FISCAL REFORM SCENARIOS AND ACCESSIBILITY TO FOOD IN GUATEMALA

Guillermo R. Fernandez
Louisiana State University and Agricultural and Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_theses

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_theses/4795

This Thesis is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Master's Theses by an authorized graduate school editor of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
FISCAL REFORM SCENARIOS AND ACCESSIBILITY TO FOOD IN GUATEMALA

A Thesis

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College In partial fulfillment of the degree of Master of Science

in

The Department of Agricultural Economics and Agribusiness

by

Guillermo Fernandez
B.S., Louisiana State University, 2014
December 2018
I would like to dedicate this work to my grandparents Alberto and Lourdes Fernandez, and Magdiel and Mirna Escobar for always encouraging me to work hard with integrity, to be inquisitive, to improve myself through education, and to never give up. To my parents who have always dreamt of a better future for Guatemala, my in-laws who have always supported and believe in me and to my wife and kids who are my ultimate inspiration and daily motivation to be better each day.
ACKNOWLEDGEMENTS

I would first like to thank my thesis advisor Dr. Kennedy of the Department of Agricultural Economics and Agribusiness at Louisiana State University. The door to Prof. Kennedy’s office was always open whenever I had a question about my research or writing. He consistently allowed this paper to be my own work but steered me in the right the direction whenever he thought I needed it.

I would also like to thank the experts who were involved in the thesis committee for this research project: Dr. Fannin and Dr. Tanger. Without their passionate participation, input, and contributions, this thesis would not have been successfully completed.

Finally, I must express my very profound gratitude to my parents, my parent in law, to my spouse and very especially to Cody Plummer and Alejandra Breve. For providing me with unfailing support and continuous encouragement throughout my years of study. This thesis and research would not have been possible without them. Thank you.
# TABLE OF CONTENTS

ACKNOWLEDGEMENTS .......................................................................................................................... iii

ABSTRACT .............................................................................................................................................. v

CHAPTER 1 INTRODUCTION ................................................................................................................. v

CHAPTER 2 LITERATURE REVIEW ........................................................................................................... 6

CHAPTER 3 CONCEPTUAL FRAMEWORK .............................................................................................. 13

CHAPTER 4 METHODS AND PROCEDURES ........................................................................................... 20

CHAPTER 5 RESULTS ............................................................................................................................. 30

CHAPTER 6 IMPLICATIONS ................................................................................................................... 47

REFERENCES .......................................................................................................................................... 50

VITA ....................................................................................................................................................... 56
ABSTRACT

Since signing the peace accords in 1996, the Guatemalan government committed to increase the tax burden of 1995 by 50% to a total of 13%. This target has only been reached 4 times in more than two decades. There have been multiple attempts at tax reforms that have failed or been incomplete. Guatemala exhibits much income inequality and is one of the poorest countries in the region.

Given this background, the problem to be considered in this analysis is that there is little information regarding how different tax reforms would affect the accessibility to food in Guatemala. With information regarding taxes collected from Superintendencia de Administracion Tributaria (SAT) a collection target of Q 13,036 million more was set and then five different income tax and VAT scenarios where put in place with the purpose of evaluating how food accessibility was affected in the five income quintiles of the population. To measure food security the cost of the basic food basket (BFB) was used. The BFB is transformed from a family unit to an individual basis. The price of the BFB is then divided by income to measure the accessibility of food for individuals in the different income quintiles. This is then divided by income creating a Food Accessibility Index (FAI) which is the maximum amount of food that the individual in the given quintile can afford.

The results show that new VAT and income taxes hurt the accessibility of food and the lower income individuals are marginally affected more than higher income ones. Held constant the tax structure providing the most food accessibility is based on taxing imported product; the least food accessibility comes from a scenario in which the revenues are attained solely through a domestic sales t
CHAPTER 1 INTRODUCTION

Hunger and poverty have been problems that humankind has been fighting since biblical times. In the past century, this problem was more formally addressed by Franklin D. Roosevelt in his 1941 state of the union address known as the speech of four freedoms, “The third is freedom from want—which, translated into world terms, means economic understandings which will secure to every nation a healthy peacetime life for its inhabitants everywhere in the world” (Roosevelt, 1941). Over 70 years ago, Roosevelt realized that the path for a safe world, free from war, was dependent on combating poverty and ensuring that every human had access to food. A few years after president Roosevelt’s words to congress, the United Nations (UN) drafted the Universal Declaration of Human Rights where in Article 25 recognizes that “Everyone has the right to a standard of living adequate for the health and well-being of himself and of this family, including food” (UN, 1948). International organizations have been leading the fight against hunger and starvation since the late 1940s with the creation of the Food and Agriculture Organization of the United Nations (FAO), The World Food Programme (WFP) and Oxfam.

In 2000, the Millennium Summit was held with 149 Heads of State and other government officials. The document that came out of the summit is known as the Millennium Declaration, which contains the international agenda for the twenty-first century, including the Millennium Development Goals (MDG) with the main objective to eradicate extreme poverty and hunger amongst others (UN, 2000). More specifically, the MDG states the objective to “halve between 1990 and 2015 the proportion of people whose income is less than $1 a day” (UN 2015). The number of undernourished people
has declined from almost 1 billion by 23.3 percent of the population to around 780 million. Yet 12.9 percent of the population, or one in seven children worldwide, are still underweight (UN 2015). Statistics on income and undernourishment do not account for the parts of the population that are vulnerable to food security issues due to economic volatility or climate change. According to the 1996 World Food Summit “food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary need and food preferences for an active and healthy life” (FAO, 1996).

Food security is conventionally categorized into four topics that are interconnected -- availability, access, utilization and vulnerability (Migotto et al. 2007). The volatility of the commodity markets and prices of grains, pulses, and animal proteins that are the most important components of a basic nutrition make food security harder to assess. To measure food security, different tools have been created. In 1995 the U.S. Household Food Security Survey Module was implemented (ERS 2012). In June of 2007 the first Latin American and Caribbean conference in measuring food insecurity took place creating a regional tool to measure food insecurity call Escala Latinoamericana y del Caribe de Seguridad Alimentaria (ELCSA) (Perez-Escamilla et al., 2012). To have a global measurement of food insecurity, FAO and the Voices of the Hungry project created the Food Insecurity Experience Scales (FIES) that are based on ELCSA (Ballard et al. 2013).

1.1 JUSTIFICATION
The prevalent rates of food insecurity in 146 countries, areas or territories using the global FIES reference scale resulted in Guatemala being ranked 112 with a prevalence
of food insecurity at 44.7% (FAO, 2016). Compared to other countries in the Central American region Costa Rica has the least food insecurity with 19.9% prevalence of food insecurity while Panama, El Salvador, Nicaragua, and Honduras have 28.9%, 37.7%, 42.3% and 56%, respectively. Guatemala’s total population in 2014, when the FIES survey took place, was estimated at 16 million, making it the most populous country in Central America; this means there are over 7 million Guatemalan’s that are food insecure, close to the entire population (8 million) of Honduras (World Bank, 2017). Even though the economy has grown at a rate of close to 3.5%, poverty increased to 59.3% in 2014 from 51.2% in 2006 (INE, 2014). The increase of poverty while the economy is growing indicates income inequality, rapid population growth, and rising food prices (World Bank, 2017). In addition, an increasingly volatile climate, and a greater degree of interdependence in the world’s economic system both affect the income and wealth of households and affects their ability to access food.

