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Common Trend in WIC and Non WIC Breastfeeding Rate: A Cointegration Approach of Panel and Time Series Data

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COMMON TREND IN WIC AND NON WIC BREASTFEEDING RATE:

A COINTEGRATION APPROACH OF PANEL AND TIME SERIES DATA

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This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science degree in Economics and is acceptable for meeting the dissertation requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABSTRACT

COMMON TREND IN WIC AND NON WIC BREASTFEEDING RATE:

A COINTEGRATION APPROACH OF PANEL AND TIME SERIES DATA

NAZIA AZIM

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This thesis explores the trend of WIC (Women Infants and Children) and non WIC breastfeeding rates in U.S.A. WIC is a special supplemental nutrition program by USDA (United States Department of Agriculture).Time and panel data series have been used for 50 states of U.S.A and D.C (District of Columbia) to analyze the common trend between the two breastfeeding rates (time series data for 35 years and panel data series for 28 years).To determine the common trend, I used residual based cointegration for time series and recently developed error correction based cointegration for panel data series. I also constructed error correction models for both data series to evaluate the speed of adjustments between the two breastfeeding rates. The results suggest the prevalence of a common trend and moreover an upward trend for WIC and non WIC breastfeeding rates which indicates that both breastfeeding rates are growing together over time. The speed of adjustments toward equilibrium is faster in the time series data compared to the panel series data.

CHAPTER-1: INTRODUCTION

1.1 Background

The Women Infants and Children (WIC) program is a special supplemental nutrition program established in 1972 by USDA (United States Department of Agriculture) to implement nutritional benefits to low income pregnant, currently breastfeeding, postpartum women, children and infants who are facing nutritional deficiency. WIC has nearly 9.3 million women and children enrolled up to April 2014 according to the USDA (United States Department of Agriculture) WIC Participant and the Program Characteristics Summary report. By category, there were 76.4% infants, pregnant women were 9.6%, breastfeeding women were 7.4% and 6.6% were non breast feeding postpartum women.

According to Oliveira et al, there are some participant eligibility requirements to qualify for the WIC program. Categorical eligibility requirements among the participants which are a pregnant woman, a non breastfeeding woman up to 6 months postpartum, a breastfeeding woman up to 1 year postpartum, one year old infant or up to 5 years old child. Residential eligibility requires the participant to stay within their state where they are qualified for the eligibility. The requirement of income eligibility is as follows,

"The family income of WIC applicants must meet specified guidelines. All WIC State agencies currently set the income cutoff at the maximum 185 percent of the Federal poverty guidelines set each year by the U.S. Department of Health and Human Services (e.g., annual income of $44,123 for a family of 4 living in the 48 contiguous States as of July 1, 2014) Either the income of the family during the past 12 months or the family's current rate of income may be used to determine an applicant's income eligibility—whichever most accurately reflects the family's status" (Oliveira et al. 2015, page 3).

There are three kinds of assistance offered by WIC to the participants, a supplemental food package, education on nutrition and referrals to health care and other heath related services. All of these assistance types are free of monetary cost.

Three kinds of food delivery systems are offered by WIC as well. One is retail where in exchange of food instruments, i.e ,check, vouchers, EBT (Electronic Benefit Transfer), participants get a WIC supplemental food package at the retail stores or vendors which are authorized by WIC state agencies. Second is home delivery, where the supplemental food is directly delivered to the home of the participants. Third is direct distribution, where the WIC participants pick the food package directly from assigned storage facilities which are operated by a WIC state or local agency.

According to Whaley et al. (2012), WIC is one of the dominant health nutrition programs existing in USA. It is a federal grant program which means a specified amount of funding is allocated each year for the WIC operations by Congress.

To counter the low breastfeeding rate among the WIC participants, in 1989 P.L 101-147, Congress allocated $8 million for the promotion of breastfeeding. Private health service providers and the federal government started promoting breastfeeding as the best form of feeding for infants.

Tenfelde et al. (2011) mentioned in their paper that the Child Nutrition and WIC Reauthorization Act of 1989 made it compulsory to include the support of breastfeeding in the WIC budget in response to the recommendation by the American Academy of Pediatrics and numerous scientific evidences in favor of breastfeeding.

In 1992, to encourage more exclusive breastfeeding WIC introduced an enhanced food package for exclusively breastfeeding mothers. In 1997, the National Breastfeeding Promotion Campaign was held by USDA (United States Department of Agriculture) to motivate and support WIC mothers to initiate and continue breastfeeding (Oliveira et al., 2002)

1.2 Objective

The primary objective of this thesis is to identify trends of WIC breastfeeding rates and non WIC breastfeeding rates in the USA. To investigate this objective, I use both aggregated time-series data and panel data of these two breastfeeding rates, and analyze if there exists a common trend, or whether they are distorting, or growing apart from each other.

The specific objectives of this thesis are first to analyze if there is a unit root in the two variables (WIC breastfeeding rate and non WIC breastfeeding rate), then to check for cointegration between them, after that, constructing an error correction model for analyzing the dynamics of the variables, and lastly testing for a common trend between the two variables (WIC breastfeeding rate and non WIC breastfeeding rate).

1.3 Justification

There has been a lot of research done measuring the impact of the WIC program on infants, maternal and postpartum women health and variables that are affecting them. This thesis will make a contribution to the existing literature in several ways. First, this thesis utilizes a rich time series and panel data series covering all 50 states of U.S.A and D.C (District of Columbia) for a significant amount of time (time series data for 35 years and panel data series for 28 years). These vast data series will give a holistic analysis of the changes in these two breastfeeding rates. Second, I will use a recently developed error correction based cointegration test for panel data and panel unit root tests to establish the long run relationship between WIC breastfeeding rates and non WIC breastfeeding rates. And lastly, this research will develop a better understanding of the pattern of WIC and non WIC breastfeeding rates in U.S, and whether these rates are following a similar path, or not, over time.

1.4 Structure of the thesis

This thesis is comprised of five chapters. Chapter two reviews the existing literature relevant to WIC and non WIC breastfeeding rates. Chapter three describes the data source, and the theoretical and the empirical models used for the analysis. Chapter four provides the empirical findings of the unit root tests, cointegration, and error correction models. The final chapter presents the conclusions as well as recommendations for future study on this issue.

CHAPTER-2: LITERATURE REVIEW

2.1 Benefits of breastfeeding

Breast milk is considered to be the most advantageous food for infants. For the proper growth and the development for infants, breast milk has the perfect combination of nutrients and vitamins. All the major health organizations, like WHO (World Health Organization), AAP (American Academy of Pediatrics), American Academy of Family Physicians and American Dietetic Society, have recommended that mothers should breastfeed exclusively for the first 6 months of an infant's life. Breastfeeding has numerous benefits for the nourishment of a child's life along with establishing a loving bond between a mother and her infant. In this part of my literature review I will discuss some of the benefits of breastfeeding.

Prado and Dewey (2014) mentioned in their paper that essential nutrients, hormones, and several growth factors which are important for the development of the brain are present in breast milk. It helps to improve the mental development of infants as well. They also argued that breastfeeding infants induce good hormones in mothers which eventually may reduce stress and postpartum depression. Infant interaction and improvement in caregivingness also developed due to breastfeeding infants.

