discussed above freely depart from allocating goods based on willingness to pay and payment based on productivity. Families do not compensate children according to the value of their services rendered nor charge them for meals, transportation, housing, tutoring, and the myriad of things a family

provides. Friends often come to the assistance of one other without compensation. Churches help members in need with tangible and intangible goods and collect from others in the church. Charities for the poor provide cash, goods, and counseling to the needy and collect payment from those who wish to support them. In short, there are a host of free enterprise institutions that knowingly and willingly attempt to allocate according to need and gain payment according to ability in a non-coercive manner. Consider the ways which these organizations operate to deal with the fundamental problems discussed above.

Assessing Needs and Abilities

Recall that one of the fundamental problems that arise in organizations of this type is the assessment of needs and abilities. Some of those with low income have the ability and skills to earn higher incomes if given the appropriate motivation. Also, needs are frequently more complex than simply requiring more cash or food and can be emotional in nature. Often, nonprofit organizations attempt to look deeply into potential recipients' characters. This can be through close, emotionally intimate, face-to-face interactions. Does the homeless man simply need a meal? Or can he earn a decent living with some guidance, friendship, and someone to hold him accountable? Workers at the homeless shelter engage in interactions to collect this information and make these assessments. Does a friend who lost a spouse need cash to pay the rent for a month or just some sympathy? Friends find out and take appropriate action. Does the child who did poorly on an exam need a tutor or more discipline to motivate work? Parents have intimate knowledge of their children through repeated interaction and make this and similar judgments.

Thus, many nonprofit organizations specialize in obtaining this detailed knowledge of individuals and allocate resources accordingly. The information problem noted above is overcome with close, repeated interactions. The knowledge gained in this manner also assists in dealing with the problem of falsifying needs and moral hazard problems of overuse and dependence. Evaluation of each potential recipient's status and motivations enables one, to some extent, to screen out those who are not appropriate for receiving the assistance, e..g., those who are could easily obtain the good by other means or who are becoming overly dependent.

Quid Pro Quos

The typical nonprofit institutions are not simply one entity giving goods and services to another. Almost invariably there is quid pro quo. There are expectations of recipients of the assistance. Giver and recipient are engaged in a nonmonetary exchange. In families, children are often given video games, TVs, and cell phones by their parents, but they are not free. In return for their use, children are expected to behave in certain ways, e.g., do their school work, be nice to their parents and siblings, eat their vegetables, and the like. For someone who gets help from friends to move their residence or just advice and commiseration, there is an implicit expectation for them return the favor for others in the group. Homeless shelters have certain expectations those who are provided with, food, shelter, and counseling. Often, these entail being sober, behaving in a polite manner, helping clean up, and engaging in some religious activity.

In short, there is a nonmonetary price for goods and/or services "given" to recipients. The price is a nonmonetary action or activity that recipients "pay." Though payment is not in cash, it carries some disutility to recipients.[4] Also, the payment is something providers gain utility by the recipients undertaking. For example, those receiving food at a shelter may be required to attend a religious service. This carries disutility to recipients and is the nonmonetary price to them. However, those providing the meals gain utility from recipients' attending a service and serves as the nonmonetary compensation to providers.

Also, this nonmonetary price serves as a check on the moral hazard of overuse and dependence by recipients. The nonmonetary price limits consumption by recipients and does so without impinging on their budgets. The latter is especially important regarding programs administrated to the poor.

The Market for Nonmonetary Exchange

We can think of the above as a market regarding nonmonetary exchange and analyze it in with a modified version of supply and demand analysis. First, consider the example above, where a homeless shelter assesses its "customers" and determines what individuals get, say, food, a night's stay, and a counseling talk. There is some nonmonetary activity that is expected in return for receipt of these services. As with any other good, there is a downward sloping demand curve. The greater the nonmonetary payment for food, shelter, and counseling, the lower the quantity demanded. This is illustrated in Figure 1.

In Figure 1, the horizontal axis represents the quantity (Q) of the good or service provided to recipients and the vertical axis is the nonmonetary price (denoted NP) asked in return. The curve D represents the demand curve as discussed above. There also is a supply relationship similar to that in the usual market setting. Though the nonmonetary price paid by recipients is not a cash payment to providers, it is something that the latter value being done. The higher this price, the more providers will offer to recipients. This is the upward-sloping supply schedule denoted S. As in the usual market setting, there is an equilibrium quantity and (nonmonetary) price, denoted Q_1 and NP_1, respectively.

