Macroeconomic Models of Consumer Demand for Consumer Packaged Goods in Asia

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Abstract

CPGCo, a global manufacturer of consumer packaged goods, has had tremendous difficulty in producing accurate forecasts for its products in developing markets. The problem was especially apparent during the global economic crisis in 2008, which caused demand for its products to become highly volatile. Its troubles have been aggravated by its long forecasting horizon, as it has not been able to adjust quickly enough to rapid market shifts due to fluctuations in various macroeconomic indicators. As a result, CPGCo faces heavy stockouts and excess inventories. This thesis explores the suitability of using macroeconomic indicators to forecast consumer demand for three developing countries in Asia as well as three separate product segments. A total of 27 macroeconomic models are constructed using stepwise multiple linear regression analysis employing three separate dependent variables: the firm's monthly wholesale shipment volume, retail market share by volume, and retail sales. The world oil price and country-specific exchange rates, stock indexes, interest rates, consumer price indexes, and consumer confidence indicators are used as independent variables. With our models, we are capable of producing extremely accurate forecasts for a small sample set with errors at or below 7.2%. Our findings also indicate that the consumer price index has the most influence on consumer demand, appearing in 81% of our models; thus, we recommend that CPGCo tracks the consumer price index of each country to complement its current forecasting processes.

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Table of Contents

List of Tables

List of Figures

1 Introduction

Forecasting has always been more of an art than a science. Indeed, even businesses possessing significant amounts of historical data and elaborate statistical software packages find it extremely difficult to match supply with demand. As the effects of the 2008 global recession have taken hold, firms have found themselves beset by large forecasting errors as demand has become tremendously volatile and no longer follows historical trends. In light of these difficulties, many supply chain professionals have called for radical changes in forecasting and demand planning processes and the technologies behind them (Foster, 2008). Dr. Larry Lapide, Director of Demand Management at MIT's Center for Transportation and Logistics, disagrees. According to Lapide, forecasting techniques should not be changed. However, he believes that forecasters should consider economic factors that potentially influence demand. In a December 2008 article appearing in *Global Logistics & Supply Chain Strategies*, Lapide states that "The state of the economy never really mattered much. Now, the impact of a bad economy has to be factored in, but it is just another variable. The techniques remain the same" (Foster, 2008).

In a separate article, Dr. Lapide (2009) asserts that the difficulty surrounding accurate forecasting stems largely from variations in demand. Figure 1-1 on the following page illustrates the degree of various factors—such as promotions and seasonality—affecting demand during normal economic times and turbulent economic times in the U.S. The pie chart on the top shows that business cycles/economic conditions drive 10% of the demand during normal economic times. During turbulent economic times, however, the effect of business cycles/economic conditions is increased to 20%—as illustrated in the lower pie chart.

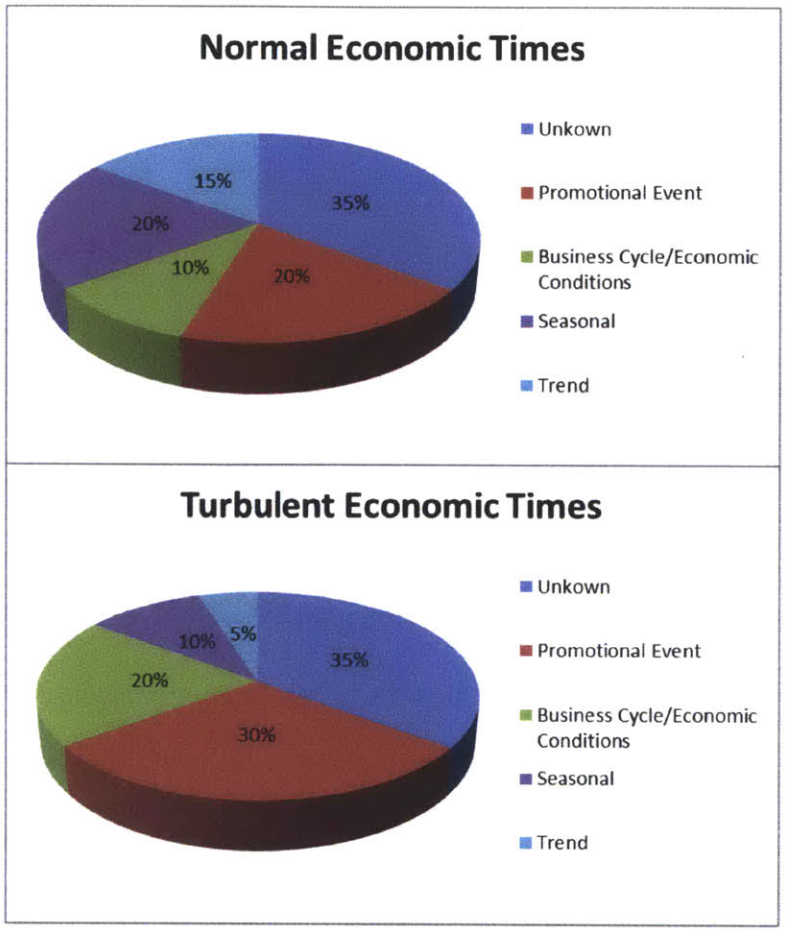

Figure 1-1 Illustrative Percent of Variation Due to Factors that Drive Demand (Lapide, 2009)

The difficulty of forecasting that exists in developed nations is even more amplified in emerging markets, where many of the dynamics have yet to be fully characterized and historical data are more limited. As we mentioned previously, the global economic recession in 2008 caused demand in many industries—including consumer packaged goods—to become highly volatile. Multinational companies whose forecasting horizons were on the yearly scale had difficulty anticipating the rapid market shifts and were plagued with stockouts and excess inventories. Our sponsor, CPGCo (a pseudonym), a global manufacturer of consumer packaged goods, found itself in this unsavory position; consequently, the firm is interested in examining

the degree to which economic conditions impact consumer demand for developing markets in Asia and how macroeconomic variables can be leveraged to act as leading indicators to better inform forecasts.

Presently, CPGCo uses an elaborate eight-block model for demand planning, of which forecast generation is merely a part. Long-term (12 to 18 month) statistical forecasts are generated by CPGCo and are updated on a monthly basis using various assumptions or information regarding promotions that may impact volume. In addition, the firm performs a multitude of different reasonability checks to ensure that the generated forecasts make sense.

The purpose of this thesis is two-fold as we investigate the effects of macroeconomic indicators on consumer demand for three different product segments across three developing countries in Asia. First, we aim to develop working macroeconomic models to forecast consumer demand in each product segment and for each country. Second, we aim to generate insights on consistencies found across countries and products to provide general rules-of-thumb for CPGCo to complement its existing forecasting process.

This thesis consists of five chapters. In Chapter 2, we present an overview of the literature relating to our topic. Chapter 3 discusses the various methods and steps used to analyze the data and construct the macroeconomic models. In Chapter 4 we present the findings and results of our data analysis. Finally, we conclude this thesis in Chapter 5 through summarizing our findings and discussing potential future research relating to the topic.

2 Literature Review

When it comes to the fields of econometrics and macroeconomics in general, a large and rich body of literature exists. Yet, when we delve deeper and examine macroeconomic forecasting of demand for consumer goods, we find the literature to be quite sparse. Indeed, the vast majority of literature on the aforementioned topic deals primarily with forecasting or predicting consumer expenditures for durable goods—rather than nondurables—although we were able to locate a small number of pieces giving attention specifically to the latter.

As we conducted our literature search, it became apparent rather quickly that much of the literature was dated. While our goal was to seek out the most up-to-date literature on the topic because it more closely represented the economic reality of present-day, we chose to include many older pieces of literature in our survey as well. Our decision to include the more dated material aligns with our ultimate purpose for conducting this literature review. That is, to seek out what methodologies have been utilized in past research with respect to forecasting or predicting demand for consumer goods using various macroeconomic indicators. Having said that, we are also very interested in the findings and conclusions of the past research—especially with respect to predicting demand for nondurable goods—as it will provide us with a foundation to interpret and understand the results of our own study.

Our literature review itself is divided into nine functional areas. We first begin by exploring the more dated literature concerning early theories of consumption as well as the illiquidity of durable goods and the impact of economic uncertainty. Next, we present the literature using the disciplines of psychology or sociology to understand consumer spending behavior and consumer panic situations. We then turn our attention to more recent sources

relating specifically to the impact of macroeconomic indicators on expenditures for nondurable goods. A discussion of modeling using subjective macroeconomic data is presented, followed by a survey of the literature with respect to modeling using objective data. This chapter concludes by presenting studies aimed at forecasting the demand for air traffic and tourism as well as the literature dealing with forecasting in emerging or volatile environments.

2.1 A Brief Overview of Early Theories of Consumption

In order to provide a solid foundation for our literature review, we surveyed several sources of early economic theories relating to the determinants of consumption. We began with John Maynard Keynes' 1936 book, *The General Theory of Employment, Interest, and Money*. In this piece, Keynes (1936) asserted that income, wealth, taxes, and perhaps interest rates affect consumption. Keynes' theory was predominant for over twenty years until it was challenged by Freidman (1957) and Ando and Modigiani (1963). Whereas Keynes had argued that current income influenced consumer spending, Freidman and Ando and Modigiani proposed that it was actually average income—including past, current, and expected future income levels—that determined consumer spending.

2.2 The Illiquidity of Durable Goods and the Impact of Economic Uncertainty

Given the highly uncertain economic environment of present-day, it is important to understand how such a setting affects consumer demand and behavior. We found two pieces of literature dealing specifically with this topic. The first, written by Frederic Mishkin in 1976 addresses the illiquid nature of durables and studies the effect of illiquidity on the demand for

such goods during uncertain economic times. The other article, written by Barrett and Slovin 12 years later, studies the impact of economic uncertainty on the demand for durable goods.

Mishkin (1976) developed a two-period "liquidity" model for consumer durable goods using the Tobin-Markowitz mean-variance framework to objectify the opportunity cost of retaining durables in the midst of uncertainty. He pointed out that consumers will sell off durables in distress sales when their debt service is greater than their income, plus any other financial assets that are immediately available (Mishkin, 1976). Using the results from his two-period model, Mishkin created a stock-adjustment model and tested it using aggregate quarterly data for consumer durable expenditures for automobiles and automobile parts as well as nonautomotive consumer goods. Regression analysis was used to estimate the constructed models, and Ray Fair's method was employed to correct any serial correlation.

Mishkin found that as consumers incur more debt, they tend to purchase smaller amounts of consumer durable goods and attempt to increase their financial assets. His findings also indicated that monetary policy impacts expenditures for durables through affecting the price of assets in the economy as well as the cost and availability of credit (Mishkin, 1976).

Barrett and Slovin's (1988) study used disposable income levels and the cost of capital on durables to measure economic uncertainty. The authors noted that in situations where perfect market conditions are present, consumers will typically save more—and therefore spend more on such goods—as the economic situation becomes more uncertain (Barrett & Slovin, 1988). Recall that Mishkin's approach was different, however. He argued that consumer goods are illiquid, and therefore cause consumers to increase savings and purchase lower amounts of durable goods as economic uncertainty increases (Mishkin, 1976).

Barrett and Slovin used Box-Jenkins and regression analysis in order to build a model to estimate the demand for consumer durable goods. The pair's findings vindicated Mishkin, highlighting the illiquidity effect of durables. In other words, economic uncertainty had a negative impact on expenditures for durable goods for the period 1974 – 1982. Interestingly enough, however, prior to 1974, it appeared that economic uncertainty did not affect expenditures greatly (Barrett & Slovin, 1988).

2.3 A Psychological Analysis of Consumer Spending

Whereas the two previous sections of this chapter discussed the impact of consumer income levels and economic uncertainty on consumer demand, this section of the literature review discusses a 1974 psychological analysis of the impact of inflation, recession, and increased assets or inventories on consumer spending. This study is of particular importance as it introduces a psychological aspect into consumer behavior and spending. Indeed, in later sections of the literature review, we will discuss the use of subjective data in modeling, derived from consumer surveys concerning consumers' thoughts, feelings, and expectations with respect to the economy.

While it was a widely-held belief at the time that consumer purchases for durable goods were affected by more than just income, Katona's (1974) study did not make an explicit distinction between durable and nondurable goods. He asserted that purchases were not just contingent upon the consumer's income level (or ability to buy) but also on his/her confidence level and willingness to make a purchase. Katona examined four different areas: how inflation impacts consumer spending, personal saving in periods of prosperity and recession, wealth and saving, and saturation with consumer goods (Katona, 1974).

He found that there was no simple answer in any of the areas and that all four were dependent upon how consumers perceived the respective situation (Katona, 1974). Katona concluded by pointing out that subjective data alone cannot supplant economic data. Instead, he argued that it should be utilized in conjunction with the economic data itself. Yet, according to him, there were numerous scholars who argued that subjective data should not be used at all, given the abundance of objective data readily available. That is, the opponents argued that objective data is a suitable proxy for consumers' expectations. Katona, however, disagreed, citing numerous instances in the past where consumers had expectations regarding inflation when price levels were relatively static. There have also been instances where consumers did not have inflationary expectations in times marked by large increases in prices (Katona, 1974).

In order to support his argument for using subjective data in conjunction with economic data, Katona provided an example citing that a family's level of spending or saving following an increase in income depends upon the family's level of satisfaction or dissatisfaction with the increase itself. He continued by highlighting that, when such a change occurs, consumers will typically have expectations about how the change will impact their money or their standard of living. These changes in consumer expectations or attitudes are able to be captured in surveys, and he suggested that they can perhaps be used in the future as a means for gauging changes in the economy as a whole (Katona, 1974).

2.4 A Sociological Framework for Examining Consumer Panic

Having discussed the literature on psychology and consumer spending, we now turn our attention to a different discipline: sociology. Strahle and Bonfield (1989) analyzed consumer behavior, focusing on consumer panic from a sociological perspective. The authors were

interested in examining the very sudden and sharp changes in the market resulting from factors such as fads and fashion, fluctuations in the stock market, runs on nondurable goods, buying sprees, hoarding, and bank panics (Strahle & Bonfield, 1989).

To investigate the phenomenon, a "panic paradigm" model was constructed with three components and partially tested using analytical induction. First, the authors stated that a panic cannot occur in absence of the individual's perception of a threat, the individual must be unable to cope with the threat itself, and possible escape routes must exist for the individual (Strahle & Bonfield, 1989). With respect to the escape routes themselves, there is a temporal aspect. Indeed, the authors described the potential escape routes as being perceived by the individual as "closing". Strahle and Bonfield pointed out that, while each condition on an individual basis is necessary, it is not adequate. Only when the three are aggregated together, do they become both necessary and adequate. The second model component involved the behavioral outcome of the panic. The authors asserted that the outcome is derived from the individual's physical or mental removal from the threat. Lastly, there are various structural factors that either facilitate or impede the decision making process. These eight structural factors—definition of the situation, norms (prior and emergent), antecedent experiences, behavioral alternatives, physical and emotional state of the individual, observation of a panic leader, group or individual goals, and panic threshold (profit estimation)—affect the time between the individual's perception of the threat itself and his or her subsequent behavior or actions (Strahle & Bonfield, 1989).

Strahle and Bonfield explicitly noted the difficulty in testing their model. While there were certainly various methodologies available for testing—including interviews and panic situation simulations—past studies were considered outright failures, with the majority of the research results viewed as conflicting or misleading (Strahle & Bonfield, 1989). Despite the

aforementioned issues, the authors were able to partially test their model. They first developed three separate hypotheses derived from the perceptions component of their model. To test the hypotheses, they analyzed interviews from a 1952 study of 135 subjects exposed to the 1938 Orsen Welles' broadcast of H.G. Wells' *War of the Worlds*. Based on their analysis of the broadcast script and the interviews, the authors concluded that none of their hypotheses could be rejected (Strahle & Bonfield, 1989).

The "panic paradigm" model provides a theoretical foundation for qualitatively understanding how consumers react to panic situations. At the same time, the model can be utilized to understand what is driving the consumer's behavior in various economic situations such as stock market fluctuations or runs on nondurable goods.

2.5 The Impact of Macroeconomic Indicators on Nondurable Expenditures

As noted, our literature search yielded few results with respect to nondurable goods. Indeed, the majority of sources we found dealt primarily with durable goods, and those that studied durables and nondurables together typically only referred to or mentioned nondurables in passing. With this in mind, we were only able to locate a total of two articles focusing exclusively on the topic of macroeconomic indicators and nondurable goods: one that examined expenditures in the retail fashion industry and another one focusing on grocery expenditures.