A research conducted in Brown University (2013) found that the babies who are exclusively breastfed for at least three months compared to exclusively formula fed or partially breast fed babies within two years of age, have better brain development. The brain development was particularly related to emotional behavior, language, and intelligence.

A policy statement named ‘Breastfeeding and Use of Human Milk’ published by the American Academy of Pediatrics mentioned that research found a very prominent evidence that breastfeeding reduces mortality rates of infants and reduces many infectious diseases such as, necrotizing enterocolitis and otitis media. Infections in infants such as respiratory tract infections, urinary tract infections and bacterial borne diseases such as bacterial meningitis, bacteremia, diarrhea, and late onset sepsis in preterm infants were also reduced due to breastfeeding.

2.2 WIC participation and breastfeeding rates

Over time, the breastfeeding rate has been increasing in the U.S. But since the beginning of the WIC program, the WIC breastfeeding rate is lower than the non WIC breastfeeding rate. Several studies have been done on this particular issue. One school of thought argues that WIC’s introduction of formula feeding is motivating mothers to breastfeed less. On the contrary, the other school of thought is that unobserved factors create a bias for WIC mothers to breastfeed less. In this particular section of my literature review I will be discussing both sides of this argument.

Oliveira and Frazao (2015) mentioned that WIC provides free infant formula to mothers of infants who do not want to breastfeed their infants exclusively. Although, WIC encourages breastfeeding as a primary feeding method for infants. Over time, the lower percentage of breastfeeding rates of WIC participants compared to non WIC participants has raised some concerns whether free infant formula is motivating women to switch to it. The authors also gave the example of the recent data on breastfeeding from the NIS (National Immunization Survey) where they mentioned that in 2007 the WIC breastfeeding rate was 67.5 percent, the breastfeeding rate was 77.5 percent for non

WIC women that were eligible for the program and this rate was 84.6 percent for mothers not eligible for the WIC program.

Jiang et al. (2010) explained that the selection bias among the WIC participants is playing a very crucial role and affecting the estimates of the breastfeeding rates. Their results were estimated by the propensity score method and fixed effects analysis, rather than a simple OLS method (ordinary least squares). And they conclude that socio demographic conditions of WIC participants have a significant impact for lower breastfeeding rates among them. The authors also argued that the trend of WIC breastfeeding rates is higher than the non WIC one because of the slightly higher coefficients among WIC mothers. Additionally women who already decided not to breast feed their children tend to enroll in WIC as they have already determined to use formula anyway, so it creates a downward biased estimation.

To solve these issues, instrumental variables (IV) have been used to investigate the relationship between WIC and non WIC breastfeeding rates. Different researchers use different instrument variables to validate their estimations. Bitler and Currie (2005) assigned state-wise WIC characteristics as instrument variables (I V), where this IV will affect the WIC participation but will not directly affect the breastfeeding rate. But they conclude this IV to be a ‘weak’ estimator as it could not predict the WIC participation as expected.

Rossin-Slater (2013) used an instrumental variable-maternal fixed effects (IV-FE) approach to measure the impact of access to WIC clinics on the breastfeeding rate, maternal characteristics, prenatal food benefit usage, pregnancy behavior, and birth outcomes among infants. An open WIC clinic during the current pregnancy of the mother was used as an instrument where the researcher assumed that she is living at the first ZIP code when she was observed and her pregnancy lasted for 39 weeks. This instrument is correlated with the mother's actual residential ZIP code and the length of her current pregnancy but independent from the other factors like birth outcome, maternal characteristics and pregnancy behavior which makes it a strong IV. The researcher concludes that there prevails a positive and significant growth in the breastfeeding rate for WIC mothers if the mother has a high school education or less.

In link with the above findings, Ryan and Zhou (2006) analyzed the reason that the WIC campaign has not improved breastfeeding drastically because the program was not responsible for the depressed breastfeeding rate in the first place. As long as the bias towards formula feeding among WIC mothers does not change, the lower breastfeeding rate will continue to remain.

Fischer and Olson (2014) conducted a qualitative study to analyze the decision making process for mothers to breast feed in the context of their cultural factors. The analysis was based on focus group discussions and one-to-one interviews of 42 pregnant women, or mothers of children less than 12 months of age. The researchers found that the perception towards breastfeeding or formula feeding is different between WIC mothers and non WIC mothers. Both types of women acknowledged that breast milk is the ideal form of nutrition and they want to pursue breastfeeding for the wellbeing of their infants. Hence the focus group discussions and interviews shed light on the different factors that are affecting WIC and non WIC eligible mothers' attitudes toward breastfeeding and formula feeding. WIC eligible mothers expressed that the use of formula was necessary when they faced some barriers toward breastfeeding. Problems such as returning to work after the maternity leave, workplace support, and pumping logistics were some of the struggles WIC women mentioned. Though non WIC women mentioned similar difficulties, their mind set to overcome these situations was creative and pertinent. Creating breastfeeding plans, seeking mentors, and setting small goals for breastfeeding were some of the solutions non WIC mothers plan to take to overcome the challenges.

A WIC infant feeding practices study was conducted in 1997 based on a longitudinal interview where 874 WIC mothers participated during their pregnancy. The study showed that Whites and Hispanics have a higher rate of breastfeeding compared to African Americans, and that half of the mothers initiated breastfeeding. Single young mothers (who are less than 20 years old), U.S. citizens, and those who had never been married intend to breastfeed less to their infants compare to other mothers. When the mother breastfed their first born it increased the likelihood of the other children to be breastfed as well.

Similar findings have been found where the researchers found that the less-educated, younger, U.S. citizen mothers intend to breastfeed less compared to other mothers (M.E Bentley et al. 1998). Perception and the attitude towards breastfeeding, past experience of breastfeeding and the social and the family support play a very important role in the intention and duration of breastfeeding in low income mothers. (Bentley et al. 1998, Miner et al. 1998)

Bulinger et al. (2015) analyzed a longitudinal study of mothers and their infants where the researchers focused on WIC participation and their breastfeeding outcomes.

The study used a complementary IV method where grocery price differences among different markets have been used as a predictor of WIC participation. The researchers concluded that WIC participation decreases the exclusively breastfeeding rate by almost 4 weeks and increases the work leave duration about 3 weeks.

2.3 The promotion and support of breastfeeding in WIC

Breastfeeding is the most important source of nutrients to infants. WIC has made several efforts to improve the breastfeeding practice among mothers who have low income at local, state and federal levels by promoting breastfeeding. For mothers who exclusively breastfeed, a new enhanced food package was introduced in 1992. Before 1992, mothers who exclusively breastfeed did not get infant formula, and thus got less costly food packages compared to other mothers.

