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In This Issue…

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MIDWESTERN BUSINESS AND ECONOMIC REVIEW

No. 50 .... Spring 2015

Table of Contents

ABSTRACTS

WHICH PETROLEUM PRICES BEST EXPLAIN RETAIL FUEL PRICE CHANGES?

This paper examines which petroleum prices best explain changes in gasoline and diesel prices during three distinct periods of fuel price volatility during the 2003 to 2010 period. The results indicate that spot retail fuel prices are best explained by their futures prices over most periods, indicating that these futures markets provide valuable information about future spot fuel prices no matter the level of fuel price volatility.

WASHINGTON CONSENSUS DEVELOPMENT HYPOTHESIS: EVIDENCE FOR MEXICO

This article uses recent developments in econometric techniques to examine the export-led growth hypothesis for Mexico over 1982:Q1–2010:Q3. The Granger-causality tests were based on two testing approaches: the vector error correction modeling approach outlined in Toda and Philips; and the augmented level VAR modeling with integrated and cointegrated processes (of arbitrary orders) separately introduced by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). Empirical results reveal the unidirectional Granger causality from real export to real GDP growth. This weak exogeneity supports the Washington consensus development hypothesis for Mexico. Additional determinants of growth are also found to be significant.

RISK DIFFERENCES BETWEEN STOCK AND MUTUAL RISK RETENTION GROUPS

This paper examines the risk differences between the two primary types of ownership structure in the risk retention group (RRG) market. RRGs appeared after 1986, offering an innovative approach to contract design and organizational form for commercial liability insurance. Interestingly, they can take a variety of forms, including the forms of stock companies or mutuals. Yet a mutual aspect is embedded in each type of ownership because RRGs are owned by their policyholders. The empirical results are consistent with the conclusions of Lamm-Tennant and Starks (1993), indicating that mutual RRGs are less involved in risk than their stock counterparts, where the variance of the loss ratio serves as a proxy for the risk inherent in future cash flows.

THE ECONOMIC IMPACT OF PRAIRIE VIEW A&M UNIVERSITY ON WALLER COUNTY, THE HOUSTON-BAYTOWN-SUGAR LAND MSA, AND THE STATE OF TEXAS

This study presents estimates of the economic impact of Prairie View A&M University on the local, regional, and state economy in 2012. The primary measurement variables used were direct spending, total output, value-added, labor income, and employment. This report also highlights the non-quantifiable impacts through a summary of the research and service contributions of various organizations on campus that serve the greater community. With the use of IMPLAN software, the study finds the direct spending impact on the economies of Waller County, the greater Houston region, and the State of Texas was $122 million, $227 million, and $267 million, respectively.

AN EMPIRICAL INVESTIGATION OF THE FEASIBILITY OF A PRODUCT LIFE CYCLE-TRANSPORTATION ACTIVITIES MODEL

Top management in several major corporations has recently expanded the role of physical distribution (PD), especially transportation, beyond traditional boundaries. Hence, a need has arisen for integrative, systems-oriented, and conceptual models that assist PD executives to more effectively manage their increased responsibilities in a dynamic environment. One such model is the product life cycle (PLC) concept. A nation-wide sample of PD executives was asked to indicate the importance level and usage frequency of each transport activity. Practitioners were also asked to assign each activity to the sales phase they thought most appropriate. Their assignments matched about one-third of the prescriptive model.

WHICH PETROLEUM PRICES BEST EXPLAIN RETAIL FUEL PRICE CHANGES?

Vance Ginn, Texas Public Policy Foundation

1. INTRODUCTION

Petroleum prices not only increased over the last decade, but they were also more volatile. With consumers and producers affected by petroleum price changes, it is vital to understand the behavior of these prices (Brown & Thies, 2009; Edelstein & Kilian, 2009; Hamilton, 2009; Ramey & Vine, 2011). By examining the last decade's volatility in retail gasoline and diesel prices, this paper attempts to determine which petroleum prices best explain the behavior of these spot retail fuel prices.

Although the automobile industry made substantial technological advancements during the last forty years, consumption and production of different vehicle types continually responded negatively to gasoline price disturbances (Ramey & Vine, 2011). In fact, Hamilton (2009) finds that the recessions in 1980, 1990, and the early part of the 2007 recession would likely not have happened had spending on automobiles and auto parts not declined. This is partially due to higher prices at the pump as a higher gas price acts like a tax on consumers by reducing their ability to purchase other goods and services (Edelstein & Kilian, 2009).

While the gas price primarily affects consumer spending, the diesel price tends to have a larger effect on business investment. The Energy Information Administration (EIA, 2011) notes that two-thirds of farm equipment, buses, most trucks used for transporting goods, and engine-generators use diesel. Since capital and labor are complementary in these sectors, a higher diesel price increases a firm's costs and reduces their incentives to invest in capital and hire workers (Brown & Thies, 2009).

If fuel prices influence the behaviors of consumers and producers, these prices may also help explain business cycles and signal to monetary policymakers whether they should act to achieve their mandate of price stability. An important issue that affects these policymakers' decisions is determining relative price changes, whereby reliable information about these changes is necessary when evaluating different policy proposals (Friedman, 1968). Although fuel prices can influence the public's expectations of higher inflation, action by the Federal Reserve (Fed) may not be appropriate if they can keep long-run inflation expectations well anchored, which is essential for price stability (Clarida et al., 2000).

During the last decade, whether the Fed should react to high petroleum prices was frequently discussed. The Fed's Chairman Ben Bernanke (2010) noted that higher petroleum prices would be temporary and would not affect core inflation, indicating that tight monetary policy was not necessary. As the economic environment changed and petroleum prices remained elevated, Chairman Bernanke signaled that the Fed was concerned about the pass-through of fuel prices to the prices of other goods and services and would monitor whether action was necessary to stabilize consumer prices (Hilsenrath & Leo, 2011).

Bernanke's view of transitory fuel price changes is not new. Pindyck (1999) explained that in the long run commodity prices frequently revert to their mean. Since the Fed may determine that monetary policy action is necessary depending on the economic impacts of gasoline and diesel price fluctuations, good explanations of future spot retail fuel prices could aid policymakers.

Ginn and Gilbert (2009) take a step towards explaining the movement of the spot retail gasoline price from changes in the one-month-ahead oil futures price. They find that a 10% increase in the current week's oil futures price leads to a 2% increase in the retail price of gas. Although their model forecasts the spot retail gas price relatively well from 1990 to 2008, there are several periods when it does not, indicating that other petroleum prices may better explain gas price changes.

In this paper, I consider a benchmark model similar to the one used by Ginn and Gilbert (2009) and compare it with other forecast models that include the following petroleum prices: crude oil spot price, futures prices of gas and diesel, and past fuel prices. After estimating each model during the 1983 to 2002 period when fuel prices were relatively stable, I examine out-of-sample rolling forecasts during three distinct periods in the 2000s and discuss which petroleum price best explains retail fuel prices. With potential structural breaks in retail fuel prices around the mid-2000s, the out-of-sample forecast periods selected are during different periods of fuel price volatility from 2003 to 2004, 2005 to 2007, and 2008 to 2010. The results indicate that the futures prices of both fuels best explain their spot retail prices during most periods, indicating that these futures prices accurately reflect activity in fuel markets.

2. FUEL PRICE COMPONENTS AND FUTURES PRICES

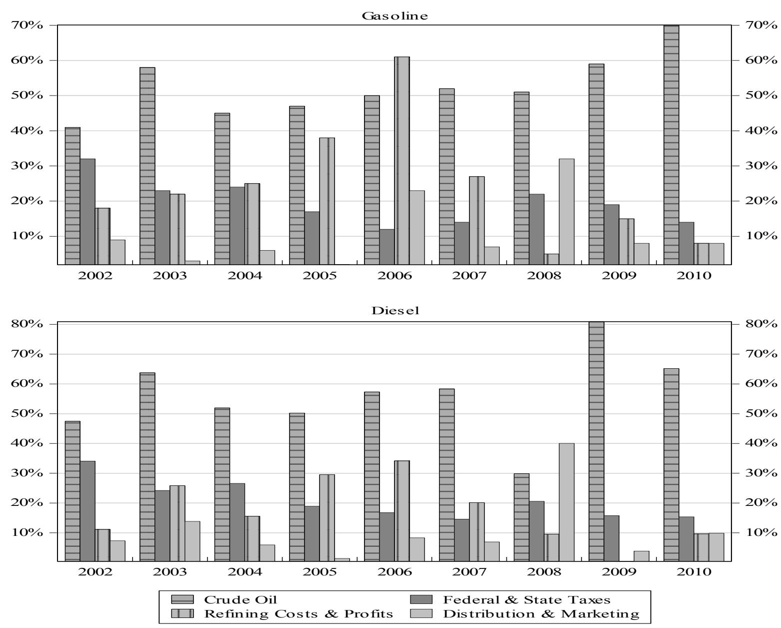
To determine which variables may help explain spot retail fuel prices, the EIA separates the average retail price of a gallon of gasoline and diesel into four components: distribution and marketing, refining costs and profits, federal and state taxes, and crude oil. Figure 1 shows the annual percentage contributions of each component to fuel price changes.

Crude oil is the only component with a substantial share of both fuel prices. Since refiners choose, on average, to refine the 42 gallons in a barrel of oil into 19 gallons of gasoline and 10 gallons of diesel, these oil-fuel price relationships are not surprising (EIA, n.d.). As expected, Chouinard and Perloff (2007) find that an increase in the oil price contributes to gas price variability. Brown and Thies (2009) obtain similar results regarding diesel price changes from oil price fluctuations. To build on their initial diesel price predictions, Brown and Thies (2009) consider other petroleum prices but do not conclude which price best explains the diesel price.

Although the spot and futures prices of oil may help predict fuel prices from their direct relationship in the production process, Fama and French (1987) note that the predictive capability of energy futures prices to forecast spot energy prices depends on the efficiency of futures markets (Fama, 1970). While Chinn and Coibion (2013) find that the futures price of gasoline is a good predictor of its spot price, Alquist and Kilian (2010) show that the oil futures price does not reliably forecast the spot price of oil, questioning the efficiency of petroleum futures prices. As an efficiency-type test of an oil futures market, Buyuksahin and Harris (2011) examine whether oil speculators were to blame for the substantial rise in the oil futures price during the 2000s. Their results indicate that oil market fundamental drove speculators' decisions to bid up the oil futures price, not perverse motives. However, McCallum and Wu (2005) find that the prices of longer-term futures contracts do not properly value the future spot price of oil because of light trading; whereas, speculators provide additional liquidity in shorter-term oil futures markets helping short-term contract prices accurately reflect the future spot price of oil (Plante & Yucel, 2011).

After the culmination of past research, an important question for those who use fuel remains: which petroleum prices best explain the behavior of spot retail fuel prices?

Figure 1: Percentage Contributions to Changes in Retail Fuel Prices



Notes: Data are from the Energy Information Administration (n.d.) for the period 2002:2-2010:12 for the retail gasoline price and 2002:6-2010:12 for the retail diesel price. These components are annualized averages of their percentage contributions to monthly percent changes in fuel prices.

Table 1: Statistical Summary of the Estimation Period

	Summary Stats		*Correlation Stats*					
	Mean	Std. Dev.	GP	GPFut	DP	DPFut	OP	OilFut
Retail Gasoline Price (GP)	$1.13	0.17	*1*					
Gas Futures Price (GPFut)	$0.61	0.15	*0.86*	*1*				
Retail Diesel Price (DP)	$1.14	0.16	*0.94*	*0.82*	*1*			
Diesel Futures Price (DPFut)	$0.60	0.15	*0.75*	*0.88*	*0.83*	*1*		
Oil Spot Price (OP)	$19.99	5.49	*0.76*	*0.91*	*0.78*	*0.94*	*1*	
Oil Futures Price (OilFut)	$21.83	5.51	*0.80*	*0.94*	*0.83*	*0.96*	*0.98*	*1*
	Mean	Std. Dev.	%ΔGP	%ΔGPFut	%ΔDP	%ΔDPFut	%ΔOP	%ΔOilFut
%ΔGP	.07%	0.04	*1*					
%ΔGPFut	.09%	0.09	*0.52*	*1*				
%ΔDP	.10%	0.04	*0.66*	*0.54*	*1*			
%ΔDPFut	.00%	0.08	*0.35*	*0.63*	*0.69*	*1*		
%ΔOP	-.07%	0.07	*0.61*	*0.73*	*0.74*	*0.79*	*1*	
%ΔOilFut	-.01%	0.08	*0.50*	*0.81*	*0.68*	*0.83*	*0.92*	*1*

Notes: Monthly data from 1983:1-2002:12 are from the Energy Information Administration (n.d.). GPFut data are from 1985:1-2002:12.

3. DATA ANALYSIS

To answer this question, I use monthly data from the EIA for the sample period 1983:1 to 2010:3[1] for motor gasoline regular grade retail price (GP) (including all taxes); on-highway diesel fuel retail price (DP) (including all taxes); New York Harbor No. 2 heating oil one-month-ahead futures contract price (DPFut) that includes diesel fuel; the crude oil one-month-ahead futures contract price (OilFut) traded on the New York Mercantile Exchange (NYMEX); and the crude oil spot price (OP) (refiner's acquisition cost of imported crude oil).[2]

The final variable is the price of the New York Harbor regular grade gasoline futures one-month-ahead contract (GPFut), which is available from 1985:1 to 2010:3. During this period, there are two measures of the gasoline futures price available: reformulated regular grade gasoline and reformulated gasoline blendstock for oxygenate blending (RBOB). The latter measures accounts for the percentage of ethanol added to gasoline in 2005 (Chinn & Coibion, 2013). I use the reformulated gasoline futures price from 1985:1 to 2006:12 and the futures price for the RBOB from 2007:1 to 2010:3.[3]

Table 1 shows that there are clear differences in petroleum price volatility since 1983. Retail fuel prices were similar with only a one-cent difference between their means during the 1983 to 2002 period. Table 2 shows that from 2003 to 2010 petroleum prices rose substantially and were more volatile relative to the earlier period. Each petroleum price in the latter period has means more than twice and standard deviations more than three times what they were during the previous period. Retail gas and diesel prices are more correlated with spot and futures prices of oil in the latter period. These high correlations support the literature that finds the price of oil helps explain changes in fuel prices.[4]

Due to potentially persistent petroleum prices, I check each of the variables for a unit root process using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests (Table 3).

Based on the initial test results, I transform the variables into their log first difference and reject the null hypothesis for both unit root tests. Since several petroleum prices appear to change substantially during the sample, Table 4 shows the results from unit root tests in the presence of structural breaks (Banerjee et al., 1992; Lee & Strazicich, 2003) and Table 5 presents results from structural break tests (Bai & Perron, 1998; Zivot & Andrews, 1992) that endogenously determine break points for petroleum prices.

The results from the Banerjee et al. (1992) sequential unit root test (Table 4(a)) and the Zivot-Andrews (1992) structural break test (Table 5(a)) indicate that these price series may be trend stationary before and after the selected break points around late 2004 or early 2005. Lee & Strazicich's (2003) Lagrange multiplier (LM) unit root test indicates most prices are trend stationary except for the diesel futures price in 2006:3 and crude

Table 2: Statistical Summary of the Forecast Period

	Summary Stats		*Correlation Stats*					
	Mean	Std. Dev.	GP	GPFut	DP	DPFut	OP	OilFut
Retail Gasoline Price (GP)	$2.39	0.63	*1*					
Gas Futures Price (GPFut)	$1.70	0.60	*0.98*	*1*				
Retail Diesel Price (DP)	$2.52	0.76	*0.96*	*0.94*	*1*			
Diesel Futures Price (DPFut)	$1.73	0.69	*0.96*	*0.96*	*0.99*	*1*		
Crude Oil Spot Price (OP)	$56.42	23.48	*0.96*	*0.97*	*0.96*	*0.98*	*1*	
Oil Futures Price (OilFut)	$61.88	24.27	*0.96*	*0.97*	*0.97*	*0.99*	*0.995*	*1*
	Mean	Std. Dev.	%ΔGP	%ΔGPFut	%ΔDP	%ΔDPFut	%ΔOP	%ΔOilFut
%ΔGP	.79%	0.08	*1*					
%ΔGPFut	1.14%	0.12	*0.81*	*1*				
%ΔDP	.82%	0.06	*0.81*	*0.65*	*1*			
%ΔDPFut	1.07%	0.09	*0.667*	*0.81*	*0.77*	*1*		
%ΔOP	1.21%	0.10	*0.76*	*0.88*	*0.73*	*0.87*	*1*	
%ΔOilFut	1.17%	0.10	*0.71*	*0.86*	*0.71*	*0.91*	*0.97*	*1*

Notes: Monthly data from 2003:1-2010:3 are from the Energy Information Administration (n.d.).

Table 3: Unit Root Tests

Log Levels:	GP	GPFut	DP	DPFut	OP	OilFut
ADF Test Statistics:	*-0.09*	*-0.51*	*-0.85*	*-1.27*	*-0.77*	*-1.44*
	(0.91)	*(0.89)*	*(0.80)*	*(0.64)*	*(0.82)*	*(0.56)*
PP Test Statistics:	*-0.59*	*-1.18*	*-0.59*	*-0.74*	*-1.31*	*-1.21*
	(0.87)	*(0.68)*	*(0.87)*	*(0.83)*	*(0.63)*	*(0.67)*
ΔLog:	ΔGP	ΔGPFut	ΔDP	ΔDPFut	ΔOP	ΔOilFut
ADF Test Statistics:	*-5.06*	*-5.30*	*-11.16*	*-13.95*	*-8.71*	*-13.14*
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
PP Test Statistics:	*-10.04*	*-14.35*	*-11.44*	*-13.97*	*-9.80*	*-12.68*
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*

Notes: The sample period is 1983:1-2010:3, except for the gasoline futures price (GPFut), which is from 1985:1-2010:3. Both tests include a constant. Lag lengths for ADF tests are selected using the Akaike information criterion and for PP tests are selected using the Newey-West automation.

oil spot price in 1986:1 and 2006:3 (Table 4(b)). The results from the Bai & Perron (1998) unit root test with a specific-to-general modeling strategy show there may be a break in the retail gasoline price series in 2005:6 (Table 5(b)). Although not all the chosen break dates are statistically significant, the results from these tests indicate structural changes in several petroleum price series may have occurred during the mid-2000s.

Potential structural break dates for retail gasoline and diesel prices appear likely in 2005 from the following: U.S. refiners and consumers altered their decisions to produce or consume fuel after the substantial rise in retail fuel prices from fuel supply disruptions from Hurricanes Katrina and Rita (Brown & Thies, 2009; Brown & Virmani, 2007); increases in oil demand from rising global economic growth put upward pressure on retail fuel prices (Kilian, 2010); and refiners changed their production of fuels because of government mandates in the Energy Policy Act of 2005 to blend ethanol with gasoline (Du & Hayes, 2009).

I use the potential structural break dates identified above to split the sample during the mid-2000s between the estimation and forecast periods.

4. FORECAST MODELS

Since many forecast models could be selected as a benchmark to compare the accuracy of forecasting retail fuel prices, I use a bivariate model similar to the one by Ginn and Gilbert (2009) that regresses the spot retail gasoline price on oil futures prices. As noted above, their model performs reasonably well during most of their sample period but does not do as well during the mid-2000s. Considering the oil futures price may not be a good predictor of its spot price (Alquist & Kilian, 2010; Buyuksahin & Harris, 2011; McCallum & Wu, 2005), I consider other models with past values of the dependent variable and either the oil futures price (AROilFut) or the crude oil spot price (AROP). After finding that the spot retail price and its futures

Table 4: Unit Root Tests in the Presence of Structural Breaks

(a) Unit Root Tests (Single Break) (BLS, 1992): 0.15 trim Null: Unit root with no break	Null Case	Lags	Break Date	t_{DF}^{min}
Retail Gasoline Price	Trend	2	12/2004	*-4.68**
	Mean	2	6/2001	*-3.47*
Gasoline Futures Price	Trend	1	12/2004	*-4.91**
	Mean	1	10/2001	*-3.89*
Retail Diesel Price	Trend	1	1/2005	*-4.55**
	Mean	1	10/2001	*-3.42*
Diesel Futures Price	Trend	3	12/2004	*-4.66**
	Mean	3	1/2002	*-3.80*
Crude Oil Spot Price	Trend	4	12/2004	*-4.46**
	Mean	4	5/2002	*-3.88*
Crude Oil Futures Price	Trend	4	12/2004	*-4.54**
	Mean	4	1/2002	*-3.84*

(b) Unit Root Tests (Two Breaks) (Lee and Strazicich, 2003): 0.10 trim Null: Unit root with two breaks	Model	Lags	T1	T2	B1(t)	B2(t)	D1(t)	D2(t)	LM test statistic
Retail Gasoline Price	Crash	2	3/2002	8/2005	0.04 (0.41)	0.35* (3.77)			*-4.37**
	Break	2	7/2001	5/2007	0.15 (1.61)	-0.21* (-2.31)	0.00 (-0.15)	0.01 (0.44)	*-6.61**
Gasoline Futures Price	Crash	1	4/2004	2/2007	0.21 (1.94)	0.25* (2.28)			*-4.58**
	Break	1	6/2001	4/2007	0.01 (0.08)	0.08 (0.77)	0.01 (0.89)	-0.01 (-0.56)	*-6.41**
Retail Diesel Price	Crash	1	1/2003	9/2005	0.11 (1.32)	0.14 (1.60)			*-3.75*
	Break	1	8/2001	11/2005	0.12 (1.42)	0.14 (1.57)	-0.01 (-0.45)	0.06* (2.88)	*-6.06**
Diesel Futures Price	Crash	3	1/2003	3/2006	0.09 (1.07)	0.23* (2.57)			*-3.68*
	Break	3	10/2002	7/2007	-0.10 (-1.19)	-0.16 (-1.86)	0.05* (3.83)	0.01 (0.29)	*-6.34**
Crude Oil Spot Price	Crash	4	1/1986	3/2006	-5.67* (-2.12)	7.15* (2.63)			*-3.27*
	Break	4	12/2000	7/2007	2.63 (1.00)	-6.40* (-2.42)	0.60 (1.75)	1.22 (2.03)	*-6.02**
Crude Oil Futures Price	Crash	4	1/1986	9/2004	-4.59 (-1.47)	5.64 (1.81)			*-3.47*
	Break	4	10/1997	5/2005	-1.04 (-0.34)	7.58* (2.46)	-0.02 (-0.04)	1.72* (3.01)	*-6.09**

Notes: The 5% critical values for the minimum ADF t-statistic are -4.38 for the trend case and -4.81 for the mean case. T1 and T2 are the dates of the structural breaks; B1(t) and B2(t) are the dummy variables for the structural breaks in the intercept; D1(t) and D2(t) are the dummy variables for the structural breaks in the trend. The 5% critical values for the LM test statistic are -3.84 for the crash model and -5.29 for the break model. The lag lengths are chosen by the AIC. Figures in parentheses are t-values. * implies significance at the 5% level.

price appear to be cointegrated from the Engle and Granger (1987) and Johansen (1988) cointegration tests, I use a error-correction model (GPFut) proposed by Engle and Granger to represent the short-run and long-run dynamics between the spot retail gas price and its futures price.[5] Table 6 reports each of these forecast model representations.[6]

4.1 GASOLINE PRICE FORECAST MODELS

To compare the accuracy of different petroleum prices to explain fuel price changes, I estimate each of the models over the 1983 to 2002 period, except for the gas price futures model that is over the 1985 to 2002 period. The benchmark forecast model's (OilFut) coefficients indicate that a 10% increase in the price of oil futures increases the retail gas price by 1.9% in the same month and by 2.4% in the subsequent month, which are similar results to those using weekly data (Ginn & Gilbert, 2009). After correcting for heteroskedasticity and including monthly dummies, the ARCH(OilFutS) model provides a higher R-squared and a lower AIC than without the correction. I perform similar estimates, tests, and adjustments when needed for other gasoline forecast models. The models that appear better at explaining the price of gas relative to others are the following: AROPS, ARCH(OilFutS), ARCH(OPS), and GPFut.