![Guatemala map of food insecurity](image)

**Figure 1.** Guatemala map of food insecurity.  
Source: Famine Early Warning Systems Network.
Food security and nutrition usually fall under the umbrella of the agricultural sector. In Figure 1 there is a Map of Guatemala food security situation with yellow and orange being accentuated and crisis regions. Because of this, food and nutrition security are often overlooked in planning for development in most states; yet they have a direct impact on the overall economy, development, and quality of life of the population (Balie et al., 2009). In addition, fiscal and economic policy will have a direct effect on food security as well as the overall world economy. If there is an absence of clear and meticulous planning for food security, the population is at risk of being victims of their own policies or the world markets.

A plan that considers accessibility when designing monetary and fiscal policy is necessary to better the food security in Guatemala. Current fiscal policy in Guatemala, compared to other Latin American countries, has the lowest tax revenue as a share of GDP, which is 11% as a consequence of low productivity of personal income tax, privileges, and loopholes in the tax law (USAID, 2014). Fiscal and economic policy will have a direct effect on food security as well as the overall economy. To facilitate the measurement of access to food, the Guatemalan government has a measurement called Canasta Basica Alimentaria, in English it means Basic Food Basket (BFB), which measures the conglomerate of foods to satisfy the caloric and protein needs of an average Guatemalan household. The average family in the BFB was 5.38 members until the update in October 2017 when it change to 4.77. The BFB is composed of dairy products, meats, eggs, cereals, sugars, fats, vegetables, fruits and others like coffee and salt (INE, 2016). In December 2014, the Instituto Nacional de Estadística (INE) calculated that for an average family to fulfil their caloric needs, their family required Q.
3,236.70 (Quetzal, Guatemala currency) monthly. This requirement is derived using an average exchange rate of 7.56 Guatemalan Quetzals per $1 US Dollar as of December 26, 2014, which is $428 (Guatemala Central Bank, 2014).

Using the Foster, Greer and Thorbecke (FGT) indicator INE established that 59.3 percent of the population was under the poverty line and had a yearly consumption below Q10,218 or $1,346 USD. With the same indicator, they determined that the percentage of the population under the extreme poverty line is 23.4 percent with a yearly consumption below Q5,750 or $757.57 (INE 2016). An average salary for a Guatemalan of Q2,131 in 2016 and the average price of the BFB of Q3868.04 in the same year, an average family with two average income earners would have to spend 90.7% of their salary on food. Guatemala’s current tax structure is regressive or neutral and does not help decrease poverty or food insecurity (Lusting 2017). Based on this, the problem to be considered in this analysis is that there is little information regarding how different tax reforms would affect the accessibility to food in Guatemala.

1.2 OBJECTIVES

The general objective of this study is to determine how different tax reforms would affect the food accessibility of the Guatemalan population. The analysis will consist of generating alternative scenarios of tax changes to determine the corresponding accessibility to food for the different income quintiles of the Guatemalan population.
CHAPTER 2 LITERATURE REVIEW

For the Guatemalan Government, the poverty line is not of $1 or $2 of income per day but is a consumption poverty line being Q10,218 (INE 2016) which includes the BFB that focuses on caloric needs (before October 2017) and other living necessities like shelter and clothing. Poverty in Guatemala has not been reduced in over a decade according to the most recent information from INE.

Figure 2. Guatemala poverty index.
Source: INE ECONVI 2014 generated in Excel.

Menchu and Osegueda (2002) made multiple recommendations to improve the BFB, so it reflects more accurately the preferences of the population, overall nutritional needs, and size of the population. The 2002 proposal to update the BFB included 10-15% of the ideal diet to proteins, 20-25% to fats, and 60-70% to carbohydrates (Menchu and
Osegueda, 2002). These recommendations were implemented in October 2017 BFB, fifteen years after they were proposed. The most important factor to determine the BFB is the minimum caloric and protein needs of a family of reference and then the selection of the foods and quantities to fill the minimum nutritional requirements. After the daily quantitates have been established, ten percent is added to account for problems with distribution and waste. The next step to determine the BFB is converting the grams of food to quantities and then determine price; there is a different measurement for the rural and urban areas that account for the price difference and dietary preferences (Menchu, and Osegueda, 2002). According to INE the update decreased the price of the BFB being closer to what the average Guatemalan family needs to be food secure (INE 2017).

Guatemala has an extensive history of regional integration becoming a member of the Central American Common Market in 1960 until it collapsed in the 1980s due to an economic crisis and political turmoil (OAS). Guatemala’s free trade efforts have ranged from suspending tariffs on 10 food staples in 2008 to free trade agreements with Panama, DR-CAFTA, a free trade agreement with Chile, free trade agreement of Central America and Mexico, and free trade agreement with Colombia, among others (FAO, 2014). In 1996 Guatemala signed the peace accords from a 36-year-old civil war that started in 1960 and claim more than 200,000 lives (Miller, 2011). In the peace accords the Guatemala government committed to increasing the tax burden with respect to GDP by 50% more than in 1995, this would be close to 13% which has only been reached four times, the last one in 2007. Another commitment by the government was to create a more progressive tax system and eliminate privilege, abuse, evasion,
and fraud (Guatemala Presidential Office for Peace, World Bank). The nutritional poverty line in Guatemala was calculated to be 75% of the population in 1997 (Hicks and Lee, 1997). Progress to reduce the nutritional poverty line has been slow and weak. According to the last calculations, poverty increased, from 51% in 2006 to 59.29% in 2014 (World Bank). Guatemala has the lowest tax to GDP ratio in Latin America (IMF) and the calculation of poverty rates for post-fiscal income are higher than market income indicating that fiscal policy is slightly regressive (Cabrera et al. 2015). Social spending in Guatemala was in 2014 one of the lowest in Latin America at 7.4% of the GDP and has been reduced to only 3%. (World Bank). The effects of these policies can be observed in Figure 1 where the Gini index is represented.

Most of the research in food tax policy is directed towards improving the health of the consumer and directing healthier food choices; for example, the tax on sodas in Mexico that improves diet quality but increases inequalities in nutrition. (Weaterlander et al., 2016). Leyaro et al. (2010) produce a welfare analysis of Tanzania and the effect that tax policy (tariffs and VAT) reforms had in the country using households budget survey and found that households appear sensitive and responsive to price changes of the commodities they consume, especially of staple foods. The researchers conclude that during the period of 1990s to 2000’s there has been a welfare loss due to price increase, but it has been offset due to tax reforms in form of mostly tariffs reductions (Leyaro et al., 2010). Lustig (2017) applied a Commitment Equity (CEQ) method to determine the effects of income and consumption taxes and compared it to the benefits from cash transfers in education and health to calculate poverty and inequality in Latin America.
Lustig (2017) concluded that Guatemala was one of the countries of the region
that redistribute the least, the incidence of poverty after taxes, subsidies and cash
transfers are higher than income poverty and is the only country in the region that
tertiary education is not equalizing (Lustig, 2017). The average Guatemalan spends
40.6% of their income in food, while in most other Latin American countries this figure is
around 30%; a more ideal fiscal policy would take food accessibility into account, so the
most vulnerable segments of the population do not suffer (Gray, 2016).