Chatterji et al. (2002) mentioned in their paper, the improved food package for the mother who exclusively breastfed included extra juice of 1.36 liters, 1 pound cheese, 2 pounds of carrots, 1 pound of drybeans/peas/peanut butter, and 26 ounces of canned tuna. These are the food items that were included in the food package for the mothers who chose exclusive breastfeeding over infant formula. These food items were rich in vitamin A among other nutrients and were available for the whole year. This food package was worth $38-$47 per month according to the final report published in 1996 by USDA in a study of WIC participants and program characteristics. The cost saving approach and the high nutritional value made the breastfeeding promotion in WIC mandatory according to the American Academy of Pediatrics (n. d)

Along with the nutritional food package, WIC started breastfeeding promotion to increase the breastfeeding rate. A major change came in 1994 when the federal government made some policies compulsory such as designating breastfeeding coordinators, appointing and training nutrition counselors on breastfeeding management, and developing non-English breastfeeding materials for Hispanic mothers. Along with these initiations, breastfeeding promotion materials were distributed to local WIC clinics and studies were designed to increase breastfeeding awareness among WIC mothers. Along with nutritional counseling, these efforts were taken further when the Healthy Meals for Healthy Americans Act was passed increasing WIC funding from $8 million to $20 million to promote breastfeeding in the USA. This act also required WIC to report the increasing breastfeeding rate to Congress (Bayder et al. 1997).

In 2009, a revised food package in WIC has been implemented and since then there has been acceleration in the breastfeeding rate in WIC participants (Oliviera et al, 2015).

Langellier et al. (2014) argued that the new revised food package has increased exclusive breastfeeding significantly at three to six months, and the initiation of breastfeeding has increased as well. To encourage breastfeeding exclusively, infant formula was not included in the revised food package for the birth month as it is very important to make sure that there is sufficient milk supply. According to Missouri Department of Health and Senior Services, (n. d.) less formula is given to partially breastfed infants to enhance the opportunity to be breastfed more, and from six months of age all infants start receiving infant foods.

Ahluwalia et al. (2000) report in a study conducted on WIC participants in Georgia that breastfeeding initiation increased after introduction of new WIC strategies, such as loans to buy breastfeeding pumps, peer-to-peer counseling, and counseling in hospitals after giving birth. Though there has been a significant increase in breastfeeding rates for those who were introduced to new strategies between 1992 and 1996 rather than those who participated in the standard structure, the participants were not randomly selected based on their characteristics (i.e. income and education). So there prevails an important difference in the results for what type of intervention is affecting the breastfeeding rate among WIC participants.

Schwartz et al. (1995) analyzed cross sectional data using the National Maternal and Infant Health Survey conducted in 1988. In their research they looked for the impact on breastfeeding among WIC participants. They found that the breastfeeding initiation among WIC participants increased when WIC participants were given breastfeeding advice. However after the authors controlled for self-selection bias they found a negative relationship in WIC participants and breastfeeding initiation. Similarly Balcazar et al. (1995) concluded that, compared to other mothers WIC mothers are less likely to breastfeed their children after enrolling in the WIC program. These striking findings from different researchers point out that the advices given to WIC program participants have a very significant effect on infant breastfeeding and formula feeding decisions.

According to the WIC participants and Program Characteristics summary report published in 2014 by FNS (Food and Nutrition Service) breastfeeding initiation has increased among the participants compared to the 2012 report. The breastfeeding data for 2014 reported that there has been two percentages increase in the 6 to 13 months old infants who were ever or currently breastfed in the WIC program compared to the data of 2012. The median duration of the breastfeeding according to the report was 13 weeks, with significant variation existing across U.S. states.

CHAPTER-3: EMPIRICAL METHODOLOGY

3.1 Data Source

This study of the relationship between non WIC breastfeeding rate and WIC breastfeeding rate in the U.S. is done in two parts. One consists of examining time-series data and another examines panel data.

The aggregated time series data are for 1978 to 2013 of both WIC and non WIC breastfeeding rates in the U.S. consolidating all 50 states and D.C. (District of Columbia). The source of the data is Ross Mother's Survey and NIS (National Immunization Survey). For 1978-2003 the data are from Ross Mother's Survey and 2003-2013 from NIS.

National Immunization Survey (NIS) provides recent data on the estimation of vaccination coverage rates for children of ages between 19 to 35 months in the U.S. To evaluate breastfeeding practices the NIS have had breastfeeding questions in their questionnaire since July 2001. Ross Laboratories Mother's Survey (RMLS) is a major source of data for analyzing breastfeeding data in U.S.A for last three decades. It conducts a large national mail survey which is designed to discover infant feeding practices for infants up to the age of 6 months.

The panel data are from 1987 to 2015 of the same two variables for 50 states and D.C (District of Columbia) in the U.S. I combined the panel data from both Ross Mother's Survey and NIS (National Immunization Survey). From 1987 to 2002 the panel data are from Ross Mother's Survey and from 2003-2015 the data are from NIS.

I analyzed the 6-month breastfeeding rate. Ross Mother's Survey and NIS report breastfeeding for all mothers and WIC mothers. Non WIC breastfeeding rate is calculated from total breastfeeding rate and WIC breastfeeding rate using the data from Ross Mother's Survey and NIS report. Then I used the below weighted average formula to refine my data,

$$TotalBreastFeedingRate = \theta WICBFRates + (1-\theta)NonWICBFrates.$$

Here, $\theta = \frac{WICInfants}{TotalBirt\ hs}$ and $1-\theta = \frac{TotalBirt\ h - WICInfants}{TotalBirt\ hs}$.

In the above formula, the data for total births and WIC infants has been collected from FNS (Food and Nutrition Service) and NIS (National Immunization Survey).

From the above equation the non WIC breastfeeding rate is calculated,

$$NonWICBFrates = \frac{TotalBreastFeedingRate \quad -\theta WICBFRates}{(1-\theta)}.$$

From the NIS data, I got the total breastfeeding rate and breastfeeding rate among the WIC participants

3.2 Graph Explanation

I begin my thesis research plotting the secondary time series data that I have for aggregated WIC and non WIC breastfeeding rates of the U.S. from 1978 to 2013. I plotted it to get an idea for how the time series data appear in a graph. This will help me to draw some conclusions for my in- depth analysis and defend the reasons for the research. Figure 1 is the representation of the time series data that plots WIC and non WIC breastfeeding rates against time. The first thing that becomes apparent is the upward trend for both breastfeeding rates. Thus, the time series are likely not to be stationary. Non stationarity means the variables have means, covariances, and variances that do not depend on time. There exists a very visible upward trend in both rates over time. The top line of the graph is the breast feeding rate of the mother's who are not enrolled in the WIC program. The bottom dashed line is the WIC mothers' breastfeeding rate. From the graph it is apparent that the both rates are growing over time though there remains a consistent gap between them.