4.2 DIESEL PRICE FORECAST MODELS

I use a similar benchmark and general models to forecast the spot retail diesel price. By examining the AIC and R-squared of the estimated benchmark model (OilFut) with different lag lengths, I find that the parsimonious model includes the current month and three lags of the oil futures price. I include monthly dummies and estimate the model (OilFutS) that shows the retail diesel price rises by 2.5% in the current month when oil futures

Table 5: Structural Break Tests

(a) Unit Root Tests with a Single Break (Zivot and Andrews, 1992): 0.10 trim Null: Unit root without break	Null Case	Lags	Break Date	t_{DF}^{min}
Retail Gasoline Price	Intercept	2	1/2005	-5.81*
	Intercept+Trend	2	1/2005	-5.71*
Gasoline Futures Price	Intercept	1	1/2005	-6.09*
	Intercept+Trend	1	1/2005	-6.06*
Retail Diesel Price	Intercept	1	1/2005	-5.65*
	Intercept+Trend	1	7/2004	-5.55*
Diesel Futures Price	Intercept	3	1/2005	-5.77*
	Intercept+Trend	3	1/2005	-5.69*
Crude Oil Spot Price	Intercept	4	1/2005	-5.52*
	Intercept+Trend	4	1/2005	-5.59*
Crude Oil Futures Price	Intercept	4	1/2005	-5.62*
	Intercept+Trend	4	1/2005	-5.63*

(b) Unit Root Tests with Multiple Breaks (Bai and Perron, 1998): 0.15 trim Null: No structural break	Lags	Break Date	# of Breaks
Retail Gasoline Price	2	6/2005	1
Gasoline Futures Price	1	--	0
Retail Diesel Price	1	--	0
Diesel Futures Price	3	2/2006	1
Crude Oil Spot Price	4	2/2006	1
Crude Oil Futures Price	4	2/2006	1

Notes: The 5% critical values for the sequential minimum ADF t-statistic are -4.93 for the intercept case and -5.08 for the intercept and trend case. The lag lengths are chosen by the AIC. * implies significance at the 5% level.

Table 6: Forecast Model Representations

AROilFutS	$\Delta X_t = c + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \sum_{j=0}^{q} \theta_j \Delta OilFut_{t-j} + \sum_{k=1}^{12} \delta_k D_k + \varepsilon_t$	AR Model With the Oil Futures Price and Seasonal Dummies
AROPS	$\Delta X_t = c + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \sum_{j=0}^{q} \phi_j \Delta OP_{t-j} + \sum_{k=1}^{12} \delta_k D_k + \varepsilon_t$	AR Model With the Crude Oil Spot Price and Seasonal Dummies
DPFut	$\Delta X_t = c + \sum_{i=0}^{p} \Psi_i \Delta DPFut_{t-i} + \varepsilon_t$	Diesel Price Futures Model
GPFut	$\Delta X_t = c - \alpha_i(X_{t-1} - a - \beta_j GPFut_{t-1}) + \sum_{i=0}^{p} \gamma_i \Delta GPFut_{t-i} + \varepsilon_t$	Gasoline Price Futures Model

Notes: Representations of variables in all models are the following: gasoline or diesel prices (X), the oil futures price traded on the NYMEX (OilFut), crude oil spot price (OP), New York Harbor regular gasoline futures price (GPFut), New York Harbor No. 2 heating oil futures price (DPFut), seasonal dummy variable (D), and a normally distributed error term (ε).

prices rise by 10%. Relative to the relationship between the prices of retail gas and oil futures, these coefficient estimates indicate there is a larger increase in the retail diesel price from an increase in the current month's oil futures price. The best-fitting models for the retail price of diesel include the following: OP, ARCH(DPFut), and ARCH(OPS).

5. ROLLING FORECAST RESULTS

Using the forecast models in Table 6, I compute rolling forecasts over different time horizons (h = 1, 3, 9, and 12 months) for retail fuel prices during the three unique out-of-sample forecast periods. Based on the potential structural break dates discussed above, the selected forecast periods with varying levels of fuel price volatility include: 2003:1 to 2004:12 when both fuel prices rose without much volatility; 2005:6 to 2007:5 when these prices were increasingly unstable from adverse fuel supply shocks; and 2008:4 to 2010:3 when both prices were highly volatile.

Although several measures may be used to evaluate the accuracy of a forecast model, I use the forecast models to estimate root mean squared errors (RMSEs) and report them in dollar terms in Table 7 for the gasoline price and in Table 8 for the diesel

Table 7: Gasoline Out-of-Sample Rolling Forecast RMSEs

Forecast Period	2003:1-2004:12				2005:6-2007:5				2008:4-2010:3			
	h=1	*h=3*	*h=9*	*h=12*	*h=1*	*h=3*	*h=9*	*h=12*	*h=1*	*h=3*	*h=9*	*h=12*
OilFut(AIC=1)	0.07	0.12	0.13	0.17	0.18	0.30	0.35	0.29	0.18	0.33	0.51	0.31
Relative RMSEs												
OilFut RMSE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ARCH(OilFutS)	1.02	1.00	0.80	0.89	0.98	0.95	0.88	1.02	1.09	1.08	1.05	1.25
GPFut	**0.70**	**0.58**	1.14	**0.31**	**0.64**	**0.57**	**0.46**	**0.71**	**0.74**	**0.71**	**0.67**	**0.58**
ARCH(OPS)	0.99	0.97	**0.76**	0.92	0.92	0.88	0.78	0.94	1.02	0.96	0.89	1.11
AROPS	0.91	0.95	0.80	0.84	0.79	0.84	0.78	0.82	0.87	0.83	0.71	0.89

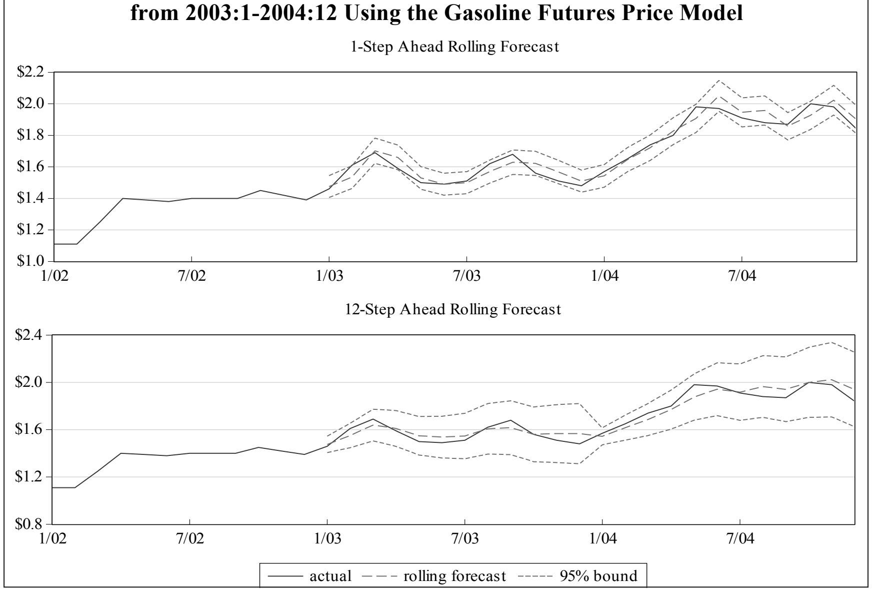
Notes: Estimation period is 1983:1-2002:12. The first row of entries are root mean squared errors (RMSEs) of the OilFut benchmark forecast for the gasoline price. For the remaining rows, the first twelve numerical columns report the RMSEs of the forecasting model relative to the OilFut benchmark (OilFut = 1.00). Bold entries denote the lowest relative RMSE for that period/horizon and highlighted entries denote the second lowest RMSE. All forecasts are pseudo out-of-sample. Seasonal dummies for gasoline are April, May, July, and December.

Table 8: Diesel Out-of-Sample Rolling Forecast RMSEs

Forecast Period	2003:1-2004:12				2005:6-2007:5				2008:4-2010:3			
	h=1	*h=3*	*h=9*	*h=12*	*h=1*	*h=3*	*h=9*	*h=12*	*h=1*	*h=3*	*h=9*	*h=12*
OilFut(AIC=3)	0.05	0.08	0.10	0.10	0.15	0.19	0.23	0.19	0.10	0.16	0.21	0.21
Relative RMSEs												
OilFut RMSE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ARCH(DPFut)	**0.88**	**0.59**	**0.63**	**0.94**	**0.86**	**0.84**	**0.82**	**0.88**	1.00	1.01	**0.77**	1.23
OP(3)	1.11	1.20	1.30	1.28	0.96	0.95	0.80	0.91	**0.96**	**0.98**	1.65	**0.98**
ARCH(AROPS)	1.08	1.17	1.46	1.39	0.89	0.94	0.77	0.92	1.17	1.19	1.68	1.12

Notes: Estimation period is 1983:1-2002:12. The first row of entries are root mean squared errors (RMSEs) of the OilFut benchmark forecast for the diesel price. For the remaining rows, the first twelve numerical columns report the RMSEs of the forecasting model relative to the OilFut benchmark (OilFut = 1.00). Bold entries denote the lowest relative RMSE for that period/horizon and highlighted entries denote the second lowest RMSE. All forecasts are pseudo out-of-sample. Seasonal dummies for diesel are February, April, August, September, and October.

Figure 2: Rolling Out-of-Sample Gasoline Price Forecasts from 2003:1-2004:12 Using the Gasoline Futures Price Model



price. I then compare these RMSEs to the benchmark model and denote them as *relative RMSEs*.[7]

To examine a period during the 2000s when fuel prices steadily increased without major fuel market disruptions, the first out-of-sample forecast period is from 2003:1 to 2004:12. Models that include the futures prices of fuel, GPFut and ARCH(DPFut), predict their future spot retail prices better than others over most forecast horizons. These are similar to the results by Chinn and Coibion (2013) who find that the gasoline futures price provides the best estimate of the gasoline spot price. Figures 2 and 3 provide the results of rolling forecasts from these two models for gas and diesel prices, respectively, for 1-step and 12-step ahead horizons.

Retail gasoline prices fall within the 95% confidence bounds from the gasoline futures price model during the entire period. Likewise, retail diesel prices fall within these bounds from the diesel futures price model during most of the period, and when it does fall outside these bounds it is temporary.

The next forecast period from 2005:6 to 2007:5 has several fuel supply disruptions from hurricanes, including Hurricanes Katrina and Rita in 2005, that shut down refineries in the Gulf of Mexico. Kilian (2010) refers to these as adverse supply shocks in the U.S. refining industry, and these shocks helped drive fuel prices up. Expectations of more hurricanes than average in 2006 and 2007 led to substantially higher fuel prices based on what Kilian (2010) terms "precautionary fuel demand," which is when fuel traders purchase fuel futures contracts today with the anticipation of future fuel supply disruptions. After forecasting over this sample period and comparing the RMSEs, the futures price models for both retail fuel prices perform better than all others. Figures 4 and 5 present these results that indicate that gas and diesel futures prices, respectively, were reflecting the disruptions to domestic refining capacity during this period, and

Figure 3: Rolling Out-of-Sample Diesel Price Forecasts from 2003:1-2004:12 Using the ARCH Diesel Futures Price Model

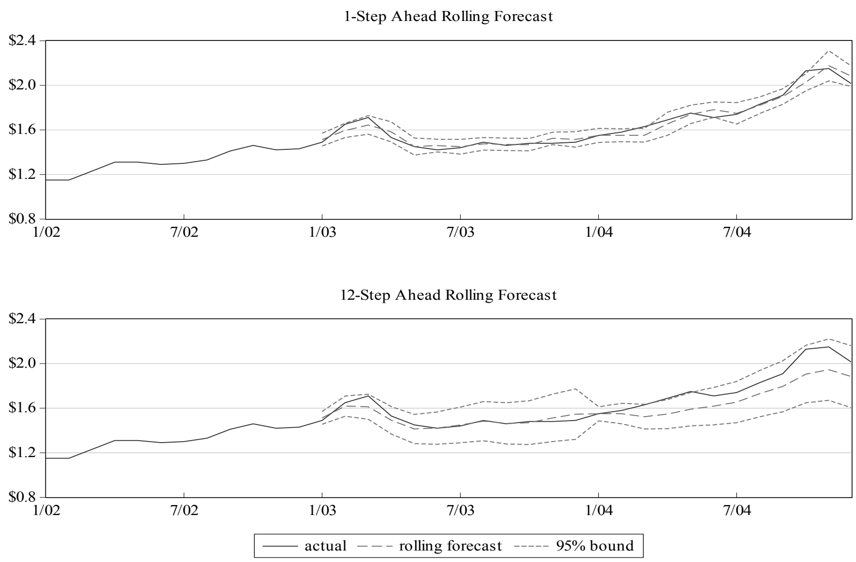
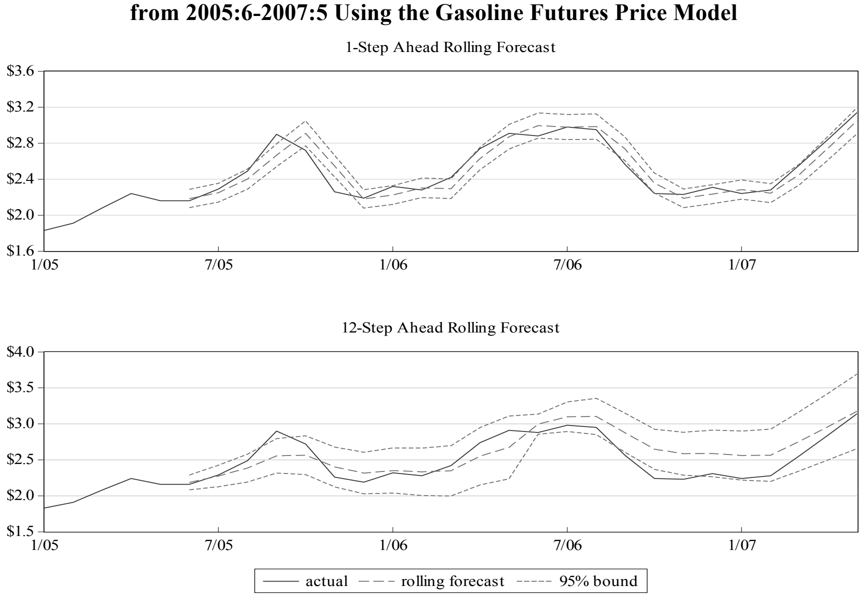


Figure 4: Rolling Out-of-Sample Gasoline Price Forecasts from 2005:6-2007:5 Using the Gasoline Futures Price Model



those disruptions were not relevant (or were much less relevant) to oil futures prices.

Lastly, retail gasoline and diesel prices in the 2008:4 to 2010:3 were quite volatile during the Great Recession and increased at a relatively stable pace thereafter. Over this relatively volatile period, Figure 6 shows that the gas futures price performs well at forecasting the spot retail gas price as with the previous two periods. However, the model with diesel futures prices did not perform as well, but Figure 7 shows that the model with the crude oil spot price (OP) that has the lowest relative RMSE for all but one forecast horizon performs well at predicting the spot retail diesel price.

During this latter period of increased volatility, it appears that the futures price of diesel did not give a clear indication of the future spot retail price of diesel, but the current production cost of refining crude oil into diesel did.

6. CONCLUSIONS

Since gasoline and diesel fuel the vast majority of transportation nationwide and indirectly influence decisions in other sectors, these petroleum products are integral to the U.S. economy. This paper attempts to provide models with petroleum prices that can accurately explain the behavior of retail fuel prices during different periods of fuel price volatility.

After estimating each model from 1983 to 2002 then estimating rolling forecasts during three different periods of volatility, the results suggest that it does not matter if the retail gas price is stable; the gasoline futures price performs better at explaining changes in the retail gasoline price. Similarly, the diesel futures price accurately explains the retail diesel price during periods of less volatility and adverse diesel supply shocks; however, the crude oil spot price is the best predictor when the price of diesel and economic growth are more volatile, such as during the Great Recession.

Figure 5: Rolling Out-of-Sample Diesel Price Forecasts from 2005:6-2007:5 Using the ARCH Diesel Futures Price Model

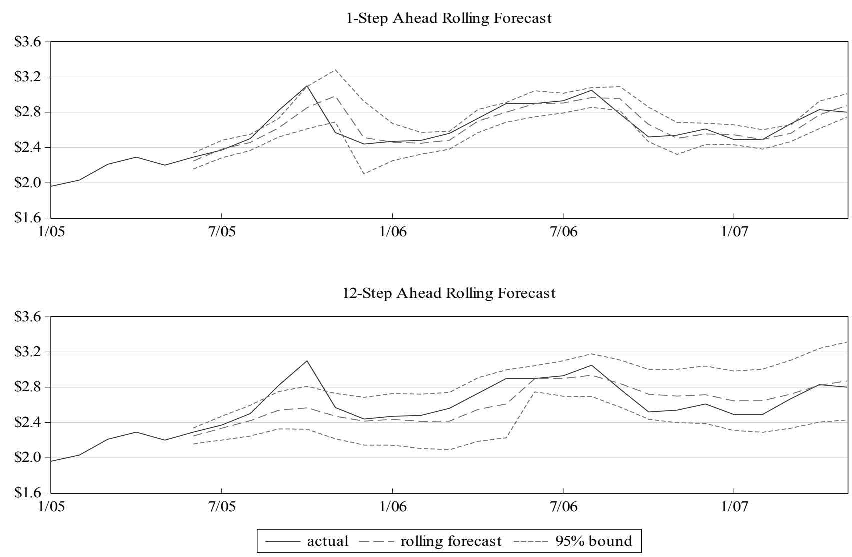
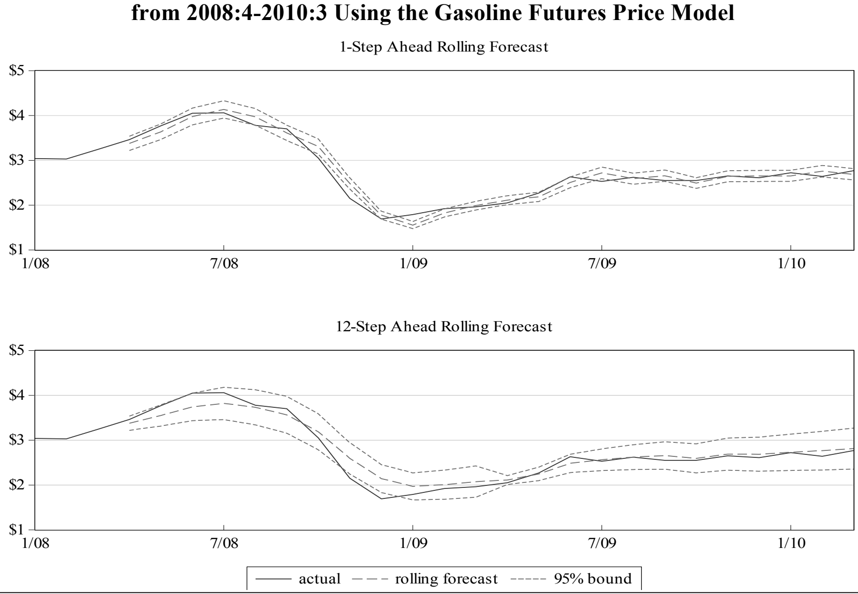


Figure 6: Rolling Out-of-Sample Gasoline Price Forecasts from 2008:4-2010:3 Using the Gasoline Futures Price Model



This paper contributes to the literature by comparing the ability of multiple petroleum prices to explain fuel price changes during different periods of volatility and noting that the futures prices appear to be the best indicators despite research claiming otherwise.