VII. Government Programs

Problems With Government Provision

Many government programs are established with the presumed intent of helping the needy and these efforts are funded by taxing those with higher incomes. Examples of large federal programs of this type include food stamps, housing assistance, and a variety of job training programs, while large federal/state collaborative programs include Medicaid and Temporary Assistance for Needy Families (TANF). Each of these, and programs like them, face the above discussed problems associated with allocating according to need and requiring

[4] Those giving the goods and services normally feel that the "payment" is good for the recipient in the long run, e.g., making children behave well may be disliked by children at the time, but inculcating good habits is good for them in the long run.

payment according to ability. There is much to suggest that these problems are not dealt with very well. There are good reasons why this is to be expected.

For the most part, eligibility for these programs is based on income. Payment of taxes to support them also is based on income. As noted above, needs and ability are likely to have correlations with income, but the correlation may not be that strong. Much deeper exploration is needed to truly ascertain need which, as discussed above, can be quite complex and involve emotional issues and not simply cash. However, government offices that administer these programs do not engage in intimate, face-to-face interactions with potential recipients with the intent to assess their true character and needs. Additionally, there are essentially no quid pro quos. There may be costs such as filling out paperwork and standing in line, but there typically are few, if any, expectations regarding the behavior of the recipient as a condition for receiving the good or service in question.[5] The result is twofold: a failure to identify true needs and a greater use of and dependence on the program. These are generally at odds with helping the needy.

Moreover, there is unlikely much incentive for government-operated programs to engage in the careful assessment of needs nor in the requiring of quid pro quos. Program administrators are not rewarded for this careful assessment. Thus, they do not have the knowledge of who needs what, nor the incentive to acquire it. Similarly, program administrators have little incentive, and usually have little discretion, to impose a quid pro quo on recipients. Dollars to support the program are from tax revenue and do not come from the providers themselves nor from voluntary donors who feel strongly about "the cause" and can withdraw funding and apply other pressure in seeking a particular type of assistance and nonmonetary price.

Nonprofit organizations may also have similar problems in motivating the managers and employees to engage in the appropriate assessment and to charge the suitable nonmonetary price. This is likely to be especially true of large organizations, e.g., United Way and Red Cross, where the donors to the organization are not its managers and may be far removed from any direct involvement. This is an issue directly analogous to the principal-agent problem that stockholders of a large corporation face who are not part of management nor associated with the operations of the corporation. There is a large literature on how corporations deal with this problem and some of those ideas apply to nonprofit organizations.[6] An important point here is that there is competition among nonprofits for donors. Donors seek some type of screening on needs and quid pro quos to be established. To compete for donors, it is in the interests of nonprofit organizations to establish procedures and provide evidence to donors that they are indeed doing what donors desire.[7] Though these processes are imperfect, they are likely to induce a substantial degree of conformity of the organization's actions to donor wishes.

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[5] Perhaps an exception to this is TANF. States are expected to require schooling, training, or work effort to receive cash assistance. Also, unemployment insurance programs usually have a requirement that recipients engage in active job search, but this apparently is not well enforced (see Burgess (1992)).

[6] See Fama and Jensen (1983b) for a discussion of how corporations deal with this issue and Glaeser (2002) on similar issues regarding nonprofit governance.

[7] See Castaneda, Garen, and Thornton (2008) for evidence on the effect on nonprofits of competition for donors.

Because the source of funds for government programs is tax dollars, potential supporters cannot withdraw their money if dissatisfied with the program and so there is not a similar competitive process to induce conformity with supporter wishes.[8] Thus, the above described forces will largely be absent for government run operations. The result is that there is no careful assessment of need and no price charged for the receipt of goods and services provided. Those obtaining the good are much less likely to be truly needy and, because of the lower price, more will be utilized.

The outcome can be illustrated with our supply and demand model. To do so, consider Figure 2. Figure 2 replicates Figure 1 but adds some additional material. One interpretation of a government program is that it essentially lowers the nonmonetary price of obtaining the good in question. Suppose that this lowers price to NP_0 and the government program supplies to the market all that is demanded at that price. Private providers must charge this same price, or its equivalent, or will not serve any recipients. The result is that the quantity supplied by the private sector shrinks to Q_0^S. The quantity demanded is higher at Q_0^D and the government program supplies the balance of demand not provided by private providers, $Q_0^D - Q_0^S$.