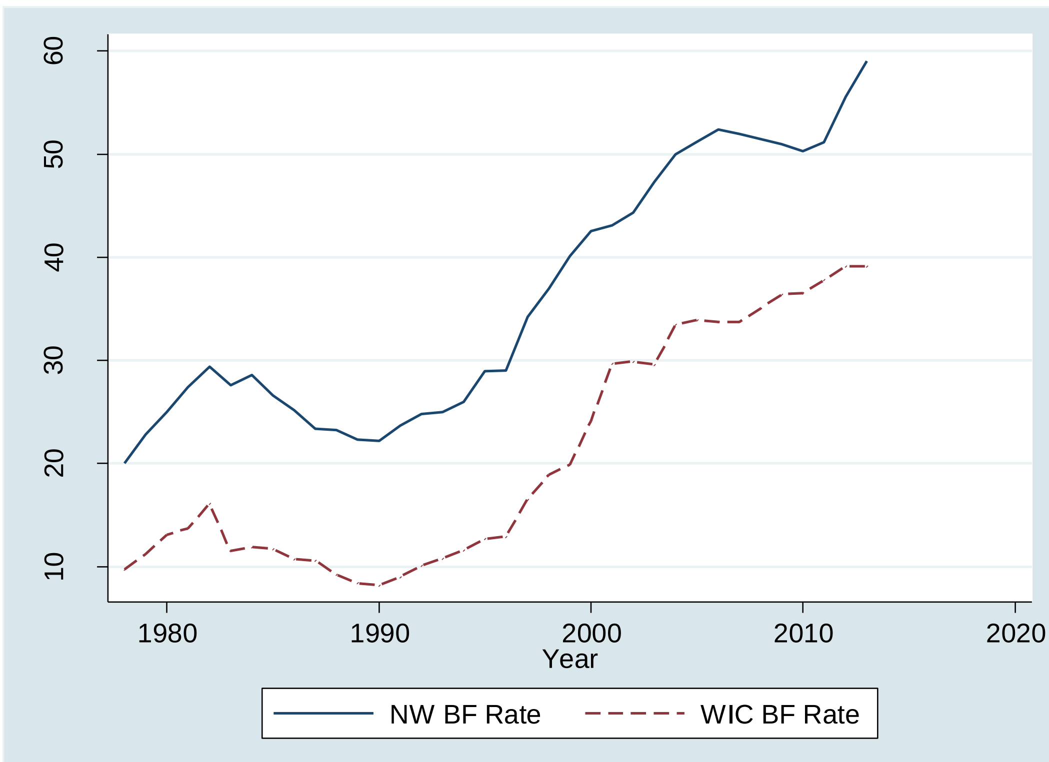

Figure 1: Time Series Graph

Figure 2 represents the panel data that plots WIC and non WIC breastfeeding rates against time. As it is a panel data set I took an average of every year for 50 states and D.C. (District of Columbia) for both breastfeeding rates. This graph also shows the upward trend for both breastfeeding rates in the panel data set.The top line of the graph is non WIC breastfeeding rate and the bottom dashed line is WIC breastfeeding rate. So both graphs look very similar and it is visible that the both rates are growing over time together.

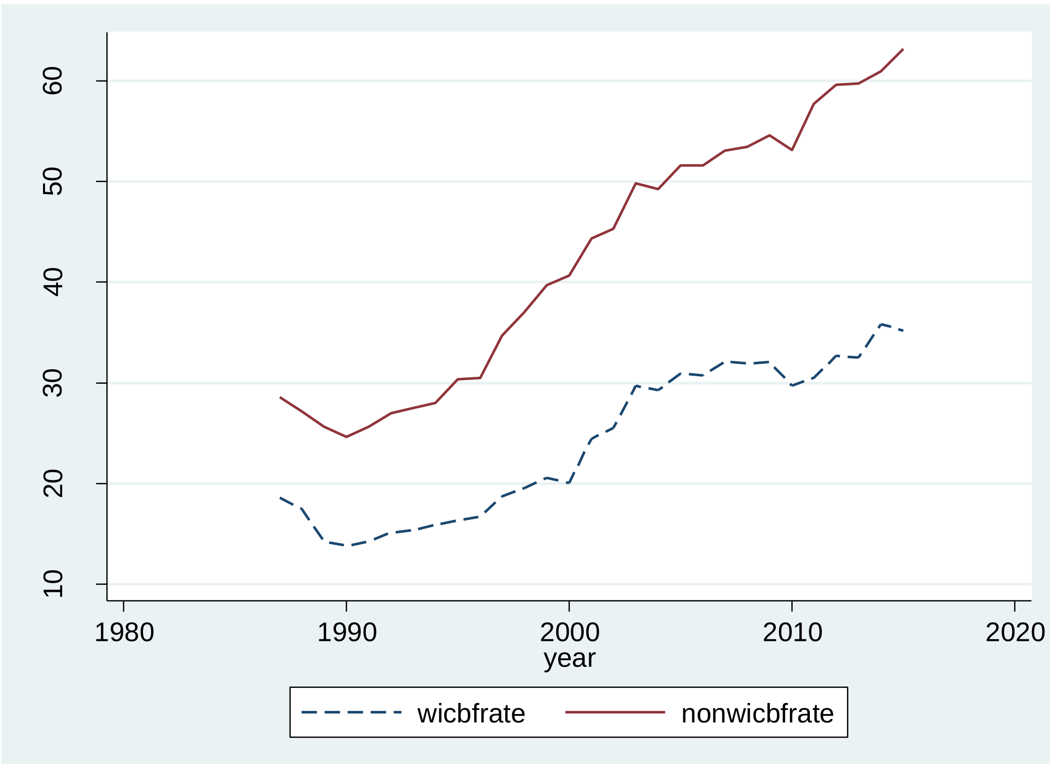

Figure 2: Yearly Average Panel Graph

3.2 Common Trend

Both WIC and non WIC breast feeding rates have been increasing since the beginning of the WIC program. Some authors claim that WIC is not promoting breastfeeding as the program offers free formula for eligible people. To analyze the research objective I am considering both time series and panel data of these variables to test whether both variables share a common trend.

The main objective of this thesis is to analyze whether the WIC breastfeeding rate and the non WIC breastfeeding rate in USA have a common trend. William H. Greene in his book Econometric Analysis (Fourth Edition) stated that, if two variables of $I(1)$ are cointegrated with each other then the linear combination of them is $I(0)$.

Stock and Watson (1988) observed that cointegrated variables must share a common stochastic trend. It provides a way to understand the cointegrating relationship between WIC and Non WIC breastfeeding rates in my thesis.

Following Greene (2000) consider,

Two $I(1)$ variables that have a linear trend,

$$y_{1t} = \alpha + \beta t + u_t$$

$$y_{2t} = \gamma + \delta t + v_t$$

Here, u_t and v_t are error terms in the regression, and the linear combination of these two variables y_{1t} and y_{2t} with vector (1, θ) will create another variable which will be,

$$z_t = (\alpha + \theta\delta) + (\beta + \theta\delta)t + u_t + \theta v_t$$

Here z_t will be $I(1)$ in general. But if $\theta = -\frac{\beta}{\delta}$ then z_t series will be stationary. So the cointegration of y_{1t} and y_{2t} indicates that these two variables share the same path. According to Greene, if there exists m cointegrated $I(1)$ series and the rank of cointegraton is $r < m$, then the series will have $m - r$ common trends. In my thesis, as there are two stochastic trends of WIC and non WIC breastfeeding rates I am expecting there will exist one conitegrated $I(1)$ series, thus the series will share one common trend.

3.3 Time Series Data Analysis

3.3.1 Unit root test

The behavior of WIC and non WIC breastfeeding rate in USA for 36 years (1978-2013) in the time series data is examined using unit root and cointegration tests followed by an error correction model.