Beginning with the retail fashion industry, Allenby, Lichung, and Leone (1996) examined the effect that macroeconomic conditions have on retail fashion sales, paying particular attention to the consumer's ability and confidence to buy. Monthly sales data spanning 84 months was provided by a large, national Fortune 500 retailer for five different apparel segments. In order to gauge consumers' attitudes, expectations, and intentions with respect to the economy, consumer

confidence surveys were employed. The authors noted that there is an inherent advantage in using consumer confidence surveys as a means of evaluating the effect that macroeconomic factors have on expenditures. Indeed, a consumer's attitude may change prior to any action being taken on the consumer's part, and the survey will be able to capture that aspect. In addition, the surveys themselves may be able to capture things that cannot be represented through various macroeconomic metrics including income, unemployment levels, gross national product, etc (Allenby et al., 1996).

The authors utilized a hierarchical Bayes model that produced aggregate estimates through stochastic pooling across the various product segments. The consumer's ability and confidence were separated into two different variables in order to account for the different selling seasons—one for summer and winter and the other for spring and fall (Allenby et al., 1996). Doing this produced four different macro-related, explanatory variables: pre-season purchasing ability, in-season purchasing ability, pre-season confidence, and in-season confidence. The ability to buy consisted of two separate components: a resource component and a cost component. The former was represented through the use of the Personal Disposable Income Index (PDI) from the Survey of Current Business—a monthly report published by the U.S. Bureau of Economic Analysis—while the latter was represented through the report's Consumer Price Index for Apparel (CPIA). The ability to buy was operationalized through dividing PDI by CPIA. The authors derived the consumer confidence variable using the University of Michigan SRC's Index of Consumer Sentiment (Allenby et al., 1996).

Allenby et al. found that both consumer confidence and the ability to purchase affected sales, although in varying ways. For example, consumer confidence was found to be a very good predictor of fashion sales before the spring and fall while purchasing ability, on the other hand,

proved to be a better predictor during the aforementioned seasons themselves (Allenby et al., 1996).

While Allenby et al. analyzed the impact of macroeconomic factors on retail fashion expenditures, Ma, Ailawadi, Gauri, and Grewal (2011) investigated the effect that gasoline prices have on grocery expenditures. Ma et al. cited the obvious impact that macroeconomic factors have, not only on consumer consumption, but on the way consumers think, feel, and behave. In their study, they used household panel data obtained from Information Resources Inc. as well as gasoline price data obtained from the Department of Energy's Information Administration web site for the two years spanning 2006 – 2008 for a particular metropolitan area within the United States. The Information Resources Inc. data set included shopping information for 1000 panelists spanning various retail formats in nearly 300 different product categories.

Regression analysis was used to build models for four sets of shopping experiences. The first set focused on shopping in a general sense and included three separate dependent variables: the number of shopping trips, purchase volume, and total expenditures per month. The second set of variables dealt with the allocation of consumer purchase volume for various retail formats. The third variable set included the portion of total purchase volume allocated to the various brand formats—regular, promotional, national, and private label. The final dependent variable set pertained to the portion of total purchase volume for national brands allocated to the various price tiers—top, mid, and bottom. Each of the respective models also possessed three sets of explanatory variables: demographic, macroeconomic, and control. The macroeconomic variables included gasoline price and GDP growth rate (quarterly data for the same two year period spanning 2006 – 2008) (Ma et al., 2011).

Ma et al. found that as gasoline prices rise, the frequency with which consumers shop declines as does the volume of goods purchased. The authors also found that higher gasoline prices tend to cause consumers to favor national brands that are promotional-priced. While the degree was minute, findings indicated a shift toward private labels. Interestingly, higher gasoline prices were found to affect the share of the bottom-tier brands the most. The mid-tier brands, however, tended to grow while the share of top-tier brands generally remained unchanged (Ma et al., 2011).

2.6 Modeling Using Subjective Macroeconomic Data

As we surveyed the literature, we found that many sources employed subjective data—typically in the form of consumer surveys—to predict consumer demand. We believe that the use of such data is advantageous because, after operationalization, it provides a means for quantifying consumers' attitudes, feelings, and expectations concerning the economy. At the same time, such data also provides valuable insight into changes in consumer demand that cannot be explained by fluctuations in the various objective macroeconomic indicators.

Adams (1964) employed over 26 different surveys administered by the Survey Research Center (SRC), spanning the ten year period from 1952 – 1962, to examine the degree to which subjective data could be used to forecast consumer expenditures for durable goods. He operationalized the survey data by assigning different values to consumers' responses after creating various "attitudinal indexes". Using regression analysis, Adams constructed a forecasting model with consumer durable expenditures as the dependent variable. Consumers' attitudes and purchasing plans were used as the model's independent variables, along with income level, all at the particular period in time the survey was carried out.

Adams' findings suggested that the greatest amount of variation in the time series was derived from consumers' attitudes with respect to their expectations about changes in the short-term business/economic climate. The regression analysis revealed that the consumers' attitudes could be used as a means for predicting durable expenditures. Purchasing plans, however, were found to have no forecasting ability (Adams, 1964).

Juster and Wachtel (1972) undertook a similar study, focusing on the degree to which anticipatory variables such as consumer sentiment and expected purchases affected consumer behavior. In addition, Juster and Wachtel wanted to understand what economic factors or variables would lead to changes in the anticipatory variables. They first explored objective models for the demand of consumer durables (both automotive and nonautomotive) using various economic explanatory variables such as income, relative prices, and unemployment rate. They then turned their attention to models using the anticipatory variables. Finally, the two examined inflation and how it impacted the aforementioned models and also investigated consumer saving and the allocation of personal income. Regression analysis was employed to evaluate each of the models.

Juster and Wachtel found that both consumer indexes had considerable explanatory power when forecasting expenditures for automobiles. The only other variable found to be significant was unemployment rate, which accounted for unexpected changes in income. When it came to forecasting durables demand for nonautomotive goods, the findings suggested that the various economic variables had significant explanatory power. The anticipatory variables, however, were found to be only slightly useful in forecasting demand (Juster & Wachtel, 1972).

Concerning inflation, the pair found that the variable only had moderate explanatory power in the durables models and the models constructed to forecast the two survey variables.

Expected price change and anticipated inflation were found to have a significant negative impact on expenditures for durable goods (both automotive and nonautomotive). Inflation that was unanticipated was found to have a very small effect. In addition, unanticipated inflation had a negative impact on the consumers' attitudes and plans to purchase. When inflation was anticipated, however, expected purchases were impacted but consumer sentiment was not. Based on their findings, the authors also suggested that fully anticipated inflation would lead consumers to increase expenditures on nondurable goods and decrease expenditures on durable goods. Moreover, fully anticipated inflation would cause consumers to save less. Inflation that was not anticipated, on the other hand, would cause consumers to reduce expenditures on nondurable goods while saving more (Juster & Watchtel, 1972).

Epright, Arguea, and Huth (1998) utilized multivariate autoregression analysis to study the effect that aggregate consumer expectation indexes have on consumer expenditures. Specifically, the authors were interested in any information the indexes possessed that could explain changes in consumer expenditures better than traditional economic indicators. They used numerous individual variables to represent the economic, aggregate consumer expectation, and consumer expenditures variables. For the economic variables, the Dow Jones Average Index, the Standard and Poor's 500 Index, the Consumer Price Index, and personal disposable income were used. For the consumer expectation variables, the authors used the University of Michigan's Indexes of Consumer Sentiment (ICS), Consumer Expectations (UME), and the Conference Board Indexes of Consumer Confidence (ICC) and Consumer Expectations (CBE). When it came to the consumer expenditures variables set, total retail automobile sales, total nondurable goods sales, and total services sales were used.

The data for the three variable sets was mined from the Citibase database, a database containing financial and economic time series data for the United States economy. The study used monthly data spanning January 1978 through August 1992, and the model itself was estimated by using a lag order of 12. Each of the individual equations included 36 lagged explanatory variables, denoting past values for two of the explanatory variables as well as the expenditures dependent variable.

The authors found that when it came to predicting future consumer expenditures, the aggregate consumer expectation indexes performed significantly better than the economic variables. The findings revealed that the aggregate consumer expectation indexes appeared to anticipate changes in the consumer's disposable income level or buying power, supporting Katona's theory (Epright et al., 1998).

2.7 Modeling Using Objective Macroeconomic Data

This particular section of the literature review discusses several studies that examined consumer demand for durables and nondurables concurrently. Whereas the previous section focused on the use of subjective data as a determinant of demand, the majority of studies presented in this part concentrate on the impact of objective macroeconomic data on the demand for consumer durables and nondurables.

Weber (1975) studied the impact of interest rates and inflation on consumer expenditures by building a multiequation model. The model itself used intertemporal utility maximization to derive consumer expenditures for both durable and nondurable goods. Weber incorporated human and nonhuman wealth, nominal interest rates, the relative price of the goods, and inflation

rates as independent variables. He used the level of consumer expenditures as the dependent variable.

The model itself was constructed so that the interest rates and the independent price variables could impact the allocation of consumer expenditures and was estimated by using aggregate data from the United States for the years 1930 – 1970. The demand functions were used to test the impact of interest rates and the price variables on consumer expenditures (Weber, 1975).

Weber found that the nominal interest rates and relative prices both impacted consumer expenditures and were statistically significant. At the same time, it was concluded that fluctuations in the inflation rate affect expenditures. Finally, Weber noted from his findings that an increase in the weighted average of nominal interest rates (both current and past) led consumers to increase expenditures for durable and nondurable goods (Weber, 1975).

Like Weber, Mankiw (1985) also studied the effect of interest rates on demand. However, Mankiw's study focused on the real interest rate as opposed to the nominal rate. To construct his model, he first estimated a consumer utility function relating consumption to ex post real interest rates. Estimation was conducted through the instrumental variables technique using data from the United States for the years spanning 1950 – 1981.

Mankiw's findings indicated that his model could accurately approximate consumer behavior. The estimates themselves suggested that changes in the real interest rate impacted consumer expenditures for durables significantly. As Mankiw pointed out, this was indeed in line with causal observation. What is particularly striking, however, are the results for the short-run interest semi-elasticities. That is, a one percent increase in the real interest rate led to a 0.5% reduction in the consumption of nondurables. When it came to durable goods, however, a one

percent increase in the real interest rate reduced consumption by nearly 13.6% in a year (Mankiw, 1985).

Heim's (2009) analysis examined various determinants of consumer demand for durable goods, nondurable goods, and services in the United States for the forty-year period between 1960 and 2000. Data was gathered from the 2002 Economic Report of the President and two separate macroeconomic demand functions were constructed, one for durable and nondurable goods and one for services. The function for durable and nondurable goods used consumer spending as the dependent variable and disposable income, the government budget deficit/surplus, the Dow Jones Composite Stock Index (to measure changes in consumer wealth), the prime interest rate multiplied by the size of the GDP two years prior, and the average exchange rate for the current and past three years as explanatory variables. In addition, Heim included other independent variables as well: population growth, the demand for new housing, and the relative cost of housing in relation to income (housing prices divided by income). The ordinary least squares method was used and stepwise regression was employed in order to identify which of the explanatory variables accounted for the most variation in consumption.

Heim found that disposable income explained the largest amount of variation in consumption for durable goods, followed by crowd out (measured by the government deficit) and exchange rate. When it came to nondurable goods, Heim's findings were similar. That is, disposable income accounted for the largest amount of variation in consumer spending, followed by crowd out (Heim, 2009).

2.8 An Investigation of Forecasting the Demand for Air Traffic and Tourism

While not directly related to our thesis topic, we found various sources giving attention to the forecasting of demand for air traffic and tourism. Our primary concern with these sources involved ensuring that we documented and understood the various forecasting methodologies employed by the authors. At the same time, we took care to note the explanatory variables included in the employed models. Doing this proved to be extremely valuable—as our list of explanatory variables and methodologies were derived from the findings of our literature review.

Profillidis (2000) utilized econometric as well as fuzzy methods in order to forecast the demand for the airport in the Greek island of Rhodes. In the past, air traffic forecasting was accomplished through trend projections, employing market surveys, or constructing econometric models. However, by the late 1990s, fuzzy linear or non-linear regression models became commonplace (Profillidis, 2000).

Fuzzy regression analysis differs from traditional regression analysis in several ways. First, the model itself is possibilistic rather than probabilistic. In addition, fuzzy regression models assume that the differences between the observed and estimated values form an ambiguity derived directly from the structure of the system itself (Profillidis, 2000). Interestingly, according to Profillidis, the ambiguity of the relationship appears to be returned to the system's coefficients, and given this, an accurate relationship can be constructed as it is manifested directly into the model through the fuzzy coefficients.

Based on various income elasticity studies conducted in the past, Profillidis pointed out the commonly held belief at the time that air traffic demand closely mirrored GDP. He also noted a sizeable increase in the demand for air travel, spurred not only by business travel, but from an increase in tourism, with the latter resulting from lower transportation costs and

consumers possessing more time and higher levels of income. Furthermore, he stated that there is evidence suggesting that tourism's evolution is closely tied to economic activity (Profillidis, 2000).

Profillidis championed the use of econometrics because, according to him, the model itself would realize any casual or explanatory relationship between demand and the independent variable(s). He constructed his model using the annual number of international passengers at the airport as the dependent variable and the exchange rate of the Greek currency (in relation to the currencies of the passengers' country of origin) as the independent variable. A fuzzy regression model was also built using the same variables. However, an additional explanatory variable, a dummy variable (0 or 1 for the year 1991), was included in the model due to the effect that the Persian Gulf War had on traffic demand at the Island's airport. The dummy variable was added to the model because the limits of fuzzy models are contingent upon unpredictable events that affect demand (Profillidis, 2000). In this case, the Persian Gulf War in 1991 represented such an event. Profillidis concluded that his models were able to predict airport demand satisfactorily, although he acknowledged the difficulty in being able to fully predict human behavior.

Whereas Profillidis assessed airport demand, Song, Witt, and Li (2003) performed a study aimed at forecasting the demand for tourism in Thailand based upon various countries of origin. The authors noted glaring problems related to the theoretical soundness of models used in past research with respect to the topic (namely prior to the 1990s). Indeed, the vast majority of research conducted on the topic during this period utilized regression analysis, consisting of a single log-linear equation. Economic theory was also employed in order to determine the proper variables to include (Song et al., 2003).

The authors proposed the use of a model that began with a general autoregressive distributed lag model (ADLM) using tourism demand (in tourism arrivals) as the dependent variable and income (GDP in 1995), the relative tourism price, the substitute tourism price, trade volume, and various dummy variables as the independent variables. The dummy variables were employed in order to account for various events that may have impacted tourism demand in Thailand. Examples included the two oil crises in 1974 and 1979, the Asian financial crisis in 1997 and 1998, and the Olympic Games in Seoul in 1988.

Song et al. noted that, while like past research, the ADLM also draws on economic theory for variable selection, the number of variables in an ADLM will typically be large. Beyond just a general model, several specific models were derived from the general ADLM through restricting its parameters. According to the authors, one of the biggest advantages in using this approach was that error correction could be incorporated rather easily and could be modeled using the Wickens-Breusch approach or the Johansen maximum likelihood method (Song et al., 2003).

Error correction in the context of tourism demand was based on the assumption that tourists are rational actors and in the long run, make decisions based on all available information at a certain period in time. However, in the short run, because of asymmetries in information, tourists make sporadic errors in their purchases. As these errors are made, the long-run equilibrium for tourism demand is disrupted. Being rational actors, tourists quickly realize their errors and correct their purchasing behavior, restoring the long-run demand equilibrium (Song et al., 2003).

Song et al. evaluated the performance of each of the specific models by carrying out various analytical tests including several different chi-square tests, Chow's test for predictive

failure, and Ramsey's RESET test for mis-specification. This method also enabled them to determine which of the models would be utilized for forecasting tourism demand itself— which was conducted through a multivariate regression model. Prior to forecasting tourism demand, however, individual forecasts for several independent variables were carried out using the Holt-Winter exponential smoothing technique, with autoregressive integrated moving average (ARIMA) models used as benchmarks to evaluate the forecasting performance of each respective econometric model (Song et al., 2003).

The authors found that income and the price variables had significant explanatory power in several of the origin countries in the study. Trade volume was found to be significant for only two of the countries, and the one-off events represented through the various dummy variables were found to have differing effects from origin to origin. The ARIMA model produced the most reserved forecasts while the forecasts generated from the Johansen maximum likelihood ECM were the most optimistic (Song et al., 2003).

2.9 Forecasting in Emerging/Volatile Markets

Given that our thesis deals with constructing models to forecast demand in developing countries, we felt it necessary to explore the literature relating to forecasting in emerging/volatile markets in order to better understand what techniques and methodologies have been employed in such environments.