Food security has been studied using different perspectives, including supply and
demand. One of the earliest researchers of food demand was Ernest Engle who, in
1857, noted that households spend more on food as income increases but decline as a
percentage of income (Tuttle and Kunhs, 2016). Tweeten stressed that increasing
productivity and real incomes of food insecure people is the principal route to food

Figure 3. Gini coefficient for Guatemala.
Source: UNU WIDER.
security, and states that sound macroeconomic policies include appropriate taxation (Tweeten 1999). World food demand was projected by Gao (2011), examining how different functional forms affect the estimation of food demand in different countries and how aggregate country-level data can be impacted by income inequality (Gao, 2011). According to Chavas (2017), the food policy goal of reducing food insecurity can be achieved in several ways, among them improving access to food and increasing consumer food purchasing power (Chavas, 2017). Mayers and Proost (2001) study tax reform offering a methodology for evaluating marginal policy reform when externalities are present. The authors take into account distributional considerations, finding that the impact of the tax reform should not only be on the externalities but also the other commodities that are affected; distributional considerations are important, and the analysis of tax reforms might be extended to include consumption and government budget balance (Mayers and Proost, 2001). Food Security can also affect the human capital of a country. In Guatemala, there have been different studies on the subject that demonstrate how nutrition intervention in young kids can positively reflect on higher incomes for males and higher educational attainment for females (Hoddinott et al., 2008 and Maluccio et al., 2006). Fuentes Knight, Guatemala finance minister during 2008-2012 explains the history of Guatemala fiscal reforms and his own experience during the UNE government to try to create a new fiscal pact that satisfies the civil society and the political and economic elites (Fuentes and Cabrera, 2006).

Prescott in his paper “Why do Americans Work So Much More Than Europeans?” finds that the reason Americans work 50 percent more than Germans, French and Italians is because changes in labor tax change the supply for the taxed
population, the welfare gains from work are reduced in high tax countries (Prescott, 2004).

From the vast poverty research, Carter and Barret (2006) develop an asset-based approach to observe static and dynamic poverty to determine the possibility of the households of escaping poverty. They also extend Foster-Greer-Thorbecke poverty measures and encourage asset-based poverty measures to determine better policy in poverty reduction, developing better safety nets (Carters and Barret 2006).

Figure 4. Guatemala GDP growth (annual %).
Source: World Bank, OECD.
Food price fluctuation is of great concern for scholars and policymakers since the food prices have risen 44% between 2004 and 2018 with large swings in between (FAO 2018). Trade policies that address food prices have been found to be inequitable and inefficient at protecting groups from being harming by shocks to international food markets, Anderson et al. (2013), suggest that government improve food security in the short and long-term by improving infrastructure, increasing domestic market efficiencies, and dismantling market-distorting price and trade policies (Anderson et al. 2013). Ecker and Qaim (2010) analyze how different policies affect nutrition in Malawi using different scenarios, separating the population by income quintile to assess the consumption of different nutrients (Ecker and Qaim, 2010). Humphries et al. 2014 observed how household consumption of animal source foods change across different income quintiles in Peru between 2002 and 2009 when there was an economic recovery in the country.

In Brazil, institutional agreements allow lower level government municipalities to apply tax relief efforts by reducing or eliminating VAT taxes in the basic basket food or the equivalent of the BFB in Brazil (Mattos and Politi, 2014).
CHAPTER 3 CONCEPTUAL FRAMEWORK

Sales tax has a direct impact on the price of food. Since Guatemala is a small country, when it implements a tariff on a commodity the burden of this tax will tend be borne by the consumers (Koo and Kennedy, 2005). Most imports to Guatemala require a 12% VAT plus the corresponding tariffs, which, for agricultural products, are an average of 9.6% (WTO, 2016). Income tax for Guatemala ranges between 5 and 10 percent depending on how income is generated, and social security contributions by employees are 4.83% of their total income (USAID, 2014). INE (2017) conducts a national employment and income survey which provides information on Guatemala’s population split by 5 income brackets including other demographic information, INE also provides monthly information on the prices of the BFB. On the scenario proposals, an accounting method will be used to determine the new income for each quintile of the population and new price of the BFB. Since the income data is on individual basis and the BFB data is on the average family unit, the latter will be transform to individual, so the same units can be observed. According to the ministry of finance or Ministerio de Finanzas Publicas (MINFIN) all the income brackets fall under the 5% income tax contribution, after an income greater than Q 300,000 a year pays 7% of income tax for the exceeded amount (MINFIN 2018).

Gastwirth in his paper ‘The estimation of the Lorenz Curve and GINI index’ explain how this two income inequality measures are calculated, how they can be used and address some confusion to exist about their use at the time (Gastwirth 1972). Base on this indication and the income information provided by INE a Lorenz curve will be calculated. Reinhardt in his paper ‘The construction of Lorenz curves and the Gini-
Coefficient to depict degrees in inequality in health care’ also explains how to obtain and construct the income inequality indicators, Lorenz curve and Gini, based on Reinhardt the Gini will be calculated (Reinhardt 2009).

Figure 5. Present scenario status.

The latest estimations are that Guatemala is 44.7% food insecure (FAO, 2016), the next scenarios will graphicly show what is expected to happen under certain conditions everything else being held equal.

According to Perloff in his book Microeconomics, “the supply and demand curves determine the price and quantity at which goods and services are bought and sold” and
explains that “When traders are able to buy and sell as much as they want, the market is in equilibrium” (Perloff 2009). Figure 4 has three demand curves TD which is the total demand $D_r$ represents the demand for the rich and $D_p$ which represents demand for the poor, in a country with high income inequality levels is important to make the distinctions on the demands that different groups poses and how they all face the same supply curve.

In scenarios 1, 3 and 4 there is a shift in the supply curve, which causes a price increase as VAT taxes are increasing in the product being consume. This would be considered a shock to the equilibrium, moving some of the variables, also reducing the quantity being consumed for both consumers and everything else would hold constant as represented in Figure 5.

3.1 Food Accessibility Index Scenario One

An 11% increase in the VAT would increase food prices by a significant amount to those in the lower income quintiles, making it harder for demand to be met, shifting the demand curve to the left. What the population consume would be decreased making accessibility of food harder for the Guatemalan population in a food insecure condition at risk of being food insecure. The change under these scenarios would be worse for the populations with the lowest incomes and it would be considered a regressive tax change. On average for the years 2014 and 2015, 78% of food was produced and consumed in the country. 78% is estimated from the Agricultural GDP – exports + imports. The domestic tax increase would affect the food produced in the country and not the imported food price.
3.2 Food Accessibility Index Scenario Three

According to Koo and Kennedy if a small import country raises a tariff, the small country bares all the weight of that new or increase tax on their import. In this case, the residents of Guatemala would completely pay the import sales tax increase. When comparing the average import of food Q 8,847.18 million between 2014 and 2015 according to UN comtrade database with the average agricultural GDP for the two years is Q49,873 million according to Guatemala central bank. Increasing the VAT tax on imports would increase for 22% of the food that is imported by 11% to reach the VAT
target on imports of 23%. This scenario has similar characteristics with the previous one with the difference that the portion of the food affected by the increase is smaller, so it is expected that the impact on food security is also less than scenario 1.