Future research should explore reasons why the crude oil price was a better predictor than the diesel futures price in the highly volatile period from 2008 to 2010. Possible explanations include inefficiencies in the diesel futures market or the speed and magnitude of changes in the price of diesel that may have been more responsive to crude oil price changes compared with the diesel futures price. Although this paper does not provide information on the relationship between business cycles and fuel prices, a precautionary fuel demand effect on economic growth may exist from people cutting their spending today because they are worried about higher retail fuel prices in the future. If these economic effects were sufficiently large to slow economic activity, forecast models provided here might help reduce the uncertainty of future fuel costs, help determine when a recession might occur, and provide appropriate policy implications.

NOTES

1. 1983 is the starting date because of the lack of data available before then for motor gasoline price.

2. Although the West Texas Intermediate (WTI) price of oil is commonly reported, the WTI price may not send a clear signal of the oil price paid by refiners during my sample period because of price controls imposed by the Nixon Administration and the dependence on foreign oil in the U.S. since 1971 (Barsky & Kilian, 2004). Moreover, both measures are highly correlated (99.7%) during my sample period and do not substantially alter the results.

3. The results are not substantially different if the starting date for the RBOB is 2007:1 or 2005:12, which is the first month of available data. Although the estimation period is shorter for the gasoline futures price than for the other petroleum prices, there appears to be sufficient observations included in the analysis.

4. See Borenstein, Cameron, & Gilbert (1997), Chouinard & Perloff (2007), and Ginn & Gilbert (2009) for further elaboration on the relationship of these petroleum prices.

5. I also considered the Johansen method and found similar results. There was slight cointegration between the retail diesel price and its futures price, but the results were not substantially different than those without correcting for this so were not included but are available upon request.

6. Forecast models with an S include monthly dummies that are statistically significant. These months include April, May, July, and December for gasoline and February, April, August, September, and October for diesel.

7 These are the ratios of each forecast model's RMSE to the benchmark—relative RMSEs below one indicate models that perform better than the benchmark and those above one are worse.

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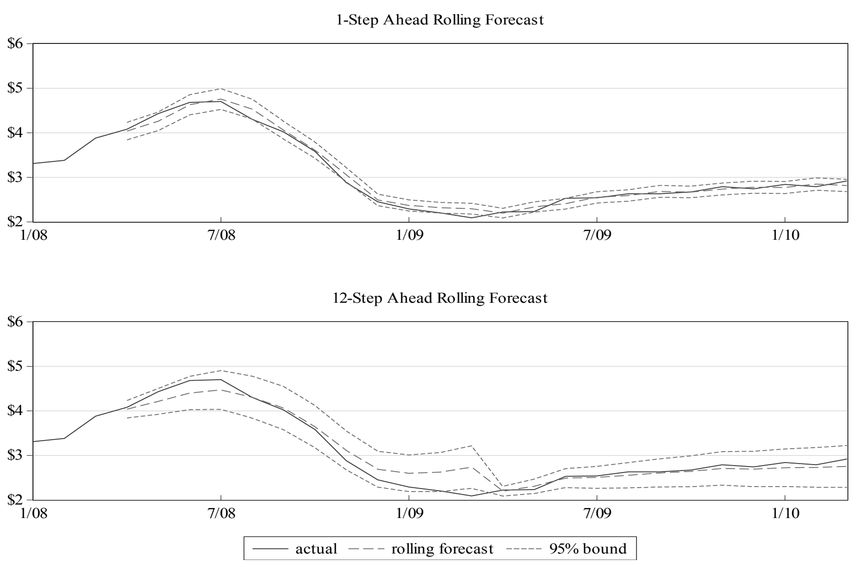
Figure 7: Rolling Out-of-Sample Diesel Price Forecasts from 2008:4-2010:3 Using the Crude Oil Spot Price Model



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WASHINGTON CONSENSUS DEVELOPMENT HYPOTHESIS: EVIDENCE FOR MEXICO

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I. INTRODUCTION

With new technological advances that seem to shrink the world, international economies have become as intertwined as a cobweb. The neoclassical export-led development strategy, advocated by the Bretton Woods Institutions, and the recent birth of the World Trade Organization have caused the volume of international trade to increase exponentially. This unprecedented mobility of capital due to advances in communication technologies and new international investment opportunities has been an impetus for nations around the world to develop their economies and to drastically improve the social welfare of their populace. Paradoxically, increases in the mobility of international capital, with its fluid nature, are often the cause of financial crises with international dimensions. This often causes large sudden reductions in the volume of international trade and investment flows and disrupts economic activities, causing monetary crises in many nations. The international contagion of the 1997 Asian financial crisis and the potential impact of the current European sovereign debt crisis are a few illustrative examples.

Moreover, in the current economic climate, not all economic relationships between two nations are alike. These bilateral relationships depend on the degree of development, natural resources, and infrastructures and so on of the countries involved. Usually advanced economies with fully developed infrastructures can weather certain crises or sustain contagions of crises from other countries better, while the less developed countries usually suffer severely from crises.

As articulated by Awokuse (2003, p. 129) the export-GDP growth causality is a long-run behavioral relationship, requiring econometric procedures appropriate for long-tern equilibria. This study follows Awokuse (2005-a) to investigate the Mexican dynamic linkages between exports and output growth by applying the recent advances in time series statistical techniques: (i) the vector error correction modeling (VECM) approach outlined in Toda and Phillips (1993); and (ii) the augmented level VAR modeling with integrated and cointegrated processes (of arbitrary orders), separately introduced by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) – henceforth, TYDL. As pointed out by Awokuse (2005-a, p. 693), the latter methodological approach is useful because it bypasses the need for potentially biased pre-tests for unit roots and cointegration, common to other formulations.

As described in the Mexican economy section, Mexico has experienced some adverse phenomena in recent history: the debt overhang in the 1980s, the Tequila attack in the early 1990s, and most recently the contagion of the U.S. subprime mortgage crisis which make the Mexican economy a fertile ground to test the Washington consensus development strategy. The remainder of the study is organized as follows. The following section briefly reviews the literature and some background of development theories; the next section summarizes the prominent features of the Mexican economy; the section that follows discusses the data, methodology, and descriptive statistics; the next section reports the empirical results; the final section provides some concluding remarks.

II. BRIEF REVIEW OF LITERATURE AND HISTORICAL BACKGROUND

After World War II, the world was shocked by the destruction caused by the conflict. This reaction led to the formation of the UN/Bretton Woods Institutions during 1944-45. In the twentieth century, many theoretical development strategies were articulated and applied to develop economies to assuage human suffering around the globe: the Marshall Plan for Europe, the reconstruction of Japan, the economic development plans at the UN General Assembly and Economic and Social Council, to name a few. Up to date, the articulated theoretical development strategies can be broadly classified into two categories: inward-looking and outward-looking strategies. These strategies are also referred to as import-subsidized and export-led development strategies. The theoretical foundation for the inward-looking development strategy was the Keynesian economic theory (Singer, 1998), which advocates subsidized import of capital and development of labor to industrialize the economy. Leading theorists in this school of thought were Sir Hans W. Singer and Raúl Prebisch. Therefore, the import-subsidized development strategy is better known as the Prebisch-Singer hypothesis. This hypothesis was the foundation of many development policies in Latin America in the ‘50s.

The Prebisch-Singer hypothesis, which has been debated and shown to have some major weaknesses, was replaced by the outward-looking development strategy around the globe. In retrospect, the Prebisch-Singer hypothesis has many features necessary for development strategies in the current age of globalization. As one of the leading theorists in the Prebisch-Singer hypothesis and one of Keynes’ disciples, Singer (1993) has argued that, from the Keynesian perspective, the new economic order established after World War II was both distorted and incomplete and was not given time to prove its effectiveness. Singer posited that the original intention of putting pressure on balance of payments surplus countries has been changed to pressure the poor countries, the deficit countries, and in particular the indebted countries. For the industrial countries, the surplus countries, and the non-indebted countries, there is nothing but a slap on the hand. Another original feature was that the global macroeconomic coordination was assumed to be in the UN General Assembly and Economic and Social Council, but the hostility to the UN as a result of the Cold War and the McCarthy era prevented this global policy coordination in the UN. Neither the US under the Pax Americana (Latin for "American Peace") of 1945-71, nor the group G5 or G7, nor the IMF or the World Bank has been able to take its place.

As to the incompleteness of the new economic order, Singer (1993) articulated that the main gap was the failure to establish the International Trade Organization (ITO), which would have helped the developing countries as it would have had commodity price stabilization as its objective. The ITO was duly negotiated and agreed (it is also known as the Havana Charter) and signed by 53 countries on March 24, 1948, but was not ratified by the US Congress. It is interesting to note that for a long period of time after World War II, the US experienced a very favorable trade balance surplus. Singer asserted that as a result of the failure to ratify the ITO, the post-war years have seen deteriorating terms of trade—the ratio of the prices of exports to the prices of imports—for developing countries. The deteriorating real price for oil was also responsible for OPEC actions of 1973 and 1979 which finally delivered the death blow to the Bretton Woods System.

Singer further articulated that the Latin American debt crisis could not be foreseen in 1944-45. At the end of World War II, Latin America and the Indian subcontinent had plenty of foreign assets and reserves while the financial affairs of Africa were a matter for their European colonial "mother countries." This new factor has placed the debtor developing countries—and that means the great bulk of them—in a condition of dependency and inferiority, which prevents them from playing any real part in global economic affairs, allowing the Bretton Woods Institutions to impose a new neoliberal ideology under the "Washington Consensus" (Singer, 1993, p. 8).

The aforementioned phenomena also transformed the UN/Bretton Woods System from the "one country one vote" to the "one dollar one vote" system. The neoclassical economic theory is the theoretical foundation of the export-led development strategy (Taylor, 1999, pp. 2-5), which is the brainchild of the Bretton Woods Institutions. This development strategy is better known as the Washington Consensus development strategy. The ideology of and the arguments for the export-led strategy are well known and voluminous in the literature, thus they are not summarized here. However, it is important to note that the export-led development strategy advocates that all economies should concentrate on developing the export sector in their development processes. This strategy has led to exponential growth in the volume of international trade, capital mobility, and closer connections among the international economies in the last three decades. While this development strategy may be the catalyst for economic development around the world, it also creates an environment conducive to international financial crises because of dangerous contagions, such as the one demonstrated by the recent US subprime mortgage crisis.

Over the last three decades the role of exports in stimulating economic growth has been the subject of debate among development economists. The recent phenomenal growth in output and exports of the Newly Industrializing Countries (NICs) of East Asia has further helped fuel this debate. In contrast to the economic success stories of the NICs, the relatively inwardly oriented economies in Africa and Latin America have experienced very dismal growth rates. Since trade theory does not provide definitive guidance on the causal relationship between exports and output growth, the debates are usually informed by empirical analyses that often yield ambiguous results. The main question in the export-growth debate is whether an export-led outward-oriented trade policy is preferable to an inward-oriented trade policy in stimulating economic growth. Some researchers argue that causality goes from exports to economic growth and denote this as the export-led growth (ELG) hypothesis. However, the reverse causal flow from growth to exports is described as growth-led exports (GLE). Most studies focus on developing countries (Balassa, 1978; Ram, 1987); some researchers have examined the ELG hypothesis for industrialized countries (Marin, 1992; Shan and Sun, 1998; Awokuse, 2003, 2005-a, 2005-b; Siliverstovs and Herzer, 2006; Chan and Dang, 2010)

III. THE MEXICAN ECONOMY

The Mexican economy has experienced some adverse phenomena in recent history: the debt overhang in the 1980s, the Tequila attack in the early 1990s, and most recently the contagion of the US subprime mortgage crisis. In the face of the Tequila crisis and its attendant economic and financial difficulties, the Mexican economy underwent a significant transformation to comply with the North American Free Trade Agreement (NAFTA), implemented in January 1994, and one year later—to the day—with the World Trade Organization (WTO) agreement. Complying with the NAFTA and WTO is an important undertaking for developing nations. Without a doubt, NAFTA and WTO memberships change the characteristics and complexity of the Mexican economy in relation to the characteristics of the economic structure articulated by the Washington consensus ideology. Tariffs in all sectors are decreased substantially over time. Being a member of NAFTA and WTO also entails a wide array of commitments from Mexico to reduce trade-distorting subsidies, thereby increasing foreign trade significantly. These developments make the Mexican economy a fertile ground to test the Washington consensus development strategy.

IV. THE DATA, METHODOLOGY AND DESCRIPTIVE STATISTICS

One of the great, if not the greatest, challenges in empirical studies of developing and emerging economies is the availability of data. This study uses available Mexican quarterly data on real GDP, real exports (EXP), real terms of trade – export unit value divided by import unit value (TOT), gross capital formation as proxy for capital (CAP), and the real GDP of advanced economies as proxy for foreign output shock (AIP). The real GDP of advanced economies is included to control for export growth not influenced by Mexican price competitiveness or productivity, but by growth in the rest of the world. The data set covers the period 1982:Q1 to 2010:Q3. All data series are obtained from the IMF databases and are expressed in natural logarithms.

In order to apply augmented VAR[k+d(*max*)] model developed by TYDL, one needs to establish the lag order of the original VAR model, k, and the maximum order of integration of the variable under consideration. The lag order of the original VAR can be determined by using several lag order selection criteria such as the sequential modified LR test statistic (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). The results of the lag selection procedure are summarized in Table 1. The LR, FPE, AIC, and HQ suggest using a lag of five. Subsequent analysis therefore proceeds with the use of VAR with lag length $k = 5$.

As to the maximum order of integration of the time series in question, *d(max)*, Siliverstovs and Herzer (2006, p. 322) argue that since the power of unit root tests is rather low against the alternative hypothesis of stationarity and to avoid the pretest bias in deciding the order of integration as well as cointegration properties of the time series in question, the integration order should be selected in accordance with the theoretical economic considerations. Based this argument and empirical reports as well as similar assumption by other studies, addressing the ELG by analyzing the same set of variables from different countries in the literature (Agosin, 1999, Ghatak et al., 1997, Awokuse, 2003, 2005-a, 2005-b), these authors assume that GDP, EXP, TOT, CAP, and AIP are I(1). Following Siliverstovs and Herzer (2006, p. 322), this study also sets *d(max)* = 1 in the subsequent analysis.

Additionally, Engle and Granger (1987) articulated that if two series are integrated of order one, I(1), there is need to test for the possibility of a long-run cointegrating relationship among the variables. Since the cointegration and error correction methodology is well documented elsewhere (Engle and Granger, 1987; Johansen and Juselius, 1990; Banerjee et al., 1993) only a brief overview is provided here. Johansen and Juselius' (1990) multivariate cointegration model is based on the error correction representation given by:

$$\Delta X_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-1} + \Pi X_{t-1} + \varepsilon_t \qquad (1)$$

where X_t is an (*n x 1*) column vector of p variables, μ is an (n x 1) vector of constant terms, Γ and Π represent coefficient matrices, Δ is a difference operator, k denotes the lag length, and $\varepsilon_t \sim N(0, \Sigma)$. The coefficient matrix, Π, is known as the impact matrix, and contains information about the long-run relationships. Johansen and Juselius' (1990) methodology requires the estimation of the VAR equation (1), and the residuals are then used to compute two likelihood ratio (LR) test statistics that can be used in the determination of the unique cointegrating vectors of X_t. The number of cointegrating vectors can be tested for using two statistics: the trace test and the maximal eigenvalue test. The testing results are reported in Table 2.

As shown in Table 2, results for cointegration tests suggest the existence of, at most, one cointegrating vector. This implies the presence of four independent common stochastic trends in this system of five variables.

Moreover, the augmented VAR procedure, proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996),

Table 1: Maximum Lag length: Mexican Quarterly Data 1982-Q1 to 2010-Q3

Lag	Log L	LR	FPE	AIC	SC	HQ
0	462.0390	NA	1.34e-10	-8.542785	-8.417886	-8.492153
1	1115.732	1234.074	1.06e-15	-20.29405	-19.54466*	-19.99026
2	1161.391	81.93009	7.21e-16	-20.68020	-19.30632	-20.12325
3	1205.454	74.94818	5.09e-16	-21.03652	-19.03814	-20.22640
4	1259.276	86.51749	3.01e-16	-21.57525	-18.95238	-20.51197*
5	1297.459	57.81015*	2.41e-16*	-21.82166*	-18.57430	-20.50523
6	1316.669	27.28876	2.78e-16	-21.71344	-17.84158	-20.14384

*Notes: * indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 2: **Johansen Cointegration Test Results, Mexican Quarterly Data 1982-Q1 to 2010-Q3**

	Trace Statistics		***Max-Eigen Statistics***	
Number of cointegrating vectors	**Statistics**	**C (5%)**	**Statistics**	**C (5%)**
***r*≤0**	92.86744**	69.81889	49.36305**	33.87687
***r*≤1**	43.50439	47.85613	21.45271	27.58434
***r*≤2**	22.05168	29.79707	13.01032	21.13162
***r*≤3**	9.04136	15.49471	6.42685	14.26460
***r*≤4**	2.61452	3.84147	2.61452	3.84147

Note: *** denotes rejection of the hypothesis at the 5 percent level.*

complements the VECM technique because it allows for causal inference based on an augmented level VAR with integrated and cointegrated processes. The dynamic causal relationship between economic growth and other potential determinants was examined, including exports using the following VAR in level specification:

$$X_t = \mu + \sum_{i=1}^{p-1} \Gamma_i X_{t-k} + \varsigma_t \qquad (2)$$

where X_t is an (*n x 1*) column vector of p variables, μ is an (*n x 1*) vector of constant terms, Γ represents coefficient matrices, k denotes the lag length, and ς_t is *i.i.d.* and *p*-dimensional Gaussian error with mean zero and variance matrix Λ.

As pointed out by Awokuse (2005-a, p. 695), the TYDL procedure uses a modified Wald test for the restriction on the parameters of the VAR(*k*) model. This test has an asymptotic chi-squared distribution with *k* degrees of freedom in the limit when a VAR[*k+d(max)*] is estimated, where d(*max*) is the maximal order of integration for the series in the system. Awokuse (2005-b, p. 852) further articulates the attraction of the TYDL approach in that prior knowledge about cointegration and testing for unit root are not necessary once the extra lags, i.e., d(*max*) lags, are included. Given that VAR(*k*) is selected, and the order of integration d(max) is determined, a level VAR can then be estimated with a total of p=[k+d(*max*)] lags. Finally, the standard Wald tests are applied to the first k VAR coefficient matrix (but not all lagged coefficients) to make Granger causal inference.

V. EMPIRICAL RESULTS

Based on the above determined appropriate lag length *k =5* and the *d(max) = 1*, the Granger causality test results using both the VECM and the augmented level VAR specifications are reported in Table 3. F-statistics and p-values (in parentheses) for Granger causality tests from the VECM specification are presented in Table 3(a).

An analysis of the empirical results indicates that the ELG hypothesis is supported, since the real exports 'Granger-causes' real GDP is at the 1 percent significance level (p=0.0000). Thus, the support for the ELG hypothesis is very strong. In contrast, an inspection of the export equation (in row 2) indicates that the GLE hypothesis is not supported at all since the test that real exports is not 'Granger-caused' by real GDP could not be rejected at any level of significance. In support of the inclusion of other variables, all of them strongly affect real GDP growth. These empirical findings reveal that in addition to the influence of exports, other variables (such as capital/investment, terms of trade, and foreign output shocks) also matter to the growth of the Mexican GDP during the study period. Similar to conclusions from panel (a) of Table 3, causality results from the TYDL testing approach [see panel (b) of Table 3] also indicate that the causal link between exports and growth in Mexico is unidirectional over the 1982:Q1–2010:Q3 period.

VI. CONCLUDING REMARKS

This study employs recently developed estimation techniques to examine the relationship between Mexican exports and GDP growth and investigates whether economic growth is ELG or if export is GLE. More specifically, VECM and the augmented level VAR model with integrated and cointegrated processes (of arbitrary orders) developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) were used to test for Granger causality. This empirical investigation analysis focused on the dynamic causal relationship between exports, output growth, capital investment, terms of trade, and foreign output shock using quarterly data over 1982:Q1–2010:Q3. Granger causality tests based on both alternative models indicates that the causal link between real exports and real GDP growth is unidirectional. This weak exogeneity from real export to GDP growth suggests that Mexico's GDP growth was export-led, but that its export was not GDP growth-driven over the sample period. These findings support the Washington consensus neoclassical development hypothesis for Mexico.

Table 3: Granger Causality Test Results, Mexican Quarterly Data 1982-Q1 to 2010-Q3

(a) Results based on error correction model (ECM)					
Dep.	Short-run lagged differences (*F-statistics*)				
Variables	ΔGDP	ΔEXP	ΔTOT	ΔCAP	ΔAIP
ΔGDP	-	5.5302 (0.0000)	5.2708 (0.0001)	4.4272 (0.0005)	4.4115 (0.0005)
ΔEXP	0.0064 (0.9973)	-	1.3905 (0.2242)	0.9134 (0.4710)	1.8867 (0.0930)
ΔTOT	3.7773 (0.0020)	7.5067 (0.0000)	-	0.9918 (0.4209)	1.3033 (0.2592)
ΔCAP	1.4394 (0.2064)	3.7916 (0.0020)	1.8970 (0.0912)	-	0.6686 (0.6473)
ΔAIP	1.1293 (0.3421)	0.2962 (0.9152)	2.2017 (0.0512)	0.6705 (0.6458)	-
(b) Results based on an augmented VAR model (TYDL procedure)					
Dep.	(Modified Wald-statistics)				
Variables	GDP	EXP	TOT	CAP	AIP
GDP	-	34.0184 (0.0000)	29.4861 (0.0000)	32.0936 (0.0000)	36.8530 (0.0000)
EXP	2.0731 (0.8389)	-	11.8990(0.0362)	8.9866 (0.1096)	12.0751 (0.0338)
TOT	28.4628 (0.0000)	58.2234 (0.0000)	-	18.1759 (0.0027)	7.1008 (0.2133)
CAP	16.7196 (0.0051)	24.6788 (0.0002)	10.3928 (0.0648)	-	6.5139 (0.2594)
AIP	9.7585 (0.0824)	2.0260 (0.8455)	14.9677 (0.0105)	5.8203 (0.3241)	-

Notes*: The [k+d(max)]th order level VAR was estimated with d(max) = 1 for the order of integration equals 1.*
Lag length selection of k=5 was based on LR, FPE and AIC.
Reported estimates are asymptotic Wald statistics. Values in parentheses are p-values.