Naik (2004) explored developing a forecasting methodology specifically for developing markets, championing a hybrid method that incorporated both qualitative and quantitative data. He tested his structural qualitative method (SQM) in an Indian seed manufacturer, using it to forecast sorghum seed sales. Prior to the implementation of the SQM, the Indian firm had been

using a growth rate model to forecast. While many organizations doing business in developing markets adopt growth rate models as their forecasting methodologies, such models are only useful up to the point where the economy begins to mature. Moreover, many organizations rarely have enough data on hand to use time series or casual models (Naik, 2004).

Naik's SQM utilized a causal structural model with two procedures. First, an industry-level forecast was generated and the various factors that influence sales were identified, with the factors themselves being broken into two tiers. The first tier included factors such as purchase frequency and purchase volume. The second tier, on the other hand, included factors such as price levels and economic conditions. Weights were applied to the second tier factors to qualitatively measure their ability to impact the forecasted variable. The latter part of the procedure involved generating a company-level forecast using the industry-level forecast along with a forecast of the company's market share. The firm's market share forecast was derived in the same manner that the company-level forecast was. According to Naik, the advantages of the SQM were that it could produce disaggregate-level forecasts with information readily available to the firm. While the methodology was intended to be utilized in developing markets, Naik argued its usefulness in developed economies as well (Naik, 2004).

Veral (2009) sought to develop a forecasting methodology in developing economies. He argued that given the uncertainty and volatility of such environments, using econometric modeling or time series methods alone is not viable for forecasting demand of consumer durables. As such, his paper explored combining the two aforementioned methods as a means of predicting monthly automobile sales in Turkey. Veral first established aggregate quarterly base-level sales forecasts via an econometric model. The base-level forecasts were then updated on a monthly basis using a two-step time series approach as automobile sales data became available—

with the first occurring at the end of months one and two for each respective quarter, and the other taking place at the end of each quarter itself. A proprietary simulation tool coded in C++ was used to implement the updating procedure and to test the integrated models' accuracy. Based on the output of the simulation, Veral concluded that the integrated forecasting model was far more accurate than either of the two forecasting methods—macroeconomic or time series—when employed alone.

3 Methods

In order to understand the relationship between the various macroeconomic indicators and consumer demand, we constructed econometric models using stepwise multiple linear regression analysis. A total of 27 models (three countries by three product segments by three sets of data) were developed using a combination of Minitab 15 (a statistical analysis program) and Microsoft Excel. For privacy reasons, the names of the countries and product segments in this study have been disguised. As such, they will be referred to as Countries A, B, and C and product segments 1, 2, and 3 for the remainder of this thesis.

3.1 Data Collection

Data for the explanatory variables was mined from the IHS Global Insight database, which provides financial and economic data as well as forecasting and market intelligence information for 204 countries. Monthly data was collected on the following macroeconomic indicators for each of the three respective countries spanning the time periods of July 2007 to November 2011:

1) Oil prices (spot market price per barrel in U.S. dollars)
2) Exchange rate (national currency unit per U.S. dollar)
3) Stock index (average monthly return of local country's stock exchange)
4) Interest rate (lending rate as an annual percentage)
5) Consumer price index
6) Consumer confidence indicator

The variables on the previous page were chosen based upon recommendations from our sponsor and data availability. We also took care to select variables that aligned with those used in past research, discovered through our literature review. With respect to data availability, it is worth pointing out that we did indeed consider other macroeconomic variables including GDP and unemployment rate. Unfortunately, monthly data was not available for the two aforementioned indicators for the countries in our study. It is also important to note that we were only able to obtain data for the consumer confidence indicator for a single country—Country A.

We used three different sets of data obtained from CPGCo as our dependent variables. The first set of data contained the firm's wholesale shipment volume to distributors for each respective country and spanned the time periods of July 2007 to November 2011 for Country A and July 2008 to November 2011 for Countries B and C. The other two sets of data were compiled by an independent, outside agency and contained both the firm's retail market share by volume as well as the firm's retail sales in thousands of U.S. dollars. Both the shipment volume and the retail market share by volume data were measured according to CPGCo's own standard units—thousands of stat units (MSU)—and spanned from July 2007 to November 2011 for all three countries.

3.2 Data Decomposition

Economic variables are typically heavily influenced by seasonal factors. Consider the seasonality of the unemployment rate in the United States, for example. Following the Christmas holiday, we see a rise in the unemployment rate as temporary holiday help is no longer needed by retailers. When dealing with shipment data, there are also certain months or periods of the year where shipments fluctuate based upon holidays, season of the year, etc.

Given such phenomena, it is important to remove the seasonal effect so that we are able to study the variable's behavior that can be attributed to economic forces (Stewart, 2005).

All data for both the dependent and independent variables was graphed using Microsoft Excel to examine any trends or seasonality. Afterwards, the data for each variable was decomposed using Minitab's time series decomposition feature. The data itself was assumed to possess a multiplicative seasonal component as presented in the model below, where Y_t is the observation at time t:

$$Y_t = \text{Trend} \bullet \text{Seasonal Factor} \bullet \text{Error} \qquad \text{(Equation 3-1)}$$

The seasonality was removed from the data by dividing each observation by its respective seasonal factor. Because the data was in monthly buckets, each variable possessed a total of 12 seasonal factors.

3.3 Independent Variable Lag Determination

CPGCo cannot respond immediately to market changes derived from fluctuations in the various macroeconomic indicators. That is, the firm requires a certain window of time to make the appropriate changes to its production plan so that it can respond to changes in demand. Moreover, very few macroeconomic indicators are published or are readily available more frequently than once per month. Intuition also tells us that changes in macroeconomic factors generally do not have an immediate effect on consumer demand. Indeed, typically the changes are not realized by the consumer until several periods after the initial event takes place.

Given these realities, we consulted with CPGCo and agreed that the independent variables would have to possess a minimum time lag of two months and a maximum of four months. Our methodology for choosing the appropriate time lag to use for each independent variable involved running regression analysis against its respective dependent variable. A total of three regressions were completed for each independent variable—starting with a lag of two months and ending with a lag of four months. The regression output yielding the highest R-squared value was chosen as the appropriate time lag to use for the respective variable.

3.4 Stepwise Multiple Linear Regression

As was previously mentioned, stepwise multiple linear regression analysis was used to model the relationship between the dependent variable (Y) and the various macroeconomic independent variables ($x_1, \ldots, x_p$). The 27 constructed econometric models took the following form:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \varepsilon, \qquad \text{(Equation 3-2)}$$

where the error term or "noise", ε, is assumed to be an independent Normally distributed random variable with a mean $\mu = 0$ and a standard deviation σ.

The value of β_0 represents the intercept of the regression line and is the value of Y when $x_1 = 0, x_2 = 0, \ldots, x_p = 0$. The values of $\beta_1, \beta_2, \ldots, \beta_p$, however, represent the amount of change in Y based upon the per unit change of each of the independent variables $x_1, x_2, \ldots, x_p$.

Given this, we are able to conclude the following:

$$E(Y \mid x_1, x_2, \ldots, x_p) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p \qquad \text{(Equation 3-3)}$$

and

$$\text{Standard Deviation}(Y \mid x_1, x_2, \ldots, x_p) = \sigma \qquad \text{(Equation 3-4)}$$

Regression analysis itself estimates the values of $\beta_0, \beta_1, \ldots, \beta_p$ from Equation 3-2, which are then used to estimate the value of the dependent variable, Y (we denote the predicted values of $\beta_0, \beta_1, \ldots, \beta_p$ as $b_0, b_1, \ldots, b_p$ and the predicted variable of Y as $\hat{Y}$). Using the ordinary least squares (OLS) method, the goal is to select values for $b_0, b_1, b_2 \ldots, b_p$ so that the residuals' sum of squares is minimized, where a residual represents the difference between the dependent variable's observed value and predicted value. The regression line that selects $b_0, b_1, b_2, \ldots, b_p$ to minimize the residual sum of squares is the line of "best" fit. The equation is depicted below:

$$\sum_{i=1}^{n} (e_i)^2 = \sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2 = \sum_{i=1}^{n} (Y_i - b_0 - b_1 x_{1i} - \ldots - b_p x_{pi})^2$$

(Equation 3-5)

To construct our models, we employed Minitab's stepwise regression function using forward selection with an alpha value of five percent. Under this method, Minitab added explanatory variables one at a time based upon the alpha value. In other words, a variable was added to the model if its p-value was less than 0.05. The program began with the independent variable that was most correlated with the dependent variable, adding additional variables only if

the adjusted R-squared value (the R-squared value adjusted for the number of explanatory variables in the model) increased after the addition.

Using this method ensured that the adjusted R-squared value was optimized and that only statistically significant variables (those with p-values less than 0.05) were included in the models. Unfortunately, Minitab's stepwise regression function was not capable of accounting for multicollinearity (correlation amongst explanatory variables) as additional variables were added.

Multicollinearity itself is problematic because it is difficult to discern the individual effects of highly correlated explanatory variables (Murray, 2006). Typically, the vast majority of economic indicators are highly correlated with one another and tend to move in the same direction. Given this, following the addition of each additional variable in the stepwise regression process, we tested for multicollinearity using Excel's correlation function. A correlation value higher than 0.70 or lower than -0.70 led us to suspect high correlation amongst the variables. In this instance, the variable causing the problem was removed from the analysis and the stepwise regression was run again.

4 Data Analysis and Results

The methodologies outlined in the previous chapter were used to construct the various macroeconomic models for each of the three Asian countries and the three different product segments. This chapter is divided by country of study and presents a step-by-step analysis regarding the construction of each respective model and provides a discussion of the results.

4.1 Seasonal Adjustment

Given that our data was not seasonally adjusted, our first step involved data decomposition through Minitab's data decomposition feature. The seasonal factors for each of the dependent and independent variables for the three countries are available in Appendix A.

4.2 Independent Variable Lag Determination

In order to determine the appropriate lag values to use (2 months – 4 months) for the macroeconomic independent variables, we regressed each of them against each one of the dependent variables for all three product segments. This approach provided us with a separate R-squared value for each of the lag periods in question for each of the independent variables. The regression analysis producing the highest R-squared value for each independent variable was chosen as the appropriate lag. The detailed results for each country are available Appendix B.

Table 4-1 below shows the average lag value for each of the macroeconomic indicators. The table itself is organized by the country of analysis and the dependent variable used.

TABLE 4-1 AVERAGE MACROECONOMIC INDICATOR LAG VALUES BY COUNTRY AND DEPENDENT VARIABLE

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Country A Shipment Volume	2.67	2.00	3.00	2.67	4.00	2.33
Country A Market Share by Volume	2.67	2.67	2.67	2.67	3.33	2.67
Country A Retail Sales	2.00	2.67	2.67	2.33	3.33	2.67
Country A Total	2.44	2.44	2.78	2.56	3.56	2.56

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Country B Shipment Volume	3.33	4.00		3.33	4.00	2.00
Country B Market Share by Volume	2.33	4.00		4.00	4.00	2.00
Country B Retail Sales	2.00	4.00		3.33	4.00	2.00
Country B Total	2.56	4.00		3.56	4.00	2.00

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Country C Shipment Volume	3.00	3.00		2.67	2.33	3.33
Country C Market Share by Volume	2.33	3.00		4.00	3.00	2.33
Country C Retail Sales	2.67	3.00		4.00	2.67	2.67
Country C Total	2.67	3.00		3.56	2.67	2.78

From the table, we see that the consumers in Country A appear to react the quickest to changes in the exchange rate, followed by those in Country B and Country C. The same is true for the average stock index indicator. That is, consumers in Country A, on average, react 2.44 months after the change takes place. Consumers in Country C, however, react—on average—after 3 months, followed by consumers in Country B at 4 months.

When it comes to changes in the consumer price index, consumers in Country A appear to react the quickest with an average reaction time of 2.56 months. Overall, however, consumers in Country B and Country C appear to be much slower to react, taking an entire additional month to change their behavior.

With respect to the consumer confidence indicator, we see that the consumers in Country A average a 2.78 month reaction time. Unfortunately, we cannot compare this result against the other two countries as data on this particular indicator was not available for them. From Table 4-1, we see that consumers in Country C react the quickest to changes in the interest rate at an

average of 2.67 months. Consumers in Country A are the next quickest, reacting after 3.56 months. Consumers in Country B are the slowest to react to the interest rate, with an average reaction time of 4 months.

Finally, we compare the average reaction times of consumers for the oil price indicator. From Table 4-1 we see that consumers in Country B react the quickest with an average reaction time of 2 months. Consumers in Country A have the next quickest average reaction time at 2.56 months, followed by Country C at 2.78 months.

4.3 Country A Model Construction (Shipment Volume)

As discussed in Chapter 3, stepwise multiple linear regression analysis was used to construct our models. To do this, we utilized Minitab's stepwise regression function and employed forward selection with an alpha value of five percent. Following the addition of each variable to each of the models, we tested for multicollinearity in Microsoft Excel using cutoff values of 0.70 and -0.70. If a high correlation was discovered, the variable causing the problem was removed from the model and the stepwise regression analysis was completed again.

As can be seen in Tables 4-2 and 4-3 below, the models for product segments 1 and 2 both consist of a single independent variable.

TABLE 4-2 COUNTRY A, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8353	0.8319	NA	0.00	NA	NA	NA	NA

TABLE 4-3 COUNTRY A, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Confidence Indicator	0.1365	0.1182	NA	0.01	NA	NA	NA	NA

From Table 4-2, we see that the consumer price index accounts for 83.19% of the total variation in CPGCo's shipments. The results from product segment 2's model tell a different story, however. As Table 4-3 indicates, the model has a significantly lower adjusted R-squared value, with the consumer confidence indicator only able to account for 11.82% of the variation in shipment volume. This result is not totally unexpected, however. Indeed, demand for products in this particular segment—especially in Country A—has historically been extremely volatile and is highly sensitive to a plethora of external factors beyond macroeconomic indicators. Given this particular model's extremely low adjusted R-squared value, it is clear that it possesses very little explanatory power, and we would not recommend its use as a forecasting tool.

Table 4-4 below depicts the construction for product segment 3's model. Whereas the final models for product segments 1 and 2 each consist of a single independent variable, product segment 3's model consists of three independent variables: the consumer price index, the interest rate, and the average stock index. In this instance, the consumer price index accounts for the largest amount of variation in CPGCo's wholesale shipments at 77.9%. When the interest rate is added to the model the adjusted R-squared value increases by 6.87%. The average stock index is added on top of the consumer price index and interest rate, increasing the adjusted R-squared by an additional 1.27%. In its final form, the model for product segment 3 accounts for 86.03% of the total variation in CPGCo's shipments.

TABLE 4-4 COUNTRY A, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.7834	0.7790	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.8540	0.8477	0.0687	0.00	0.00	NA	NA	NO
Consumer Price Index + Interest Rate + Exchange Rate	0.8753	0.8669	0.0193	0.00	0.00	0.01	NA	YES
Consumer Price Index + Interest Rate + Consumer Confidence Indicator	0.8737	0.8653	0.0176	0.00	0.00	0.01	NA	YES
Consumer Price Index + Interest Rate + Average Stock Index	0.8690	0.8603	0.0127	0.00	0.00	0.03	NA	NO

Having discussed the construction of the macroeconomic models, we are now interested in identifying the explanatory variables that CPGCo should monitor closely if we are to make generalizations regarding the macroeconomic variables that impact shipment volume the greatest. That is, by looking across the models created for each of the three product segments using the shipment volume data, we want to identify the indicators that show up in multiple models. As Table 4-5 below indicates, the consumer price index shows up in two of the three models (67% of the time). The average stock index, the consumer confidence indicator, and the interest rate all show up once (33% of the time). Given these results, it appears that the consumer price index is the macroeconomic indicator that impacts shipment volume in Country A the most. However, it is also important to consider the amount of variation in the firm's shipment volume that is explained by each of the respective macroeconomic indicators. With this in mind, we recommend that CPGCo monitors changes in the price index the closest. That said, it is also important to note that, while the consumer confidence indicator is the sole indicator for product segment's 2 model—and because of this, we would typically recommend that it be monitored—the amount of variation explained by the indicator itself is so small that, in our opinion, it is not worthwhile to watch closely.

TABLE 4-5 COUNTRY A MACROECONOMIC INDICATOR FREQUENCY MATRIX (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				■		
Product Segment 2			■			
Product Segment 3		■		■	■	
	0%	33%	33%	67%	33%	0%

4.4 Country A Regression Results Analysis (Shipment Volume)

While the previous section described the construction of the various macroeconomic models using the shipment volume data for the three different product segments within Country A, our primary concern in this section is to analyze the regression coefficients and ensure that their signs make sense from an intuitive standpoint. Additionally, we will discuss the significance levels of the macroeconomic indicators. For those seeking more granular-level results, the regression equations and detailed outputs are available in Appendix C.