3.3 Food Accessibility Index Scenario Four

The fourth scenario would be a VAT increase on both domestic and import products; the VAT tax would increase by 6% making a total VAT tax 18% for the country. It would still be a regressive tax that hurts marginally more the lower income quintiles of the populations more than the ones with a higher income.

In scenario 2 there is an income tax being added to all segments of the population, representing a shock to the equilibrium where all the demands curves shift to the left if everything else is held constant, price and quantity are reduced, these changes can be observed in figure 6.
3.4 Food Accessibility Index Scenario Two

An increase in income tax would mean a decrease in disposable income. This would affect demand by shifting the demand curve to the left, while decreasing prices and decreasing the quantity of food, that is being consume. This would potentially make food accessibility worse but in a more progressive way than in FAI 1, 3 and 4 without affecting the lower quintiles as drastically. To calculate this scenario income would be reduce by 4% in all levels to reach the 9% target.

3.5 Food Accessibility Index Scenario Five
There are multiple shocks to the equilibrium in scenario 5 the income for the population is being affected shifting the demand curve to the left, reducing price and quantity. At the same time VAT is increasing also shifting the supply curve also to the left, the price of the BFB would increase and quantity would also be reduced.

The fifth scenario would consist of a domestic and import increase of the VAT tax by 2.75% to 14.74% and an income tax increase of 2% for all the brackets to 7%. Is expected that food prices will increase, and disposable income will diminish. Individually both changes will be less drastic that in the previous scenarios individually but combine the effects will still marginally affect the lower income quintiles and the results for food accessibility will be similar.

Figure 8. Food Accessibility Index scenario 5.
CHAPTER 4 METHODS AND PROCEDURES

4.1 Model

Empirical methods will be used to determine how the different population segment divided by five income brackets would be affected by the proposed tax scenarios, and how this would affect their ability to access food. Food purchasing power can be measured using a budget share approach of income I divided by price p, which measures the largest quantity of food that can be bought at that income (Deaton and Muellbauer, 1980). The change in inequality will be measured using a Lorenz curve and Gini index according to the data available on incomes in the respective quintiles and the results on the scenarios. Our food accessibility index would measure the portion or maximum amount of the BFB that an individual can purchase depending on their income bracket denoting their level of food accessibility for their minimum caloric needs.

The equation function for the BFB is,

\[ BFB = F(F_D, F_S, T, N) \]

The basic food basket is a function of food demand \( F_D \), food supply \( F_S \), taxes \( T \), and nutritional needs \( N \), where

- \( BFB_I \) => Individual Cost of Food Basket,
- \( INC_B \) => Income Brackets,
- \( FAI \) => Food Accessibility Index, and
- \( FAI = BFB_I/INC_B \).

In general, we utilize the following definition and assumptions:
• The FAI is the maximum amount of food that a person can buy with respect to the BFB.

• Food accessibility increases as the FAI decreases

• Food accessibility decreases as the FAI increases

• A FAI of 0.2 indicates that an individual only needs to spend 20% of his salary on food he can consume of the recommended caloric needs.

• A FAI of 2.0 indicates that an individual has to spend double his monthly income to obtain the minimum amount of calories recommended.

• Even if an individual has a FAI of 1.0 this does not indicate that he consumes the recommended energetic and protein nutrition since it is impossible to spend 100% of income in food since other needs and wants are also necessary like shelter, clothing, education and entertainment.

• Depending on the score of the FAI any individual with less than .78 will be below the poverty line according to our calculations using the 2014 consumption poverty line and inflation data from the Guatemala central bank and individuals with a FAI less than 0.5 will still be consider food insecure because if there is a big upswing in food prices there is a risk of accessibility.

• For simplicity reasons elasticity will not be taken into account.

There are multiple factors that influence the BFB which include price inflation and market shocks of supply and demand.

The scenarios are presented in table 1. The FAI for the October 2017 income and BFB for the five quintiles will be calculated. Five different scenarios will then be
presented, assuming all other factors stay constant and assuming that the government has a target tax collected percent of GDP of 13%, which is consistent with the peace accords. The current GDP according to the Guatemalan central bank is Q 554,292.60 million. According to the SAT, the tax collected from 2017 was of Q 59,022, which is 11% of the GDP leaving a gap of 2%, or Q 13,036 million that will be the total tax increase of the different must achieve.

“Given a set of n order numbers, \( x_1 \leq x_2 \leq \ldots \leq x_n \), the empirical Lorenz curve generated by them is defined at the points \( i/n, i = 0, \ldots, n \) by \( L(0) = 0 \) and \( L(i/n) = s_i/s_n \), where \( s_i = x_1 + \ldots + x_i \). The empirical Lorenz curve, \( L(p) \), is defined for all \( p \) in the interval \((0,1)\) by linear interpolation and represents a fraction of the total variable measured (e.g., income) that the holders of the smallest \( p^{th} \) fraction possess” (Gastwirth 1972). Reinhardt explain that given a Lorenz curve plot that goes from 0% to 100% the entire area of the box equals 1. Area A (above the Lorenz curve) + area B (under the Lorenz curve) must equal \( \frac{1}{2} \). Gini coefficient can be calculated by \( G = \frac{\text{area A}}{\frac{1}{2}} = 2 \times \text{(Area A)} \) (Reinhardt 2009).

The first scenario, FAI\(^1\), is an increase in domestic sales tax of 11% that would increase the current 12% rate to 23%. The changes to the BFB can be observed in Table 1 This would put the domestic VAT tax above the average in Latin American countries (KPMG, 2012).
Table 1. Scenario 1 change, generated in Excel.

<table>
<thead>
<tr>
<th>BFB</th>
<th>Domestic portion of BFB</th>
<th>Total Increase</th>
<th>BFB 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 743.69</td>
<td>Q 580.00</td>
<td>Q 63.81</td>
<td>Q 807.50</td>
</tr>
<tr>
<td>100%</td>
<td>78%</td>
<td>9%</td>
<td>109%</td>
</tr>
</tbody>
</table>

The second scenario, FAI^2, is an increase in income tax for all of the quintiles of 4%, This would bring all quintiles to a total of 9%, assuming that segment of the population is in the informal sector pay income taxes of 5% already. The changes can be observed in table 2 and this address the recommendations from the Foundation for the Development of Guatemala (FUNDESA) and Coordinating Committee of Agricultural, Commercial, Industrial and Financial Associations (CACIF) to expand the tax base to all citizens on individual income taxes (FUNDESA and CACIF).

Table 2. Scenario 2 changes, generated in Excel.

<table>
<thead>
<tr>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC</td>
<td>292.00</td>
<td>842.00</td>
<td>1,539.00</td>
<td>2,659.00</td>
</tr>
<tr>
<td>Q</td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
<td>Q</td>
</tr>
<tr>
<td>INC 2</td>
<td>280.32</td>
<td>808.32</td>
<td>1,477.44</td>
<td>2,552.64</td>
</tr>
</tbody>
</table>

Scenario FAI^3 would be an increase on the VAT on imports of 11% from 12% to 23% the portion of the BFB that is imported is smaller than the domestic one.