The Short Run, the Long Run, and the Transitional Gains Trap

Two related issues that often arises in the context of government assistance programs are the issue of dependence and Tullock's (1975) transitional gains trap. Dependence increases as individuals adjust to the availability of the program and come to use it more and rely on it. This is essentially the long-run elasticity of demand for use of the program exceeding the short-run elasticity. Because of this, the short-run outcomes of a program can seem quite favorable, but after the long-run adjustments, the effects are less attractive. Transitioning back toward the original equilibrium by reducing the program can be politically difficult because the short-run gains are small, despite having larger and desirable long-run effects. As a result, starting programs may be easier than stopping them, even if they are not working as desired. This is discussed by Clark and Lee (2008) regarding government income-assistance programs and can be easily illustrated with the supply and demand analysis developed here.

In Figure 3, we illustrate the equilibrium in the market for nonmonetary exchange as previously. Point A is the equilibrium without a government program and points B and C show the equilibrium for private demanders and suppliers with the government program in place. These are as in figures 1 and 2. Suppose that the demand curve D and supply curve S are the long-run relationships. Consider starting without a government program at point A

[8] Dissatisfaction with government programs is expressed via lobbying efforts and voting. Both of these have free-rider problems, hampering their effectiveness. Also, voting usually occurs regarding a candidate representing a whole platform of issues. Thus, a vote cannot be targeted specifically at one program, blurring the signal it gives. Though the relation between a program's popularity and the votes its political supporters obtain probably is positive, it is much weaker than for voluntary support for particular programs. Another avenue by which there is competition regarding government-operated programs is Tiebout (1956) competiton, where individuals move to the locale providing their desired level and type of government programs. This, too, has its limits and is not applicable to federal programs.

and implicit price NP_1 and then initiating a program, pushing the implicit price to NP_0. Because both suppliers and demanders do not adjust immediately to the new situation, both the short-run demand and short-run supply going through point A are less elastic than their long-run counterparts. Let them be given by D_{SR} and S_{SR}.

The short-run effect is that quantity demanded rises modestly to Q^D_{SR}, quantity supplied falls slightly to Q^S_{SR}, and the amount provided by the government program is relatively small, given by the horizontal distance of segment FE. Any concerns about dependence by recipients, withdrawal of services by the private sector, and government budgetary commitments seem quite minimal. In the long run, however, demanders and suppliers adjust to the new environment and we move to the long-run equilibrium at points B and C. Each of these concerns becomes much greater: there is more use and dependence by recipients, a larger reduction in private provision, and a much larger government presence and budgetary commitment. Thus, if there is any shortsightedness in policy making, such a program is likely to be very popular when implemented, but lose its popularity later.

If this long-run equilibrium is undesirable to policy makers and there is a desire to cut all or part of the government program, transitioning away from this equilibrium can be politically difficult. To see this, suppose that policy makers take steps to reduce the size of the program by raising its implicit price to NP'. In the short run, recipients and providers will move along their short-run demand and supply curves running through points B and C, respectively. These are given by D^0_{SR} and S^0_{SR}.

The immediate outcome is point G for recipients and point H for private providers. Despite the cut in the government program, there is barely a reduction in usage, a minimal increase in private supply, and so barely a reduction in government presence. Thus, in the short run, the cut in the program has little effects, making it politically unpopular. This is true despite the long run effects being much larger, at points J and I for demanders and suppliers, respectively. Assuming that it is desirable to reduce dependence, increase private provision, and reduce government commitments, the long-run consequences are substantially better than those in the short run. Yet with political shortsightedness, there will be a lot of political opposition in the short term, making it difficult to enact and sustain the cut in the government program. Also, instant removal of the program causes a huge increase in the nonmonetary price, likely leading to strong political opposition to doing so.

VIII. Conclusion

Attempting to allocate resources based on need raises a whole host of issues, including the assessment of needs and controlling the moral hazard problem of overuse and dependency when goods and services are "free." Yet despite these problems, and despite claims that the free enterprise system neglects needs and is fundamentally unfair, private sector organizations and institutions have emerged that seek to undertake this type of allocation. They may operate as a complement to, in lieu of, or alongside the for-profit firm that is the standard of classroom models.