From Table 4-6 on the next page, we see that the consumer price index's coefficient for product segments 1 and 3 are both positive. This finding seems counterintuitive. Certainly, as the prices of goods increase, one would expect consumers to purchase less, especially i

n difficult and uncertain economic times. As such, we should expect a negative coefficient. However, we believe that consumers in Country A—especially in light of the difficult economic environment—are purchasing goods in large volumes to hedge against future price increases. This theory is also in line with Juster and Wachtel's (1972) hypothesis. That is, based on their findings, the two authors suggested that fully anticipated price increases (inflation) would lead consumers to increase expenditures on nondurable goods.

Table 4-6 reveals that the consumer confidence indicator in product segment 2's model is also positive. The sign of this coefficient appears to make intuitive sense. Typically, when the economic outlook is poor and consumer confidence is down, consumers save more and spend less. Conversely, as consumers feel more confident regarding the economy and its outlook, one expects expenditures and demand to increase. According to our results, this is exactly what appears to be taking place in Country A.

The coefficients for the remaining macroeconomic indicators included in product segment 3's model—the average stock index and interest rate—all appear to make sense. As the average stock index increases, consumer wealth increases. In other words, as the average stock index increases, consumers will have more disposable income in their possession, spurring an increase in demand. The interest rate, however, has the opposite effect. That is, as interest rates increase, consumer wealth diminishes.

TABLE 4-6 COUNTRY A REGRESSION COEFFICIENT SIGNS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				+		
Product Segment 2			+			
Product Segment 3		+		+	-	

Table 4-7 on the next page shows the significance levels from the regression results for the various macroeconomic indicators. As we see, the consumer price index variable for the models for product segments 1 and 3 are highly statistically significant with p-values less than 0.000. We also see that the interest rate variable for product segment 3's model is highly statistically significant with a p-value less than 0.000. The consumer confidence indicator for

product segment 1's model and the average stock index for product segment 3's model are both also statistically significant. Their significance levels, however, are not as high as those of the consumer price index and interest rate variables.

TABLE 4-7 COUNTRY A INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				0.000		
Product Segment 2			0.009			
Product Segment 3		0.028		0.000	0.000	

4.5 Country A Model Construction (Retail Market Share by Volume)

From Table 4-8 below, we see that the final model for product segment 1 consists of four macroeconomic explanatory variables: the consumer price index, the interest rate, the oil price, and the average stock index.

TABLE 4-8 COUNTRY A, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.9554	0.9545	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.9700	0.9687	0.0142	0.00	0.00	NA	NA	NO
Consumer Price Index + Interest Rate + Consumer Confidence Indicator	0.9778	0.9763	0.0076	0.00	0.00	0.00	NA	YES
Consumer Price Index + Interest Rate + Oil Price	0.9725	0.9706	0.0020	0.00	0.02	0.05	NA	NO
Consumer Price Index + Interest Rate + Oil Price + Exchange Rate	0.9782	0.9762	0.0055	0.00	0.00	0.00	0.00	YES
Consumer Price Index + Interest Rate + Oil Price + Average Stock Index	0.9755	0.9733	0.0027	0.00	0.04	0.00	0.02	NO

The consumer price index alone explains 95.45% of the total variation in CPGCo's retail market share by volume. The interest rate, oil price, and average stock index have incremental

effects on the adjusted R-squared value of 1.42%, 0.20%, and 0.27% respectively. As we see, the model for product segment 1 turns out to be excellent and explains 97.33% of the total variation in CPGCo's retail market share by volume.

Due to multicollinearity, the model for product segment 2 consists of two explanatory variables, the consumer confidence indicator and the consumer price index. From Table 4-9 below, we see that the consumer confidence indicator alone accounts for 48.25% of the total variation in CPGCo's retail market share by volume. By adding the consumer price index to the model, we are able to increase the adjusted R-squared value by an additional 10.69%. In its final form, this particular model is only able to explain 58.94% of the total variation in the firm's retail market share for product segment 2. This result is expected, however, given the previously discussed volatility and sensitivity associated with demand for the products in this segment.

TABLE 4-9 COUNTRY A, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Confidence Indicator	0.4933	0.4825	NA	0.00	NA	NA	NA	NA
Consumer Confidence Indicator + Consumer Price Index	0.6065	0.5894	0.1069	0.00	0.00	NA	NA	NO
Consumer Confidence Indicator + Consumer Price Index + Interest Rate	0.6503	0.6270	0.0376	0.00	0.00	0.02	NA	YES
Consumer Confidence Indicator + Consumer Price Index + Exchange Rate	0.6481	0.6247	0.0353	0.00	0.00	0.03	NA	YES
Consumer Confidence Indicator + Consumer Price Index + Average Stock Index	0.6446	0.6209	0.0316	0.00	0.00	0.03	NA	YES

As Table 4-10 on the following page shows, the final model for product segment 3 consists of three explanatory variables: the consumer price index, the interest rate, and the average stock index. Our findings indicate that product segment 3's model has considerable explanatory power as it is able to explain 95.05% of the total variation in CPGCo's market share. As the table points out, the consumer price index accounts for 86.80% of the total variation in the

firm's retail market share by volume while the interest rate and the average stock index indicators increase the model's adjusted R-squared value by 6.86% and 1.39% respectively.

TABLE 4-10 COUNTRY A, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8707	0.8680	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.9392	0.9366	0.0686	0.00	0.00	NA	NA	NO
Consumer Price Index + Interest Rate + Average Stock Index	0.9536	0.9505	0.0139	0.00	0.00	0.00	NA	NO

From Table 4-11 below, we see that the consumer price index appears in all three of the models (100% of the time). We also see that the average stock index and the interest rate both appear in two of the three models (67% of the time). The consumer confidence indicator and oil price appear the least at 33% of the time. Given these results, if we were to generalize about the macroeconomic indicators that impact CPGCo's retail market share by volume the most, we would advise the firm to monitor the consumer price index, the average stock index, and the interest rate the closest. However, once we take into consideration the amount of variation explained by each of the indicators, we recommend that the firm pay the most attention to the consumer price index for product segments 1, 2, and 3 as well as the consumer confidence indicator for product segment 2.

TABLE 4-11 COUNTRY A MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1						
Product Segment 2						
Product Segment 3						
	0%	67%	33%	100%	67%	33%

4.6 Country A Regression Results Analysis (Retail Market Share by Volume)

As Table 4-12 on the next page points out, the coefficients for the average stock index are positive in the models for product segments 1 and 3. This result mirrors our findings from the shipment volume analysis. That is, as the average stock index increases, consumer wealth increases. The positive coefficients for the consumer price index in the models for product segments 1, 2, and 3 are also in line with our previous findings. Again, we hypothesize that consumers in Country A purchase in large volumes as a hedge against future price increases.

We also find that the sign of the coefficient for the consumer confidence indicator for product segment 2 mirrors our finding from the shipment volume analysis. As consumer confidence rises, we expect consumers to increase their spending and, as a result, expect to see an increase in demand. With respect to the interest rate indicator, we see that the signs of the coefficients for product segments 1 and 3 again align with our findings from the shipment volume analysis. As interest rates increase, consumer wealth diminishes.

Finally, we consider the negative coefficient for the oil price in product segment 1's model. This seems to make intuitive sense. Indeed, as the price of oil increases, the price of gasoline increases as well. The increase in gasoline prices cause consumers to spend less and save more. This aligns with the findings of Ma et al.'s (2011) study, where it was concluded that

an increase in gasoline prices cause consumers to shop less frequently and purchase smaller volumes of nondurable goods.

TABLE 4-12 COUNTRY A REGRESSION COEFFICIENT SIGNS (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		+		+	-	-
Product Segment 2			+	+		
Product Segment 3		+		+	-	

From Table 4-13 below, we see that the consumer price index for product segments 1 and 3, the interest rate for product segment 3, and the consumer confidence indicator for product segment 2 are all extremely statistically significant with p-values less than 0.000. The consumer price index for product segment 2 and the average stock index for product segment 3 are also highly statistically significant with p-values of 0.001. From the table, we see that product segment 1 appears to contain the macroeconomic indicators with the least statistical significance. Indeed, we see that the average stock index, the interest rate, and the oil price have p-values of 0.024, 0.040, and 0.004 respectively. That said, it is again important to reiterate that the aforementioned variables are still statistically significant using an alpha value of five percent. They are simply not as significant as the indicators in the models for the other product segments.

TABLE 4-13 COUNTRY A INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		0.024		0.000	0.040	0.004
Product Segment 2			0.000	0.001		
Product Segment 3		0.001		0.000	0.000	

4.7 Country A Model Construction (Retail Sales)

From Table 4-14, we see that the final model for product segment 1 consists of three explanatory variables: the consumer price index, oil price, and the consumer confidence indicator. The consumer price index alone accounts for 95.18% of the total variation in CPGCo's retail sales. Adding the oil price to the model increases the adjusted R-squared value by 2.13%. While the value is small, the consumer confidence indicator also adds to the adjusted R-squared value, increasing it by 0.40% to 97.71%. In its final form, the model for product segment 1 accounts for 97.71% of the total variation in CPGCo's retail sales.

TABLE 4-14 COUNTRY A, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.9528	0.9518	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Oil Price	0.9742	0.9731	0.0213	0.00	0.00	NA	NA	NO
Consumer Price Index + Oil Price + Consumer Confidence Indicator	0.9785	0.9771	0.0040	0.00	0.00	0.00	NA	NO
Consumer Price Index + Oil Price + Consumer Confidence Indicator + Interest Rate	0.9861	0.9849	0.0077	0.00	0.00	0.00	0.00	YES

Table 4-15 below displays the model for product segment 2. The model consists of a single explanatory variable—the oil price—and has a relatively low adjusted R-square value of 33.98%. This indicates that the model is only able to account for 33.98% of the total variation in

CPGCo's retail sales. However, as was the case with the shipment volume and market share models for this particular product segment, the lower explanatory power is expected, especially in light of the nature of the product segment itself.

TABLE 4-15 COUNTRY A, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Oil Price	0.3536	0.3398	NA	0.00	NA	NA	NA	NA

The model for product segment 3 includes three macroeconomic variables: the consumer price index, the interest rate, and the average stock index. From Table 4-16, we see that the consumer price index accounts for 86.70% of the total variation in CPGCo's retail sales for product segment 3. Adding the interest rate and the average stock index increases the adjusted R-squared value by an additional 5.76% and 3.22% respectively. Overall, the model is able to explain 95.69% of the total variation in CPGCo's retail sales for product segment 3, indicating extremely high explanatory power.

TABLE 4-16 COUNTRY A, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8697	0.8670	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.9278	0.9247	0.0576	0.00	0.00	NA	NA	NO
Consumer Price Index + Interest Rate + Average Stock Index	0.9596	0.9569	0.0322	0.00	0.00	0.00	NA	NO

As Table 4-17 below shows, the consumer price index and the oil price appear in two of the three retail sales models (67% of the time). All of the other macroeconomic indicators—the average stock index, the consumer confidence indicator, and the interest rate—appear only once (33% of time). Given this, and taking the amount of variation explained by each of the macroeconomic indicators into account, it appears that CPGCo should pay the most attention to changes in the consumer price index for product segments 1 and 3 and the oil price indicator for product segment 2 (especially because it is the sole indicator in the model). While both of the aforementioned indicators appear in two of the three models, the amount of variation the oil price accounts for in product segment 1's model is relatively small. We notice that the price index, on the other hand, explains the greatest amount of variation in CPGCo's retail sales for the models in the two segments it appears in.

TABLE 4-17 COUNTRY A MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL SALES)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1						
Product Segment 2						
Product Segment 3						
	0%	33%	33%	67%	33%	67%

4.8 Country A Regression Results Analysis (Retail Sales)

As Table 4-18 on the next page indicates, the coefficients for the average stock index, the consumer confidence indicator, and the consumer price index are all positive. The positive signs all make intuitive sense and agree with the findings from our other models for Country A. The same is true regarding the negative coefficients for the oil price indicator for product segment 1

and the interest rate for product segment 3. Again, an increase in the interest rate or a rise in oil price diminishes consumer wealth. As the price of oil increases, we expect the price of gasoline to increase as well. The increase in price, according to Ma et al. (2011), causes consumers to purchase in smaller volumes and shop less frequently.

For product segment 2, the oil price has a positive coefficient. We do not necessarily have a definitive explanation for this finding, especially in light of the negative coefficient for the oil price indicator for product segment 1. That said, we suspect that this finding has something to do with the nature of product segment 2 itself. As we've described, it has historically been extremely volatile and has been influenced by many factors beyond macroeconomic indicators—as evidenced by our relatively low adjusted R-squared values.

TABLE 4-18 COUNTRY A REGRESSION COEFFICIENT SIGNS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1			+	+		-
Product Segment 2						+
Product Segment 3		+		+	-	

From Table 4-19 below, we see that all of the indicators—with the exception of the consumer confidence indicator for product segment 1's model—are highly statistically significant with p-values less than 0.000. The p-value for the consumer confidence indicator, however, is slightly higher at 0.003. Nonetheless, it is still highly statistically significant using an alpha value of five percent.

TABLE 4-19 COUNTRY A INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1			0.003	0.000		0.000
Product Segment 2						0.000
Product Segment 3		0.000		0.000	0.000	

4.9 Country B Model Construction (Shipment Volume)

As Table 4-20 points out, due to mulitcollinearity, the model for product segment 1 consists of a single macroeconomic explanatory variable, the consumer price index. In its final form, the model accounts for 85.92% of the total variation in CPGCo's shipment volume for this particular product segment. The adjusted R-squared value is high enough to conclude that it possesses excellent explanatory power.

TABLE 4-20 COUNTRY B, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8630	0.8592	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Average Stock Index	0.8717	0.8641	0.0050	0.00	0.04	NA	NA	YES

We see from Table 4-21 on the following page that the model for product segment 2 contains two explanatory variables, the consumer price index and the exchange rate. In this instance, the consumer price index accounts for 89.34% of the total variation in CPGCo's shipment volume for product segment 2. When the exchange rate is added to the model, the

adjusted R-squared value increases by 1.08%. This brings the adjusted R-squared value for the final model to 90.22%.

Given the final model's relatively high adjusted R-squared value, it appears that macroeconomic factors impact CPGCo's shipment volume in Country B for product segment 2 significantly more than in Country A.

TABLE 4-21 COUNTRY B, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8964	0.8934	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Exchange Rate	0.9076	0.9022	0.0088	0.00	0.05	NA	NA	NO
Consumer Price Index + Exchange Rate + Average Stock Index	0.9203	0.9130	0.0108	0.00	0.00	0.03	NA	YES

Because of multicollinearity, the model for product segment 3—like that of product segment 1—consists of a single explanatory variable, the consumer price index. As Table 4-22 shows, this particular model accounts for 77.92% of the total variation in CPGCo's shipment volume for product segment 3. While the adjusted R-squared value is respectable, it is certainly not as high as those in the other two product segments. Indeed, it appears that this model only possesses moderate explanatory power.

TABLE 4-22 COUNTRY B, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.7851	0.7792	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Average Stock Index	0.8075	0.7962	0.0171	0.00	0.02	NA	NA	YES

It is quite evident from Table 4-23 below that the consumer price index is the most influential indicator of CPGCo's shipment volume. Indeed, it appears in all three of the models (100% of the time). At the same time, the price index explains the greatest amount of variation in the firm's shipment volume for all three product segments. We also do see that the exchange rate is somewhat influential, appearing in the model for product segment 2 (33% of the time). However, the amount of variation the indicator itself explains is extremely small. Given these results, it is clear that CPGCo should monitor the consumer price index the closest.

TABLE 4-23 COUNTRY B MACROECONOMIC INDICATOR FREQUENCY MATRIX (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1						
Product Segment 2						
Product Segment 3						
	33%	0%	0%	100%	0%	0%

4.10 Country B Regression Results Analysis (Shipment Volume)

Again, our primary concern in this section is to evaluate the signs of the regression coefficients and ensure that they make intuitive sense. We will also briefly discuss the significance levels of the various macroeconomic indicators. For those seeking the full regression outputs and/or equations for each of Country B's models, they are available in Appendix C.

From Table 4-24 on the next page, we notice that the signs for the consumer price index coefficients are positive for all three models. This mirrors our findings for the consumer price index in Country A. As such, we hypothesize that the same phenomenon is occurring in Country

B. That is, we suspect that consumers are purchasing goods in large volumes as a means of hedging against expected future price increases. Recall that this also agrees with Juster and Wachtel's (1972) assertion of fully anticipated inflation yielding an increase in nondurable expenditures.

We also see that the coefficient for the exchange rate for product segment 2's model is negative. Logically, this makes sense. Indeed, as the exchange rate increases, consumer wealth decreases. In other words, an increase in the exchange rate means that a greater amount of a particular country's currency is required to obtain one U.S. dollar.