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RISK DIFFERENCES BETWEEN STOCK AND MUTUAL RISK RETENTION GROUPS

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I. INTRODUCTION

The liability insurance crisis of the mid-1980s has led to a number of innovations in the alternative risk-financing market, including the formation of risk retention groups (RRGs). The RRG is a variation on the mutual insurance company, in which the policyholders own the company. That is, RRGs are owned by their policyholders. RRGs can be organized as stock companies, mutuals, reciprocals, insurance exchanges, not-for-profit organizations, etc. Traditionally, stock organizations are characterized by a separation between owners and customers, while mutual organizations are owned by their customers. Lamm-Tennant and Starks (1993) conclude that stock insurers are engaged in riskier activities than their mutual counterparts. However, the RRG structure breaks down the conventional barrier between the stock and mutual organizational forms. Because there is a mutual aspect embedded in each of their various forms of ownership, RRGs offer researchers an opportunity to test the agency, adverse selection, and efficient risk-sharing theories by examining whether mutual RRGs are less associated with risk characteristics than stock RRGs.

This paper investigates risk differences between stock and mutual ownership structures in the RRG market, building on the framework set up by Lamm-Tennant and Starks (1993). This market has been selected because diverse forms of ownership coexist to provide liability insurance. On the one hand, the RRG provides a streamlined regulatory advantage, because an RRG can do business nationwide once it is licensed in a domiciliary state. On the other hand, an RRG is restricted to writing liability insurance for policyholders engaged in similar activities that expose them to similar liability risks. The coexistence of various organizational forms has been explained as growing out of agency problems (Fama and Jensen, 1983a, 1983b; Mayers and Smith, 1988, 1990, 2000), adverse selection problems (Smith and Stutzer, 1990; Ligon and Thistle, 2005), and the efficiency of risk-sharing arrangements (Doherty and Dionne, 1993; Doherty, 1991). However, not all explanations agree about how mutual insurers differ from stock insurers with respect to risk activities. The agency and adverse selection theories suggest that the mutual insurer should be involved in activities that are less risky than those of the stock insurer, while the efficient risk-sharing argument implies that the mutual insurer tends to insure riskier customers. These implications are empirically tested by examining the risk differences between mutual and stock RRGs. This research goes beyond prior literature by looking into whether the innovative risk financing technique offered by RRGs provides a different picture of the relationship between ownership structure and risk activities.

This empirical analysis of risk differences between two organizational forms taken by RRGs draws on data from the *Risk Retention Group Directory & Guide*. The sample is composed of thirty-two RRGs that have been in business for more than eight years between 1989 and 2008. The logistic regression model is used to examine whether stock RRGs have more risk than do mutual RRGs, and the amount of risk is proxied by the variance of the loss ratio.

The results of the logistic regressions indicate that stock RRGs are associated with riskier cash flows when risk is measured by the variance of the loss ratio. This is consistent with the findings of Lamm-Tennant and Starks (1993), and supports the agency and adverse selection theories, but it contradicts the efficient risk-sharing argument. In addition, the size variable is significantly and positively related to mutual RRGs, meaning that mutual RRGs are in general larger than stock RRGs. This is inconsistent with the findings of Lamm-Tennant and Starks (1993) and Ligon and Thistle (2005).

My empirical tests of the risk differences between these two types of ownership structure in the RRG industry are distinct from those employed in the existing literature. The RRG represents an innovation in contract design and organizational form after 1986. My data set covers 84% of the U.S. RRGs that have been in operation for more than eight years over the sample period 1989 to 2008. It is important to examine the differences in risk characteristics between mutual RRGs and stock RRGs. This study allows an assessment of the agency conflict hypothesis, the adverse selection hypothesis, and the efficient risk-sharing hypothesis as explanations of ownership structure. Even though previous research has provided evidence about the differences among various organizational forms in the insurance industry, it has not offered such evidence on the differences between the two main organizational forms used in the RRG market.

The next section reviews the regulatory environment and the history of RRGs in the U.S. Section III briefly describes the theoretical background of this study, and develops testable hypotheses regarding the risk differences between mutual RRGs and stock RRGs. Section IV offers details about the methodology, data, and results. This paper concludes in Section V with a summary.

II. THE REGULATORY ENVIRONMENT AND THE HISTORY OF RRGS

With the passage of the 1981 Product Liability Risk Retention Act and the 1986 Liability Risk Retention Act (LRRA) at the federal level, the RRG became a risk-financing alternative to conventional liability insurance (Webel, 2003). The first act was relatively narrow because RRGs could be only formed for product liability and completed operations liability. The LRRA expanded the scope of insurance to include most types of commercial liability insurance.[1] Also expanded are the organizations that can form RRGs. Any business as well as state or city governments or governmental entities are allowed to obtain commercial liability insurance coverage via RRGs as long as the group members of a single group are engaged in similar business activities and exposed to similar risks. Literally speaking, this act was intended to offer an alternative to the standard insurance markets—one that would broaden the coverage options available to businesses in need of liability insurance.

Simply put, an RRG is a liability insurer that is exempt from many aspects of state insurance regulation. Once licensed by its state of domicile, an RRG can insure members from coast to coast. Its primary function is to assume the liability exposure of its members. Members must be homogeneous: i.e., they must be engaged in similar businesses or activities with respect to the liability to which they are exposed. Interestingly, RRGs are similar to mutual organizations in principle, but they can be structured as any type of corporation or other limited liability association.

RRGs gained popularity in the first decade of the new millennium. Throughout the 1990s, the number of RRGs lingered around sixty. The number of RRGs almost quadrupled between 2000 and 2008, rising from 58 to 222 (see Figure 1). According to Webel (2003), the number of RRGs has risen dramatically since 2001 because regular insurance has become increasingly expensive and sometimes unavailable. More and more homogeneous employers banded together to obtain their liability insurance coverage by means of RRGs.

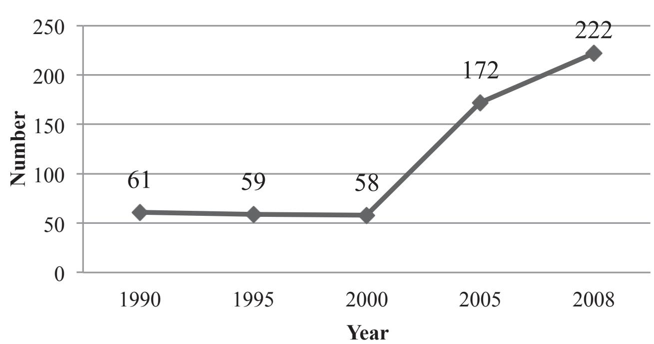
III. THEORETICAL BACKGROUND AND HYPOTHESES

This study examines the variation in RRG ownership structure to explain the risk differences between mutual insurers and stock insurers. Unlike traditional property-liability insurers, which can operate in several lines of business, RRGs can only write commercial liability insurance. Liability insurance contracts are essentially long-tailed, and their claims often take years to settle. For instance, Nelson (2000) indicates that it takes, on average, twenty years for medical malpractice claims to be paid in full. Even though they are formed by members that are engaged in similar activities and exposed to similar long-tailed liability risk, RRGs may be incorporated as stock insurers, mutuals, reciprocals, insurance exchanges, etc.

Agency problems play a critical role in the choice between the stock form and the mutual form of organization, and different ownership structures have a comparative advantage in different activities. Mayers and Smith (1986, 1988, 1990, 1992, 1994) have developed a managerial discretion hypothesis, that mutuals should be more prevalent in lines of business in which management exercises little discretion. Therefore, the activities of mutual insurers should be less risky than those of stock insurers. Using the agency paradigm, Fama and Jensen (1983a, 1983b) hypothesize that the future cash flows of financial stock companies should be more uncertain than those of financial mutual companies.

The adverse selection problem is also employed to explain the coexistence of both types of ownership (Smith and Stutzer, 1990a, 1995; Ligon and Thistle, 2005). Smith and Stutzer (1990b) argue that a mutual structure can function as a self-selection mechanism to handle adverse selection, thanks to the participatory nature of mutual insurance policies. Ligon and Thistle (2005) conclude that mutuals must offer some advantages over conventional insurance in addressing problems of adverse selection. Thus, the empirical implication is that mutual insurers tend to cover lower-risk policyholders than do stock insurers.

Figure 1
Number of RRGs, 1990–2008



Note: This count is based on the availability of financial data for RRGs. That is, any RRG without net premiums written is not counted. Source: annual editions of the *Risk Retention Group Directory & Guide*, published by Insurance Communications.

In addition, the choice of a specific organizational form for an insurance firm can be explained by the efficiency of risk-sharing arrangements (Doherty and Dionne, 1993; Doherty, 1991). Doherty and Dionne (1993) suggest that a mutual insurer can provide a more efficient risk-sharing arrangement than a stock insurer can. As a result, one would expect the mutual insurer to be involved in riskier activities than the stock insurer.

IV. METHODOLOGY, DATA, AND RESULTS

This empirical analysis looks at RRGs nationwide in an effort to account for risk differences between mutual insurers and stock insurers. This section begins by specifying the regression model used in the analysis, continues by describing data sources, and finishes by providing empirical results and interpretations.

Methodology

I test the hypotheses by examining aggregate risk measures for each RRG in my final data set. The empirical test of risk differences between mutual insurers and stock insurers is approached by employing a set of logistic regressions, which can be expressed as

$$\mathrm{Log}[P_t/(1-P_t)] = a_o + a_t\mathrm{Size}_t + a_2\mathrm{Risk}_t + e_i, \quad (1)$$

P_t = the probability that the RRG is structured as a mutual organization,

Size_t = the relative size of the RRG in relation to all the RRGs in my sample,

Risk_t = the firm's total risk (measured as the variance of the RRG's loss ratio).

As Lamm-Tennant and Starks (1993) do, I use a logistic regression model described by equation (1) because the independent variables are not normally distributed. In order to overcome the skewed distribution of risk measures, I rank total risk values and then run the logistic regression on their ranks. The size variable is determined by the number of net premiums written by each specific RRG as a percentage of the number written by all RRGs. This variable is averaged by firm across the firm's sample period, as annual net premiums written are adjusted for inflation.

Data

This empirical analysis of the risk differences between mutual insurers and stock insurers uses financial data from multiple editions of the *Risk Retention Group Directory & Guide*, published annually by Insurance Communications.[2] This study observes RRGs from 1990 through 2008, and the data set of thirty-two RRGs was chosen from an initial data set containing thirty-eight RRGs: twenty-two stock firms, ten mutuals, and six reciprocals and insurance exchanges. The initial sample includes RRGs that meet the following criteria: (1) their 2008 financial information is available and (2) the business was in operation for more than eight years.[3] This process screened out new RRGs arranged after 2000 that had a shorter time horizon. The final sample of thirty-two RRGs does not contain reciprocals and insurance exchanges, in order to focus on the risk differences between RRGs structured as mutual organizations and RRGs structured as stock organizations.

The selected data set of 32 RRGs allows this study to provide a window into the ownership structure of RRGs in the United States that were established before 2000. The results of this paper based on an innovative risk financing vehicle via RRG can generate complimentary information about risk differences between mutual and stock organizational forms to existing studies based on traditional property-liability insurers.

Empirical Results

Risk analysis for mutual and stock RRGs is contained in Table 1 in a preliminary, univariate setting. Table 2 exhibits the bivariate relationship between several attributes of RRGs. Table 3 provides the results of the logistic regression using risk and size measures in a multivariate condition.

Table 1 shows the distribution of the variance of the loss ratio for mutual and stock RRGs. Mutual RRGs on average have lower variance of loss ratios than stock insurers do. The median variance of loss ratios is lower for mutual RRGs than for stock RRGs. In other words, mutual RRGs have a median variance of 0.4, compared with 0.99 for their stock counterparts. This result implies that mutual RRGs are less involved in risk than stock RRGs; and it remains to be seen whether it holds up in a multivariate setting.

Table 1
Risk Analysis across Mutual and Stock RRGs

RRG	N	Percentile 100	75	50	25	0	Mean	Std. Dev.
Mutual firms	10	4.16	1.40	0.40	0.22	0.06	1.20	1.31
Stock firms	22	17.30	1.78	0.99	0.39	0.06	1.94	3.57

Table 2 illustrates the correlations between firm ownership form and other firm variables, while the results of logistic regression are reported in Table 3. Organizational type is significantly related to both the risk and relative size of the RRG but in opposite directions. The coefficient for the risk variable is negative and statistically significant—in line with Lamm-Tennant and Starks (1993) who suggest mutual insurers have less risk than stock insurers. That is, mutual RRGs have less risk than stock RRGs where the risk measure is proxied by the variance of the loss ratio. On the other hand, the size measure is positively and significantly linked to mutual ownership, and its coefficient (2.919) is very large compared with the coefficient for the risk factor (-.007). This outcome appears to clash with the findings of Lamm-Tennant and Starks (1993) and Ligon and Thistle (2005). The former conclude a negative relationship between size and mutual organizational type of insurers. The latter find the size distribution of mutual property-liability insurers has a larger proportion of relatively small companies than the size distribution of their stock counterparts. They suggest the size of mutual insurers is limited because they may offer advantages over conventional insurance in addressing problems of adverse selection. As a result, this outcome encourages one inference: the size factor may play different roles in explaining the risk activities of RRGs and traditional property-liability insurance companies with respect to mutual and stock ownership. Thus, after controlling for the fact that mutual RRGs are larger than stock RRGs, this study indicates that mutual RRGs have less total risk (as measured by the variance of firm loss ratios) than their stock counterparts. This finding is consistent with the implications of the agency cost hypotheses of Fama and Jensen (1983b) and Mayers and Smith (1988, 1990) and of the adverse selection hypotheses of Smith and Stutzer (1990) and Ligon and Thistle (2005) when it comes to the riskiness of RRGs' activities.

V. CONCLUSION

This empirical work uses the financial data on thirty-two member-owned RRGs in the U.S. over the years 1989 to 2008 to investigate the relationship between ownership structure and risk implications in the RRG market. The agency and adverse selection theories posit that the mutual insurer should be associated with activities that are less risky than those of the stock insurer, while the efficient risk-sharing argument implies that the mutual insurer should be associated with riskier underwriting activities. This paper examines the relationship between RRGs' ownership type and the riskiness of their activities. It provides evidence that mutual RRGs have lower total risk (measured by the variance of the loss ratio) than do stock insurers.

The RRG market offers a window through which organizational forms can be studied. Unlike traditional insurers, which can engage in multiple lines of business, RRGs are restricted to

Table 2
Correlation Coefficient

	Mutual	Risk	Size	States	Years
Mutual	1	−.115	.124	−.007	.086
		.531	.499	.970	.640
Risk		1	−.201	−.252	−.025
			.270	.164	.891
Size			1	.058	−.173
				.751	.344
States				1	.126
					.492
Years					1

Note: "Risk" is measured as the variance of an RRG's loss ratio. "Size" is measured as the number of an RRG's net premiums as a percentage of all RRGs' net premiums written. The size variable is averaged by firm across the firm's sample period, since annual net premiums written are adjusted for inflation. "States" is the number of states that a RRG operates its business. "Years" is the number of years that a RRG has been in business. ** significant at the 0.01 level. * significant at the 0.05 level.

Table 3
Logistic Regression of Organizational Type (Mutual RRG = 1) on Risk and Size

Variable	Coefficient		Standard Error
Intercept	−.297	***	.000003
Risk	−.007	***	.000000
Size	2.919	***	.000035
R^2	0.99		
Number of observations	32		

Note: Risk is measured as the variance of an RRG's loss ratio, ranked across all RRGs in the sample. Size is measured as the number of an RRG's net premiums as a percentage of all RRGs' net premiums written. The size variable is averaged by firm across the firm's sample period, since annual net premiums written are adjusted for inflation. The asterisks (*), (**), and (***) denote statistical significance at the 10%, 5%, and 1% levels, respectively (2-tailed).

liability insurance. They exhibit rich variation in their choices of ownership structure and risk-taking activities. Yet this variation occurs within a single, liability-insurance-only industry. This makes the analysis of this variation more controlled. This paper offers a stepping stone toward a better understanding of the organizational forms of mutual RRGs and stock RRGs—innovative risk-financing techniques for liability insurance since 1986.

ENDNOTES

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1. The definition of "liability" includes all types of third-party liability, such as general liability, errors and omissions liability, directors and officers liability, medical malpractice, professional liability, and products liability. However, the LRRA does not extend to workers' compensation, property insurance, or personal lines of insurance, such as homeowners and personal auto insurance.

2. Financial information for RRGs included in the Directory & Guide has been directly obtained from the National Association of Insurance Commissioners (NAIC). However, before 1994, financial information for Vermont-domiciled RRGs was obtained from the Vermont Department of Banking, Insurance and Securities. Following an amendment of Vermont's law that provided for a phase-in period, all Vermont-domiciled RRGs are now required to file the NAIC blank, effective 1994. In a few cases where financial information was not available from NAIC, it was obtained directly from the RRG or its state of domicile. As a result, Insurance Communications provides more comprehensive data on RRGs than NAIC does when it comes to the data set used in this paper. Other publications of Insurance Communications include Risk Retention Reporter, Purchasing Group Users' Handbook, etc. Statistics from Risk Retention Reporter have been cited in a few studies, including those of Ligon and Thistle (2005) and Born et al. (2009).

3. Some RRGs became retired due to factors such as dissolutions, liquidations, mergers and acquisitions, etc. Nevertheless, Warfel (2003a) concludes that more mainstream commercial insurers than RRGs are likely to go insolvent in any given year.

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THE ECONOMIC IMPACT OF PRAIRIE VIEW A&M UNIVERSITY ON WALLER COUNTY, THE HOUSTON-BAYTOWN-SUGAR LAND MSA, AND THE STATE OF TEXAS

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1. INTRODUCTION

This study presents estimates of economic benefits that Prairie View A&M University (PVAMU) delivered to the local (Waller County), regional (Houston-Baytown-Sugar Land Metropolitan Statistical Area), and state (Texas) economy in fiscal year 2012. To capture some long-term benefits, this report also presents estimates of the annual contributions PVAMU makes to the lifetime earnings potential of its alumni residing in Waller, Greater Houston, Texas, and other states. In addition to estimating the quantifiable economic impact of PVAMU, this report presents a summary of various center activities through which the University serves the greater community. The literature recognizes that many beneficial contributions of an institution of higher learning cannot be quantified, but are significant for improving the quality of life in the neighboring communities.

The primary focus of this study is to estimate PVAMU's short-term economic impact, which can be defined as the change in overall economic activity associated with spending related to the University. Economic impact is estimated for five categories of university-related expenditures: (1) university spending on wages and salaries of faculty and staff, (2) university spending on other budget categories (other than wages and salaries), (3) spending by undergraduate students, (4) spending by graduate students, and (5) spending by visitors. The estimated results measure the extent to which the University creates additional economic activities, labor income, and employment. This economic impact analysis, we believe, will help PVAMU document the scope and extent of the role the University plays in supporting the local community and the citizens of Texas.[1]

The remainder of this study is organized as follows. Section 2 contains the literature review. Section 3 discusses the estimation results. Section 4 highlights the long-term benefits of Prairie View A&M University. Section 5 lists the University's non-quantifiable impacts and Section 6 concludes.

2. LITERATURE REVIEW

Measuring the total economic impact of a university on a defined study area is a challenging task. There are several facets of this economic impact: short and long-term benefits, and tangible and intangible benefits. The short-term tangible economic benefits measure the changes in overall economic activities associated with expenditures related to universities. The long-term intangible benefits capture the positive effects of universities on human capital, labor productivity, technology transfer, business assistance and recruitment, increased lifetime earnings of graduates, and other positive social externalities, which are difficult to quantify. Most impact studies have generally focused on capturing the short-term tangible benefits universities deliver to pre-defined study areas.

Among the early impact studies, Caffrey and Issacs (1971) made a seminal contribution to the impact study literature. Commissioned by the American Council of Education, this study estimated the short-term economic impacts of universities on their local economies. Using linear cash flow formulas and multipliers, their models estimated the economic benefits to three groups within the local economy -- local businesses, local government, and local individuals. The more recent impact studies have used more sophisticated input-output models, which are reviewed in Stokes and Coomes (1998). Among other significant impact studies, Elliot et al. (1988) discuss how the focus of impact studies can be expanded from measuring only the short-term spending impacts to include the long-term economic impact of universities on local development.

In a recent impact study, Jafri et al. (2004) provide a good summary of many short-term impact studies conducted by universities. For example, the University of Colorado and the University of Massachusetts conducted studies estimating the economic effects at the state level, while Southern Illinois University and the University of Waterloo studies had a more regional focus, and the Texas A&M University-Corpus Christi, Sam Houston State University, and Tarleton State University studies had a more local focus. Using the IMPLAN input-output models, these studies derived several measures of multipliers, which are summarized Table 1.