Table 3. Scenario 3 changes, generated in Excel.

<table>
<thead>
<tr>
<th>BFB</th>
<th>Import portion of BFB</th>
<th>Total Increase</th>
<th>BFB 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 743.69</td>
<td>Q 163.61</td>
<td>Q 18.00</td>
<td>Q 761.69</td>
</tr>
<tr>
<td>100%</td>
<td>22%</td>
<td>2%</td>
<td>102%</td>
</tr>
</tbody>
</table>
Table 4. Proposed scenarios in millions of Q with information from SAT.

<table>
<thead>
<tr>
<th>Tax</th>
<th>Tax Generated</th>
<th>Tax Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current tax Collected</td>
<td>Total Scenario tax</td>
</tr>
<tr>
<td>FAI 1</td>
<td>VAT domestic</td>
<td>14380.21</td>
</tr>
<tr>
<td>FAI 2</td>
<td>Income</td>
<td>16306.87</td>
</tr>
<tr>
<td>FAI 3</td>
<td>VAT to imports</td>
<td>14148.06</td>
</tr>
<tr>
<td>FAI 4</td>
<td>VAT domestic and imports</td>
<td>Domestic 1438.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Imports 1418.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>43490.97</td>
</tr>
<tr>
<td>FAI 5</td>
<td>VAT Total and Income</td>
<td>44835.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5. Scenario 4 changes, generated in Excel.

<table>
<thead>
<tr>
<th>BFB</th>
<th>Domestic portion of BFB</th>
<th>Import portion of BFB</th>
<th>Total Increase</th>
<th>BFB 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 743.69</td>
<td>Q 580.08</td>
<td>Q 163.61</td>
<td>Q 44.62</td>
<td>Q 788.31</td>
</tr>
<tr>
<td>100%</td>
<td>78%</td>
<td>22%</td>
<td>6%</td>
<td>106%</td>
</tr>
</tbody>
</table>

As observed in table 5, FAI$^4$ will be a combination of the first and third scenario increasing both import and domestic sales taxes from 12% to 18%.

Table 6. Scenario 5 BFB changes, generated in Excel.

<table>
<thead>
<tr>
<th>BFB</th>
<th>Domestic portion of BFB</th>
<th>Import portion of BFB</th>
<th>Total Increase</th>
<th>BFB 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 743.69</td>
<td>Q 580.08</td>
<td>Q 163.61</td>
<td>Q 20.45</td>
<td>Q 764.14</td>
</tr>
<tr>
<td>100%</td>
<td>78%</td>
<td>22%</td>
<td>3%</td>
<td>103%</td>
</tr>
</tbody>
</table>

The scenario for FAI$^5$, would be a combination of domestic and import sales tax with income tax increases that would increase the sales tax to 14.75% and the income tax for the five income quintiles to 7%.

Table 7. Scenario 5 income changes, generated in Excel.

<table>
<thead>
<tr>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC Q 292.00</td>
<td>Q 842.00</td>
<td>Q 1,539.00</td>
<td>Q 2,659.00</td>
<td>Q 5,947.00</td>
</tr>
<tr>
<td>INC 5 Q 286.16</td>
<td>Q 825.16</td>
<td>Q 1,508.22</td>
<td>Q 2,605.82</td>
<td>Q 5,828.06</td>
</tr>
</tbody>
</table>

The results from these scenarios will allow us to identify how different tax structures affect the ability of an individual to feed one person according to the BFB. After these calculations are conducted, they will be presented in a table with the different quintiles and different scenario outcomes for comparison.
For scenarios 2 and 5 there are changes in the population incomes since there are income taxes being added, a new Lorenz curve and Gini index will be calculated to understand better how the income inequality was affected the increase of the income tax.

On each scenario there will be a XY graph that shows the status quo FAI and the individual scenario FAI for each quintile, so the scenario changes can be compare with the current situation in Guatemala.

At the end of the analysis there will be a table with all the FAI and quintile results that will help determine how each different scenario affected each income quintile different and which ones were less detrimental for the food insecure segments of the population. The last graph will present all the FAI for scenarios and status quo with a poverty line. This poverty line will be determined by using the previously estimated yearly consumption poverty line in 2014 by INE in the ENCONVI 2014 survey, adding the inflation for October 2017 and transforming it into a monthly consumption this amount will divide the BFB so there is a FAI poverty line.

4.2 Data

Diseño de la nueva canasta básica de alimentos de Guatemala by Monroy-Valle, Rodriguez-Valladares and Toledo Chavez determines the composition and amounts of the BFB. The information on food imports and production for Guatemala can be obtained from FAO food balance sheets. International prices of commodities can be sourced from GIEWS FPMA tool monitoring and analysis of food prices from FAO. The World Trade Organization (WTO) has historical data on the tariff schedule and Guatemalan trade policy. INE has historical information on the prices of the BFB which
updates monthly. There have been recent changes to the BFB where the family unit changed from 5.3 to 4.77 and some of the ingredients that integrated the BFB also changed following the recommendations from Monroy-Valle et al. This family unit will be transformed to individuals, so it matches the unit of income reported. The BFB for October 2017 is Q 3,547.40 that divided by 4.77 is Q 743.69. INE also reports the different levels of income for population quintiles and by demographic characteristics. The data for October 2017 was used because it was the most recent month where both income and BFB data were reported. In Guatemala, Congress must approve increases to sales tax, better known as impuesto al valor agregado (IVA), where the historical data for this change is of public knowledge. It will be used to evaluate the effect of a VAT on BFB prices.

The WTO has extensively researched the implementation of trade policy and Free Trade Agreements. The decreto 10-2012 is the income tax law that shows details of tax rates and regulations. However, there is no specification for income earn outside the country, making this tax exempt. Consumption data in figure 9 comes from pooreconomics.com which is the web site that supports the book Poor Economics by
Figure 9. Average monthly income by quintile.  
Source: ENEI-2-2017, INE.

Figure 10. % Monthly budget spent on food.  
Source: Poor Economics.
Banerjee and Duflo. This data will be transformed to quetzales for consistency. The Guatemalan Central Bank has data on GDP and agricultural GDP. They also have historical exchange rates for the country and inflation data among others. The superintendence of tributary administration or SAT in Spanish have data on tax collection for Guatemala. Value of food imports to Guatemala are available at the UN commercial trade data bank. The Guatemalan government poverty line of 2014 will be transformed into a FAI by calculating the inflation and dividing it by the BFB. The Lorenz curve will be calculated using the income data from INE, ENEI-2-2017 survey, after obtaining the areas for the curve a Gini will be calculated.
CHAPTER 5 RESULTS

The FAI calculation for the BFB and income calculated by the INE in October 2017 is represented in table 8, where shows that how lower income individuals, especially those in the 1st quintile, cannot afford the recommended food intake for the month, observing a FAI of 2.5469 represents that for these individuals to consume the recommended caloric needs they would have to spend 2.5469 times or 254.69% of their monthly income. Individuals in the second quintile with a FAI of .8832 would have to spend 88.32% of their monthly income in food to obtain the recommended caloric intake, if these individuals would spend that amount on food, other needs would go unfulfilled like health and shelter. The third quintile individuals would have to spend close to 50% of their income in food with an FAI of 0.48, which compares to the calculations by Gray 2016. Guatemalan’s spend close to 40% of their budget on food, which for the Latin American region this statistic is between 20% and 30%. Only the individuals in the fourth quintile have a comparable condition to that of the region with a FAI of 0.2797 if they were only feeding themselves and not the household, having to spend close to 28% of their income to fulfil their caloric needs. The individuals in the fifth quintile only have to spend 12.5% of their budget in fulfilling their caloric needs according to the BFB, like stated in table 8 the FAI for this group is 0.1251. The only quintiles where the individuals that have an income are food secure are the fourth and fifth quintile, where they are able to fulfill their caloric needs and have enough income to cover other needs and wants like shelter, health, education and entertainment.
Table 8. Current FAI, generated in Excel.