Following Wooldridge (2000), the main analogy is to test that WIC and Non WIC breastfeeding rates have a random walk, where a value of a variable is equal to its previous value with the addition of a stochastic term. In this case, a time series is said to be non stationary and contains a unit root.

I used Dickey-Fuller (DF) and Augmented Dickey Fuller (ADF) tests to check for stationarity, and whether there is a unit root present in the two time series of data. I also used the Phillips Peron test as it is more reliable than ADF test. I then compare the consistency of the results between the tests.

3.3.2 Dickey Fuller and Augmented Dickey Fuller test

The Dickey Fuller test (1979) is one of the most frequently used tests to detect a unit root. This test was constructed on the basis of the model of first order autoregressive process (Box Jenkins, 1970).

In equation (1) below the null hypothesis of the unit root test would be

$H_0 : \rho_0 = 1$ and the alternative hypothesis would be $H_1 : |\rho_1| < 1$. Here it is assumed that the constant term α and the error term ε_t have a zero mean, constant variance and they are both independently normally distributed around the mean.

$$y_t = \alpha + \rho y_{t-1} + \varepsilon_t \qquad (1)$$

The null hypothesis of the unit root test where ρ_0 =1 will imply that the WIC and non WIC breastfeeding rates individually follow a random walk, and if the constant term is not zero then there will be a drift. So WIC and non WIC breastfeeding rates will be nonstationary processes under the null hypothesis. The alternative hypothesis would be the WIC and non WIC breastfeeding rates will change around a constant level in the long run.

Equation (1) with a unit root test suggests the possibility of the presence of a deterministic trend in WIC & Non WIC breastfeeding rates. Spurious correlation could be present in a regression analysis if the presence of unit root is detected which eventually leads to overestimation of t value statistics and adjusted R^2 values in a model. So the problem of spurious regression may be solved if a time trend parameter is added to a model.

So I change equation (1) to equation (2) below after adding a time trend,

$$y_t = \alpha + \delta_t + \theta y_{t-1} + \varepsilon_t \qquad (2)$$

From equation (2), the null hypothesis that θ =1 depicts that WIC and non WIC breastfeeding rates have a unit root, and they progress as a random walk around a deterministic trend.

3.3.3 Philips Peron Test

In the regression model, the problem of selection of lags arises frequently while testing for the unit roots because usually the unit root test consists of heteroscedastic components. To deal with this situation Philip Perron (1988) used the standard Dickey Fuller test with non parametrically modified test statistics replacing the related autocorrelation model. They used a centered time variable instead of a linear trend which is used in the Dickey Fuller test. So in my thesis I used these two unit root tests to detect any deviation of results in the stationarity of WIC and non WIC breastfeeding rates.

3.3.4 Residual Based Cointegration Test

There is a possibility of arising spurious regression if two nonstationary variables are regressed on each other. Granger and Newbold (1974) identified the spurious regression problem. They showed through a simulation that even though two variables are independent from each other, large significant t statistics can be found when one variable is regressed on another one. The problem of spurious regression is that it leads to unreliable estimation results. To test the correlation between two non stationary variables, a very useful econometric technique named cointegration has been used extensively. In general, a series is cointegrated when two or more than two variables are nonstationary, but a linear combination of them is stationary.

Engel and Granger (1987) suggested the most well known test for cointegration.

Considering the model,

$$y_t = \beta x_t + \varepsilon_t \quad (3)$$

I will assume that the variables y_t & x_t are cointegrated of order one, or *I* (1), and both are non stationary. First of all, I will estimate equation (3) above using OLS method and will save the residuals of the regression ε_t ˆ . For selecting the optimal lag for the ADF (Augmented Dickey Fuller) unit root, as it is very lag sensitive, I will use DFGLS (Dickey Fuller Generalized Least Square) method to determine the optimal lag for the ADF (Augmented Dickey Fuller)unit root test. Then I will perform the Augmented Dickey Fuller unit root test on ε_t ˆ .

$$\varepsilon_t = \alpha + \delta_t + \theta\varepsilon_{t-1} + u_t \quad (4)$$

As mentioned before, the deterministic trend component δ_t is added to solve the problem of spurious regression in my model.

The null and the alternative hypothesis for the above equation (4) would be

H_0: ε_t ˆ = *I* (1): The nonstationary variables are not cointegrated

H_1: ε_t ˆ = *I* (0): The nonstationary variables are cointegrated

Under the null hypothesis the residuals are non stationary and there prevails a unit root in the residuals in the probable cointegrating regression. If we reject the null it will state that the non stationary variables are cointegrated with each other which means that among the non stationary variables there exists a stationary linear combination. And the alternative hypothesis would be the residuals are stationary and the non stationary variables are not cointegrated with each other.

3.3.5 Error Correction Model

To estimate an error correction model among two variables, they must be cointegrated with each other. The error correction model is an estimation process that estimates the speed of adjustment of the explained variable (*y)* to equilibrium after a change in an explanatory variable (*x)*. In other words, the speed at which the y variable returns to the equilibrium after a change in the x variable.

According to Wooldridge (2000), when the two time series are non stationary, cointegrated and integrated in the same order, then the error correction model is appropriate to estimate the potential long run relationship between two series.

Following Wooldridge (2000),

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + \gamma_0 \Delta x_t + \gamma_1 \Delta x_{t-1} + u_t \quad (5)$$

where Δy_t is the change in y_t, Δx_t is the change in x_t and u_t has a zero mean.

If y_t and x_t are cointegrated with an additional *I(0)* parameter β then equation (5) can be restructured.

Assume, $s_t = y_t - \beta x_t$

Where, s_t is *I(0)* and has a zero mean. Now we include only one lag of s_t for the simplicity of our regression and transform equation (5) to:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + \gamma_0 \Delta x_t + \gamma_1 \Delta x_{t-1} + \delta s_{t-1} + u_t$$

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta y_{t-1} + \gamma_0 \Delta x_t + \gamma_1 \Delta x_{t-1} + \delta(y_{t-1} - \beta x_{t-1}) + u_t \qquad (6)$$

Here the term $\delta(y_{t-1} - \beta x_{t-1})$ is called the error correction term and the equation (6) is called the error correction model. And the E ($u_t \mid I_{t-1}$) = 0 and I_{t-1} contains all the information on changes in x_t and the all the previous values of x and y.

The advantage of using an error correction model is to analyze the short run dynamics in the relationship between the x and y variables. If we consider our equation (6) without any lags of Δy_t and Δx_t then it can be transformed as below,

$$\Delta y_t = \alpha_0 + \gamma_0 \Delta x_t + \delta(y_{t-1} - \beta x_{t-1}) + u_t \qquad (7)$$

where $\delta<0$.The rationale of δ is as follows,

When $\delta<0$ then $y_{t-1} > \beta x_{t-1}$ it means that the previous period y has overshot the equilibrium and the error correction term is pushing back the y towards the equilibrium as the error correction term is negative.

When the error correction term is positive, then $y_{t-1} < \beta x_{t-1}$, and it means that it is creating a positive change in y to bring it back to the equilibrium.

To estimate equation (6), Δy_t needs to be regressed on Δx_t and s_{t-1}. And the significance of the coefficient of the error correction term should be tested.