TABLE 4-24 COUNTRY B REGRESSION COEFFICIENT SIGNS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				+		
Product Segment 2	-			+		
Product Segment 3				+		

As we see from Table 4-25 on the following page, the statistical significance for the consumer price index for all three product segments is extremely high. As the table shows, the p-values for all three models are less than 0.000. While still statistically significant using an alpha value of five percent, we see that the p-value for the exchange rate for product segment 2 is much higher than the p-values for the consumer price index at 0.050—indicating a lower level of statistical significance.

TABLE 4-25 COUNTRY B INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				0.000		
Product Segment 2	0.050			0.000		
Product Segment 3				0.000		

4.11 Country B Model Construction (Retail Market Share by Volume)

Table 4-26 below shows the construction of the model for product segment 1 using the market share data. As a result of multicollinearity, this particular model consists of a single macroeconomic explanatory variable, the consumer price index. In this instance, we see that the price index itself accounts for 94.99% of the total variation in CPGCo's retail market share by volume for product segment 1. Given the high adjusted R-squared value, this model appears to have substantial explanatory power.

TABLE 4-26 COUNTRY B, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.9509	0.9499	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.9568	0.9549	0.0050	0.00	0.02	NA	NA	YES

As Table 4-27 below points out, the model construction for product segment 2 is somewhat complex. Minitab initially produced a model consisting of the interest rate, the average stock index, and the consumer price index. However, because of multicollinearity, the

interest rate was removed from the model. When the stepwise regression analysis was run again, Minitab produced a new model consisting of the consumer price index and the exchange rate.

As Table 4-27 shows, the consumer price index alone accounts for 62.66% of the total variation in CPGCo's retail market share by volume for product segment 2. We are able to increase the adjusted R-squared value by 27.46% by adding he exchange rate. In its final form, the model is able to explain 90.13% of the total variation in the firm's market share by volume for product segment 2.

TABLE 4-27 COUNTRY B, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Variable 5 P-value	Multicollinearity
Interest Rate	0.6694	0.6624	NA	0.00	NA	NA	NA	NA	NA
Interest Rate + Average Stock Index	0.8385	0.8315	0.1691	0.00	0.00	NA	NA	NA	NO
Interest Rate + Average Stock Index + Consumer Price Index	0.8782	0.8701	0.0386	0.01	0.00	0.00	NA	NA	YES
Consumer Price Index	0.6344	0.6266	NA	0.00	NA	NA	NA	NA	NA
Consumer Price Index + Exchange Rate	0.9054	0.9013	0.2746	0.00	0.00	NA	NA	NA	NO

Table 4-28 on the next page shows that model for product segment 3 consists of two explanatory variables, the consumer price index and the oil price. As we see, the price index and the oil price have incremental effects on the adjusted R-squared value of 81.82% and 3.43% respectively. Overall, this particular model has superb explanatory power—as evidenced through its relatively high adjusted R-squared value of 85.24%.

TABLE 4-28 COUNTRY B, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8219	0.8182	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Oil Price	0.8586	0.8524	0.0343	0.00	0.00	NA	NA	NO
Consumer Price Index + Oil Price + Average Stock Index	0.8744	0.8660	0.0136	0.00	0.00	0.02	NA	YES

It is clear from Table 4-29 below that the consumer price index has a heavy impact on CPGCo's retail market share by volume. Indeed, the aforementioned indicator appears in the models for all three product segments (100% of the time). The exchange rate also appears to affect the firm's market share, showing up in the model for product segment 2 (33% of the time). We also see that the oil price appears in product segment 3's model (33% of the time). The consumer price index indicator accounts for the greatest amount of variation in the firm's retail market share by volume for the models in all three product segments. We also recall that the exchange rate is able to explain a considerable amount of variation in the market share for product segment 2. In light of these results, we recommend that CPGCo monitors the consumer price index and the exchange rate the closest.

TABLE 4-29 COUNTRY B MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				■		
Product Segment 2	■			■		
Product Segment 3				■		■
	33%	0%	0%	100%	0%	33%

4.12 Country B Regression Results Analysis (Retail Market Share by Volume)

From Table 4-30, we see that the signs of the coefficients for the consumer price index are positive for the models for all three product segments. This finding aligns with our findings for Country B using the shipment volume data as well as with what we found for Country A. It appears that consumers in both countries are purchasing goods in large volumes as a means to hedge against expected future price increases.

As the table points out, the coefficient for the exchange rate in product segment 2's model is negative. The sign makes intuitive sense and mirrors our finding for Country B's shipment volume analysis. Again, as the exchange rate increases, consumers must exchange a higher amount of their respective currency to obtain one U.S. dollar. This diminishes wealth. Given this effect, we expect that an increase in the exchange rate decreases consumer demand.

Finally, we see that the coefficient for the oil price indicator for product segment 3's model is positive. This finding does not make logical sense and is opposite of the findings from Ma et al.'s (2011) study as well as our findings from Country A. However, we believe that the different findings between the two countries may be related to differences in consumer behavior. In other words, whereas the consumers in Country A appear to shop less frequently and purchase smaller volumes of goods as oil prices rise, we believe that consumers in Country B may be purchasing goods in larger volumes in anticipation of future oil price increases.

TABLE 4-30 COUNTRY B REGRESSION COEFFICIENT SIGNS (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				+		
Product Segment 2	-			+		
Product Segment 3				+		+

From Table 4-31 we see that the consumer price index is highly statistically significant for all three models. Indeed, the p-values for the consumer price index for all three product segments are less than 0.000. We also see that the exchange rate for product segment 2's model is highly statistically significant with a p-value less than 0.000. We notice that the oil price is not as statistically significant as the consumer price index or exchange rate indicators with a p-value of 0.001. However, this difference is extremely small.

TABLE 4-31 COUNTRY B INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				0.000		
Product Segment 2	0.000			0.000		
Product Segment 3				0.000		0.001

4.13 Country B Model Construction (Retail Sales)

Table 4-32 below shows the construction of product segment 1's model using the retail sales data. As we see, the final model consists of two macroeconomic explanatory variables, the consumer price index and the oil price. The price index itself accounts for 92.82% of the total variation in CPGCo's retail sales for product segment 1. When the oil price is added to the model the adjusted R-squared value increases by 1.38% to 94.20%. Given the high adjusted R-squared value, this model appears to possess significant explanatory power.

TABLE 4-32 COUNTRY B, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.9297	0.9282	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Oil Price	0.9444	0.9420	0.0138	0.00	0.00	NA	NA	NO
Consumer Price Index + Oil Price + Interest Rate	0.9503	0.9469	0.0049	0.00	0.01	0.03	NA	YES

As Table 4-33 indicates, the model for product segment 2 consists of three explanatory variables: the consumer price index, the oil price, and the exchange rate. Like product segment 1's model, this model also appears to possess significant explanatory power—with an adjusted R-squared value of 96.51%. From the table, we see that the consumer price index alone accounts for 95.87% of the total variation in CPGCo's retail sales for this particular segment. The oil price and the exchange rate have incremental effects on the model's adjusted R-squared value of 0.36% and 0.28% respectively.

TABLE 4-33 COUNTRY B, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.9595	0.9587	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Interest Rate	0.9634	0.9618	0.0030	0.00	0.00	NA	NA	YES
Consumer Price Index + Oil Price	0.9638	0.9623	0.0036	0.00	0.02	NA	NA	NO
Consumer Price Index + Oil Price + Average Stock Index	0.9671	0.9650	0.0026	0.00	0.00	0.00	NA	YES
Consumer Price Index + Oil Price + Exchange Rate	0.9672	0.9651	0.0028	0.00	0.00	0.03	NA	NO

We see from Table 4-34 on the following page that the final model for product segment 3 consists of the consumer price index and the oil price. This particular model possesses a moderately highly adjusted R-squared value of 86.95%, indicating considerable explanatory power. The consumer price index alone accounts for 84.66% of the total variation in CPGCo's

retail sales for product segment 3. By adding the oil price to the model we are able to explain an additional 2.29% of the variation for product segment 3's retail sales.

TABLE 4-34 COUNTRY B, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.8498	0.8466	NA	0.00	NA	NA	NA	NA
Consumer Price Index + Oil Price	0.8749	0.8695	0.0229	0.00	0.00	NA	NA	NO
Consumer Price Index + Oil Price + Average Stock Index	0.8884	0.8809	0.0114	0.00	0.00	0.02	NA	YES

From Table 4-35 it appears that the consumer price index and the oil price have a considerable influence on CPGCo's retail sales for Country B. Indeed, both of the indicators appear in the models for all three product segments (100% of the time). We also see that the exchange rate appears in the model for product segment 2 (33% of the time). However, when we take the amount of variation explained by each of the respective indicators into consideration, it is clear that CPGCo's time would be best spent monitoring fluctuations in the price index. As we recall, the amount of variation the oil price accounted for was extremely small.

TABLE 4-35 COUNTRY B MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1						
Product Segment 2						
Product Segment 3						
	33%	0%	0%	100%	0%	100%

4.14 Country B Regression Results Analysis (Retail Sales)

From Table 4-36 on the next page, we see that the signs of the coefficients for the consumer price index are positive for the models for all three product segments. This finding is in line with our findings thus far for both Country A and Country B. Again, we suspect that consumers in both countries are purchasing goods in large volume as a hedge against expected future price increases.

Interestingly, the sign of the coefficient for the exchange rate for product segment 2's model is positive. This finding is not only opposite of our previous findings with respect to the exchange rate indicator, but it also does not make intuitive sense. As we stated, we expect a negative coefficient for the exchange rate. That is, as the exchange rate increases, a higher amount of a particular country's currency is required to obtain a single U.S. dollar. This effect should diminish consumer wealth and decrease demand. Unfortunately, we do not have a logical explanation for this finding. Indeed, we feel that the result itself may simply be spurious. We also feel that it is important to point out that after the indicator was added to product segment 2's model, the adjusted R-squared value increased by only 0.28%, indicating very low explanatory power.

Finally, we see that the coefficients for the oil price indicator are positive for all three product segments. Again, while this result is opposite our findings for Country A, it does align with our finding for oil price in Country B's market share analysis. Again, we believe that consumers in Country B are reacting to increases in oil prices in the same manner that they are to general increases in prices. That is, consumers are purchasing goods in bulk or in higher volumes as a means of hedging against future oil price increases.

TABLE 4-36 COUNTRY B REGRESSION COEFFICIENT SIGNS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				+		+
Product Segment 2	+			+		+
Product Segment 3				+		+

From Table 4-37 below, we see that the consumer price index is highly statistically significant for all three models with p-values less than 0.000. We also see that the significance levels for oil price are not as high as those of the price index. Indeed, the p-value of the oil price indicator for product segment 1's model is 0.001. The p-values for the models for product segments 2 and 3 are even higher at 0.002 and 0.004 respectively. Finally, we notice that the exchange rate for product segment 2's model has the highest p-value of any of the indicators with a value of 0.033. While still statistically significant using an alpha value of five percent, the exchange rate's significance level is lower than those of the consumer price index and the oil price.

TABLE 4-37 COUNTRY B INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				0.000		0.001
Product Segment 2	0.033			0.000		0.002
Product Segment 3				0.000		0.004

4.15 Country C Model Construction (Shipment Volume)

As Table 4-38 indicates, the final model for product segment 1 consists of a single macroeconomic explanatory variable, the consumer price index. The model for this particular product segment possesses a less-than-ideal adjusted R-squared value of 45.12%. Given this, it appears that the various macroeconomic indicators do not possess a great deal of explanatory power with respect to CPGCo's shipment volume for product segment 1 in Country C.

TABLE 4-38 COUNTRY C, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.4656	0.4512	NA	0.00	NA	NA	NA	NA

From Table 4-39, we see that the model for product segment 2 is nearly identical to product segment 1's. It also consists of a single explanatory variable, the consumer price index. The adjusted R-squared value for this particular model, however, is slightly lower than that of product segment 1's at 44.76%. Again, given the low adjusted R-squared value, we conclude that the model possesses relatively low explanatory power.

TABLE 4-39 COUNTRY C, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Consumer Price Index	0.4629	0.4476	NA	0.00	NA	NA	NA	NA

Like the models for the other two product segments, the model for product segment 3 also contains a single explanatory variable. In this instance, the average stock index accounts for 57.60% of the total variation in CPGCo's shipment volume for this segment. While the adjusted R-squared value is certainly higher than those of the other two models, the model's overall explanatory power is still considerably low.

TABLE 4-40 COUNTRY C, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (SHIPMENT VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Average Stock Index	0.5874	0.5760	NA	0.00	NA	NA	NA	NA

From Table 4-41 below, we see that the consumer price index appears to have the most influence on CPGCo's shipment volume for Country C. The price index itself appears in the models for product segments 1 and 2 (67% of the time). We also see that the average stock index appears only one time, in the model for product segment 3 (33% of the time). Given these results, coupled with the amount of variation explained by each of the macroeconomic indicators, we recommend that the firm monitors changes in the consumer price index closely. At the same time, it may also be advantageous for CPGCo to monitor fluctuations in the average stock index as well—especially since it is the only variable in product segment 3's model.

TABLE 4-41 COUNTRY C MACROECONOMIC INDICATOR FREQUENCY MATRIX (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1						
Product Segment 2						
Product Segment 3						
	0%	33%	0%	67%	0%	0%

4.16 Country C Regression Results Analysis (Shipment Volume)

As was the case for Countries A and B in the previous sections, our primary goal in this section is to analyze the regression coefficients. Again, we want to ensure that the signs of the coefficients themselves make sense from a logical standpoint. We will also discuss the significance levels of the various macroeconomic indicators. Detailed regression results are available in Appendix C.

As Table 4-42 below shows, the signs of the coefficients for the consumer price index are positive for the models for product segments 1 and 2. This finding is indeed in line with our findings for the two other countries and agrees with Juster and Wachtel's (1972) assertion regarding anticipated price increases (inflation) yielding an increase in expenditures for nondurable goods. As we have stated several times, we believe that consumers are purchasing goods in large volumes in order to hedge against expected future price increases.

As the table points out, we also see that the sign of the coefficient for the average stock index for product segment 3's model is positive. This finding aligns with our results from Countries A and B. Again, an increase in the average stock index increases consumer wealth. As consumer wealth increases, we expect an increase in consumer demand.

TABLE 4-42 COUNTRY C REGRESSION COEFFICIENT SIGNS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				+		
Product Segment 2				+		
Product Segment 3		+				

From Table 4-43, we see the consumer price index indicator is highly statistically significant for the models for product segments 1 and 2. Indeed, the p-values for the variable are less than 0.000 in both instances. We also see that the average stock index in the model for product segment 3 is highly statistically significant with a p-value less than 0.000.

TABLE 4-43 COUNTRY C INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (SHIPMENT VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1				0.000		
Product Segment 2				0.000		
Product Segment 3		0.000				

4.17 Country C Model Construction (Retail Market Share by Volume)

When building the model for this particular product segment using the market share data, we noticed a glitch in Minitab. Despite the fact that we had set our alpha value to five percent, Minitab included the interest rate variable in the model despite a p-value of 0.63. We tried rebuilding the model numerous times, but for whatever reason, Minitab continually included the interest rate. Ultimately, the variable was removed because of multicollinearity, and the

regression analysis was conducted again. Once this was done, we were given a final model consisting of the average stock index, the consumer price index, and the oil price.

In this instance, as Table 4-44 shows, the average stock index alone accounts for 64.27% of the total variation in CPGCo's retail market share by volume for product segment 1. We are able to explain an additional 20.33% of the variation in the firm's market share by adding the price index. Finally, we increase the adjusted R-squared value by 4.43% to 89.03% by adding the oil price to the model. Given the relatively high adjusted R-squared value, we conclude that this model has excellent explanatory power.

TABLE 4-44 COUNTRY C, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Interest Rate	0.6537	0.6467	NA	0.00	NA	NA	NA	NA
Interest Rate + Consumer Price Index	0.7577	0.7472	0.1005	0.00	0.00	NA	NA	NO
Interest Rate + Consumer Price Index + Average Stock Index	0.8532	0.8434	0.0963	0.63	0.00	0.00	NA	YES
Average Stock Index	0.6500	0.6427	NA	0.00	NA	NA	NA	NA
Average Stock Index + Consumer Price Index	0.8524	0.8460	0.2033	0.00	0.00	NA	NA	NO
Average Stock Index + Consumer Price Index + Oil Price	0.8971	0.8903	0.0443	0.00	0.00	0.00	NA	NO

From Table 4-45 on the following page, we see that the final model for product segment 2 consists of a single explanatory variable, the exchange rate. This model has relatively low explanatory power with an adjusted R-squared value of 52.53%. Recall that product segment 2's model from the shipment volume analysis also had extremely low explanatory power. This leads us to believe that product segment 2 for Country C may be similar to that of Country A's. That is, demand for products in this segment are likely sensitive to a multitude of external factors beyond macroeconomic indicators.