<table>
<thead>
<tr>
<th></th>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BFB</strong></td>
<td>Q</td>
<td>743.69</td>
<td>Q</td>
<td>842.00</td>
<td>Q</td>
</tr>
<tr>
<td><strong>INC</strong></td>
<td>Q</td>
<td>292.00</td>
<td>Q</td>
<td>1,539.00</td>
<td>Q</td>
</tr>
<tr>
<td><strong>FAI</strong></td>
<td>Q</td>
<td>2.5469</td>
<td>0.8832</td>
<td>0.4832</td>
<td>0.2797</td>
</tr>
</tbody>
</table>

Figure 10 presents the FAI for each different income quintile in the case of the status quo for Guatemala; it is striking the inability of the lower income quintiles to have access for the minimum amount of food to fulfill their caloric and protein needs. Even the third quintile that must spend nearly 50% of his budget to fulfill his needs is not considered food secure since such a large part of their income must be spent on food. Graph 10 shows a wide disparity in FAI between the bottom 3 income quintiles and the top two with respect to their availability for food if this gap increase or decrease will be an important part of the implications that this study will have.

In 2014, the World Bank calculated that the Guatemala Gini index was of 48.7, with the information income quintiles provided by INE, a Lorenz curve, figure 11 was built and new Gini of 46.5537 calculated.
Figure 11. FAI by quintiles, generated in Excel.

Figure 12. Lorenz Curve status quo, generated in Excel.
5.1 Scenario 1

After calculating the FAI for the status quo in Guatemala, a scenario where there is an 11% increase for the local VAT from the current 12% where over 14 million quetzals are collected a simulation would imply that the total sales tax for food is 23% for local products. The new revenue would represent over 13 million quetzals to a total over 27 million quetzals that local VAT taxes generate, everything else held constant. Represented in table 9 is the total increase in the BFB would be Q 63.81 per individual for a total of Q 807.50 as expected, since the price of the BFB would increase, and income would stay constant, the FAI would also increase. In the case of the individuals on the first quintile with a FAI of 2.7654, to afford their caloric needs for the month they would have to spend 277% of their monthly income on food a 22% increase. For individuals in the second quintile FAI is 0.9590 it would be 95% of their income spent on food to fulfil their caloric needs, which represents a 7.58% increase. The first and second income quintiles would be in a severe state of food insecurity. As income increases, the marginal effect of the increase taxes on the BFB is reduced. For the third quintile, FAI of 0.5247 is 52% of the person’s income around 4% more than before the changes. The individuals in the fourth quintile with a FAI of 0.3037 would have enough to feed themselves; the amount spent on food to reach the caloric need would only increase by 2% to a total just above 30%. Those in the fifth quintile with a FAI of 0.1358 will spend 1% more for a total of 13.58%.

The FAI 1 graph in figure 13 demonstrates how the marginal effects of the proposed tax change of increasing the VAT in 11% for domestic products impacts the low-income segments of the population, specifically quintiles 1, 2 and 3, more than the
high-income quintiles, 4 and 5. The tax increase makes the overall population less food secure, affecting their accessibility to food.

Table 9. Scenario 1 results increase domestic VAT, generated in Excel.

<table>
<thead>
<tr>
<th>BFB 1</th>
<th>Q 807.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quintile 1</td>
</tr>
<tr>
<td>INC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q 292.00</td>
</tr>
<tr>
<td>FAI</td>
<td>2.5469</td>
</tr>
<tr>
<td>FAI 1</td>
<td>2.7654</td>
</tr>
<tr>
<td>Difference</td>
<td>0.2185</td>
</tr>
</tbody>
</table>

Figure 13. FAI 1 by quintiles, generated in Excel.
5.2 Scenario 2

In the second scenario, an increase of the income tax from 5% to 9% has presented the assumption that all Guatemalans pay income tax as the law indicates must be made. Even so, large numbers of the population operate in the informal sector, meaning that they do not pay taxes. To realize scenario two, a reduction of 4% of the income will take place represented in table 10, holding all else constant and assuming that the income reported is after taxes for simplicity.

Table 10. Scenario 2 results increase of income tax, generated in Excel.

<table>
<thead>
<tr>
<th></th>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFB</td>
<td>743.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INC</td>
<td>Q 292.00</td>
<td>Q 842.00</td>
<td>Q 1,539.00</td>
<td>Q 2,659.00</td>
<td>Q 5,947.00</td>
</tr>
<tr>
<td>INC 2</td>
<td>Q 280.32</td>
<td>Q 808.32</td>
<td>Q 1,477.44</td>
<td>Q 2,552.64</td>
<td>Q 5,709.12</td>
</tr>
<tr>
<td>FAI</td>
<td>2.5469</td>
<td>0.8832</td>
<td>0.4832</td>
<td>0.2797</td>
<td>0.1251</td>
</tr>
<tr>
<td>FAI 2</td>
<td>2.653</td>
<td>0.92</td>
<td>0.5034</td>
<td>0.2913</td>
<td>0.1303</td>
</tr>
<tr>
<td>Difference</td>
<td>0.1061</td>
<td>0.0368</td>
<td>0.0201</td>
<td>0.0117</td>
<td>0.0052</td>
</tr>
</tbody>
</table>

FAI 2 results in table 10 demonstrate that the new income tax makes food accessibility worse than the status quo for the entire population and effects in greater proportion the lower income quintiles. The first income quintile must spend 265% of their monthly income to fulfill the caloric and protein needs of one individual, represented by FAI of 2.653 this is 10% than before the tax changes. Individuals in the second quintile must spend 92% of their income to fulfill their caloric needs which is 3% more than before the changes. This group would also be severely food insecure and unable to fulfill their necessities. Individuals in the third income quintile should spend at least 50% of their income represented by FAI of 0.5034 to fulfill their caloric and protein needs.
needs being 2% more than before the changes. In the fourth quintile, individuals with an FAI of 0.2913 must increase their food budget by only 1% to meet their needs and in the fifth quintile, individuals with an FAI of 0.1305 would observe a slight increase of 0.5%.

Scenario 2 results further demonstrate that the lower-income individuals are affected marginally more than the high-income earners. These differences can be observed on the figure 13 where the separation of the lines is more noticeable on the first and second quintiles and as income increases in the third quintile the blue line starts merging in the fourth and fifth quintile where the changes are minimal.