The Thurgood Marshall Scholarship Fund (TMSF) published a comprehensive overview of the economic impact of 42 public Historically Black Colleges and Universities (HBCUs) that are members of the fund (Thurgood Marshall Scholarship Fund, 2001). The TMSF study reported only the direct spending associated with the HBCUs, but the multiplier effects of direct spending (the re-spending and induced effects) and the total economic impact of individual institutions on their host communities were not reported. Based on the estimated direct spending, the study concluded: "Through buying and spending together, the students and the universities are a significant portion of the economic activity of the host communities. The impact is greatest felt in the more rural communities. However, the greatest spending is in the metropolitan communities."

Another group that conducts research to assess the economic impact of colleges and universities is Appleseed, Inc. Since 1993, this group has assisted a variety of for-profit firms, non-profit organizations, and academic institutions with strategic planning, program development, and economic research. For determining the direct and indirect impact of academic institutions, they utilize the IMPLAN modeling system. The group's publications using IMPLAN data include a lengthy analysis of Tulane University's growing economic impact on the greater New Orleans area (January 2010) and a focused study of Harvard University's significant impact on economic activity in Boston (January 2009). In 2011, Appleseed published an analysis of Johns Hopkins University's impact on Baltimore and the state of Maryland. In 2012, Appleseed released an analysis of Brown University's economic impact on Providence and the state of Rhode Island. Both universities are major employers and purchasers of goods and services in their states. Additionally, they both attract thousands of students while employing large shares of their states' full-time workforce.

The Appleseed (2011) study revealed that Johns Hopkins University's multiplied impact on the state of Maryland's economic output was $5.3 billion. This figure is a reflection of spending by the University, as well employees, students, affiliates, vendors, and contractors. This economic output is also responsible for generating nearly 40,000 full-time jobs in the state. The Brown study was an update from their 2005 publication. Appleseed (2012) emphasized Brown University's role as a major private employer in the state and how University spending contributed to Rhode Island's post-recession economy recovery. They found, based on the direct, indirect, and induced effects of the University's spending on payroll, purchasing, and construction in fiscal year 2011, the University contributed to more than $725 million in Rhode Island economic output and 7,800 full time jobs. When factoring in student, faculty, and visitor spending, the University's contribution to statewide economic output rises to $834 million and full-time jobs increase to 8,909.

Carroll and Smith (2006) published a study analyzing the economic impact of Bowling Green State University on Ohio's economy. Using the IMPLAN Group's Type III multipliers, their primary finding was that every state-supported dollar Bowling Green received translated into $8 of economic activity. This economic impact is low relative to most economic impact studies because Carrol and Smith (2006) did not account for Bowling Green's contribution to the development of human capital in their analysis. They "concur with the view that inclusion of a measure of human capital…will substantially overestimate the [economic] impacts." Thus, the economic impact of Bowling Green was solely a result of capital improvements, employee spending, student spending, and visitor spending.

Gorjidooz and Vasigh (2011) agree that institutions of higher education have a significant impact on their local economies. Using IMPLAN data, they studied the economic impact of Embry-Riddle Aeronautical University on Yavapai County, Arizona. Similar to our study, they identified and assessed four main areas of the University's impact: University operations, payroll, student spending, and visitor spending.

Humphreys (2006) estimated the short-term economic impacts of 101 Historically Black Colleges and Universities (HBCUs), including PVAMU, on their regional economies for the year 2001. The impact estimates are based on IMPLAN regional input-output models of each HBCU's regional economy and data collected from the Integrated Postsecondary Education Data System (IPEDS) and Consumer Expenditure Survey. The study estimates four indicators of economic impact --total output, total value added, total labor income, and total employment. The key findings of this study are summarized below.

- The collective initial spending of all HBCUs in their host communities totaled nearly $6.6 billion in 2001.
- The combined total economic impact of all HBCUs was $10.2 billion (65 percent of this total is initial impact, while the remaining 35 percent is the multiplier effect).
- The collective labor income impact of all HBCUs was nearly $4 billion.
- The combined employment impact of all HBCUs was 180,142 jobs.

Humphreys (2006) reports the short-term economic impacts of PVAMU on the Greater Houston Region (Houston-Baytown-Sugar Land Metropolitan Statistical Area) in the year 2001 (Table 2). This present study improves upon the Humphrey's (2006) study in many important ways. First, it estimates the short-term economic impact of PVAMU on three levels - the local, regional, and state. Second, this study uses the most recent available statistics from PVAMU, student/faculty surveys, and the IMPLAN modeling system (see section 3). Third, it relies upon a more accurate local measure of student spending than Humphreys study, which applies national average student spending estimates to PVAMU students. Fourth, this study includes the impact of construction spending and visitor spending related to PVAMU, types of spending omitted in the Humphreys study. Finally, in addition to short-term impacts, this study estimates the potential lifetime earnings gain of PVAMU graduates.

It is also important to note that some studies attempt to improve the measurement technique used in economic impact research. Siegfried et al. (2007) criticized the methodological approach used in numerous college and university studies. Their view is that impact studies should be careful about claiming multiplied effects of publically-provided, university-spent dollars. These studies can mislead readers into believing that "marginal returns on investment in higher education is several orders of magnitude more than returns on other public investments." The authors also provide numerous suggestions to improve the substance of economic impact studies. Primarily, studies should not compare actual to counterfactual outcomes by presenting "an institution's economic activity that would remain in the local area even if the institution were not there." They conclude that these outcomes are effectively not contributions to the local economy.

3. ESTIMATED SHORT-TERM ECONOMIC IMPACTS OF PRAIRIE VIEW A&M UNIVERSITY

The results below (and presented in Table 3) are calculated with multipliers developed by the IMPLAN modeling system and data gathered from the *PVAMU Fact Book*, Alumni Office, Office of Institutional Research, Comptroller's Office, and direct surveys.[2] IMPLAN is proprietary software from IMPLAN Group, LLC that uses local, state, and national economic data to calibrate a sophisticated multi-region input-output model embedded in a social accounting matrix. This software allows us to follow the input-output approach to estimating the short term economic impact of a university pioneered by Caffrey and Issacs (described in section 2) and used in most economic impact studies of universities. By gathering data regarding spending related to PVAMU and inputting this data into the IMPLAN model, we derive estimates of PVAMU's economic impact on the local, regional, and state economies.[3]

Data on direct spending by PVAMU, including wages and salaries of PVAMU employees, and construction and other institutional spending, were assembled from official PVAMU financial documents as well as specially-tailored data provided to us by PVAMU's Office of Institutional Research and the Comptroller's Office. Spending data includes: wages and salaries paid to PVAMU employees; construction and other spending by PVAMU; estimated spending by PVAMU students; and estimated spending by visitors to PVAMU. Data on spending by students, visitors, and faculty were estimated based on information gathered by surveying a representative sample of PVAMU undergraduate and graduate students as well as faculty.[4]

For comparison purposes, Tables 4-6 present similar estimates from the 2010, 2008, and 2006 studies. Additionally, Charts 1-3 compare Prairie View's impact on different geographic regions between the years 2006-2012. A clear increase in Prairie View's impact is demonstrated, particular for the larger Houston MSA and the State of Texas regions.

Initial Spending (Direct Spending) Impact

The initial spending accruing to the local economy is the aggregation of all five types of direct spending: spending on wages and salaries, spending on other budget categories (including construction), spending by undergraduate students, spending by graduate students, and spending by visitors. In FY 2012, initial spending associated with PVAMU totaled $122.10 million in Waller County, $227.03 million in Greater Houston, and $267.74 million in Texas. Next, for each category of initial spending, four indicators of economic impact - total output, total value-added, labor income, and total employment - are calculated.

Total Output Impact

The total output impact was calculated for each category of initial spending using the multiplier effect, which captures the total economic repercussions of repeated rounds of spending and re-spending that take place throughout the region until the initial spending has completely leaked to other regions. The total output impact is the largest measure of economic impact, which estimates the value of production by all industries and households. In FY 2012, PVAMU's total output impact is estimated at $162.38 million in Waller County, $419.60 million in Greater Houston, and $553.57 million in Texas.

Total Value-Added Impact

Total value-added impact avoids double-counting of intermediate goods (both produced in the region and purchased outside the region) by excluding expenditures related to foreign and domestic trade. This measure is approximately equal to the increase in the local economy's gross regional product caused by PVAMU spending, which provides a more accurate measure of the actual economic benefits accruing to local businesses and households. In FY 2012, PVAMU generated a total value-added impact of $97.16 million in Waller County, $253.38 million in Greater Houston, and $316.56 million in Texas.

Labor Income Impact

The labor income received by local residents includes all forms of employment income, such as wages, salaries, and proprietors' incomes. It does not include non-wage compensation (e.g., pensions or health insurance), transfer payments (e.g., welfare or Social Security benefits), or unearned income (e.g., dividends, interest, or rent). In FY 2012, PVAMU generated a total labor income impact of $83.62 million in Waller County, $175.00 million in Greater Houston, and $222.38 million in Texas.

Employment Impact

The economic impact of an institution on the local economy is probably most easily understood in terms of its effects on employment, which includes wage and salary employees and self-employed individuals. In FY 2012, PVAMU-related spending supported a total of 1,563 jobs in Waller County, 3,182 jobs in Greater Houston, and 4,047 jobs in Texas.

4. LONG-TERM BENEFITS

Effects on Lifetime Earnings Potential

It is generally accepted that a college education significantly enhances human capital of graduates, which in turn helps them achieve significant boosts in their lifetime earnings potential. The U.S. Census Bureau (2002) reports the following average "synthetic work-life earnings" according to education level:

- High school graduate: $1,037,759
- Some college education: $1,267,803 (a premium of $230,044 over high school graduation)
- Bachelor's degree: $1,838,432 (a premium of $800,673 over high school graduation)
- Master's degree: $2,127,947 (a premium of $1,090,188 over high school graduation)
- Doctorate degree: $3,105,793 (a premium of $2,068,034 over high school graduation)

In the 2011-12 academic year, PVAMU awarded 1,026 Bachelor's degrees, 445 Master's degrees, and 17 Doctoral degrees. It is estimated from the most recent alumni residency data that among the PVAMU alumni with Bachelor's degrees, 9.3% reside in Waller County, 44.4% reside in the Houston-Baytown-Sugar Land (H-B-SL) MSA, 84.8% reside in Texas, and 15.2% reside outside of Texas. For alumni with graduate degrees (Master's and Doctorate), the corresponding figures are 4.5% in Waller County, 48.7% in the H-B-SL MSA, 88.1% in Texas, and 11.9% outside of Texas. Given this residency breakdown and the average lifetime earnings potential for university graduates (reported by the Census Bureau), we estimate that the University contributes $99.81 million in additional lifetime earnings to 2012 graduates who reside in Waller County. The corresponding figures for 2012 graduates who reside in the Greater Houston Region, state of Texas, and other states are $618.12 million, $1.15 billion, and $186.78 million, respectively. A breakdown of the increase in the lifetime earnings potential for 2012 graduates with Bachelor's, Master's and Doctorate degrees in the four geographic areas is given in Table 7.

The Higher Education Gap in Texas and the Houston Metropolitan Area

Prairie View A&M University's most important long-term contribution to Texas is college-educated citizens. A college degree benefits not only the recipient, but also the state in many ways. College graduates attract more high value businesses to the state; they pay more state and local taxes; they are less likely to be unemployed; and they are less likely to need government benefits. Yet for decades, Texas colleges and universities have produced fewer college graduates than required by Texas employers, and as a result Texas has been a net importer of college graduates from other states. This reliance upon imported skilled workers has hindered economic development in the state.

Recent demographic trends will put further pressure on colleges and universities in Texas. The average education level of immigrants to Texas has fallen in the 1990s and 2000s relative to the education levels of immigrants in the 1970s and 1980s. An increasing portion of Texas families have members that have not attended college; hence the proportion of Texans who are underserved by the higher education system continues to grow. This trend places even more importance on universities such as Prairie View A&M University whose primary mission is to educate those who have traditionally shunned college.

The higher education gap in Texas is mirrored in the Houston metropolitan area. Research by economist Barton Smith (2006) indicates that the Houston area ranks second to last among the 60 largest metropolitan areas in the percentage of its residents enrolled in college. Smith predicts a shortage of more than 50,000 college graduates in the Houston metropolitan area over the next five years, and the surge in lower-skilled immigrants into the Houston area portends a reduction in the education level of the average Houston-area worker. Prairie View A&M University, with expertise honed over its 130-year history, has demonstrated success in educating the underserved, with graduation rates exceeding its peer institutions (Table 8). Prairie View A&M University is a leader in enhancing the economic future of Houston and of Texas by helping to close the higher education gap and to lift opportunities for the educationally underserved.

Prairie View A&M University is one of the largest producers of minority professionals in business, engineering, nursing, education, architecture, and juvenile justice in Texas and perhaps in the nation. With four doctoral programs, it is well on its way in measurably impacting the production of minority doctorates in engineering, juvenile justice, psychology and education leadership. Chart 4 presents the graduation data for the University in the last ten years.

5. NON-QUANTIFIABLE IMPACTS

Through a variety of activities (teaching, research, and service) conducted by departments and special centers, Prairie View A&M University serves the greater community. This section briefly describes the activities of a subset of these organizations. For current information and greater details on an organization, please visit the organization's homepage.

- Future Aerospace, Science and Technology (http://www.pvamu.edu/pages/5158.asp)

The Future Aerospace Science & Technology (FAST) Center at Prairie View A&M University (PVAMU) was established with funds from the US Air Force Office of Scientific Research in 1995.

- International Goat Research Center (http://www.pvamu.edu/pages/5157.asp)

The International Goat Research Center was built in 1981 and currently home to over 1,000 dairy and meat goats. The Center is one of the largest and longest established goat research programs in the country.

- Community Urban Rural Enhancement Service (CURES) Center (http://www.pvamu.edu/soa/resources/research-center/c-u-r-e-s-center/)

Through collaboration, the Community Urban Rural Enhancement Service Center works with public and private entities to bring workable solutions to challenging community problems. By engaging students through the *Community Urban Rural Enhancement Service Learning STUDIO*, the CURES Center brings unprecedented focus and coordination of national, state and local resources to underserved areas and populations.

- PVAMU Athletics Department (http://www.pvpanthers.com/)

The PVAMU Athletics Department has partnered with community organizations at various intervals throughout the year. Through these partnerships, the Department aims to promote the University and its athletic programs.

- Center for International Business Education (http://www.pvamu.edu/pages/4478.asp)

The Center for International Business Education was established in spring 2005 with a $168,000 grant from the Business and International Education (BIE) Program of the U.S. Department of Education. To date, the Center has received over $600,000 in external funding from various sources.

- Small Business Development Center (http://www.pvamu.edu/sbdc)

The Small Business Development Center promotes small business success by providing management education. It assists small businesses in creating jobs and economic growth by utilizing the elements of quality counseling and training, community involvement and the leveraging of resources.

- Computational Fluid Dynamics Institute (CFDI) (http://www.pvamu.edu/pages/5158.asp

The Computational Fluid Dynamics Institute was established on February 16, 1996 at the Roy G. Perry College of Engineering at Prairie View A&M University (PVAMU) in partnership with Rocketdyne Division of Pratt & Whitney. The purpose of the Institute was to conduct applied research and development in a key engineering discipline and to provide a mechanism for the development of an advanced degree program with concentration on CFD.

6. CONCLUSION

This study measured and reported the many impacts of Prairie View A&M University on the economy, including additional business activity, household income, employment, and lifetime earnings. For example, the university adds more than $550 million to Texas' annual GDP and supports more than 4,000 jobs in the state, and its graduates annually add more than $1.1 billion in lifetime earnings to Texas' labor income. PVAMU's many service and outreach activities are also important to the economy, including local impact through the Small Business Development Center and international impact through the International Goat Research Center. The many and varied quantified and intangible impacts expounded in this paper clearly demonstrate that Prairie View A&M University plays a significant role in the economy.

NOTES

1. This present study is an updated version of Quddus et al. (2010).

2. Impact Analysis for Planning - Professional Version 3.0.

3. Spending data includes: wages and salaries paid to PVAMU employees; construction and other spending by PVAMU; estimated spending by PVAMU students; and estimated spending by visitors to PVAMU.

4. The student survey instrument is displayed in the appendix. Due to space constraints, the faculty survey instrument is available upon request.

5. "Value-added (or gross regional product) consists of employee compensation, proprietor income, other property income, and indirect business taxes. Value-added is equivalent to gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus intermediate inputs (consumption of goods and services purchased from industries or imported). It is often referred to as the state- or regional-level counterpart of the nation's gross domestic product (GDP)." Humphreys (2006).

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APPENDIX

Table 1: Summary of Multipliers from Several Impact Studies

	Total Output Multiplier	Employment Multiplier	Value Added Multiplier
University of Colorado (state level)	1.90	1.80	
University of Massachusetts (state level)	2.40	1.98	
Southern Illinois University (36 county region)	2.00		
SIU-Carbondale (19 county region)	1.78		
SIU-Edwardsville (14 county region)	1.75		
University of Waterloo (region only)			0.84
University of Waterloo (entire province)			1.46
University of Waterloo (region only)		1.34	
University of Waterloo (entire province)		1.65	
Texas A&M – Corpus Christi (local level)	2.75		
Sam Houston State University (local level)	1.70		
Tarleton State University (local level)	1.48		
Tarleton State University (state level)	1.70		

Source: Jafri et al (2004)

Table 2: Estimates of Economic Impact of PVAMU on the H-B-SL MSA (2001)

	Initial Spending (mil $)	Output Impact (mil $)	Value-added Impact (mil $)	Labor Income Impact (mil $)	Employment Impact
Wages and salaries	40.7	95.6	65.7	54.8	2,358
Other institutional spending	36.8	55.2	26.0	16.6	364
Undergraduate students	52.2	66.8	42.4	23.5	832
Grad/professional students	9.9	13.0	8.3	4.7	161
Total Impact	139.6	230.6	142.4	99.6	3,715

Source: Humphreys (2006)

Table 3: Economic Impact of PVAMU (FY 2012)

	Initial Spending ($)	Total Output Impact ($)	Value-added Impact ($)	Labor Income Impact ($)	Employment Impact
Waller County					
Wages and Salaries	67,307,051	71,652,201	70,135,242	68,412,557	1,144
Other Institutional Spending*	15,570,197	34,314,139	15,802,536	11,107,333	277
Undergraduate Students	30,220,250	43,002,526	8,347,509	3,007,019	106
Graduate Students	1,570,129	2,283,908	459,595	172,663	6
Visitors	7,430,781	11,129,194	2,411,654	916,087	30
Total	**122,098,408**	**162,381,968**	**97,156,536**	**83,615,659**	**1,563**
Houston-Baytown-Sugar Land MSA					
Wages and Salaries	67,557,051	136,823,138	110,870,139	82,330,069	1,602
Other Institutional Spending*	41,173,389	107,428,618	53,482,787	41,960,876	583
Undergraduate Students	67,384,945	99,339,553	49,828,460	28,371,826	553
Graduate Students	36,468,170	54,310,510	27,885,391	15,963,874	318
Visitors	14,449,774	21,694,066	11,314,812	6,377,045	127
Total	**227,033,329**	**419,595,885**	**253,381,589**	**175,003,690**	**3,182**
State of Texas					
Wages and Salaries	67,557,051	160,406,387	122,609,917	97,688,574	1,788
Other Institutional Spending*	59,883,415	167,374,451	82,755,300	62,528,394	912
Undergraduate Students	85,103,492	135,426,451	65,411,692	35,637,949	784
Graduate Students	40,363,221	65,953,518	33,262,026	19,732,155	412
Visitors	14,828,978	24,412,835	12,525,378	6,794,373	152
Total	**267,736,157**	**553,573,642**	**316,564,313**	**222,381,445**	**4,047**

Notes: *Other institutional spending includes construction spending (4 year annual average).
Source: Calculations based on data provided by the University, direct surveys, authors' assumptions (following other studies), and the IMPLAN multipliers.

Table 4: Economic Impact of PVAMU (FY 2010)

	Initial Spending ($)	Total Output Impact ($)	Value-added Impact ($)	Labor Income Impact ($)	Employment Impact
Waller County					
Wages and Salaries	69,634,822	71,224,320	70,665,765	70,076,181	1,146
Other Institutional Spending*	14,369,201	29,664,677	12,969,035	10,379,307	178
Undergraduate Students	19,861,698	26,373,874	4,215,820	1,754,488	66
Graduate Students	2,695,738	3,457,301	491,465	207,428	7
Visitors	2,411,752	3,202,508	607,492	260,442	8
Total	**108,973,211**	**133,922,680**	**88,949,577**	**82,677,846**	**1,405**
Houston-Baytown-Sugar Land MSA					
Wages and Salaries	69,884,822	128,280,580	97,141,132	84,012,789	1,448
Other Institutional Spending*	42,106,320	109,458,468	50,846,714	38,054,457	484
Undergraduate Students	56,491,324	81,534,269	36,564,311	18,683,832	423
Graduate Students	36,831,160	53,158,637	23,839,166	12,181,468	276
Visitors	10,774,298	15,550,609	6,973,722	3,563,471	81
Total	**216,087,923**	**387,982,562**	**215,365,045**	**156,496,017**	**2,711**
State of Texas					
Wages and Salaries	69,884,822	137,383,859	108,604,130	90,541,502	1,621
Other Institutional Spending*	61,705,382	168,983,051	59,535,056	42,244,366	765
Undergraduate Students	75,091,484	118,400,698	54,858,393	28,767,092	695
Graduate Students	39,701,585	62,599,579	29,004,155	15,209,435	368
Visitors	10,774,298	16,988,402	7,871,207	4,127,568	100
Total	**257,157,571**	**504,355,589**	**259,872,941**	**180,889,963**	**3,549**

Notes: *Other institutional spending includes construction spending (4 year annual average).
Source: Calculations based on data provided by the University, direct surveys, authors' assumptions (following other studies), and the IMPLAN multipliers.