TABLE 4-45 COUNTRY C, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Exchange Rate	0.5350	0.5253	NA	0.00	NA	NA	NA	NA

As Table 4-46 below points out, we again experienced a glitch in Minitab. The program built our regression model incorporating the interest rate variable with a p-value of 0.80. As was the case in product segment 1's model, the interest rate was removed because of multicollinearity. Once the regression analysis was rerun, we were given a model consisting of the average stock index, the consumer price index, and the exchange rate. In this instance, the exchange rate indicator was removed because of multicollinearity, and the stepwise regression analysis was run one more time. This time we were presented with our final model, comprised of the average stock index, the price index, and the oil price.

As the table shows, the average stock index alone accounts for 74.44% of the total variation in CPGCo's market share by volume for product segment 3. By adding the consumer price index to the model, we are able to increase the adjusted R-squared value by an additional 19.15%. Finally, if we add the oil price, we increase the adjusted R-squared by another 1.05% to 94.65%. With such a high adjusted R-squared value, we conclude that this model has substantial explanatory power.

TABLE 4-46 COUNTRY C, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL MARKET SHARE BY VOLUME)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Interest Rate	0.7307	0.7251	NA	0.00	NA	NA	NA	NA
Interest Rate + Consumer Price Index	0.8259	0.8183	0.0933	0.00	0.00	NA	NA	NO
Interest Rate + Consumer Price Index + Average Stock Index	0.9387	0.9346	0.1163	0.80	0.00	0.00	NA	YES
Average Stock Index	0.7495	0.7444	NA	0.00	NA	NA	NA	NA
Average Stock Index + Consumer Price Index	0.9386	0.9359	0.1915	0.00	0.00	NA	NA	NO
Average Stock Index + Consumer Price Index + Exchange Rate	0.9533	0.9501	0.0142	0.00	0.00	0.00	NA	YES
Average Stock Index + Consumer Price Index + Oil Price	0.9498	0.9465	0.0105	0.00	0.00	0.00	NA	NO

From Table 4-47 below, we see that the average stock index, the consumer price index, and the oil price all appear to influence CPGCo's market share for Country C. All three of the aforementioned indicators appear in the models for product segments 1 and 3 (67% of the time). We also see that the exchange rate appears only one time, in the model for product segment 2 (33% of the time). Given these results, we recommend that the firm monitors changes in the average stock index, the consumer price index, and the oil price. That said, we have shown that the average stock index accounts for the greatest amount of variation in the models for product segments 1 and 3, followed by the consumer price index. In light of this, the firm may want to pay closer attention to those two particular indicators. At the same time, it would also be advantageous for CPGCo to monitor fluctuations in the exchange rate, given that it is the sole variable in product segment 2's model.

TABLE 4-47 COUNTRY C MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		■		■		■
Product Segment 2	■					
Product Segment 3		■		■		■
	33%	67%	0%	67%	0%	67%

4.18 Country C Regression Results Analysis (Retail Market Share by Volume)

As we see from Table 4-48 on the next page, the signs of the regression coefficients for the retail market share analysis all appear to make intuitive sense. We notice that the sign of the coefficient for the exchange rate is negative for product segment 2's model. This finding makes sense and agrees with our results for the shipment volume and market share analyses from Country B. We also see that the coefficient signs of the consumer price index indicator for the models for product segments 1 and 3 are both positive. This mirrors our findings for this particular indicator for all three countries. In addition, we see that the coefficients for the average stock index for the models for product segments 1 and 3 are both positive. This finding is also in line with our results from Country A as well as the shipment volume analysis for this country.

Finally, we see that the coefficients of the oil price are negative for the models in product segments 1 and 3. This finding agrees with Ma et al.'s (2011) conclusions and our results from Country A. That said, it is important to note that the finding itself is at odds with what we found for oil price in Country B. Nevertheless, we believe that consumer behavior in Country C closely mimics that of Country A in many regards. Indeed, the coefficients for the average stock index, the consumer price index, and the oil price all generally have the same signs. Moreover,

our findings suggest that the average stock index has no impact on CPGCo's shipment volume, market share, or retail sales for Country B.

TABLE 4-48 COUNTRY C REGRESSION COEFFICIENT SIGNS (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		+		+		-
Product Segment 2	-					
Product Segment 3		+		+		-

From Table 4-49, we see the exchange rate indicator is highly statistically significant for the model for product segment 2. Indeed, the p-values for the variable are less than 0.000. We also see that the average stock index and the consumer price index in the models for product segments 1 and 3 are highly statistically significant with p-values less than 0.000. The oil price indicator for product segment 1 has high statistical significance with a p-value less than 0.000. However, the significance level of the oil price for product segment 3's model is not as high as in the model for product segment 1, nor is at as high as the significance of the average stock index or consumer price index.

TABLE 4-49 COUNTRY C INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (RETAIL MARKET SHARE BY VOLUME)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		0.000		0.000		0.000
Product Segment 2	0.000					
Product Segment 3		0.000		0.000		0.003

4.19 Country C Model Construction (Retail Sales)

From Table 4-50 below, we see that the model for product segment 1 consists of three macroeconomic explanatory variables: the average stock index, the consumer price index, and the oil price. The aforementioned indicators have incremental effects on the adjusted R-squared value of 63.10%, 22.22%, and 1.98% respectively. In its final form, the model has moderately high explanatory power and is able to explain 87.31% of the total variation in the firm's retail sales for product segment 1.

TABLE 4-50 COUNTRY C, PRODUCT SEGMENT 1 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Average Stock Index	0.6385	0.6310	NA	0.00	NA	NA	NA	NA
Average Stock Index + Consumer Price Index	0.8594	0.8533	0.2223	0.00	0.00	NA	NA	NO
Average Stock Index + Consumer Price Index + Oil Price	0.8810	0.8731	0.0198	0.00	0.00	0.01	NA	NO

Whereas the model for product segment 1 was comprised of three explanatory variables, the model for product segment 2 consists of two, the oil price and the interest rate. From Table 4-51 on the next page, we see that the oil price indicator accounts 42.24% of the total variation in CPGCo's retail sales for product segment 2. We are able to increase the adjusted R-squared value by 11.03% by adding the interest rate to the model. Overall, the model for product segment 2 accounts for just 53.27% of the total variation in the firm's retail sales. However, as we pointed out during our analysis of product segment 2's model using the market share data, we believe that this particular segment for Country C is similar to product segment 2 in Country B. As such, a model with lower explanatory power is expected.

TABLE 4-51 COUNTRY C, PRODUCT SEGMENT 2 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Oil Price	0.4344	0.4224	NA	0.00	NA	NA	NA	NA
Oil Price + Interest Rate	0.5522	0.5327	0.1103	0.00	0.00	NA	NA	NO

As Table 4-52 on the following page points out, we experienced a glitch in Minitab for the third time. In this circumstance, the program again built the regression model incorporating the interest rate variable with a p-value well over 0.05. However, as was the case in the market share analysis, the interest rate was removed because of multicollinearity. Once the regression model was rebuilt, we were given a model comprised of the average stock index, the consumer price index, and the exchange rate. Unfortunately, because of multicollinearity we had to remove the exchange rate indicator and rerun the stepwise regression one additional time before arriving at our final model.

As the table shows, the average stock index alone accounts for 65.97% of the total variation in CPGCo's market share by volume for product segment 3. By adding the consumer price index to the model, we are able to increase the adjusted R-squared value by an additional 23.92%. Finally, if we add the oil price, we increase the adjusted R-squared by another 2.07% to 91.95%. With such a high adjusted R-squared value, we conclude that this model has significant explanatory power.

TABLE 4-52 COUNTRY C, PRODUCT SEGMENT 3 MODEL CONSTRUCTION RESULTS (RETAIL SALES)

	R^2	Adjusted R^2	Change in Adjusted R^2	Variable 1 P-value	Variable 2 P-value	Variable 3 P-value	Variable 4 P-value	Multicollinearity
Interest Rate	0.7058	0.6997	NA	0.00	NA	NA	NA	NA
Interest Rate + Consumer Price Index	0.8249	0.8173	0.1176	0.00	0.00	NA	NA	NO
Interest Rate + Consumer Price Index + Average Stock Index	0.9038	0.8974	0.0801	0.56	0.00	0.00	NA	YES
Average Stock Index	0.6665	0.6597	NA	0.00	NA	NA	NA	NA
Average Stock Index + Consumer Price Index	0.9031	0.8988	0.2392	0.00	0.00	NA	NA	NO
Average Stock Index + Consumer Price Index + Exchange Rate	0.9354	0.9311	0.0323	0.00	0.00	0.00	NA	YES
Average Stock Index + Consumer Price Index + Oil Price	0.9245	0.9195	0.0207	0.00	0.00	0.00	NA	NO

From Table 4-53 below, we see that the average stock index and the consumer price index both appear in the models for product segments 1 and 2 (67% of the time). We also see that the interest rate only appears in the model for product segment 2 (33% of the time). From the table, it is clear to see that the oil price indicator appears most frequently (100% of the time). Given these results—and after taking into account the amount of variation each respective indicator explains—we recommend that CPGCo monitors changes in the average stock index, the consumer price index, and the oil price.

The oil price should be monitored closely given that it influences all three product segments. However, it is important to note that for product segments 1 and 3, the indicator itself has relatively low explanatory power. We also believe that the average stock index should be monitored closely given its ability to explain a significant amount of the variation for the two product segments. Finally, the firm should monitor changes in the consumer price index given its considerable explanatory power for the models in the segments that it impacts.

TABLE 4-53 COUNTRY C MACROECONOMIC INDICATOR FREQUENCY MATRIX (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		■		■		■
Product Segment 2					■	■
Product Segment 3		■		■		■
	0%	67%	0%	67%	33%	100%

4.20 Country C Regression Results Analysis (Retail Sales)

As we see from Table 4-54 on the following page, the signs of the regression coefficients for the retail sales analysis all appear to make sense with the exception of those in product segment 2. Indeed, we notice that the signs of the coefficients for the interest rate and the oil price indicators are positive for the model in this particular segment. The result for the oil price is not only counterintuitive, but it does not agree with our other findings for Country C. We do not have an explanation for this result, but as was the case with positive coefficient for the oil price in the retail sales analysis for Country A, we suspect that it can be attributed to the nature of the product segment itself.

The finding with respect to the interest rate also does not make logical sense. Again, we believe that consumer behavior in Country C closely mirrors that of Country A's. Given this, we expect to find a negative coefficient sign like we did in Country A. Indeed, as interest rates increase, consumer wealth is diminished. Therefore, we expect a decrease in demand. Unfortunately, as was the case with the positive oil price coefficient, we do not have a definitive explanation for this result. We merely believe that the finding, like the positive oil price coefficient, is attributed to the highly volatile and unpredictable nature of product segment 2.

The positive coefficients for the average stock index for the models in product segments 1 and 3 as well as the positive coefficients for the price index models make sense and agree with our other findings concerning these variables.

TABLE 4-54 COUNTRY C REGRESSION COEFFICIENT SIGNS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		+		+		-
Product Segment 2					+	+
Product Segment 3		+		+		-

As Table 4-55 points out, we see that the average stock index and the consumer price index are both highly statistically significant for the models for product segments 1 and 3. As the table shows, the p-values for these indicators are less than 0.000. We also see that the p-value for the oil price for product segment 2's model is highly statistically significant with a p-value less than 0.000. The oil price indicators for the models for product segments 1 and 3, however, possess slightly lower levels of statistical significance with p-values of 0.006 and 0.001 respectively. Finally, we see that the interest rate for product segment 2's model is marginally less significant than the average stock index and price index indicators for the models for product segments 1 and 3.

TABLE 4-55 COUNTRY C INDEPENDENT VARIABLE SIGNIFICANCE LEVELS (RETAIL SALES)

	Exchange Rate	Average Stock Index	Inflation Rate	Consumer Price Index	Interest Rate	Oil Price
Product Segment 1		0.000		0.000		0.006
Product Segment 2					0.001	0.000
Product Segment 3		0.000		0.000		0.001

4.21 Forecasting Accuracy and Autocorrelation

Through graphical inspection of our models' residuals over time, we recognized that several of them showed signs of autocorrelation. This fact violates one of the assumptions of linear regression stating that the error terms are independently distributed or serially independent. In other words, the presence of autocorrelation in our models indicates that the error in one period affects the error of the next period (Asteriou, 2007).

Regardless of the presence of autocorrelation, the estimators of our models remain unbiased, where there is zero difference between the expected and the true value of the parameters. Additionally, autocorrelation does not affect the consistency of the estimators—indicating that as the sample grows ad infinitum, our estimators will converge on the true value of the parameters (Asteriou, 2007).

That said, it is important to point out that one consequence of autocorrelation involves inefficient estimators and a failure to satisfy the Cramer-Rao lower bound on variance (Taylor, 1981). As such, other coefficients may exist possessing smaller variances (Fisher, 1925). Additionally, it is possible that the variances are no longer unbiased and consistent, leading to inflation of the R-squared values and t-statistics of the models. The result is a false sense of goodness of fit, leading one to believe that the models look better than they actually are (Asteriou, 2007).

Given the potential consequences of autocorrelation, we wanted to test its impact on our models' ability to produce accurate forecasts. To do this, we chose several models exhibiting the presence of autocorrelation at random and tested their forecasting accuracy using new data obtained from CPGCo. That said, we must note that we were only provided with one additional data point for retail sales—December 2011. While we were provided with actual shipment

volume data through March 2012, we were only given retail market share data through February of the same year. It is also important to note that we took care to ensure that forecasts were produced for each country and each product segment, using each set of data—shipment volume, retail market share, and retail sales—at least once.

As Table 4-56 on the next page shows, autocorrelation does not appear to have a significant effect on our models' ability to produce accurate forecasts. Indeed, the highest error we found was 7.2% in Country C. In light of these results, we do not believe that autocorrelation impacts the accuracy of our models and therefore did not perform any measures to correct for it.

TABLE 4-56 THE IMPACT OF AUTOCORRELATION ON FORECASTING ACCURACY

	COUNTRY A			
	Retail Sales (MUS$) Product Segment 1 December 2011	Retail Market Share by Volume (MSU) Product Segment 1 December 2011	Retail Market Share by Volume (MSU) Product Segment 1 January 2012	Retail Market Share by Volume (MSU) Product Segment 1 February 2012
Actual	64897	2183	2380	2540
Forecast	63372	2157	2460	2510
Difference	-1525	-26	80	-30
% Error	2.3%	1.2%	3.4%	1.2%

	COUNTRY B			
	Shipment Volume (MSU) Product Segment 2 December 2011	Shipment Volume (MSU) Product Segment 2 January 2011	Shipment Volume (MSU) Product Segment 2 February 2011	Shipment Volume (MSU) Product Segment 2 March 2011
Actual	2931	3053	2754	2979
Forecast	2976	2907	2834	2899
Difference	45	-146	80	-80
% Error	1.6%	4.8%	2.9%	2.7%

	COUNTRY C			
	Retail Sales (MUS$) Product Segment 3 December 2011	Retail Market Share by Volume (MSU) Product Segment 3 December 2011	Retail Market Share by Volume (MSU) Product Segment 3 January 2012	Retail Market Share by Volume (MSU) Product Segment 3 February 2012
Actual	15259	575	575	548
Forecast	16364	605	585	581
Difference	1105	30	10	33
% Error	7.2%	5.2%	1.7%	6.1%

5 Summary and Conclusion

In this thesis, we investigated the effects of several macroeconomic variables on consumer demand in emerging markets in Asia through both magnitude and time dimensions. We also developed working models to forecast wholesale shipment volume, retail market share by volume, and retail sales for three different product segments within the three emerging markets. Our objective was to complement CPGCo's current forecasting processes and improve its forecasting accuracy.

In this chapter, we summarize our key findings and conclude with suggestions for future research.

5.1 Summary of Analysis and Findings

In this thesis, we explored ways to explain consumer demand variation through linear combinations of six possible macroeconomic indicators. Table 5-1 below summarizes the indicators used for each of the 27 macroeconomic models. As the table shows, it is clear that the consumer price index is the dominant variable across our models, appearing in the final equation 81% of the time. In fact, the price index is the sole predictor variable in six of the models. Additionally, the signs of the coefficients for the price index are consistently positive for all 27 models. The positive signs indicate that if the price index increases, the demand will also increase. Conversely, if the price index decreases, so will the demand. We hypothesize that during the global downturn from 2007 to 2011, consumers in the three Asian countries were purchasing goods in large volumes to hedge against future price increases. This assertion aligns

with what Juster and Wachtel (1972) hypothesized based on their findings—that is, that fully anticipated price increases (inflation) led consumers to increase expenditures on nondurable goods.