3.4 Panel Data Analysis

The attributes of non WIC and WIC breastfeeding rates in USA can be determined by using the properties of stationarity and the cointegration approach. Campbell and Perron (1991) mentioned in their paper that the standard unit root and cointegration test might under perform for some major cases. Engel and Granger (1987) asserted that, OLS and GLS on non stationary variables can result in misspecified and spurious regressions.

Another article by Granger and Newbold (1974) mentioned that there is a possibility of committing a Type I error in those regressions as they produce high t-statistics and R^2. So for the analysis of panel data, I used a recent panel unit root test and cointegration test to get more accurate results. For the panel unit root tests I have used Levin, Lin, Chu (2002) as it is more powerful and less likely to accept Type II errors.

Baltagi (2001) argued that the panel unit root tests have the advantage to report the statistics with a normal distributions in the limit in contrast to the individual unit root test that leads to complicated limiting distributions.

3.4.1 Panel Unit Root Test

Recently Levin, Lin and Chu (2002) have developed a panel based unit root test which is more convenient to use rather than the tests on single series. They have shown that these panel tests have more power than the usual unit root test carried out on a single series.

Levin, Lin and Chu (2002) used Augmented Dickey Fuller (ADF) specifications for each of the cross sections as in equation (8),

$$\Delta NW_{i,t} = a_i \Delta NW_{i,t-1} + \delta W_{it} + \sum_{j=1}^{p_i} \beta_{ij} \, \Delta NW_{i,t-j} + \varepsilon_{it} \quad (8)$$

Where, $NW_{i,t}$ is the pooled variable, W_{it} is the exogenous variable and ε_{it} is an error term which is independent from any disturbances.

This test follows the below hypothesis

$H_0 =$ Panel contains a unit root

$H_1 =$ Panels are stationary

According to the authors, the test performs well when N varies between 10 and 250 and when T varies between 5 and 250. The justification for using this particular test in my thesis is that I have N= 51 states and D.C (District of Columbia) and t=28 years in my panel data. So, the test should perform well.

3.4.2 Panel Cointegration Tests

For checking the long run relationship between WIC and non WIC breast feeding rates I used the error correction based cointegration tests for panel data by Westerlund and Persyn (2008). The authors of this method proposed four new panel tests where the null hypothesis implies no cointegration and any common factor restrictions are not imposed. These panel tests are based on structural dynamics rather than residual dynamics which was developed by Pedroni (2004). Among the four panel tests, two methods are developed to test the alternative hypothesis that the panel is cointegrated as a whole and the other two methods test the alternative hypothesis that there is at least one individual unit which is cointegrated. So to be concise, these panel tests will detect the lack of cointegration by taking into account whether error correction exists for the whole panel data set or for the individual units of the panel data. When the null hypothesis of no cointegration is rejected then simultaneously the null hypothesis of no error correction is also rejected at all significant levels.

Following Westerlund and Pyerson (2008), the error correction test assumes the following data generating process:

$$\Delta y_{i,t} = \delta_i^{'} d_t + \alpha_i \left(y_{i,t-1} - \beta_i^{'} x_{i,t-1} \right) + \sum_{j=1}^{p_i} \alpha_{it-j} + \sum_{j=qt}^{p_{t-1}} \gamma_{ij} \, \Delta x_{i,t-j} + \varepsilon_{it} \quad (9)$$

In the above equation,t= 1,……T and i=1,……N denote the time series and cross sectional units. Here d_t contains the deterministic components. There are three possible cases according to the authors of the paper.

Case 1: $d_{t\,=}$ 0 where equation (8) has no deterministic trend

Case 2: d_t = 1 where equation (8) has a constant but no trend

Case 3: d_t = (1, t) where equation (8) has both constant a trend

Now the equation (9) can be written as below,

$$\Delta y_{i,t} = \delta_i^{'} d_t + \alpha_i \left(y_{i,t-1} - \gamma_i^{'} x_{i,t-1} \right) + \sum_{j=1}^{p_t} \alpha_{ij} \Delta y_{i,t-j} + \sum_{j=qt}^{p_{t-1}} \gamma_{ij} \, \Delta x_{i,t-j} + \varepsilon_{it} \quad (10)$$

Here, $\gamma_i^{'} = -\alpha_i \beta_i^{'}$

For my thesis, I am considering the below model for the tests of panel cointegration following Westurland and Pyerson (2008),

$$\Delta NW_{i,t} = a_i + \delta_i(NW_{i,t-1} - \beta W_{i,t-1}) + \sum_{j=1}^{p_t} \gamma_{ij}\, \Delta NW_{i,t-j} + \sum_{j=1}^{p_i} \theta_{ij}\, \Delta W_{i,t-j} + \varepsilon_{it}$$

(10)

In my thesis, I am replacing y_{it} with non WIC breastfeeding rate of state *i* at time *t* and x_{it} with WIC breastfeeding rate of state *i* at time *t* In the above equation. Here,δ_i is the error correction term and it will estimate the speed of adjustment of non WIC breast feeding rate towards its equilibrium for state *i* at time *t* and ε_{it} is the error term.

As mentioned before Westurland (2007), suggested four different panel cointegration test inferences which are G_a, G_t, P_a, P_t. These values are normally distributed and based on the Error Correction Term. Here, P_a, P_t are the panel tests which are inferred from the estimate of δ_i for the whole panel data set and the value G_a, G_t are the group mean tests that are inferred from the weighted sum of the δ_i estimated for the individual states in USA.

Based on Newey and West (1994) standard errors, G_a, P_a are calculated and adjusted for heteroscedasticity and autocorrelations where as G_t, P_t are calculated with the standard errors of δ_i . In the model it is assumed that all the variables are integrated in order 1 (i. e $I(1)$). According to Westerlund (2007) the tests will check the presence of cointegration based on the presence of error correction term in the whole panel or for the individual panel sets.

In equation (10), when δ_i<0 it indicates error correction is present in the regression and WIC and non WIC breastfeeding rate are cointegrated with each other. On the contrary, when δ_i = 0 then there is no error correction and no cointegration present in the model.

So the null and alternative hypothesis of the group mean test (G_a, G_t)will be as follows,

$$H_0^G = \delta_i = 0, \text{ for all the states } (i)$$

$$H_1^G = \delta_i < 0, \text{ for at least one state } (i)$$

Here the rejection of the null hypothesis (H_0^G) will indicate that there is a cointegration between WIC and non WIC breast feeding rate for at least one state in USA.

And the null and alternative hypothesis of the panel test (P_a, P_t) will be as follows,

$$H_0^p = \delta = 0$$

$$H_1^p = \delta < 0$$

As the panel tests assumes, $\delta_i = \delta$ for all the states. So the rejection of the null hypothesis will indicate that there is a cointegration between WIC and non WIC breast feeding rates for the panel as a whole.