Figure 14. FAI 2 by quintiles, generated in Excel.

Since scenario two has a change in the income of the population, a new Lorenz curve can be calculated to observe and evaluate the changes that the income tax increase of 4% has on the, income inequality, among the population. The status quo
Gini index was calculated to be 46.5537, after the tax the new Gini index is calculated to be 46.5537 where the new tax is same for the entire population and does not change income equality according to the new Gini calculation.

![Lorenz Curve Scenario 2](image)

Figure 15. Lorenz Curve Scenario 2, generated in Excel.

5.3 Scenario 3

The third scenario is based on how much the import VAT tax would have to increase to reach the target of Q13,036, which is a 12% increase above the current rate to a total of 23%. It was also calculated how much of the food is imported in Guatemala which is 22%. This scenario only considers the effects that the increase in the imported food would have in the BFB; it did not consider the consequences that increasing an import tax would have on the production of the agricultural economy given that food imports are 22% of total food consumption, which would increase by 11%. The total increase in
the BFB would only be 2.36%. The total increase in the BFB Q 18 to a total BFB of Q 761.69. The first quintile has a FAI of 2.608 that translates into these individuals having to spend 260% of their income to fulfill their caloric and protein needs this is only 6% more than the status quo.

The second quintile the increase is 2% more than in the status quo with a FAI of 0.90 which represents a total of 90% of their income having to be spent on food to meet the recommended quantities. The changes on the third quintile are approximately 1%, bringing the total amount spent on food to 49.49%. The individuals in this segment would still be considered food insecure. For individuals in the fourth and fifth quintile with FAI’s of 0.2864 and 0.1280 the change was less than 1%. Individuals in the fourth and fifth quintile have relatively high income; if they have no dependents then food accessibility should not be a concern for these groups. The FAI for each quintile is represented in Table 11 and Figure 15. In Figure 15 the status quo FAI is graphed with scenario three FAI 3, the changes are most noticeable in the first quintile for the second and third quintile the difference is hardly noticeable in the higher income fourth and fifth quintiles the lines have almost completely merged.
Table 11. Scenario 3 results increase import VAT, generated in Excel.

<table>
<thead>
<tr>
<th></th>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFB</td>
<td>292.00</td>
<td>842.00</td>
<td>1,539.00</td>
<td>2,659.00</td>
<td>5,947.00</td>
</tr>
<tr>
<td>INC</td>
<td>2.5469</td>
<td>0.8832</td>
<td>0.4832</td>
<td>0.2797</td>
<td>0.1251</td>
</tr>
<tr>
<td>FAI</td>
<td>2.60852</td>
<td>0.90462</td>
<td>0.49492</td>
<td>0.28646</td>
<td>0.12808</td>
</tr>
<tr>
<td>FAI 3</td>
<td>0.0616</td>
<td>0.0214</td>
<td>0.0117</td>
<td>0.0068</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Figure 16. FAI 3 by quintiles, generated in Excel.
5.4 Scenario 4

In scenario four, a total VAT increase was calculated for imports and exports that would reach the target of Q 13,036 million. A 6% increase in the VAT was needed for a total VAT tax domestic and on imports of 18%. As in the previous scenarios the effects were greater for the lower income quintiles. The first quintile saw a 15% increase in the amount of their income needed to be spent to fulfill their individual caloric needs for a total FAI of 2.6997. For the second quintile with an FAI of 0.9362, to consume the BFB individuals must increase their spending by 5%, to a total of 93.62% of their income to afford the BFB. On the third quintile with an FAI of 0.5122, a 3% increase of income being spent on food brings the BFB to 51.22% of their monthly income. This number is still high for an individual to be consider food secure. For the fourth quintile with an FAI of 0.2965, the new scenario means that they have to spend 1.68% more of their income to fulfill their caloric needs, which in the case of the fifth quintile with an FAI of 0.1326 is less than 1%.

Table 12. Scenario 4 results increase domestic and import VAT, generated in Excel.
Figure 16 and Table 12 show how the changes proposed for Scenario 4 affect the individuals with lower incomes in the first, second and third quintiles much more than individuals in the higher income fourth and fifth quintiles, where the changes are less noticeable graphically.

![Scenario 4 Graph](image)

**Figure 17. FAI 4 by quintiles.**

5.5 Scenario 5

The fifth scenario combine income and VAT taxes, where these taxes increase by 2% and 2.75%, respectively to a total of 7% and 14.75%. Since income changes in this scenario, a Lorenz curve and Gini index will be calculated. The 2.75% increase in the VAT is a Q 20.45 increase in the BFB that will result on a total BFB of Q 764.14. Income in all quintiles is reduced by 2%. The FAI increases for all quintiles as expected. For the first quintile, the FAI increases by 0.12 which means that individuals in this quintile
would have to spend 2.67 times their monthly income to fulfill their caloric needs. In the second quintile the FAI increases by only 0.04, this puts the income percentage of the individuals in this group at 92.61% to fulfill their caloric needs. This is still a food insecure situation with respect to the aspect of accessibility. Individuals in the third income quintile would also be food insecure under this scenario since they would have to spend just over 50% of their budget on food leaving little room for other necessities. For earners in the fourth quintile the change in FAI is of 0.013 from the status quo. Individuals in the fifth quintile would have to spend less than 1% more of their income to fulfill their caloric needs.

Table 13. Scenario 5 increased of income and VAT tax, generated in Excel.

<table>
<thead>
<tr>
<th></th>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFB Q</td>
<td>292.00</td>
<td>842.00</td>
<td>1,539.00</td>
<td>2,659.00</td>
<td>5,947.00</td>
</tr>
<tr>
<td>INC Q</td>
<td>286.16</td>
<td>825.16</td>
<td>1,508.22</td>
<td>2,605.82</td>
<td>5,828.06</td>
</tr>
<tr>
<td>FAI</td>
<td>2.5469</td>
<td>0.8832</td>
<td>0.4832</td>
<td>0.2797</td>
<td>0.1251</td>
</tr>
<tr>
<td>FAI 4</td>
<td>2.6703</td>
<td>0.9261</td>
<td>0.5067</td>
<td>0.2932</td>
<td>0.1311</td>
</tr>
<tr>
<td>Difference</td>
<td>0.1234</td>
<td>0.0428</td>
<td>0.0234</td>
<td>0.0136</td>
<td>0.0061</td>
</tr>
</tbody>
</table>

Scenario 5 changes, presented in Figure 17, have different effects on each quintile. The first quintile the difference is much more noticeable; as income for individuals increase the effects of the changes in Scenario 5 diminish gradually to where they are barely noticeable in the fifth quintile.
Figure 18. FAI 5 by quintiles.