As a general rule-of-thumb, the consumer price index in each respective country is an extremely important leading indicator of consumer demand. In Country A, it is the most important variable. Indeed, in this particular country, the price index is able to explain 78% to 95% of all variation in seven out of nine models. In Country B, the indicator is even more important as it appears in all nine models and is the sole predictor variable in three of them. In this instance, the price index accounts for 78% to 96% of the total variation in all but one model. In Country C, the consumer price index again appears to be the most influential indicator in terms of frequency. However, when we consider the amount of variation that each respective indicator explains, we see from Table 5-1 that the average stock index is able to explain 58% to 74% of the variation in five of the nine models while the price index is able to explain 19% to 45% for six of the nine models. Given this fact, we feel that the average stock index is a more influential indicator than the consumer price index is for Country C. We also found that the signs of the coefficients for the average stock index were consistently positive, indicating that consumer demand moves in the same direction as the predictor. That is, as the average stock index increases, consumer demand increases as well.

TABLE 5-1 FREQUENCY OF MACROECONOMIC INDICATORS IN MODELS AND AMOUNT OF VARIATION EXPLAINED

		Exchange Rate	Average Stock Index	Consumer Confidence Indicator	Consumer Price Index	Interest Rate	Oil Price
C	Product Segment 1 Shipment Volume				0.8319		
O	Product Segment 2 Shipment Volume			0.1182			
U	Product Segment 3 Shipment Volume		0.0127		0.7790	0.0687	
N	Product Segment 1 Market Share		0.0027		0.9545	0.0142	0.0020
T	Product Segment 2 Market Share			0.4825	0.1069		
R	Product Segment 3 Market Share		0.0139		0.8680	0.0686	
Y	Product Segment 1 Retail Sales			0.0040	0.9518		0.0213
	Product Segment 2 Retail Sales						0.3398
A	Product Segment 3 Retail Sales		0.0322		0.8670	0.0576	
C	Product Segment 1 Shipment Volume				0.8592		
O	Product Segment 2 Shipment Volume	0.0088			0.8934		
U	Product Segment 3 Shipment Volume				0.7792		
N	Product Segment 1 Market Share				0.9499		
T	Product Segment 2 Market Share	0.2746			0.6266		
R	Product Segment 3 Market Share				0.8182		0.0343
Y	Product Segment 1 Retail Sales				0.9282		0.0138
	Product Segment 2 Retail Sales	0.0028			0.9587		0.0036
B	Product Segment 3 Retail Sales				0.8466		0.0229
C	Product Segment 1 Shipment Volume				0.4512		
O	Product Segment 2 Shipment Volume				0.4476		
U	Product Segment 3 Shipment Volume		0.5760				
N	Product Segment 1 Market Share		0.6427		0.2033		0.0443
T	Product Segment 2 Market Share	0.5253					
R	Product Segment 3 Market Share		0.7444		0.1915		0.0105
Y	Product Segment 1 Retail Sales		0.6310		0.2223		0.0198
	Product Segment 2 Retail Sales					0.1103	0.4224
C	Product Segment 3 Retail Sales		0.6597		0.2392		0.0207
		15%	33%	33%	81%	19%	44%

While our models are able to account for much of the variability in consumer demand, we had difficulty with product segment 2 in Country A and Country C. As confirmed by our sponsoring firm, this product segment has been problematic to forecast. It is not clear whether it is possible to use macroeconomic indicators to predict demand for this segment, and other variables and methods may be more suitable in explaining the underlying intricacies.

The adjusted R-squared values for the 27 models we developed range from 0.34 to 0.97, with the majority of values skewed towards 1.0. Using adjusted R-squared values to assess the models' abilities to explain demand variation, we found that retail data— retail market share by volume and retail sales—provide more accurate models, especially for Country C. The adjusted R-squared values for shipment volume data ranges from 0.45 to 0.58 while the adjusted R-squared values for the retail market share by volume data ranges from 0.53 to 0.95. Intuitively, the closer the demand data to the consumer, the more representative it is in both magnitude and time lag. As you go further up the supply chain (e.g. to the wholesaler echelon from consumer-facing retailers), the greater the bullwhip effect; therefore, we recommend that CPGCo place more emphasis on examining retail sales data over wholesale shipment volume data.

5.2 Suggestions for Future Research

Although we achieved high R-squared values in many of our models, further research is suggested to better understand the effects of macroeconomic factors on consumer demand in emerging markets. In this thesis, we examined numerous macroeconomic indicators but only employed a total of six as explanatory variables in our models. We recommend investigating additional indicators such as Gross Domestic Product (GDP) and the unemployment rate, which were not included because these variables were updated on a quarterly basis in our countries of

interest. In order to include such indicators, we would require additional historical data. Our data spanned the months of July of 2007 to December of 2011, providing between 40 and 52 data points. Moving to quarterly data would decrease the sample size by a factor of four—providing between 10 and 12 data points.

The motivation for the narrow range of data was to encompass the periods between the onset of the recent global economic crisis and present day, given that the demand during this particular period was extraordinarily volatile; however, data that spans a longer timeframe to include non-recession and additional recession periods may provide higher explanatory power. To incorporate recessionary periods in linear regression modeling, one can utilize a dummy variable to indicate the specific periods that are defined as recessionary.

We also recommend examining the timing of major cultural festivals and local customs of each respective country, as they can affect the short-term buying patterns of consumers. Although we accounted for seasonality in our analysis, many cultural holidays in Asia are based on the lunar calendar, where the length of a month varies and does not align with the Gregorian calendar on a year-to-year basis. This phenomenon can better be accounted for, again, through the use of a dummy variable.

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Appendix A

Seasonal Factors

Country A: Dependent Variables

	July	August	September	October	November	December
Product Segment 1 Shipment Volume	0.5670	0.6501	1.2775	0.9544	1.0941	1.4522
Product Segment 2 Shipment Volume	1.0297	1.0474	1.1925	0.8748	0.9765	1.0997
Product Segment 3 Shipment Volume	0.9989	1.0838	1.3036	0.8843	0.9596	1.1106
Product Segment 1 Retail Market Share by Volume	0.8397	0.8005	0.8555	0.8174	0.8685	0.9964
Product Segment 2 Retail Market Share by Volume	1.0130	1.0100	1.0197	1.0208	0.9516	0.9691
Product Segment 3 Retail Market Share by Volume	1.0545	1.1060	1.0855	1.0460	0.9294	0.9351
Product Segment 1 Retail Sales	0.8527	0.8102	0.8669	0.8253	0.8717	0.9966
Product Segment 2 Retail Sales	1.0252	1.0085	1.0157	1.0276	0.9527	0.9557
Product Segment 3 Retail Sales	1.0431	1.0822	1.0704	1.0389	0.9407	0.9343

	January	February	March	April	May	June
Product Segment 1 Shipment Volume	1.3801	0.8646	1.1285	1.0795	0.8304	0.7218
Product Segment 2 Shipment Volume	1.0014	0.5752	1.1590	1.0864	0.9936	0.9638
Product Segment 3 Shipment Volume	1.0398	0.8203	1.0495	0.9541	0.9348	0.8605
Product Segment 1 Retail Market Share by Volume	1.1494	1.1902	1.1583	1.1898	1.1367	0.9974
Product Segment 2 Retail Market Share by Volume	1.0437	0.9122	1.0423	0.9965	1.0041	1.0171
Product Segment 3 Retail Market Share by Volume	1.0085	0.9465	1.0793	0.9067	0.9382	0.9644
Product Segment 1 Retail Sales	1.1482	1.1878	1.1540	1.1808	1.1224	0.9834
Product Segment 2 Retail Sales	1.0185	0.9211	1.0436	0.9956	1.0089	1.0267
Product Segment 3 Retail Sales	1.0070	0.9639	1.0973	0.9199	0.9446	0.9577

Country A: Independent Variables

	July	August	September	October	November	December
Consumer Confidence Indicator	1.0179	1.0171	1.0002	0.9986	0.9944	0.9752
Interest Rate	1.0012	1.0012	1.0012	1.0012	0.9792	1.0012
Consumer Price Index	0.9915	0.9952	0.9968	0.9959	0.9953	1.0026
Exchange Rate	1.0005	1.0007	1.0003	0.9967	0.9980	1.0010
Oil Price	1.0172	1.0909	0.9792	0.9297	0.9270	0.9597
Average Stock Index	0.9626	0.9456	0.9521	1.0053	1.0620	1.0201

	January	February	March	April	May	June
Consumer Confidence Indicator	0.9869	0.9840	1.0083	1.0007	1.0108	1.0058
Interest Rate	0.9968	1.0055	1.0004	1.0056	1.0052	1.0012
Consumer Price Index	1.0057	1.0146	1.0059	1.0040	0.9996	0.9928
Exchange Rate	1.0006	1.0002	1.0015	1.0005	0.9995	1.0005
Oil Price	0.9495	0.9447	1.0012	1.0633	1.0152	1.1225
Average Stock Index	1.0240	1.0212	1.0088	1.0283	1.0249	0.9451

Country B: Dependent Variables

	July	August	September	October	November	December
Product Segment 1 Shipment Volume	0.8167	0.9818	0.9791	0.9411	1.1560	1.3817
Product Segment 2 Shipment Volume	0.9250	0.9104	0.8873	0.9100	0.9271	1.0554
Product Segment 3 Shipment Volume	0.8315	1.0523	0.9867	0.8700	1.0573	0.9633
Product Segment 1 Retail Market Share by Volume	0.9265	0.9016	0.8944	0.9330	0.9623	1.1404
Product Segment 2 Retail Market Share by Volume	1.0007	1.0194	1.0156	1.0171	0.9715	1.0261
Product Segment 3 Retail Market Share by Volume	0.9740	0.9869	0.9893	1.0417	1.0338	1.0700
Product Segment 1 Retail Sales	0.9179	0.9249	0.8960	0.9317	0.9829	1.1329
Product Segment 2 Retail Sales	1.0121	1.0255	1.0306	1.0081	0.9906	1.0438
Product Segment 3 Retail Sales	0.9843	1.0086	0.9805	1.0312	1.0061	1.0550

	January	February	March	April	May	June
Product Segment 1 Shipment Volume	1.4528	1.0636	0.9144	0.8265	0.7801	0.7062
Product Segment 2 Shipment Volume	1.0132	1.0111	1.0443	1.0674	1.0276	1.2211
Product Segment 3 Shipment Volume	0.8450	1.1516	0.8782	1.2451	1.1121	1.0069
Product Segment 1 Retail Market Share by Volume	1.2033	1.1120	1.0860	0.9788	0.9490	0.9126
Product Segment 2 Retail Market Share by Volume	0.9931	0.9621	1.0193	0.9765	1.0166	0.9819
Product Segment 3 Retail Market Share by Volume	0.9981	0.9271	0.9750	0.9680	1.0560	0.9800
Product Segment 1 Retail Sales	1.1973	1.1074	1.0888	0.9748	0.9330	0.9124
Product Segment 2 Retail Sales	0.9875	0.9810	1.0064	0.9717	0.9920	0.9508
Product Segment 3 Retail Sales	0.9908	0.9429	0.9826	0.9789	1.0601	0.9789

Country B: Independent Variables

	July	August	September	October	November	December
Interest Rate	0.9906	0.9940	0.9975	1.0000	1.0018	1.0035
Consumer Price Index	1.0069	1.0102	1.0061	1.0075	1.0103	1.0100
Exchange Rate	1.0080	1.0101	1.0144	0.9935	0.9976	1.0024
Oil Price	1.0172	1.0909	0.9792	0.9296	0.9270	0.9597
Average Stock Index	0.9636	1.0418	1.0579	1.0446	1.0093	1.0174

	January	February	March	April	May	June
Interest Rate	1.0059	1.0194	0.9961	0.9820	1.0038	1.0052
Consumer Price Index	1.0066	0.9914	0.9896	0.9846	0.9858	0.9909
Exchange Rate	0.9989	1.0069	0.9954	0.9760	1.0000	0.9969
Oil Price	0.9495	0.9447	1.0012	1.0633	1.0152	1.1225
Average Stock Index	1.0061	0.9361	0.9453	0.9841	1.0002	0.9936

Country C: Dependent Variables

	July	August	September	October	November	December
Product Segment 1 Shipment Volume	0.9066	0.9686	0.9451	1.0491	1.1567	0.8712
Product Segment 2 Shipment Volume	0.8079	0.8998	1.0375	1.0369	1.0925	1.0983
Product Segment 3 Shipment Volume	0.9585	0.9162	1.1027	0.8861	0.8532	0.9759
Product Segment 1 Retail Market Share by Volume	0.9565	0.9750	0.9645	0.9607	0.9877	1.0592
Product Segment 2 Retail Market Share by Volume	1.0084	1.0300	0.9762	1.0194	0.9798	1.0307
Product Segment 3 Retail Market Share by Volume	1.0176	1.0156	0.9561	1.0162	0.9973	1.0278
Product Segment 1 Retail Sales	0.9590	0.9671	0.9551	0.9747	0.9785	1.0635
Product Segment 2 Retail Sales	0.9974	1.0136	0.9757	1.0159	0.9768	1.0380
Product Segment 3 Retail Sales	1.0129	1.0148	0.9599	1.0211	0.9894	1.0384

	January	February	March	April	May	June
Product Segment 1 Shipment Volume	1.2838	1.2182	0.9131	0.8845	0.9451	0.8580
Product Segment 2 Shipment Volume	1.0764	0.9553	0.9541	0.9903	1.0311	1.0198
Product Segment 3 Shipment Volume	1.0035	1.1298	1.0524	1.2999	0.9110	0.9108
Product Segment 1 Retail Market Share by Volume	1.0475	1.0317	1.0579	1.0157	0.9935	0.9500
Product Segment 2 Retail Market Share by Volume	0.9905	0.9646	1.0054	0.9841	1.0105	1.0003
Product Segment 3 Retail Market Share by Volume	0.9731	0.9492	1.0175	1.0047	1.0315	0.9932
Product Segment 1 Retail Sales	1.0467	1.0346	1.0578	1.0175	0.9950	0.9505
Product Segment 2 Retail Sales	0.9894	0.9724	1.0222	0.9904	1.0120	0.9962
Product Segment 3 Retail Sales	0.9776	0.9538	1.0235	1.0121	1.0140	0.9825

Country C: Independent Variables

	July	August	September	October	November	December
Interest Rate	1.0110	1.0087	1.0132	1.0604	1.0002	1.0236
Consumer Price Index	1.0011	1.0010	0.9979	0.9999	1.0006	0.9972
Exchange Rate	1.0122	1.0089	0.9939	0.9970	1.0058	0.9978
Oil Price	1.0172	1.0909	0.9792	0.9296	0.9270	0.9597
Average Stock Index	0.9568	1.0801	1.0593	1.0344	1.0387	1.0209

	January	February	March	April	May	June
Interest Rate	1.0096	0.9585	1.0021	0.9501	0.9843	0.9785
Consumer Price Index	0.9965	1.0001	0.9994	1.0029	1.0022	1.0014
Exchange Rate	0.9937	1.0025	0.9992	0.9878	0.9948	1.0064
Oil Price	0.9495	0.9447	1.0012	1.0633	1.0152	1.1225
Average Stock Index	1.0009	0.9341	0.9438	0.9813	0.9844	0.9653

Appendix B

Independent Variable Lag Determination

Country A

	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 1 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.550	2	0.108	2	0.091	2	0.835	2	0.036	2	0.198
	3	0.519	3	0.090	3	0.109	3	0.806	3	0.048	3	0.162
	4	0.473	4	0.064	4	0.088	4	0.801	4	0.070	4	0.144
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 2 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.089	2	0.100	2	0.066	2	0.0338	2	0.050	2	0.005
	3	0.119	3	0.073	3	0.111	3	0.0367	3	0.047	3	0.009
	4	0.126	4	0.052	4	0.137	4	0.0412	4	0.073	4	0.000
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 3 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.593	2	0.136	2	0.170	2	0.7834	2	0.123	2	0.083
	3	0.554	3	0.132	3	0.158	3	0.7615	3	0.164	3	0.066
	4	0.514	4	0.123	4	0.123	4	0.7230	4	0.193	4	0.036
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 1 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.736	2	0.206	2	0.151	2	0.955	2	0.063	2	0.161
	3	0.676	3	0.165	3	0.128	3	0.943	3	0.073	3	0.156
	4	0.616	4	0.133	4	0.105	4	0.927	4	0.091	4	0.153
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 2 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.091	2	0.181	2	0.282	2	0.0030	2	0.507	2	0.217
	3	0.096	3	0.237	3	0.365	3	0.0060	3	0.477	3	0.239
	4	0.117	4	0.316	4	0.493	4	0.0065	4	0.439	4	0.263
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 3 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.651	2	0.142	2	0.214	2	0.8707	2	0.103	2	0.136
	3	0.624	3	0.134	3	0.195	3	0.8498	3	0.136	3	0.098
	4	0.586	4	0.133	4	0.205	4	0.8177	4	0.176	4	0.076
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 1 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.742	2	0.215	2	0.164	2	0.9528	2	0.070	2	0.148
	3	0.688	3	0.178	3	0.140	3	0.9427	3	0.081	3	0.143
	4	0.634	4	0.148	4	0.117	4	0.9301	4	0.099	4	0.142
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 2 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.025	2	0.006	2	0.036	2	0.1992	2	0.279	2	0.278
	3	0.016	3	0.025	3	0.081	3	0.2063	3	0.270	3	0.300
	4	0.005	4	0.063	4	0.166	4	0.1963	4	0.257	4	0.354
	Exchange Rate		Average Stock Index		Consumer Confidence Indicator		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 3 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.588	2	0.097	2	0.163	2	0.8697	2	0.073	2	0.151
	3	0.561	3	0.091	3	0.149	3	0.8450	3	0.106	3	0.112
	4	0.523	4	0.090	4	0.157	4	0.8043	4	0.147	4	0.085