The above raised issues are dealt with in the private sector by the organizations engaging in intimate, face-to-face interactions with potential recipients to screen out those who are not in true need, with expectations of quid pro quos for services provided, and from competition for donors and participants for support. The public sector institution is likely to be less successful in controlling these problems. They tend to be rule driven, where screening out potential recipients on non-income basis is not allowed and quid pro quos are not expected. Thus, the public organization does not have the information to allocate based on need and the lack of a nonmonetary price can raise the likelihood of dependency. Given that public sector programs do not face competition as in the private sector, there also is a lack of incentive by the government organization to undertake these activities. Given this, government programs would be least problematic relative to the private sector when there is less need for careful screening to determine need and when the elasticity of demand for use by recipients is very low. This perhaps is the case for things such as natural disasters or accidents that cannot be anticipated and are difficult to avoid.

Nothing in economics or in a free-enterprise economy declares that organizations must be profit seeking or that individuals care only about themselves. Indeed, many organizations in a free-enterprise economy are organized otherwise. It seems that the private sector's ability to meet the "needs" of individuals and act in a "fair" manner is greatly underestimated and underappreciated and the converse holds for the public sector.

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Figure 1

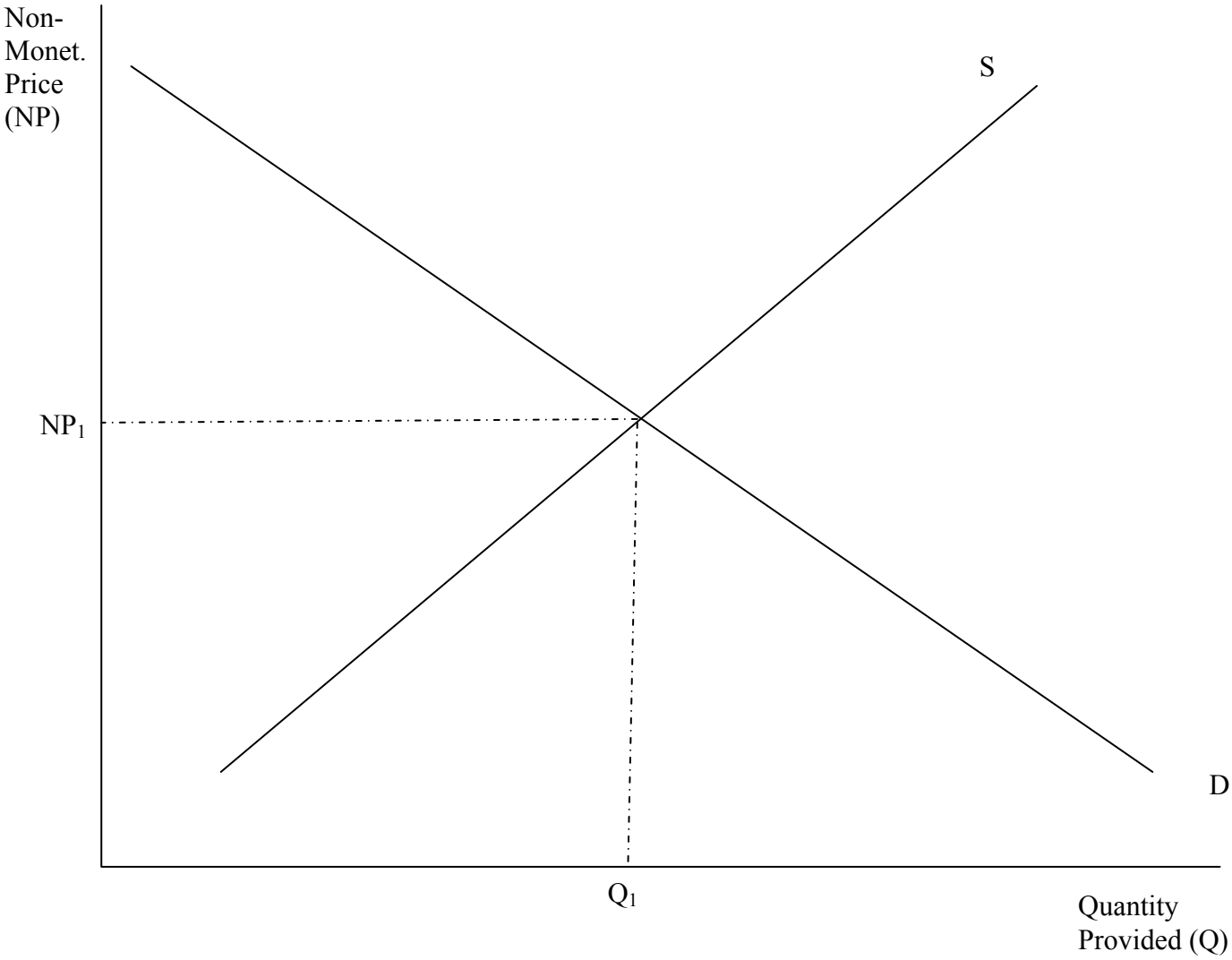


Figure 2

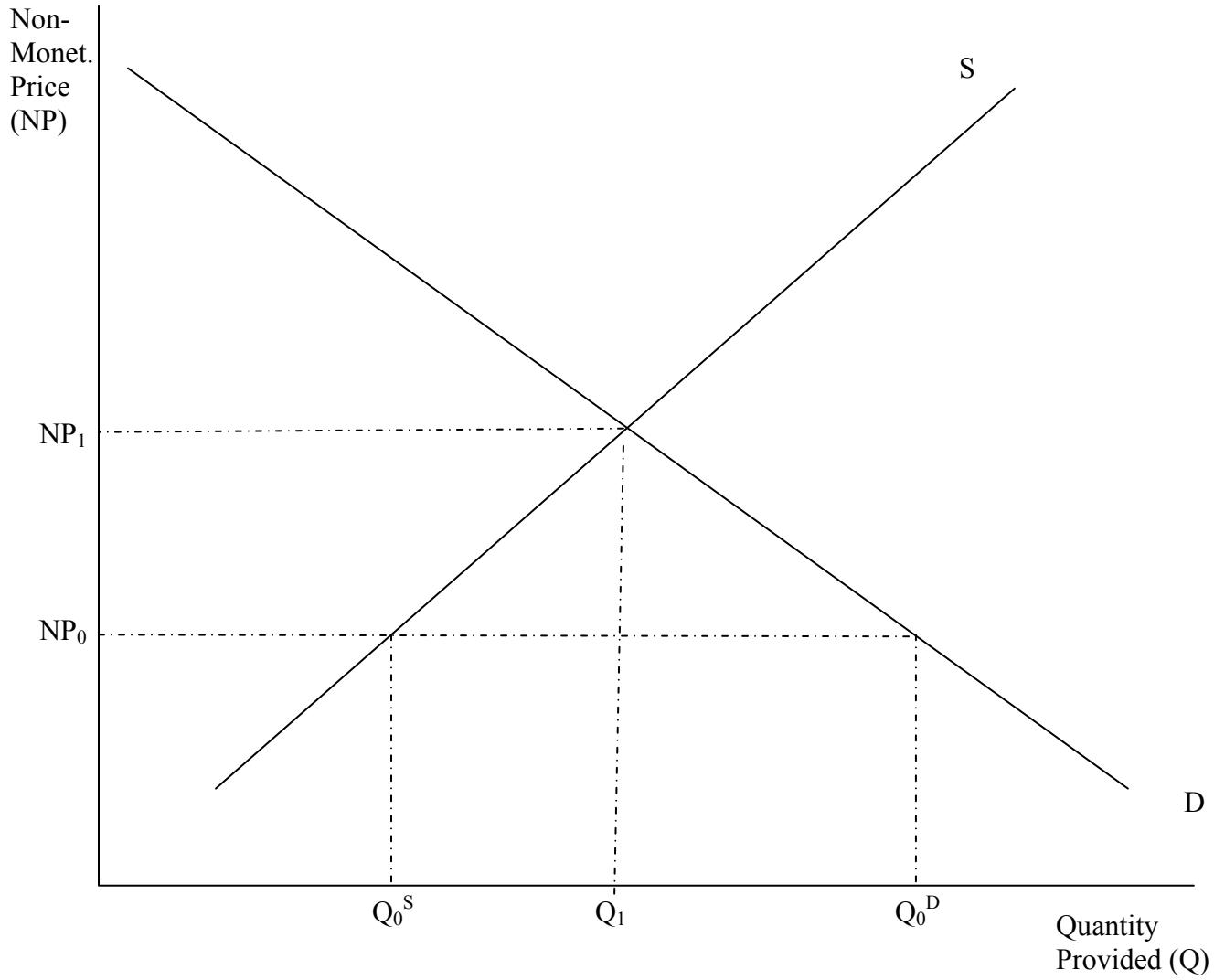
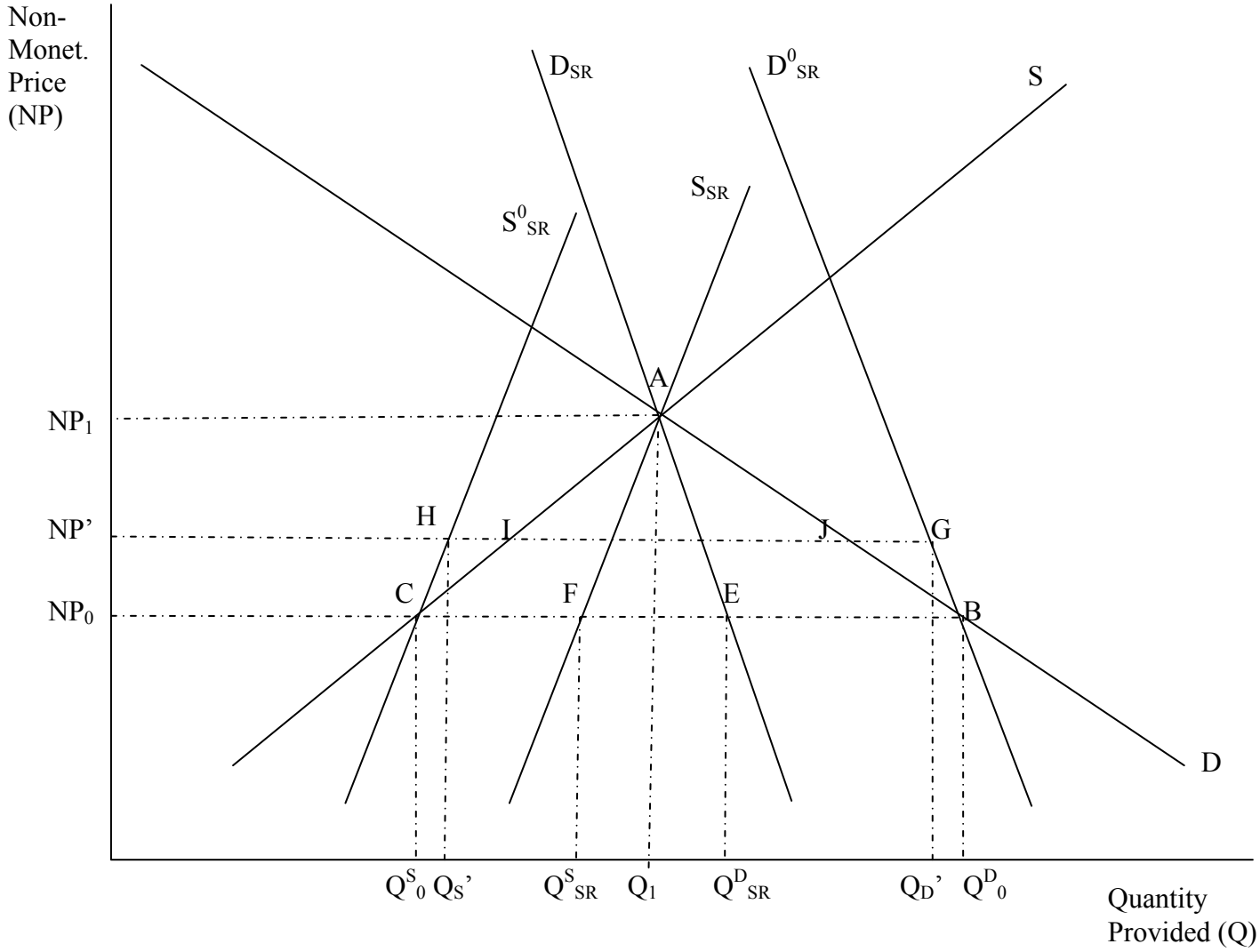


Figure 3


Non-
Monet.
Price
(NP)
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E
B
D
Q^S_0
Q_S'
Q^S_{SR}
Q_1
Q^D_{SR}
Q_D'
Q^D_0
Quantity
Provided (Q)