CHAPTER -4: EMPIRICAL RESULTS

4.1 Results of the Time Series Analysis

For the time series analysis I used the data of 35 years for WIC and non WIC breastfeeding rates in USA. As mentioned, I plotted the time series and the panel data and there was a very clear indication of upward trends for both non WIC and WIC breastfeeding rates over time. It is very important to test for the non stationarity before estimating a model. If the two variables are non stationary in a series the problem of spurious regression can occur. Spurious regression occurs when one non stationary variable is regressed on a completely different non stationary variable but we get a relative high R^2 which is the indication of a good fit of a model. Inferences made using t-stats and F-stats are most likely to be irrelevant in hypothesis testing as the non stationary data does not have a finite mean or variance.

TABLE 1: THE RESULTS FROM ADF FOR NON WIC BREASTFEEDING RATE

Null Hypothesis : the series contains a unit root Lag length : 1 Number of obs : 34			
		t-Statistic	
Augmented Dickey-Fuller Test Statistic		-1.740	
Test Critical Values : 1% level		-4.297	
5% level		-3.564	
10% level		-3.218	
Mackinnon Approximate p-value for Z(t) =		.7331	
Dependent Variable = D. nonwicbfrate			
	Coefficient	Std.Error	P>|t|
Nonwicbfrate Lagged One	.0950212	.054621	.0165296
LD	.4915567	.1557492	0.004
Trend	.136864	.0639419	0.041
Cons	1.414702	1.03147	0.180

In the Table 1, I report the Augmented Dickey-Fuller Test Statistic which is -1.740 for non WIC breastfeeding rate, greater than the negative critical values at 1%, 5% and 10% significant level. Thus, I cannot reject the null hypothesis that the series contains a unit root. So this test suggests the variable non WIC breastfeeding rate is not stationary.

TABLE 2: THE RESULTS FROM ADF FOR WIC BREASTFEEDING RATE

Null Hypothesis : wicbfrate has a unit root Lag length : 3 Number of obs : 32			
	t-Statistic		
Augmented Dickey-Fuller Test Statistic	-2.650		
Test Critical Values : 1% level	-4.316		
5% level	-3.572		
10% level	-3.223		
Mackinnon Approximate p-value for Z(t) =	.2574		
	Coefficient	Std.Error	P>|t|
wicbfrate			
Lagged One-	.1651956	.0623346	0.014
Lagged Diff.	0759372	.1682925	0.656
Lagged Two Diff.	0194933	.1666955	0.908
Lagged Three Diff.	.3766996	.1660229	0.032
Trend	.2108454	.0724359	0.007
Cons	-.2660209	.6769231	0.698

In the Table 2, I report the Augmented Dickey-Fuller Test Statistic for WIC breastfeeding rate. The ADF t-statistics = -2.65 and is greater than the negative critical values at 1%, 5% and 10% significant level. Thus, I cannot reject the null hypothesis that the series contains a unit root. So this test suggests the variable WIC breastfeeding rate is not stationary and contains a unit root.

TABLE 3: THE RESULTS FROM PPERRON TEST FOR NON WIC BREASTFEEDING RATE

Newey-West Lags: 3 Number of obs : 35			
	t-Statistic		
Phillips-Perron Test Statistic	-1.392		
Test Critical Values : 1% level	-4.288		
5% level	-3.560		
10% level	-3.216		
Mackinnon Approximate p-value for Z(t) =	0.8634		
	Coefficient	Std.Error	P>|t|
Lagged One	.9434393	.061907	0.000
Trend	.0957916	.0719553	0.193
Cons	1.386648	1.184018	0.250

In the Table 3 above the Phillips- Perron Test Statistic is -1.392 for Non WIC breastfeeding rate which is greater than the negative critical values at 1%, 5% and 10%

significant level. I cannot reject the null hypothesis that the series contains a unit root. So the variable non WIC breastfeeding rate is not stationary according to the Phillips Perron Test as well.

TABLE 4: THE RESULTS FROM PPERRON TEST FOR WIC BREASTFEEDING RATE

Newey-West Lags: 3 Number of obs : 35			
			t-Statistic
Phillips-Perron Test Statistic			-1.420
Test Critical Values : 1% level			-4.288
5% level			-3.560
10% level			-3.216
Mackinnon Approximate p-value for Z(t) =			0.8549
	Coefficient	Std.Error	P>|t|
Lagged One	.9234267	.0585547	0.000
Trend	.1107287	.0623723	0.085
Cons	.3813034	.6289621	0.549

In the Table 4, Phillips Perron Test Statistic is -1.420 for WIC breastfeeding rate and is greater than the negative critical values at 1%, 5% and 10% significant level. Thus, I cannot reject the null hypothesis that the series contains a unit root. So the variable WIC breastfeeding rate is not stationary and contains a unit root based on this Phillips Perron test as well.

TABLE 5: THE RESULTS FROM ADF FOR RESIDUALS

Null Hypothesis : residuals has a unit root Lag length : 1 Number of obs : 34			
		t-Statistic	
Augmented Dickey-Fuller Test Statistic		-3.677	
Test Critical Values : 1% level		-4.297	
5% level		-3.564	
10% level		-3.218	
Mackinnon Approximate p-value for Z(t) =		.0239	
	Coefficient	Std.Error	P>|t|
Residuals Lagged One	-.5598841	.1522611	0.001
Lagged Dif	.3539369	.1727439	0.049
Trend	.0140842	.0284585	0.624
Cons	-.105499	.5961847	0.861

In the above table the representation is the result from the residual based cointegration test. Non WIC breastfeeding rate is regressed on WIC breastfeeding rate using OLS (Ordinary Least Square). And ADF test is conducted on the saved residual including a trend and lag of 1. The Test statistic of the ADF is -3.677 in table 5 which is less than -3.564 of 5% test critical value. Hence on the basis of the test statistics above I reject the null hypothesis that, the residual of WIC and non WIC breastfeeding rates has a unit root or they are nonstationary in nature and conclude that the residuals are stationary. This indicates that non WIC and WIC breastfeeding rates are cointegrated.

TABLE 6: THE RESULTS FROM ERROR CORRECTION MODEL OF TIME SERIES DATA

	(1)
VARIABLES	Coefficient
DifferencedWICbfrate	0.653***
	(0.154)
Lagged Resd	-0.277**
	(0.132)
Constant	0.544*
	(0.285)
Observations	35
R-squared	0.363

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In table 6 I report the error correction model of the aggregated WIC time series data. The dependent variable is differenced non WIC breastfeeding rate, which has been regressed on differenced WIC breastfeeding rates and lagged residuals. In the above error correction model, the error correction term, which is the lagged residual in this model, is negative and significant at 5% and 1% level. So if all things remain constant (Cetirus Peribus), it can be depicted that if the non WIC breastfeeding rate is above the WIC breastfeeding rate in one year then non WIC breastfeeding rate falls .27 points on average in the next year towards the equilibrium. So the negative error correction term means that the last year's value of non WIC breastfeeding rate has overshot the equilibrium. In other words, the error correction term in the model is pushing the dependent variable, which is non WIC breastfeeding rate, towards the equilibrium. To sum up, the coefficient of the error correction term (lagged Residual) is negative and statistically significant in my model.

4.2 Results of the Panel Data Series Analysis

I analyze the panel data of Non WIC and WIC breastfeeding rate of 50 states of USA and D.C (District of Columbia) from 1987 to 20015 in three steps. First I check the stationary property by doing a panel unit root test on both variables. The next step is to check whether cointegration exists between these two variables. The third step is that if the panels are cointegrated then I estimated the error correction model.