Table 5: Economic Impact of PVAMU (FY 2008)

	Initial Spending ($)	Total Output Impact ($)	Value-added Impact ($)	Labor Income Impact ($)	Employment Impact
Waller County					
Wages and Salaries	66,444,727	70,195,218	67,616,335	66,948,752	1,124
Other Institutional Spending*	12,245,719	26,389,524	3,894,139	2,804,270	68
Undergraduate Students	25,538,122	28,628,234	8,172,199	3,881,795	144
Graduate Students	7,633,526	8,557,183	2,404,561	1,145,029	43
Visitors	2,862,493	3,217,443	973,248	435,099	16
Total	**114,724,588**	**136,987,604**	**83,060,482**	**75,214,944**	**1,395**
Houston-Baytown-Sugar Land MSA					
Wages and Salaries	66,444,727	119,432,483	89,671,960	78,482,817	1,402
Other Institutional Spending*	35,209,312	89,924,583	23,132,518	13,872,469	263
Undergraduate Students	57,860,914	80,426,671	34,369,383	18,399,771	446
Graduate Students	48,606,785	67,563,432	28,872,431	15,456,958	374
Visitors	12,171,894	18,038,747	8,106,482	4,272,335	110
Total	**220,293,633**	**375,385,917**	**184,152,774**	**130,484,350**	**2,595**
State of Texas					
Wages and Salaries	66,444,727	136,915,426	98,205,045	83,061,953	1,554
Other Institutional Spending*	52,109,442	137,138,295	36,163,953	21,566,431	435
Undergraduate Students	70,821,192	105,452,755	46,741,987	25,212,345	648
Graduate Students	55,556,961	82,724,315	36,667,595	19,778,278	509
Visitors	12,171,894	18,026,575	8,106,482	4,272,335	110
Total	**257,104,217**	**480,257,369**	**225,885,061**	**153,891,342**	**3,256**

Notes: *Other institutional spending includes construction spending (4 year annual average).
Source: Calculations based on data provided by the University, direct surveys, authors' assumptions (following other studies), and the IMPLAN multipliers.

Table 6: Economic Impact of PVAMU (FY 2006)

	Initial Spending ($)	Total Output Impact ($)	Value-added Impact ($)	Labor Income Impact ($)	Employment Impact
Waller County					
Wages and Salaries	61,008,219	76,995,040	65,886,528	63,159,647	1,221
Other Institutional Spending*	64,640,079	82,163,636	4,834,860	3,485,498	92
Undergraduate Students	20,784,834	23,310,070	6,649,719	3,153,174	127
Graduate Students	7,453,353	8,348,002	2,352,760	1,116,482	45
Visitors	1,913,197	2,147,865	651,289	289,853	12
Total	**155,799,683**	**192,964,613**	**80,375,156**	**71,204,654**	**1,497**
Houston-Baytown-Sugar Land MSA					
Wages and Salaries	61,008,219	112,136,641	83,432,131	72,604,989	1,443
Other Institutional Spending*	64,640,079	132,268,508	28,642,719	17,154,106	354
Undergraduate Students	51,452,028	71,482,741	30,534,689	16,366,268	431
Graduate Students	30,568,183	42,480,522	18,196,093	9,721,412	256
Visitors	7,255,202	10,751,764	4,833,674	2,537,604	71
Total	**214,923,712**	**369,120,176**	**165,639,306**	**118,384,379**	**2,555**
State of Texas					
Wages and Salaries	61,008,219	127,494,923	90,957,464	76,673,505	1,576
Other Institutional Spending*	64,640,079	170,014,297	44,858,651	26,697,040	589
Undergraduate Students	63,757,160	94,942,289	42,064,710	22,683,009	634
Graduate Students	31,448,748	46,835,999	20,746,858	11,195,985	313
Visitors	7,255,202	10,751,764	4,833,674	2,537,604	71
Total	**228,109,408**	**450,039,272**	**203,461,357**	**139,787,143**	**3,183**

Notes: *Other institutional spending includes construction spending (4 year annual average).
Source: Calculations based on data provided by the University, direct surveys, authors' assumptions (following other studies), and the IMPLAN multipliers.

Table 7: Lifetime Earnings Benefit to 2012 Graduates

Area	Graduates with Bachelor's Degrees	Graduates with Master's Degrees	Graduates with Doctorate Degrees	Total Lifetime Earnings Gains
Waller County	$76,398,616	$21,831,015	$1,582,046	$99,811,677
H-B-SL MSA	$364,741,781	$236,260,092	$17,121,253	$618,123,127
State of Texas	$696,623,942	$427,402,754	$30,972,945	$1,154,999,642
Other States	$124,866,556	$57,730,906	$4,183,633	$186,781,094

Source: Authors' calculations based on data provided by the PVAMU Alumni and Placement offices, and assumptions used by authors from the impact study literature.

Table 8: Graduation Rates: Impact on the Workforce

Institution	Graduation Rate (6-year)
Prairie View A&M University	37.0%
University of Houston – Downtown	21.4%
Texas Southern University	14.1%

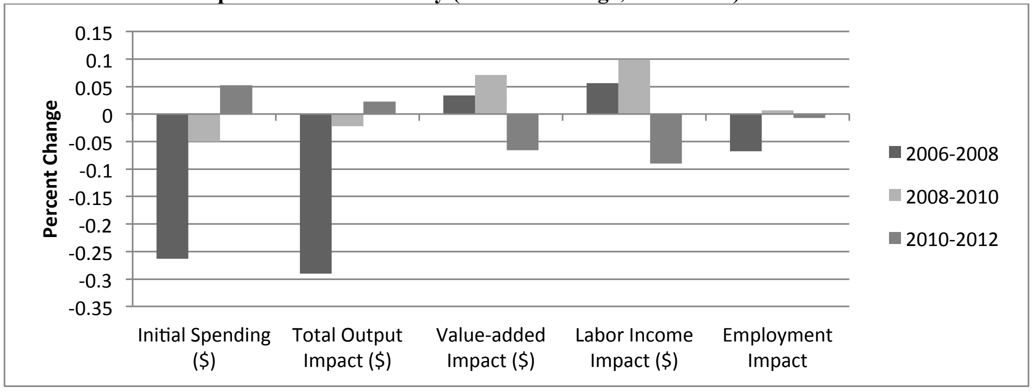
Source: THECB document, *Baccalaureate Graduation Rates*. THECB uses certified data, reporting statistics for the Fall 2005 cohort (6-yr graduation rate): http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=2530.

Table 9: Key Performance Indicators of the Small Business Development Center

	2007	2008	2009
New Jobs	41	7	42
New Business Starts	7	2	5
New Capital	$6,454,000	$253,000	$1,480,000
New Clients	37	34	37
Extended Engagement	21	18	9

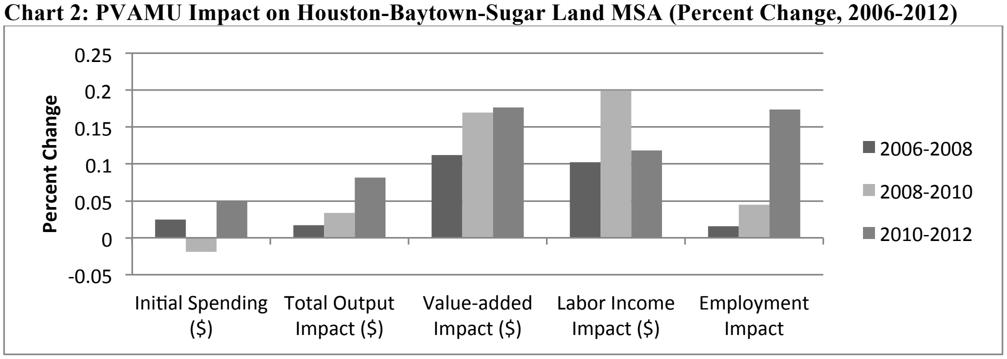
Source: Small Business Development Center, College of Business.

Chart 1: PVAMU Impact on Waller County (Percent Change, 2006-2012)



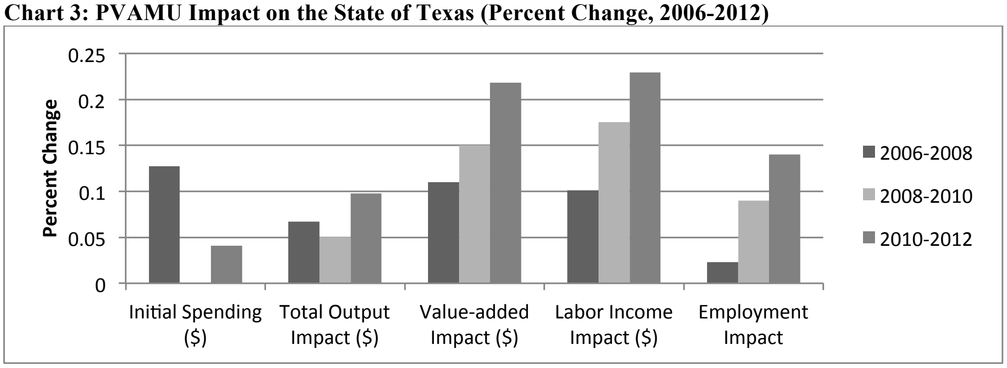
Source: Author's calculations.

Chart 2: PVAMU Impact on Houston-Baytown-Sugar Land MSA (Percent Change, 2006-2012)



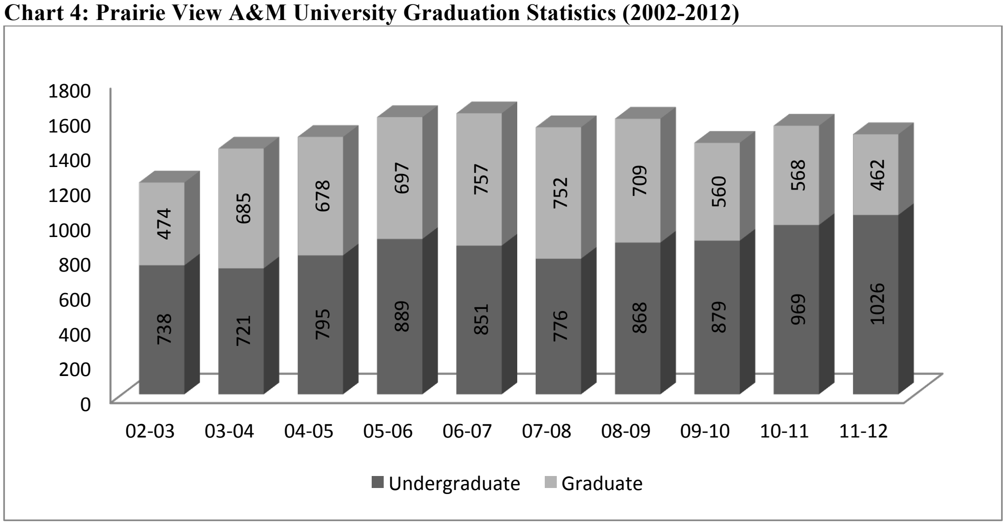
Source: Author's calculations.

Chart 3: PVAMU Impact on the State of Texas (Percent Change, 2006-2012)



Source: Author's calculations.

Chart 4: Prairie View A&M University Graduation Statistics (2002-2012)



Source: Office of Institutional Research, PVAMU.

PVAMU Student Spending Survey Form

The University is estimating its economic impact at the county and state levels. The impact includes expenditures of PVAMU students. Please complete the following survey even if you do not currently reside in Waller County. Only summary figures (not individual responses) will be used in the final report. Thank you for your time.

1. Name______________________________________
2. Your status? ____Freshman ____Sophomore ____Junior ____Senior ____Graduate Student
3. Do you live in University-Owned Housing? ___Yes ___No
4. If you live off-campus, where do you live? (City/Town) _________________ Zip__________

Please estimate the following regarding your guests/visitors who reside in:

Visitors	Total number of visitors for the year	Average Number of Days Spent Per Visit	Estimated $ Spent by Each Visitor Per Day
5. Waller County			
6. Greater Houston Area (GHA)*			
7. Texas (but not from Waller or GHA)			
8. From other states and countries			

**Note: The Greater Houston Area (GHA) is defined as including the following counties: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery and San Jacinto.*

Monthly Off-Campus Spending *(The four columns of percentages should add to 100% horizontally.)*	Average $ Spent Per Month	% Spent in Waller County	% Spent in GHA	% Spent in Rest of Texas	% Spent in other states and countries
9. Housing: rent or house payment					
10. Utilities: electric, gas, heat, water, garbage, sewer, alarm, etc.					
11. Communication: local and long distance telephone, cell phone, internet, cable or satellite dish					
12. Food and Beverages: groceries, convenience store purchases, restaurants, etc.					
13. Entertainment and Recreation: movies, special events, sports equipment and activities, concerts, etc.					
14. Shoes and Clothing: purchases of shoes and clothing, dry cleaning, laundry services, alterations, etc.					
15. Books and Supplies: textbooks, paper, pens, etc. (for monthly average, divide semester expenses by 4)					
16. Automobile: car payments, gas, maintenance, repairs, annual fees (parking, registration, state inspections, etc.)					
17. Insurance: auto, property, life, medical, dental, vision, etc.					
18. Health Care: medical, dental, vision and prescriptions not covered by insurance					
19. Other Retail: household goods, computer/electronics, other personal items, gifts, etc.					
20. Major cash purchases during the last 12 months (home improvements, furniture, etc.)					
21. Other purchases during the last 12 months (please specify): ______________________________					

Yearly Online Spending	Total $ amount spent in the year	% Spent in Waller County	% Spent in GHA	% Spent in Rest of Texas	% Spent in other states and countries
22. Of the total expenses, how much was spent online (books, clothing, etc. that are purchased from online retailers, such as Amazon.com)? This category is not to be confused with online transactions such as online banking or paying your bills online. Please note that the amount below should be the yearly total, not the monthly average.					

This survey is adopted from *PASSHE Economic Impact Study 2006.*

AN EMPIRICAL INVESTIGATION OF THE FEASIBILITY OF A PRODUCT LIFE CYCLE-TRANSPORTATION ACTIVITIES MODEL

David R. Rink, Indiana University Kokomo
Peter F. Kaminski, Northern Illinois University

INTRODUCTION

Because of spiraling costs, intensifying global competition, added product complexity, rapidly changing technology, and increasing demands on customer service, top management in many firms is re-evaluating its physical distribution (PD) function, especially transportation. Accustomed to traditional activities (e.g., scheduling carriers, negotiating rates, and monitoring claims), transport managers are frequently being asked by different departments in the company to participate in the development and implementation of function-related strategies. Increasingly, PD executives are doing more forecasting and planning, commanding greater decision-making authority, and being charged with more accountability in assuming an active role in formulating and implementing corporate policies and strategies (e.g., Collins and Whybark, 1985; Bowersox et al., 1989; Bowersox et al., 1992; Sutton, 1993; Bowersox et al., 1995; Bowersox and Closs, 1996; Kahn and Mentzer, 1997; Daugherty et al., 1998; Johnson et al., 1999; Ballou et al., 2000; Lambert and Burduroglu, 2000; Stock and Lambert, 2001; Zhao et al., 2001; Bowersox et al., 2002; Coyle et al., 2006; Zacharia and Mentzer, 2007; Murphy and Wood, 2008).

In order to effectively perform and coordinate these new responsibilities with their traditional tasks, transport managers will require a reconceptualization of their role. Their functioning as an indispensable link within the firm will also necessitate revision. Finally, it will be necessary for transportation executives to think and act in a more strategic and corporate manner as well as systems perspective (e.g., Bowersox et al., 1992; Kahn and Mentzer, 1996; Morash et al., 1996; Spear, 1997; Lynch et al., 2000; Rodrigues et al., 2004; Stank et al., 2005; Lambert et al., 2008; Hofmann, 2010).

A need has arisen among transport managers, therefore, for an integrative, systems-oriented, and conceptual model to serve as an aid in decision making. Specifically, there is a need for a set of carefully conceived transportation activities sequenced according to some workable framework. The product life cycle (PLC) concept represents such a guideline (e.g., Levitt, 1965; MacKenzie, 1971; Smallwood, 1973; Kotler, 1976; Webster, 1979; Thietart and Vivas, 1984; Lazer and Shaw, 1986; Boyd and Walker, 1990; Kotler, 1994; Jain, 1997; Kotler, 2000; Kotler and Keller, 2012).[1] The PLC concept can integrate, coordinate, and relate the effects of various traffic practices within the department, across functions,[2] and at the corporate level as well as to a dynamic business environment characterized by variables that are constantly changing and largely uncontrollable (e.g., Morash et al., 1996; Spear, 1997; Bowersox et al., 1999; Ballou, 2000; Ellinger, 2000; Lynch et al., 2000; Rodrigues et al., 2004; Stank et al., 2005; Lambert et al., 2008; Hofmann, 2010), thereby assisting transportation executives in the effective and timely performance of their ever-expanding duties and responsibilities for the optimal benefit of the company.

PRODUCT LIFE CYCLE CONCEPT

The product life cycle (PLC) represents the unit sales trend of a narrowly defined product from the time it is introduced into the marketplace until it is later withdrawn. Schematically, the PLC may be approximated by a bell-shaped curve that is divided into several stages (e.g., Kotler and Keller, 2012). For purposes of this study, the researchers adopted the same five-stage PLC used by Rink and Kaminski (2013)--Design, Introduction, Growth, Maturity, and Decline. Table 1 summarizes the major characteristics of each of these stages. Figure 1 presents a generalized PLC curve.

The PLC does not automatically occur. It is a result of the interaction of a number of variables. In addition to the firm's marketing efforts, the PLC is shaped by market-demand factors, competitors' actions, and other external conditions (e.g., technology), which are usually beyond the company's control (e.g., Swan and Rink, 1982; Kotler and Keller, 2012). The time length of any stage and the shape of the overall PLC varies across products and industries (e.g., Swan and Rink, 1982).

MARKETING AND PRODUCT LIFE CYCLE

Most marketing academicians and practitioners agree that the PLC concept is a useful tool in the successful management of a company's marketing efforts (e.g., Rink and Swan, 1979; Kotler, 2000). By identifying the stage a product is in, more effective marketing actions can be formulated (e.g., Kotler, 1976). But, only in the broadest sense has the PLC concept influenced the planning of marketing activities. Academicians initially focused on the general configuration of marketing mix variables (i.e., price, product, place, and promotion) across four PLC phases—Introduction, Growth, Maturity, and Decline (e.g., Clifford, 1965; Levitt, 1965; Buzzell, 1966). Kotler (1994) was one of the first writers to develop more specific, operational marketing recommendations for each of these four stages.

PHYSICAL DISTRIBUTION, TRANSPORTATION, AND PRODUCT LIFE CYCLE

The dependence of physical distribution (PD), or logistics management, on a product's sales trend was initially recognized by Bowersox, Smykay, and LaLonde (1968). Early writers formulated several PD, or logistics, strategies for each of four stages in the PLC—Introduction, Growth, Maturity, and Decline (e.g., Bowersox, 1974; Davis and Brown, 1974). However, these initial applications were too general and non-operational. Lynagh and Poist (1977) partially overcame this problem by developing a normative framework of 32 PD practices across these four sales phases.

TABLE 1

MAJOR CHARACTERISTICS OF EACH PLC STAGE

Design Stage encompasses all those activities initiated prior to the actual introduction of the product or service to the market. The company is distributing and selling a product for which it has not previously developed a marketing system. Planning represents a period of great uncertainty. The costs involved in creating the system are large. But, at this point, no sales of the product have been made. Experimentation with determining the appropriate levels for the marketing variables may involve a test market in this stage.

Introduction Stage begins with a full-scale market introduction of the new product or service. The uncertainty of the new product's ultimate success or failure creates a desire to maintain flexibility in marketing activities. Systems are redesigned and modified to smooth out problems as they are discovered. Close monitoring of internal reports is critical both to identify these problems and to discover at the earliest possible moment indications of the ultimate destiny of the product. Product availability to the market is a crucial factor at this point in time. Near the end of this phase, management will decide either to withdraw the product as a failure or to continue to support the product if its sales are increasing. If the decision to support is confirmed, then performance standards and controls will be developed.

Growth Stage is characterized by sales increasing at an increasing rate. Sales forecasting becomes critical to effective distribution of the product. Performance standards are implemented and maintained. Marketing strategy focuses first on encouraging potential new customers to try the product, and later in this stage, on developing brand loyalty with customers. As competitors begin to enter the marketplace, customer service becomes critical as a competitive tool. For example, orders are monitored closely to assure speedy and dependable delivery. Cost is secondary in importance.

In the **Maturity Stage**, sales level off. Extremely vigorous competition yields to price-cutting tactics and large increases in promotion to maintain sales levels. To minimize the impact on profits, a company-wide pursuit for efficiency is initiated. Also, new marketing opportunities in the form of product modification and repositioning are sought. Product improvements are encouraged in quality, style, and accessorial features to become more competitive in existing markets and to enter new markets. However, the pursuit of efficiency is paramount.

Decline Stage is characterized by a rapid decrease in sales. The objective to be pursued here is one of minimizing risk and maintaining flexibility. Marketing strategy is one of retrenchment (or pulling back from declining markets), but at the same time, watching for market opportunities in both those segments abandoned by competitors and those composed of significant groups of brand loyal customers. The available number of product varieties and promotional expenditures are minimized in anticipation of abandonment.

On the basis of these previous efforts, experience, and discussions with several transport managers, Rink and Kaminski (2013) substantially expanded earlier PLC-PD models by focusing exclusively on the transportation aspect of physical distribution. Using the PLC as a gauge of changing market conditions, they formulated a list of specific transport actions for each PLC stage. These lists, in turn, can serve as references for continuous reprogramming of transportation activities across a product's life span. Unlike previous writers, Rink and Kaminski also incorporated pre-introduction transportation-oriented activities into their model. The end result was 78 TAs segregated across five PLC stages--Design, Introduction, Growth, Maturity, and Decline. These strategies are listed in Table 2.