Country B

	Exchange Rate		Average Stock Index		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 1 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.169	2	0.498	2	0.862	2	0.564	2	0.266
	3	0.198	3	0.599	3	0.863	3	0.539	3	0.258
	4	0.173	4	0.601	4	0.859	4	0.587	4	0.228
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.300	2	0.558	2	0.872	2	0.528	2	0.398
	3	0.301	3	0.626	3	0.887	3	0.540	3	0.336
	4	0.304	4	0.712	4	0.896	4	0.579	4	0.350
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.157	2	0.387	2	0.785	2	0.370	2	0.348
	3	0.196	3	0.447	3	0.785	3	0.436	3	0.292
	4	0.194	4	0.502	4	0.782	4	0.519	4	0.314
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 1 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.118	2	0.173	2	0.949	2	0.678	2	0.064
	3	0.109	3	0.195	3	0.947	3	0.700	3	0.047
	4	0.117	4	0.222	4	0.951	4	0.723	4	0.042
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.027	2	0.503	2	0.618	2	0.578	2	0.305
	3	0.030	3	0.573	3	0.623	3	0.624	3	0.240
	4	0.019	4	0.627	4	0.634	4	0.669	4	0.188
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.049	2	0.165	2	0.801	2	0.597	2	0.135
	3	0.042	3	0.202	3	0.809	3	0.642	3	0.115
	4	0.046	4	0.236	4	0.822	4	0.683	4	0.107
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 1 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.077	2	0.205	2	0.924	2	0.678	2	0.099
	3	0.069	3	0.236	3	0.925	3	0.713	3	0.076
	4	0.075	4	0.268	4	0.930	4	0.744	4	0.066
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.148	2	0.159	2	0.960	2	0.661	2	0.071
	3	0.133	3	0.187	3	0.957	3	0.701	3	0.055
	4	0.142	4	0.211	4	0.959	4	0.738	4	0.045
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.063	2	0.170	2	0.832	2	0.646	2	0.115
	3	0.056	3	0.198	3	0.838	3	0.685	3	0.090
	4	0.060	4	0.227	4	0.850	4	0.718	4	0.083

Country C

	Exchange Rate		Average Stock Index		Consumer Price Index		Interest Rate		Oil Price	
Product Segment 1 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.268	2	0.464	2	0.466	2	0.431	2	0.090
	3	0.283	3	0.431	3	0.454	3	0.364	3	0.091
	4	0.288	4	0.393	4	0.431	4	0.274	4	0.061
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.320	2	0.420	2	0.4567	2	0.332	2	0.117
	3	0.280	3	0.418	3	0.4329	3	0.416	3	0.200
	4	0.224	4	0.440	4	0.4629	4	0.396	4	0.155
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Shipment Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.508	2	0.582	2	0.5677	2	0.469	2	0.204
	3	0.533	3	0.587	3	0.5461	3	0.456	3	0.195
	4	0.455	4	0.575	4	0.5293	4	0.440	4	0.219
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 1 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.140	2	0.646	2	0.498	2	0.654	2	0.089
	3	0.106	3	0.650	3	0.510	3	0.639	3	0.066
	4	0.062	4	0.574	4	0.557	4	0.592	4	0.041
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.463	2	0.134	2	0.0267	2	0.010	2	0.361
	3	0.535	3	0.199	3	0.0353	3	0.040	3	0.381
	4	0.523	4	0.258	4	0.0451	4	0.064	4	0.378
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Market Share by Volume	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.128	2	0.750	2	0.4512	2	0.661	2	0.114
	3	0.085	3	0.698	3	0.5383	3	0.731	3	0.088
	4	0.042	4	0.606	4	0.5972	4	0.730	4	0.057
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 1 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.149	2	0.633	2	0.530	2	0.643	2	0.115
	3	0.123	3	0.639	3	0.540	3	0.644	3	0.091
	4	0.083	4	0.584	4	0.574	4	0.600	4	0.068
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 2 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.138	2	0.000	2	0.0007	2	0.015	2	0.181
	3	0.267	3	0.011	3	0.0037	3	0.000	3	0.309
	4	0.343	4	0.040	4	0.0109	4	0.004	4	0.434
	Exchange Rate		**Average Stock Index**		**Consumer Price Index**		**Interest Rate**		**Oil Price**	
Product Segment 3 Retail Sales	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2	Lag	R^2
	2	0.072	2	0.666	2	0.4921	2	0.640	2	0.071
	3	0.042	3	0.599	3	0.5814	3	0.706	3	0.050
	4	0.013	4	0.503	4	0.6381	4	0.686	4	0.027

Appendix C

Detailed Regression Output

Country A: Shipment Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 1	51	0.835	0.832	155.456

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-7950.508	0.000	-9184.683	-6716.333
Consumer Price Index	84.728	0.000	73.927	95.528

$\text{Shipment Volume}_t = 84.728 * \text{Consumer Price Index}_{t-2} - 7950.508$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 2	49	0.137	0.118	410.586

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-331.408	0.834	-3497.680	2834.865
Consumer Confidence Indicator	40.382	0.009	10.583	70.181

$\text{Shipment Volume}_t = 40.382 * \text{Consumer Confidence Indicator}_{t-4} - 331.408$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 3	49	0.869	0.860	407.994

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-19396.732	0.000	-23372.586	-15420.879
Consumer Price Index	240.663	0.000	208.294	273.031
Interest Rate	-419.754	0.000	-561.883	-277.626
Average Stock Index	0.172	0.028	0.020	0.325

$\text{Shipment Volume}_t = 240.663 * \text{Consumer Price Index}_{t-2} - 419.754 * \text{Interest Rate}_{t-4} + 0.172 * \text{Average Stock Index}_{t-2} - 19396.732$

Country A: Retail Market Share by Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 1	49	0.976	0.973	51.335

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-8008.481	0.000	-8854.446	-7162.515
Consumer Price Index	85.052	0.000	78.037	92.066
Interest Rate	-25.954	0.040	-50.713	-1.194
Oil Price	-2.065	0.004	-3.420	-0.710
Average Stock Index	0.027	0.024	0.004	0.050

$\text{Market Share}_t = 85.052*\text{Consumer Price Index}_{t-2} - 25.954*\text{Interest Rate}_{t-4} - 2.065*\text{Oil Price}_{t-2} + 0.027*\text{Average Stock Index}_{t-2} - 8008.481$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 2	49	0.606	0.589	206.894

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-5945.683	0.000	-8926.633	-2964.732
Consumer Confidence Indicator	66.381	0.000	50.426	82.336
Consumer Price Index	30.918	0.001	13.811	48.024

$\text{Market Share}_t = 66.381*\text{Consumer Confidence Indicator}_{t-4} + 30.918*\text{Consumer Price Index}_{t-4} - 5945.683$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 3	49	0.954	0.951	245.430

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-21221.969	0.000	-23613.660	-18830.277
Consumer Price Index	260.156	0.000	240.684	279.627
Interest Rate	-386.423	0.000	-471.921	-300.924
Average Stock Index	0.170	0.001	0.078	0.262

$\text{Market Share}_t = 260.156*\text{Consumer Price Index}_{t-2} - 386.423*\text{Interest Rate}_{t-4} + 0.170*\text{Average Stock Index}_{t-2} - 21221.969$

Country A: Retail Sales

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 1	51	0.979	0.977	1598.289

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	-313947.955	0.000	-347779.485	-280116.424
Consumer Price Index	2948.618	0.000	2766.459	3130.777
Oil Price	-117.218	0.000	-150.730	-83.706
Consumer Confidence Indicator	263.971	0.003	91.419	436.523

$\text{Retail Sales}_t = 2948.618*\text{Consumer Price Index}_{t-2} - 117.218*\text{Oil Price}_{t-2} + 263.971*\text{Consumer Confidence Indicator Stock}_{t-2} - 313947.955$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 2	49	0.354	0.340	4158.692

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	62324.364	0.000	57588.606	67060.123
Oil Price	136.673	0.000	82.443	190.904

$\text{Retail Sales}_t = 136.673*\text{Oil Price}_{t-4} + 62324.364$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country A, Product Segment 3	49	0.960	0.957	5315.408

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	-501051.149	0.000	-552849.220	-449253.079
Consumer Price Index	6239.043	0.000	5817.341	6660.744
Interest Rate	-8509.237	0.000	-10360.914	-6657.560
Average Stock Index	5.878	0.000	3.889	7.868

$\text{Retail Sales}_t = 6239.043*\text{Consumer Price Index}_{t-2} - 8509.237*\text{Interest Rate}_{t-4} + 5.878*\text{Average Stock Index}_{t-2} - 501051.149$

Country B: Shipment Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 1	38	0.863	0.859	32.445

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-604.914	0.000	-717.457	-492.371
Consumer Price Index	5.758	0.000	4.983	6.534

Shipment Volume$_t$ = 5.758*Consumer Price Index$_{t-3}$ – 604.914

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 2	37	0.908	0.902	175.390

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	-1698.393	0.092	-3688.659	291.873
Consumer Price Index	36.365	0.000	31.409	41.321
Exchange Rate	-33.258	0.050	-66.443	-0.073

Shipment Volume$_t$ = 36.365*Consumer Price Index$_{t-4}$ – 33.258*Exchange Rate$_{t-4}$ – 1698.393

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 3	38	0.785	0.779	102.944

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-1227.910	0.000	-1585.001	-870.819
Consumer Price Index	13.916	0.000	11.455	16.376

Shipment Volume$_t$ = 13.916*Consumer Price Index$_{t-3}$ – 1227.910

Country B: Retail Market Share by Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 1	49	0.951	0.950	21.114

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-560.514	0.000	-610.646	-510.383
Consumer Price Index	5.441	0.000	5.078	5.803

Market Share$_t$ = 5.441*Consumer Price Index$_{t-4}$ – 560.514

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 2	49	0.905	0.901	121.832

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	1275.815	0.000	758.827	1792.804
Consumer Price Index	22.876	0.000	20.632	25.121
Exchange Rate	-68.138	0.000	-80.089	-56.188

$\text{Market Share}_t = 22.876*\text{Consumer Price Index}_{t-4} - 68.138*\text{Exchange Rate}_{t-3} - 1275.815$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 3	49	0.859	0.852	65.406

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-659.155	0.000	-821.070	-497.240
Consumer Price Index	8.780	0.000	7.637	9.923
Oil Price	1.472	0.001	0.614	2.330

$\text{Market Share}_t = 8.780*\text{Consumer Price Index}_{t-4} - 1.472*\text{Oil Price}_{t-2} - 659.155$

Country B: Retail Sales

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 1	49	0.944	0.942	800.793

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-20759.517	0.000	-22741.919	-18777.115
Consumer Price Index	185.376	0.000	171.379	199.372
Oil Price	18.253	0.001	7.747	28.760

$\text{Retail Sales}_t = 185.376*\text{Consumer Price Index}_{t-4} - 18.253*\text{Oil Price}_{t-2} - 20759.517$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 2	51	0.967	0.965	1425.341

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-45111.955	0.000	-54137.505	-36086.404
Consumer Price Index	396.754	0.000	365.123	428.385
Oil Price	46.214	0.002	17.964	74.464
Exchange Rate	230.238	0.033	19.851	440.625

$\text{Retail Sales}_t = 396.754*\text{Consumer Price Index}_{t-2} + 46.214*\text{Oil Price}_{t-2} + 230.238*\text{Exchange Rate}_{t-2} - 45111.955$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country B, Product Segment 3	49	0.875	0.870	1107.594

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-10539.045	0.000	-13280.948	-7797.142
Consumer Price Index	161.969	0.000	142.610	181.327
Oil Price	21.963	0.004	7.431	36.495

$\text{Retail Sales}_t = 161.969 * \text{Consumer Price Index}_{t-4} + 21.963 * \text{Oil Price}_{t-2} - 10539.045$

Country C: Shipment Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 1	39	0.466	0.451	35.442

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-623.096	0.001	-958.083	-288.108
Consumer Price Index	785.307	0.000	505.075	1065.539

$\text{Shipment Volume}_t = 785.307 * \text{Consumer Price Index}_{t-2} - 623.096$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 2	37	0.463	0.448	146.920

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-2745.155	0.001	-4270.648	-1219.662
Consumer Price Index	3464.428	0.000	2183.932	4744.925

$\text{Shipment Volume}_t = 3464.428 * \text{Consumer Price Index}_{t-4} - 2745.155$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 3	38	0.587	0.576	91.413

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	157.214	0.010	39.507	274.921
Average Stock Index	0.128	0.000	0.092	0.164

$\text{Shipment Volume}_t = 0.128 * \text{Average Stock Index}_{t-3} + 157.214$

Country C: Retail Market Share by Volume

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 1	49	0.897	0.890	14.775

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-91.190	0.038	-176.973	-5.407
Average Stock Index	0.051	0.000	0.042	0.060
Consumer Price Index	264.827	0.000	186.628	343.026
Oil Price	-0.619	0.000	-0.902	-0.337

Market Share$_t$ = 0.051*Average Stock Index$_{t-3}$ + 264.827*Consumer Price Index$_{t-4}$ – 0.619*Oil Price$_{t-2}$ – 91.190

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 2	50	0.535	0.525	56.661

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	2327.835	0.000	1997.614	2658.055
Exchange Rate	-26.994	0.000	-34.297	-19.690

Market Share$_t$ = -26.994*Exchange Rate$_{t-3}$ + 2327.835

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 3	49	0.950	0.946	16.183

Variable	Coefficient (in MSU)	P-value	Lower 95%	Upper 95%
Intercept	-236.286	0.000	-328.744	-143.829
Average Stock Index	0.070	0.000	0.061	0.079
Consumer Price Index	473.530	0.000	389.305	557.755
Oil Price	-0.444	0.003	-0.727	-0.162

Market Share$_t$ = 0.070*Average Stock Index$_{t-2}$ + 475.530*Consumer Price Index$_{t-4}$ – 0.444*Oil Price$_{t-2}$ – 236.286

Country C: Retail Sales

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 1	49	0.881	0.873	557.051

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	-4077.828	0.015	-7312.129	-843.527
Average Stock Index	1.606	0.000	1.252	1.960
Consumer Price Index	10330.400	0.000	7382.040	13278.760
Oil Price	-15.092	0.006	-25.728	-4.455

$\text{Retail Sales}_t = 1.606*\text{Average Stock Index}_{t-4} + 10330.400*\text{Consumer Price Index}_{t-4} - 15.092*\text{Oil Price}_{t-2} - 4077.828$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 2	49	0.552	0.533	867.402

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	17534.440	0.000	14615.946	20452.934
Oil Price	43.350	0.000	31.546	55.153
Interest Rate	527.080	0.001	222.039	832.122

$\text{Retail Sales}_t = 43.350*\text{Oil Price}_{t-4} + 527.080*\text{Interest Rate}_{t-2} + 17534.440$

Model	Observations	R Squared	Adjusted R Squared	Standard Error
Country C, Product Segment 3	49	0.925	0.920	500.958

Variable	Coefficient (in MUS$)	P-value	Lower 95%	Upper 95%
Intercept	-5751.367	0.000	-8613.397	-2889.338
Average Stock Index	1.680	0.000	1.391	1.969
Consumer Price Index	13169.020	0.000	10561.827	15776.212
Oil Price	-15.535	0.001	-24.275	-6.794

$\text{Retail Sales}_t = 1.680*\text{Average Stock Index}_{t-2} + 13169.020*\text{Consumer Price Index}_{t-4} - 15.535*\text{Oil Price}_{t-2} - 5751.367$