For the unit root test of panel data I used the Levin-Lin-Chu (LLC) unit-root test. I have 28 years and 51 cross-sections in my data. As mentioned before this test performs well when T varies in between 5 and 250.Then I analyzed the cointegration and error correction coefficient among the panels using the Westerlund error correction based cointegration test.

TABLE 7: THE RESULTS FROM LEVIN-LIN-CHU UNIT-ROOT TEST FOR PANEL DATA

Ho: Panels contain unit roots	Number of panels =	51
Ha: Panels are stationary	Number of periods =	29
Non WIC breastfeeding rate	statistic	p value
Adjusted t*	3.3401	0.9996
WIC breastfeeding rate	statistic	p value
Adjusted t*	1.0097	0.8437

The results of the LLC panel unit root tests in table 7 shows that the null hypothesis cannot be rejected as the p-value is high at all significance levels for both variables. So it fails to rejects the null hypothesis that the variables Non WIC and WIC breastfeeding rate panels contain unit roots. So the panels are non stationary. If OLS and GLS method is conducted in these panels the outcome of the results will be unreliable, biased and inconsistent. So after detecting non stationarity it is mandatory to implement a panel cointegration approach to check whether there exits an equilibrium relationship in the long term between the two non stationary variables.

TABLE 8: THE RESULTS WESTURLAND COINTEGRATION TEST ON PANEL DATA

Results for H0: no cointegration With Trend but no Constant			
Statistics	Value	Z-Value	P-Value
Gt	-2.237	-3.564	0.000
Ga	-10.222	-3.981	0.000
Pt	-11.992	-1.443	0.075
Pa	-8.703	-6.767	0.000

The Westerlund panel cointegration test reported in table 8 shows that there is a linear combination of non WIC and WIC breastfeeding rate. I used the error correction based cointegration test for strongly balanced panel data following Westerlund and Persyn (2008). The reason for using this error correction based cointegration test is that it will give a great degree of diversification in context of cointegration both in long and short periods of time in the 50 states of USA and in D.C (District of Columbia) panel data (Westerlund and Persyn 2008). The Westerlund cointegration test has the null hypothesis that there is no cointegration among the panel data. The values of Pt and Pa mirror the panel tests where the null hypothesis is that the panel is cointegrated as a whole, whereas the values of Gt and Ga show the group mean test of the null hypothesis is that at least one unit is cointegrated. According to Westerlund and Persyn 'a' is the estimation of the error correction estimate and 't' is the estimation of standard error of a.

In this test I chose the optimal lag and lead length with at most 3 using AIC and a Bartlett kernel window which is $4*(T/100)^{2/9} = 3$. Here T = 28 which is a plug in procedure according to the authors. The model has been estimated including a constant term in the estimation of the error correction. The above result indicates that the null hypothesis of no cointegration is rejected at most of the significance levels by the p – values (Table-8). The p values of the group mean tests (Gt and Ga) also reject the null of no cointegration at all significance levels. The null hypothesis of no cointegration in the panel test (Pt and Pa) can only be rejected at the 10 % significance level as the p value of Pt is .075. The large negative values of panel and group mean tests also imply that we should accept the alternative hypothesis which is there is cointegration in panels. The results above verify that the panel is cointegrated as a whole and non WIC and WIC breastfeeding rates are also cointegrated at least in some states.

The results of the panel cointegration syncs with the results of the time series data analysis of aggregated non WIC and WIC breastfeeding rates in USA. As I found cointegration among the panels it would be logical to find an error correction term in my desired model.

TABLE 9: THE RESULTS FROM ERROR CORRECTION BASED COINTEGRATION FOR PANEL DATA

VARIABLES	Coefficient
Differenced Wicbfrate	0.272***
	(0.0276)
Lagged Residual	-0.174***
	(0.0167)
Constant	1.096***
	(0.152)
Observations	1,377
Number of state	51
R-squared	0.111

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 reports the results of an error correction model of panel data series based on Westerlund and Persyn (2008) cointegration tests. The dependent variable is difference of non WIC breastfeeding rate and the independent variable is the difference of WIC breast feeding rate and lagged residual of the model. Both independent variables are highly significant at all significance level of p-values. In the above regression on panel data, the error correction term, which is the lagged residual, is negative and significant at all significant level. Although the error correction term is highly significant, the adjustment speed of non WIC breastfeeding rate is very slow towards the equilibrium in the long term. The coefficient is (.174) of the lagged residual of WIC and non WIC breast feeding rate. In other words, the non WIC breast feeding rates is decreasing and merging towards the equilibrium but in a comparatively slow rate.

4.3 Result of the Common Trend Analysis

The aggregated time series analysis and the panel data analysis both show that the WIC and non WIC breastfeeding rates are cointegrated. As Stock and Watson (1988) mentioned in their paper, the cointegrated variables must share a common stochastic trend so I can state that there is a common trend existing between WIC and non WIC breastfeeding rates. That means both of these rates are moving together and simultaneously over time. I have identified that (z_t), which is the linear combination of WIC breastfeeding rate (y_{1t}) and non WIC breastfeeding rate (y_{2t}), will be stationary because the variables are cointegrated in both times series and panel data. So as (z_t) is stationary I conclude that there is a common trend prevailing between WIC and non WIC breastfeeding rates in the U.S.

CHAPTER-5: CONCLUSION AND POLICY IMPLICATIONS

This thesis investigates whether there is a common trend between WIC and non WIC breastfeeding rates for 50 states and D.C (District of Columbia) of U.S.A. I used panel data spanning 1987-2015 and a newly developed panel model (Levin, Lin and Chu, 2002) and error correction model by Westerlund and Persyn (2008) to test the stationarity properties and cointegration of panel data for the U.S. For the time series approach after testing for the unit roots I used an Engel-Granger residual based cointegration test and an error correction model to capture the dynamic equilibrium relationship between WIC and non WIC breastfeeding rates. My empirical analysis showed fairly convincing evidence that the variables are cointegrated both in time series and panel data, and therefore share a common trend.

According to the findings of my analysis the error correction term for the time series is negative and significant. The economic implication of this is if all things remain constant the dependent variable, which is non WIC breastfeeding rate will merge towards the equilibrium in this data set. Similar findings also have been deduced from the panel data. The error correction term is pushing the non WIC breastfeeding towards the equilibrium but for this panel data set this adjustment speed is very slow. So it implies the possibility that WIC and non WIC breastfeeding rates will merge after a distant amount of time.

Further research can be done as follows: first if the data are available then what are factors that are driving these two breastfeeding rates upwards over this time. There should be one or several common factors that are working for both WIC and non WIC breastfeeding rates because both the rates are trending upward or growing together.

On the basis of U.S. wide data, the WIC breastfeeding rate is lower than the non WIC breastfeeding rate. To improve the margins of exclusive breastfeeding and child nutrition the combined effort of WIC and hospitals would be much beneficial. Apart from the regular outlets, WIC should also consider other outlets to promote breastfeeding support and infant health nutrition.

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