PURPOSE

The purpose of this paper is to empirically determine the feasibility of the Rink and Kaminski PLC-TAs model in assisting PD executives to implement timely transportation activities across the sales cycle of their organization's product. This was accomplished by asking a nation-wide sample of PD practitioners to indicate the importance level and usage frequency of each of the prescribed 78 TAs as well as assign each TA to the one most important PLC stage.

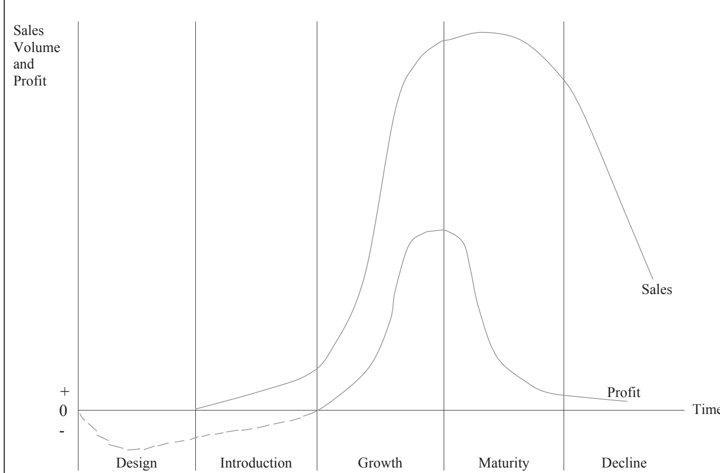
METHODOLOGY

In assessing the feasibility of Rink and Kaminski's model, the researchers realized an inordinate amount of time would be required for PD executives to evaluate all 78 TAs. Consequently, each strategy was randomly assigned to one of two questionnaire versions (A or B). This reduced the number of transport practices to be evaluated by each distribution manager from 78 to a more manageable 39. Balance in the number of actions across questionnaire versions by PLC stage was maintained. Finally, the order of these TAs was randomized.

The researchers' previous experience with PD professionals indicated few fully understand the PLC concept. As a result, Table 1, which describes the major characteristics of each sales phase, was enclosed in each out-going mail packet.

FIGURE 1

A GENERALIZED PRODUCT LIFE CYCLE CURVE



In the cover letter, potential respondents were asked to first read Table 1. Then, they were instructed to specify on their questionnaire version one of their firm's major products with which they had had transport experience. Next, keeping this product in mind, executives were invited to indicate for each TA the: (1) Importance level, using a four-point scale where 4=Very important, 3=Important, 2=Somewhat important, and 1=Not important; and (2) Usage frequency, using a four-point scale where 4=Used all of the time, 3=Used frequently, 2=Used occasionally, and 1=Not at all. In addition, managers were asked to assign each TA to the most important PLC stage for their specified product, as if this was the only item their company manufactured. Written comments concerning these normative TAs were also solicited. Finally, practitioners were requested to provide relevant demographic information about themselves (e.g., number of years in distribution) and their organizations (e.g., number of employees).

Each version of the questionnaire was structured and undisguised. The questions were of the fixed alternative variety, which ensured respondents were answering the same questions and in the same sequence for each type. Excluding some wording changes, pretests of the two questionnaire versions with local PD managers revealed no major problems.

TABLE 2

RINK AND KAMINSKI PLC-TRANSPORTATION ACTIVITIES MODEL[a]

Number	TRANSPORTATION ACTIVITY
	DESIGN STAGE
1	Participate in generation of new product ideas
2	Cooperate fully in providing transportation-related information to the new product developers
3	Monitor the development of the new product
4	Identify product transportability factors critical to the ultimate success of the new product
5	Develop and monitor close interdepartmental and intercompany relationships
6	Request company product design engineers to consider the impact of alternative product designs on the company's transportation system
7	Identify middlemen who may be integrated into the company's transportation network with a minimum of disruption
8	Assess the abilities of the company's existing private transportation capability, if any, concerning existing routes, load factors, and delivery schedules
9	Initiate contacts with for-hire carriers
10	Identify preferred transportation modes and carriers
11	Resolve the new product's common carrier rate classification
12	Establish the availability of small-volume rates and economy rates on large-sized shipments
13	Establish protective packaging requirements in line with carrier specifications and desired customer service standards
14	Scrutinize transportation-related regulatory requirements
15	Develop delivery schedules
16	Monitor the newly designed transportation system to resolve potential interruptions and conflicts before the system comes on line
	INTRODUCTION STAGE
17	Cooperate closely with middlemen to discover transportation difficulties and shortcomings
18	Monitor carrier performance for conformance with desired customer service standards
19	Replace carriers unwilling or unable to provide required service levels
20	Continue carrier contacts to develop good business relationships with carrier personnel
21	Delegate the routine task of monitoring carrier rate increase proposals to lower management echelons
22	Use direct shipment by air and/or motor carrier when possible to avoid unnecessary fixed investment
23	Avoid longer-term commitments for transportation equipment, facilities, and services
24	Consider consolidation programs to take advantage of existing transportation systems only if customer service levels can be maintained
25	Rely heavily on air and/or motor carriers to maintain customer service on lower-volume routes
26	Modify performance standards using feedback from the new transportation system
27	Commence negotiations with for-hire carriers for additional necessary service adjustments
28	Institute expediting and tracing services on important routes
29	Assess the need for the return movement of the new product for servicing, recycling, or recall
30	Monitor sales research reports to anticipate how soon the expected jump in sales will occur
	GROWTH STAGE
31	Monitor system performance to minimize the effects of rapid increases in demand
32	Expand the transportation staff to handle the additional workload created by the increasing volume of orders
33	Establish temporary market priorities in response to unexpected surges in demand
34	Recognize the need for rapid and frequent deliveries
35	Require compliance with established delivery schedules to maintain customer service standards
36	Continue premium transportation where necessary to maintain service standards
37	Gear carrier relations toward solving mutual problems
38	Encourage carrier personnel in the development of expanded carrier services
39	Review the product's classification and rating as the product undergoes minor modifications
40	Initiate aggressive negotiations by company rate specialists for lower commodity rates
41	Negotiate with competing carriers to secure lower rates or improved service
42	Formulate procedures for setting up an internal freight bill auditing system

The sampling frame adopted for this study was the membership roster of the National Council of Physical Distribution Management (NCPDM). Due to the nature of the topic, the researchers limited their sample to distribution executives. The study was further delimited to U.S. manufacturers.

Five hundred PD professionals were randomly selected to mail one of the two questionnaire versions. Only one manager was selected from each company. Ninety-three questionnaires were returned. However, five were blank and three were incomplete, which resulted in 85 usable returns for a 17% response rate. Of these, 32 were Version A, and 53 were Version B of the questionnaire.

RESULTS

As a preliminary form of analysis, three separate independence tests were performed on the data. At the 0.05 level, there was no significant difference in the expected number of assigned TAs by executives across questionnaire versions for: (1) Importance level; (2) Usage frequency; and (3) PLC stage. This permitted the researchers to aggregate practitioners' responses from the two questionnaire versions, and conduct subsequent analyses on one data set.

Importance Level and Usage Frequency

The overall average importance level and usage frequency of the prescribed 78 TAs were 3.29 (where 4=Very important) and 2.89 (where 4=Used all of the time), respectively. Across these 78 TAs, average importance levels and usage frequencies ranged from 1.21-3.89 and 1.04-3.81, respectively. For each TA, the average importance level exceeded the average usage frequency (Table 3).

It was not surprising respondents evaluated transport activities (e.g., scheduling carriers, expediting, etc.) as being "important" to "very important" and "used frequently" to "used all the time" (e.g., TA#s 15, 19, 27, 28, 40, 41, 56, and 65). The same was true of those TAs dealing with transportation costs (e.g., TA#s

TABLE 2 continued

43	Develop a more stringent loss and damage prevention program
44	Deemphasize consolidation programs on high-volume routes
45	Substitute more efficient forms of consolidation for others already in use
46	Institute variable route delivery schedules
47	Give serious consideration to complete private carrier operations on high-volume routes
48	Engage in longer-term commitments for transportation equipment, facilities, and services
49	Initiate planning for transportation system expansion as new opportunities are identified
50	In disputes with carrier, make concessions to obtain crucial services quickly, but do not waive company's rights in future negotiations
	MATURITY STAGE
51	Anticipate the impact of changes in the company's marketing strategy and of continued product modification
52	Improve departmental operating efficiency
53	Control transportation costs closely
54	Reevaluate customer service policies
55	Phase out carriers offering marginal or high cost service
56	Become increasingly diligent concerning favorable mode and carrier cost-service trade-offs
57	Rely increasingly on rail transportation with its lower-cost volume rates
58	Consider additional for-hire transportation service on a contractual basis
59	Evaluate the cost-service trade-offs of shippers' associations, containerized freight shipments, distribution centers, and freight consolidation programs
60	Identify shipments and routes which provide beneficial outbound and/or inbound consolidations
61	Change to fixed route delivery systems
62	Monitor freight bills closely
63	Consider using a pre-shipment audit procedure
64	Delegate routine cost-monitoring activities to first-line supervisors and dispatchers
65	Expedite shipments on a request basis only; bill customers for added costs
66	Coordinate product and packaging modifications with the product manager
67	Expand the private carrier operation using specialized vehicles and equipment
68	Investigate additional for-hire carrier services which improve system operating efficiency
69	Reevaluate the routing of shipments
70	In rate/service disputes with carriers, enlist the help of the company's legal department where necessary to defend the company's rights
	DECLINE STAGE
71	Monitor sales research reports for anticipated decreases in sales
72	Simplify the transportation system to maintain flexibility
73	Commit unneeded private transportation capacity to other burgeoning products
74	Aggressively pursue freight consolidation programs
75	Pool shipments into selected markets on selected days
76	Employ an outside agency to audit freight bills
77	Plan and implement a system for spare parts and product servicing
78	Establish a contingency plan for transporting future product recalls

[a] Adapted from Rink and Kaminski (2013).

23, 42, 43, 45, 52, 53, 55, 57, 62, 74, and 75). Slightly more than one-half of the 78 TAs were rated as "important" or higher and "used frequently" or more often.

On the other hand, TAs associated with non-traditional transport operations (e.g., TA#s 1, 3, 30, 51, and 71) were rated as being "not important" to "somewhat important" and "used occasionally" to "not used". Similar evaluations occurred for transportation of product returns, spare parts, etc. (TA#s 29, 77, and 78). Almost 20% of the 78 TAs were rated as "somewhat important" or lower and "used occasionally" or less often.

Interestingly, PD executives rated almost 30% of the 78 TAs as being "important" or higher, but used them only "occasionally", if at all (e.g., TA#s 2, 5, 14, and 66). Most of these TAs involved interdepartmental, intercompany, and external activities or relationships (e.g., product design engineers, regulatory agencies, etc.), which might explain why distribution

TABLE 3

IMPORTANCE LEVEL, USAGE FREQUENCY, DISTRIBUTION OF EXECUTIVES' ASSIGNMENTS OF EACH TRANSPORTATION ACTIVITY TO PLC STAGES, AND CHI-SQUARE TEST

TA #[a]	Brief Description of Transportation Activity	Impor-tance[b]	Usage[c]	Distribution of Executives' Assignments of Transportation Activity to PLC Stages[e]					# of Execs	Chi-Square[f]
				D[d]	I	G	M	DD		
1	Generate new product	1.21	1.08	37* (70%)	6 (11%)	2 (4%)	4 (8%)	4 (8%)	53	82.9[g]
2	Provide transport info	3.09	2.26	40* (75%)	10 (19%)	1 (2%)	2 (4%)		53	107.8[g]
3	Monitor new product	1.57	1.04	12* (38%)	12 (38%)	7 (22%)		1 (3%)	32	20.8[g]
4	Identify transport factors	3.18	2.45	24* (75%)	7 (22%)			1 (3%)	32	65.8[g]
5	Develop internal relations	2.90	1.73	21* (40%)	14 (26%)	11 (21%)	7 (13%)		53	23.1[g]
6	Ask design engineers	3.28	2.52	19* (59%)	3 (9%)	3 (9%)	6 (19%)	1 (3%)	32	33.0[g]
7	Identify middlemen	3.79	3.64	6* (19%)	7 (22%)	7 (22%)	12 (38%)		32	11.4[g]
8	Assess existing transport	3.65	3.41	12* (23%)	7 (13%)	23 (43%)	10 (19%)	1 (2%)	53	24.6[g]
9	Contact private carriers	3.42	3.36	14* (44%)	9 (28%)	4 (13%)	5 (16%)		32	17.7[g]
10	Identify preferred modes	3.81	3.67	16* (50%)	6 (19%)	5 (16%)	5 (16%)		32	21.4 [g]
11	Resolve rate class	3.78	3.67	21* (66%)	7 (22%)	2 (6%)	2 (6%)		32	45.8[g]
12	Available economy rates	3.34	3.13	10* (19%)	5 (9%)	23 (43%)	15 (28%)		53	29.9[g]
13	Set packaging specs	3.61	3.49	23* (43%)	15 (28%)	8 (15%)	7 (13%)		53	28.8[g]
14	Evaluate regulations	2.97	2.11	27* (51%)	10 (19%)	5 (9%)	9 (17%)	2 (4%)	53	35.6[g]
15	Set delivery schedules	3.82	3.65	14* (44%)	4 (13%)	6 (19%)	8 (25%)		32	16.8[g]
16	Monitor transport system	3.80	3.37	17* (32%)	21 (40%)	13 (25%)	2 (4%)		53	32.2[g]
17	Work with middlemen	3.84	3.68	3 (6%)	18* (34%)	25 (47%)	6 (11%)	1 (2%)	53	40.9[g]
18	Monitor carrier performance	3.83	3.69		9* (28%)	14 (44%)	9 (28%)		32	23.9[g]
19	Replace poor carriers	3.78	3.67	2 (4%)	12* (23%)	27 (51%)	12 (23%)		53	43.3[g]
20	Maintain carrier relations	3.54	2.58	1 (2%)	4* (8%)	16 (30%)	30 (57%)	2 (4%)	53	58.0[g]
21	Delegate rate monitoring	1.91	1.23	3 (9%)	3* (9%)	6 (19%)	19 (59%)	1 (3%)	32	33.0[g]
22	Use direct shipment	3.69	2.87	2 (6%)	17* (53%)	6 (19%)	4 (13%)	3 (9%)	32	23.3[g]
23	Avoid long commitments	3.56	3.01	1 (2%)	6* (11%)	8 (15%)	15 (28%)	23 (43%)	53	27.7*

managers used them "occasionally" or less. Unfortunately, few respondents volunteered written comments, and none provided insight regarding this disparity.

Of the two scales--importance and usage, the latter seemed to represent a more accurate indicator of respondents' assessment of the "true" usefulness of these 78 TAs (and hence the prescriptive model). That is, almost 80% of the 78 TAs were rated as "important" or higher. However, only 53% were "used frequently" or more often by PD executives in implementing TAs across the sales cycle of their organization's products.

Assignment of TAs

As an initial form of analysis, the researchers wanted to determine to which PLC stage distribution professionals did assign each transportation activity relative to the Rink and Kaminski model. This was accomplished by formulating a

TABLE 3 continued

TA #[a]	Brief Description of Transportation Activity	Importance[b]	Usage[c]	Distribution of Executives' Assignments of Transportation Activity to PLC Stages[e]					# of Execs	Chi-Square[f]
				D[d]	I	G	M	DD		
24	Consolidate programs	3.73	3.59	1 (2%)	5* (9%)	25 (47%)	22 (42%)		53	54.1[g]
25	Rely on air/motor	3.72	3.48	2 (6%)	9* (28%)	13 (41%)	7 (22%)	1 (3%)	32	15.5[g]
26	Revise performance stds.	3.26	2.57	1 (2%)	4* (8%)	23 (43%)	24 (45%)	1 (2%)	53	52.9[g]
27	Negotiate with carriers	3.65	3.46	5 (16%)	2* (6%)	16 (50%)	9 (28%)		32	25.2[g]
28	Start expediting/tracing	3.82	3.79	2 (6%)	15* (47%)	11 (34%)	4 (13%)		32	25.2[g]
29	Set up product return	1.65	1.29	13 (41%)	10* (31%)	3 (9%)	5 (16%)	1 (3%)	32	15.5[g]
30	Monitor sales reports	1.29	1.08	8 (15%)	27* (51%)	16 (30%)	2 (4%)		53	46.3[g]
31	Monitor system perform.	3.31	2.67	2 (6%)	8 (25%)	20* (63%)	2 (6%)		32	41.8[g]
32	Expand transport staff	3.76	3.50	2 (6%)	1 (3%)	26* (81%)	1 (3%)	2 (6%)	32	75.2[g]
33	Set market priorities	3.24	2.68	5 (9%)	14 (26%)	29* (55%)	5 (9%)		53	49.5[g]
34	Need for rapid delivery	3.33	2.81	4 (13%)	11 (34%)	13* (41%)	4 (13%)		32	18.3[g]
35	Comply with delivery	3.82	3.70	2 (4%)	12 (23%)	13* (25%)	23 (43%)	3 (6%)	53	27.7[g]
36	Use premium transport	3.75	3.62	1 (2%)	21 (40%)	20* (38%)	9 (17%)	2 (4%)	53	34.5[g]
37	Gear carrier relations	3.31	2.79	3 (9%)	6 (19%)	11* (34%)	12 (38%)		32	16.4[g]
38	Expand carrier services	3.64	3.26	1 (3%)	4 (13%)	16* (50%)	11 (34%)		32	29.6[g]
39	Review product class	3.58	2.71	7 (22%)	8 (25%)	7* (22%)	9 (28%)	1 (3%)	32	6.1
40	Negotiate for lower rates	3.87	3.81	3 (9%)	5 (16%)	11* (34%)	12 (38%)	1 (3%)	32	14.9[g]
41	Negotiate for better service	3.83	3.76	2 (4%)	7 (13%)	20* (38%)	23 (43%)	1 (2%)	53	39.7[g]
42	Set up bill auditing	3.49	2.80	14 (44%)	6 (19%)	8* (25%)	4 (13%)		32	16.8[g]
43	Create damage prevention	3.18	2.67	1 (2%)	7 (13%)	17* (32%)	24 (45%)	4 (8%)	53	34.8[g]
44	Reduce consolidation	3.68	3.25	2 (6%)	5 (16%)	12* (38%)	10 (31%)	3 (9%)	32	12.1[g]
45	Use more efficient forms	3.67	3.29	3 (6%)		9* (17%)	39 (74%)	2 (4%)	53	99.4[g]
46	Use variable routes	3.41	2.88	3 (6%)	9 (17%)	16* (30%)	23 (43%)	2 (4%)	53	29.9[g]
47	Use more private carriers	3.35	2.90	6 (11%)	2 (4%)	23* (43%)	20 (38%)	2 (4%)	53	38.8[g]
48	Set up longer commitments	3.42	2.79	4 (13%)	2 (6%)	13* (41%)	13 (41%)		32	23.9[g]

contingency table where the rows represented "PLC Stage Suggested by Rink and Kaminski Model" for some particular activity, and the columns symbolized "PLC Stage Assigned by Executives" to that TA. A bivariate distribution was then developed for each manager according to these two criteria. Finally, these distributions were summed.

If respondents were agreeing perfectly with Rink and Kaminski's model, the diagonal values would be 100%. A cursory review of Table 4 reveals this was not the case. Only three of the five diagonal values were near to or slightly higher than 40% (i.e., Design, Growth, and Maturity stages). The remaining two diagonal percentages were significantly less. That is, only 24% and 14% of the transport strategies suggested as belonging to the Introduction and Decline stages, respectively, were assigned as such by executives. Interestingly, managers tended to classify TAs in each of the first three PLC phases one or two

TABLE 3 continued

TA #[a]	Brief Description of Transportation Activity	Importance[b]	Usage[c]	Distribution of Executives' Assignments of Transportation Activity to PLC Stages[e]					# of Execs	Chi-Square[f]
				D[d]	I	G	M	DD		
49	Expand transport system	3.20	2.68	5 (9%)	12 (23%)	30* (57%)	6 (11%)		53	51.2[g]
50	Make carrier concessions	3.57	3.25		19 (36%)	25* (47%)	7 (13%)	2 (4%)	53	45.0[g]
51	Expect product changes	1.29	1.07	10 (19%)	7 (13%)	16 (30%)	16* (30%)	4 (8%)	53	10.9[g]
52	Improve efficiency	3.71	3.56	10 (19%)	4 (8%)	13 (25%)	25* (47%)	1 (2%)	53	32.9[g]
53	Control transport costs	3.89	3.83	1 (3%)	6 (19%)	6 (19%)	17* (53%)	2 (6%)	32	25.2[g]
54	Evaluate service policy	3.62	3.48	1 (2%)	6 (11%)	9 (17%)	27* (51%)	10 (19%)	53	36.3[g]
55	Drop marginal carriers	3.83	3.77		1 (3%)	7 (22%)	22* (69%)	2 (6%)	32	52.1[g]
56	Assess best mode	3.78	3.64	2 (6%)	1 (3%)	5 (16%)	23* (72%)	1 (3%)	32	55.5[g]
57	Rely more on rail	3.61	3.36	4 (8%)	1 (2%)	11 (21%)	28* (53%)	9 (17%)	53	41.6[g]
58	Use more for-hires	3.53	3.41	4 (8%)	6 (11%)	30 (57%)	13* (25%)		53	52.8[g]
59	Evaluate cost-service	3.46	2.99	14 (26%)	7 (13%)	11 (21%)	20* (38%)	1 (2%)	53	19.4[g]
60	Do more consolidating	3.58	3.16	8 (15%)	6 (11%)	17 (32%)	22* (42%)		53	29.4[g]
61	Go to fixed routes	3.42	3.08	3 (6%)	1 (2%)	3 (6%)	42* (79%)	4 (8%)	53	116.7[g]
62	Monitor freight bills	3.81	3.77		7 (22%)	6 (19%)	18* (56%)	1 (3%)	32	32.1[g]
63	Pre-shipment audit	3.35	2.69	5 (16%)	6 (19%)	2 (6%)	16* (50%)	3 (9%)	32	19.6[g]
64	Delegate cost monitoring	2.83	2.25	1 (2%)	5 (9%)	12 (23%)	31* (58%)	4 (8%)	53	55.2[g]
65	Expedite shipments	3.62	3.46	2 (4%)	6 (11%)	11 (21%)	25* (47%)	9 (17%)	53	28.8[g]
66	Coordinate changes	3.29	2.47	16 (50%)	9 (28%)	5 (16%)	2* (6%)		32	25.2[g]
67	Expand carrier system	3.36	2.78	1 (3%)	4 (13%)	25 (78%)	2* (6%)		32	68.9[g]
68	Use extra services	3.47	3.09			16 (50%)	14* (44%)	2 (6%)	32	39.3[g]
69	Evaluate routings	3.38	3.11	1 (3%)	2 (6%)	14 (44%)	13* (41%)	2 (6%)	32	26.4[g]
70	Enlist legal's help	2.36	1.67	4 (13%)	3 (9%)	5 (16%)	17* (53%)	3 (9%)	32	22.4[g]
71	Anticipate sales drop	1.48	1.09		1 (3%)	5 (16%)	20 (63%)	6* (19%)	32	40.2[g]
72	Simplify transport system	2.92	2.40	4 (13%)	2 (6%)	6 (19%)	18 (56%)	2* (6%)	32	28.0[g]
73	Shift unused capacity	3.31	2.88	5 (9%)	1 (2%)	9 (17%)	17 (32%)	21* (40%)	53	26.0[g]

stages later than recommended by the prescriptive model and one stage earlier in Maturity and Decline.

Next, the researchers tested the null hypothesis that PLC stage is independent of each transportation activity. This is basically a test of whether practitioners were randomly assigning each TA to one of the five PLC stages. In developing the contingency table for this analysis, a frequency distribution of each manager's assignment of TAs by sales phase was developed. Then, these distributions were summed. Finally, a one-sample chi-square test was performed on each strategy. At the 0.05 level, the null hypothesis of random assignment was rejected for 76 of the 78 TAs, as shown in the last column of Table 3. Slightly more than 96% of the 78 transport activities were not assigned to PLC stages in a random fashion; in fact, a distinctive pattern prevailed in most cases.

Having determined respondents were not randomly classifying transportation strategies to sales phases, the researchers decided to determine how these patterns coincided with the Rink and Kaminski model. This was achieved by evaluating the percentage distribution of executives' responses for each TA relative to the prescriptive model. Using 50% as a "rough" standard of comparison, it can be seen from Table 3 that 24 of

TABLE 3 continued

TA #[a]	Brief Description of Transportation Activity	Importance[b]	Usage[c]	Distribution of Executives' Assignments of Transportation Activity to PLC Stages[e]					# of Execs	Chi-Square[f]
				D[d]	I	G	M	DD		
74	Pursue consolidation	3.59	3.21	2 (4%)	4 (8%)	18 (34%)	28 (53%)	1* (2%)	53	53.5[g]
75	Pool shipments	3.68	3.52	3 (9%)	5 (16%)	7 (22%)	13 (41%)	4* (13%)	32	9.9[g]
76	Use outside agency	2.46	1.79	1 (2%)	2 (4%)	16 (30%)	30 (57%)	4* (8%)	53	58.0[g]
77	Spare parts system	2.87	1.91	13 (25%)	15 (28%)	6 (11%)	11 (21%)	8* (15%)	53	5.0
78	Plan for recalls	1.92	1.65	13 (41%)	7 (22%)	5 (16%)	6 (19%)	1* (3%)	32	11.8[g]

* PLC stage transportation activity should be assigned according to Rink and Kaminski model (Table 2).

[a] Transportation activity (TA) numbers correspond to those in Table 2.

[b] A four-point importance scale was employed, where 4=Very important, 3=Important, 2=Somewhat important, and 1=Not important. Overall average importance level was 3.29.

[c] A four-point usage scale was employed, where 4=Used all the time, 3=Used frequently, 2=Used occasionally, and 1=Not used. Overall average usage frequency was 2.89.

[d] PLC stages are coded as: D=Design; I=Introduction; G=Growth; M=Maturity; and DD=Decline.

[e] Due to rounding, the percentage distribution of executives' assignments of some activities may not total 100%.

[f] Critical Chi-Square value is 9.49 for 4 degrees of freedom and alpha of 0.05.

[g] $p<0.05$.

TABLE 4

PLC STAGES WHERE RESPONDENTS CLASSIFIED TRANSPORTATION ACTIVITIES

		PLC Stage Assigned by Respondents[a]					Total
		Design	Introduction	Growth	Maturity	Decline	
PLC Stage Suggested by Rink and Kaminski Model	Design	312 (46%)	143 (21%)	120 (18%)	94 (14%)	10 (1%)	679
	Introduction	49 (8%)	155 (24%)	238 (37%)	173 (27%)	33 (5%)	648
	Growth	65 (8%)	145 (18%)	310 (39%)	252 (32%)	25 (3%)	797
	Maturity	87 (10%)	88 (10%)	224 (26%)	393 (46%)	58 (7%)	850
	Decline	41 (12%)	37 (11%)	72 (21%)	143 (42%)	47 (14%)	340
Total		554	568	964	1,055	173	3,314

[a] Due to rounding, row percentages may not total 100%.

the 78 TAs (or almost 31%) equaled or exceeded this criterion. This means PD executives assigned less than one-third of the prescribed 78 TAs to the PLC stage recommended by the Rink and Kaminski model. [Interestingly, if the "rough" standard is reduced to 40%, PD practitioners assigned 39 (or one-half) of the 78 TAs to the PLC phase suggested by the prescriptive model.]

A phase-by-phase analysis confirmed the general conclusions corresponding to Table 4. Only two, five, and none of the 14, 20, and 8 TAs in Introduction, Growth, and Decline, respectively, exceeded the 50% standard, compared to seven and ten of the 16 and 20 TAs in Design and Maturity, respectively. Four, nine, and eight of the 16, 14, and 20 TAs in Design, Introduction, and Growth, respectively, were classified one or two stages later than suggested--two were three phases later (i.e., TA#s 7 and 23). Four and five of the 20 and 8 TAs in Maturity and Decline, respectively, were assigned one or two stages earlier than recommended--three were three and four stages sooner (i.e., TA#s 66, 67, and 78).

Finally, the researchers wanted to ascertain the individual and company demographic characteristics of above-average classifiers of TAs to sales phases. The average number of activities correctly assigned relative to the Rink and Kaminski model was 23.1. [As mentioned earlier, each respondent evaluated only one-half of the 78 TAs.] Using this figure, distribution executives were segregated into one of two categories--above-average classifiers, or average/below-average classifiers. Next, cross-tabulations of various individual

TABLE 5

INDIVIDUAL AND COMPANY DEMOGRAPHICS OF ABOVE-AVERAGE AND AVERAGE/BELOW-AVERAGE CLASSIFIERS

Variable and Categories	Above-Average (n=41)	Average/ Below-Average (n=44)	Base	Chi-Square Value[a]
Gender				
Female	11 (50%)	11 (50%)	22	0.04
Male	30 (48%)	33 (52%)	63	
Education Level Attained				
≤ Some college	10 (34%)	19 (66%)	29	
College	26 (62%)	16 (38%)	42	7.20[b]
≥ Masters	10 (71%)	4 (29%)	14	
Number of Years in Distribution				
<5 years	12 (35%)	22 (65%)	34	
5-12	16 (55%)	13 (45%)	29	6.17[b]
>12 years	15 (68%)	7 (32%)	22	
CTL or Non-CTL				
CTL	29 (59%)	20 (41%)	49	5.98[b]
Non-CTL	12 (33%)	24 (67%)	36	
Job Title				
Lower-level management	14 (36%)	25 (64%)	39	4.38[b]
Manager or above	27 (59%)	19 (41%)	46	
Organizational Level				
Corporate, home office, etc.	9 (53%)	8 (47%)	17	
Division, subsidiary, etc.	16 (44%)	20 (56%)	36	0.41
One main firm, office, etc.	16 (50%)	16 (50%)	32	
Tonnage Handled by Firm				
High	13 (54%)	11 (46%)	24	
Medium	16 (52%)	15 (48%)	31	1.29
Low	12 (40%)	18 (60%)	30	
Number of Employees in Firm				
Large	6 (43%)	8 (57%)	14	
Medium	15 (56%)	12 (44%)	27	0.91
Small	20 (45%)	24 (55%)	44	
Manufacturing				
Raw Materials	16 (43%)	21 (57%)	37	0.62
Component Parts	25 (52%)	23 (48%)	48	
College Major	(n=30)	(n=26)		
Distribution or transportation	24 (65%)	13 (35%)	37	5.65[b]
Non-PD/transportation	6 (32%)	13 (68%)	19	

[a]Critical chi-square value for alpha=0.05 for independent variables with two categories is 3.84 for 1 degree of freedom; and for independent variables with three categories, it is 5.99 for 2 degrees of freedom.

[b] $p < 0.05$.

and company demographics were developed. Finally, chi-square tests were performed.

As shown in Table 5, classification of TAs across PLC stages relative to the prescriptive model appears to be influenced by only five of ten demographic variables: education level, number of years worked in PD, professional certification, job title, and college major. That is, 62% of the respondents with a college education were above-average classifiers while only 34% of those with some college education were. (Of those who were college graduates, 65% who majored in PD or transportation were above-average assigners while only 32% of those who did not major in either of these areas were.) Almost 70% of the individuals who had worked more than 12 years in PD were above-average classifiers while only 35% of those who had worked less than 5 years in distribution were. About 60% of the people possessing CTL designation were above-average assigners while only one-third of those not possessing CTL designation were. Almost 60% of the respondents who had job titles of "manager or above" were above-average classifiers while only 36% of those who had job titles of "lower-level management" were. The common denominator among these five individual demographic variables is "experience" and "education".

Miscellaneous

When asked if they had heard of the PLC concept prior to this survey, 61% of the respondents remarked "No" (Table 6). Slightly more than three out of five PD professionals felt Table 1 accurately described their specified product. Almost 60% said their product was in the Maturity stage. In terms of using PLC to make transportation-related decisions, about six out of ten managers indicated "rarely" and "not at all". However, almost two-thirds felt PLC would be useful in developing and implementing TAs.

LIMITATIONS

Study

The obvious limitation of this study was the small number of respondents (i.e., 85). Another was the use of a random sampling method to select potential participants instead of a proportionate stratified random sampling procedure. In all likelihood, these two limitations negatively impacted the representativeness of the sample. This, in turn, probably reduced the generalizability of the study's results to the population of distribution and transportation executives. Instructing respondents to select one product from their firms on which to make their assessments may have significantly reduced the practical value of the study's results.[3] However, from a methodological standpoint, having participants focus on one of their firm's major products with which they had transport experience likely increased the validity and reliability of the study's findings, at least in terms of the product each PD executive selected. Finally, the importance level and usage frequency of each TA were measured using four-point scales, which might not qualify the results for interval-scaled statistics (e.g., mean), whereas five-point scales would.

TABLE 6

MISCELLANEOUS INFORMATION

1. Accuracy of Table 1 Description of PLC Stages of Product Specified					
Very accurate	3	(4%)	Slightly inaccurate	24	(28%)
Accurate	22	(26%)	Inaccurate	8	(9%)
Slightly accurate	27	(32%)	Very inaccurate	1	(1%)
2. PLC Stage Specified Product In					
Design	0	(0%)	Maturity	49	(58%)
Introduction	14	(16%)	Decline	0	(0%)
Growth	22	(26%)			
3. Extent Use/Have Used PLC in Making Transportation Decisions					
Continuously	0	(0%)	Rarely	31	(36%)
Frequently	9	(11%)	Not at all	19	(22%)
Occasionally	26	(31%)			
4. Usefulness of PLC in Developing and Implementing Transportation Activities[a]					
Very useful	7	(8%)	Slightly unuseful	16	(19%)
Useful	19	(22%)	Unuseful	12	(14%)
Slightly useful	31	(36%)	Very unuseful	0	(0%)
5. Ever Heard of PLC Before This Survey					
Yes	33	(39%)			
No	52	(61%)			

[a]Due to rounding, percentages do not total 100%.

Rink and Kaminski Model

The researchers had a concern regarding the Rink and Kaminski model. It does not adequately address several important topics, such as Just-In-Time (JIT) manufacturing, Materials Requirement Planning (MRP), Total Quality Management (TQM), and Supply Chain Management (SCM). Also, this prescriptive model overlooks other crucial topics, such as Customer Relationship Management (CRM), job sequencing, systems focus, enhanced communications, and environmental concerns.

Product Life Cycle Concept

One of the issues surrounding the PLC concept is whether it applies to product class (e.g., vehicles), product form (e.g., SUVs), or brand (e.g., Buick Enclave). The little research that has been conducted supports product form (e.g., Buzzell, 1966; Brockhoff, 1967; Bass, 1969; Polli and Cook, 1969; Smallwood, 1973). Also, it can be hard to determine in which PLC stage the product is (e.g., Day, 1981; Boyd and Walker, 1990; Kotler, 2000). Even more difficult, however, is predicting when the next PLC stage will begin and how long it will last (e.g., Churchill and Peters, 1998). In addition, the time span and shape of the PLC varies by product and industry (e.g., Swan and Rink, 1982; Peter and Donnelly, 1992; Evans and Berman, 1994; Kotler, 2000). Another problem is ascertaining the appropriate unit of measurement, such as unit sales, sales revenue, etc. (e.g., Boyd and Walker, 1990). Further, the PLC concept can lead to making the wrong decision, such as withdrawing resources from a product management believes has entered the Decline stage, when it has not (e.g., Dhalla and Yuspeh, 1976).

Despite these limitations, the PLC concept "is generally accepted as a useful heuristic model" (Lazer and Shaw, 1986, p. 15-11). Its major benefit may be "as a forward-looking conceptual tool for strategic planning" (Webster, 1979, p. 93) that provides management "with a general guide to planning and strategy formulation" (Lazer and Shaw, 1986, p. 15-11) by PLC stage and overall.

MANAGERIAL IMPLICATIONS

By using Rink and Kaminski's product life cycle-transportation activities (PLC-TAs) model, executives can determine the set of prescriptive transport activities they should consider implementing in each stage of a product's sales cycle. These lists, in turn, can serve as references for continuous reprogramming of traffic operations across the PLC. In formulating and executing more effective and timely transport strategies, at least two factors need to be considered--corporate objectives, and changing conditions in the marketplace. The actions of a firm are determined by its objectives. Direct linkage between corporate and transportation objectives gives meaning to the contributions from traffic managers. Planners and doers both know what is expected of the transport department as well as how these efforts relate to the broader objectives of transportation and the organization, especially in terms of desired customer service levels and corresponding costs.

Flexibility is incorporated into the traffic plan by anticipating changes in market conditions. Using the PLC concept as a gauge, these basic changes can be anticipated as a product moves through the stages of its sales cycle. Transport planners knowing what they want to take place can gain this desired flexibility by fitting transportation actions to PLC phases. The emphasis in this type of planning is on timing the changes in traffic operations to produce the best utilization of company resources. The contingency transportation plan says, in effect, "when this happens, transport will do this, or these alternatives are available."

Adoption of Rink and Kaminski's PLC-TAs model can proceed piecemeal. Most urgent, however, is transportation executives' attention to products in their early PLC phases (i.e., Design, Introduction, and Growth). These are more transitory and volatile, and they often necessitate a more radical departure from operational routines. During a stable Maturity stage, the implication of seasonal patterns may become more obvious, and a more normalized sales trend can be established. But, when a product's sales decline, management needs to consider profitable actions in relation to this product as well as to its newer counterparts entering their product life cycles. After some trial adoptions, if results suggest more extensive use of Rink and Kaminski's model, traffic managers can incorporate it into departmental objectives and policies. Even then, however, the model will have to be continuously fine-tuned. If other functions' operations follow this same guide, the model's effectiveness will be maximized.

Finally, Rink and Kaminski's model, which depicts transport in a systems perspective, makes explicit transportation's relationship with other departments of the firm in the decision-making process. This is especially timely, because transport is assuming top-management status in many corporations. Traffic executives interact almost daily with managers from other functions either on an individual basis or as part of cross-functional teams. Since one of the major advantages of the PLC concept is it helps integrate thinking in all functional areas (e.g., Levitt, 1965; MacKenzie, 1971; Smallwood, 1973; Kotler, 1976; Webster, 1979; Thietart and Vivas, 1984; Lazer and Shaw, 1986; Boyd and Walker, 1990; Kotler, 1994; Jain, 1997; Kotler, 2000; Kotler and Keller, 2012), Rink and Kaminski's PLC-TAs model can be invaluable in illustrating the inter-relationships of transportation with other departments in the firm. This can assist executives of transport and other functions to dovetail their operations. However, the overall approach and the constituent details are not universals, but a point of departure for custom-tailoring to the macro-environmental conditions confronting the organization.

RECOMMENDATIONS FOR FUTURE RESEARCH

Qualitative research (e.g., personal interviews or focus groups) should be conducted among transportation executives to ascertain why they think non-traditional TAs (e.g., "monitor marketing reports for anticipated decrease in sales") in Rink and Kaminski's PLC-TAs model were rated "somewhat important" or lower and "used occasionally" or less often by respondents. In addition, these same managers should be queried as to why they think interdepartmental-, intercompany-, and external-oriented TAs (e.g., "cooperate in providing transportation-related information to new product developers") in Rink and Kaminski's model were evaluated by respondents as "important" or higher, but used only "occasionally" or less often. Finally, these executives should be asked to assess the applicability and relevance of each of the TAs in Rink and Kaminski's model, suggest changes to existing TAs, and provide suggestions for additional TAs.

As previously mentioned, Rink and Kaminski's PLC-TAs model did not adequately cover several important topics (e.g., JIT and MRP). Also, their model overlooked other key aspects (e.g., environmental-related issues). After reviewing the relevant literature in these areas and talking to transport managers concerning these subjects, researchers will be better equipped to develop a more comprehensive, up-to-date, and applicable PLC-TAs model that will assist transportation executives in the successful performance of their traditional and new responsibilities.

After a more comprehensive and up-to-date PLC-TAs model has been developed, it should be subjected to qualitative research (e.g., personal interviews or focus groups) among a representative sample of transport and/or distribution managers, who are members of the National Council of Physical Distribution Management (NCPDM). Using their comments and suggestions for additional TAs, the revised PLC-TAs model would be further expanded and refined. Next, the final version of this PLC-TAs model should be subjected to a larger-scale survey of PD executives from a wider variety of industries and products. This study should be conducted under the auspices of the NCPDM. To ensure representativeness of the sample, and therefore generalizability of the study's results, a proportionate stratified random sampling procedure should be utilized in selecting prospective respondents.

CONCLUSIONS

A nation-wide sample of 85 distribution executives rated over three-fourths of the 78 transportation activities in Rink and Kaminski's PLC-TA model as "important" or higher. Slightly more than one-half of the 78 TAs were "used frequently" or more often by these managers in implementing transport activities for one of their organization's products. Practitioners' assignments of 78 TAs to sales phases matched about one-third of the prescriptive model.

While some of these results may appear disappointing, Rink and Kaminski's model of 78 TAs across a product's sales cycle represents a major improvement over those of earlier writers. However, the topics not adequately addressed or overlooked by them, which were previously mentioned, must be discussed and incorporated in order to achieve a more comprehensive, realistic, and therefore useful PLC-TAs model. When this occurs, the transportation strategies comprising this expanded model will represent potential input for organizations' policy manuals, or standard procedures, which will foster transport and PD effectiveness as well as inter-functional cooperation.

At any one firm, the useful number of TAs could probably be increased by a longer period of orientation and experimentation, encouragement of inputs from executives of distribution and other functions, and endorsement by top management. The widespread problems of spiraling transportation costs, intensifying global competition, added product complexity, rapidly changing technology, and increasing demands on customer service make such functional alignment in conformance with overall objectives a project of high priority. In such an endeavor, these recommended transport activities could serve as a point of departure. Every organization has a distinct set of resources, structural elements, and objectives. Therefore, its standard TAs must be tailor-made.

Finally, this study demonstrates to top management the possible benefits and limitations of the Product Life Cycle (PLC) concept as an integrating tool with respect to transportation. For PD executives, it also indicates that deeper knowledge and deliberate use of the PLC concept could help them formulate and implement timelier TAs as well as effectively integrate and coordinate their basic and expanding responsibilities. One survey respondent, with over 35 years of distribution experience, remarked "I wish I'd have had this model when I first started working. It would have been an invaluable guideline for effectively managing transportation activities for my company's products."

NOTES

1. Alternative conceptual models exist in the strategic planning literature (e.g., product portfolio models, market-attractiveness business-position matrix, and PIMS—Profit Impact of Marketing Strategy); but none of these models "define specific actions to be taken to reach a new strategic position" (Abell and Hammond, 1979, p. 379).

2. According to one marketing executive, the PLC concept can "provide the basis for plans and strategy for every function within the firm. …It will also greatly diminish the normal and obstructive conflicts often inherent among functions" (MacKenzie, 1971, p. 42).

3. The researchers wish to thank Reviewer # 3 for highlighting this limitation of their study.

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