The changes in income with the income tax increase of 2% have an effect on the inequality of the population, as shown in Figure 18. The status quo Gini index was calculated to be 46.5537, after the tax the new Gini index is 46.5537 where the new tax is the same for the entire population and scarcely equalizing. Additionally, it does not show any difference from the results in Scenario 2. Depending how the revenue from the new taxes is used the inequality situation can improve.
All the scenarios proposed increased either VAT or income taxes, which would increase the price of the BFB or decrease income for the population, decreasing their purchasing power. For a comparison of every scenario, the FAI numbers are presented in Table 14. The third scenario results in food security being affected the least, but the consequences of raising taxes on all imports could be devastating for many industries and change the production characteristics of Guatemala’s own agricultural industry. The second-best scenario for food accessibility is the second scenario where an income tax
is increased for the entire population. The more feasible scenario would also be the second scenario if there is an effort to formalize the entire economy, where most income earners would pay taxes. For food accessibility the worst results are in the third scenario where it resulted in higher FAI number for all quintiles affecting specifically the lower income the first and second quintiles. In all scenarios the most affected groups where the lower quintiles first and second, this is especially troublesome since they are under the poverty line.

Table 14. FAI comparison.

<table>
<thead>
<tr>
<th></th>
<th>Quintile 1</th>
<th>Quintile 2</th>
<th>Quintile 3</th>
<th>Quintile 4</th>
<th>Quintile 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAI</td>
<td>2.5469</td>
<td>0.8832</td>
<td>0.4832</td>
<td>0.2797</td>
<td>0.1251</td>
</tr>
<tr>
<td>FAI 1</td>
<td>2.7654</td>
<td>0.9590</td>
<td>0.5247</td>
<td>0.3037</td>
<td>0.1358</td>
</tr>
<tr>
<td>FAI 2</td>
<td>2.6530</td>
<td>0.9200</td>
<td>0.5034</td>
<td>0.2913</td>
<td>0.1303</td>
</tr>
<tr>
<td>FAI 3</td>
<td>2.6085</td>
<td>0.9046</td>
<td>0.4949</td>
<td>0.2865</td>
<td>0.1281</td>
</tr>
<tr>
<td>FAI 4</td>
<td>2.6997</td>
<td>0.9362</td>
<td>0.5122</td>
<td>0.2965</td>
<td>0.1326</td>
</tr>
<tr>
<td>FAI 5</td>
<td>2.6703</td>
<td>0.9261</td>
<td>0.5067</td>
<td>0.2932</td>
<td>0.1311</td>
</tr>
</tbody>
</table>

Figure 18 shows the poverty line FAI with respect to the income quintiles FAI in each scenario. For all scenarios, the poverty line crosses between the second and third quintile which is consistent with the previous estimates of food insecurity of 44.7% by FAO, but inconsistent with the poverty estimate of 59% INE in 2014. This may be explained by the changes in the BFB in 2017, where some products of the BFB change and it reduced the size of the average Guatemalan family.
Figure 20. Poverty Line and Scenarios, Generated with Excel, Data from INE and Banco de Guatemala.
CHAPTER 6 IMPLICATIONS

A comparison of the impact of the alternative tax structures on the FAI for all income groups can be seen graphically in Figure 18 and in tabular form in Table 14. Each of the five tax structures results in less food accessibility relative to the status quo FAI for each of the five income groups. Although the FAI outcomes are different across income groups, their rankings are the same for each quintile.

To examine this more closely, consider the FAI outcomes for quintile 1 as presented in Table 17. The tax structure FAI1, with a domestic sales tax increase to 23%, results in the least food access with a FAI of 2.7654. The tax structure FAI4, with a domestic sales tax and import VAT increase to 18%, results in the second least food access with a FAI of 2.6997. This is followed by the tax structure FAI5, a combination of a domestic sales tax and import VAT increase to 14.75% and an income tax increase to 7%, which results in a FAI of 2.6703. The tax structure FAI2, an income tax increase to 9%, results in a FAI of 2.6530. Finally, the tax structure FAI3, which increases the import VAT to 23%, results in a FAI of 2.6085.

These results are not surprising. The tax structure providing the most food accessibility is based on taxing imported product. While this may be regressive, it does not tax domestic production and, thus, encourages domestic production and income opportunities. At the other end of the spectrum, the least food accessibility comes from a scenario in which the revenues are attained solely through a domestic sales tax. Not only is this regressive and harmful to the lower quintiles, it may also have a negative income effect as it discourages domestic production.
Given data availability, the scenarios analyzed in this thesis involved tax structures that were the same across all quintiles. As shown in the results, each of the scenarios resulted in outcomes that offered less food accessibility for each of the income groups. Given the poverty conditions of the lower quintile groups, alternative tax structures could be constructed in which the food accessibility of at risk groups can be improved while still achieving the government’s revenue goals. For example, a tax structure in which graduated income tax rates are combined with some type of sales tax could increase the food accessibility of at risk groups while still achieving the target revenue of 13%. Higher income groups would still experience a decrease in food accessibility, but not to any level where they would become food insecure. Future research should explore these alternative tax structures if the necessary data, disaggregated across income quintiles, becomes available.

It is likely that tax structure scenarios could be constructed which allow the government to meet its revenue targets while still allowing for increased food access among the lowest income groups. However, the existence of such a scenario does not mean that it is politically feasible. An additional area for future work involves the analysis of the political influence among the upper-quintiles to determine their influence on determining the tax structure. Detailed, disaggregated analysis can be used to identify Pareto superior outcomes in which all groups can benefit.

The results of this study have implications in the further planning of tax policy in Guatemala where the food insecure need to be considered. Tax structures must be examined to determine how tax changes will affect the accessibility of food for many families and individuals, not just the interest of a few powerful players. As Fuentes
explains, fiscal pacts are complicated and can be unglued by details that a powerful group dislike. Further investigation in how to create a fair tax system that considers property taxes, remittances, or other revenue sources such as internet VAT, it can also take into account making food tax except and put that burden on other goods but data is needed for the analysis, this different studies can also help to increase the chance for successful fiscal reform. If taxes are increased and a group of individuals are disproportionately affected it can be in the best interest of the government to focus the social spending on this group, especially if they already cannot achieve their basic needs. Fiscal policies can benefit the food insecure by either reducing their tax burden or allowing for investment in infrastructure, health, and education.
REFERENCES


Arcand Jean-Louis 2001. ‘Undernourishment and economic growth’ The efficiency cost of hunger. FAO.


FAO. 2018 ‘Food Price Index’ (accessed February, 2018)


Humphries DL, Behrman JR, Crookston BT, Dearden KA, Schott W, et al. (2014) Households across All Income Quintiles, Especially the Poorest, Increased Animal Source Food Expenditures Substantially during Recent Peruvian


Kirkpatrick and Diakosavvas (1986) explain how to find the cost of “food security imports”.


Tabucanon M.T. 1993. ‘Applications of Multiple-criteria Decision-making Methodology in Food-policy Analysis’ Food Security and Food Inventories in Developing Countries.


World Bank. Tax Revenue % of GDP, Guatemala


World Bank. GDP growth (annual %) Guatemala. World Bank accounts data, and OECD National Accounts data files.

VITA

Guillermo Remigio Fernandez, born in Baton Rouge, grew up in Guatemala and move back to Baton Rouge at the age of 18. Received a bachelor's degree from Louisiana State University. As his interest in agricultural economics and world markets grew, he decided to enter the Department of Agricultural Economics and Agribusiness at Louisiana State University anticipating graduation in December 2018. Upon completion of her master's degree, he will be joining Keytrade as a junior trader for the Latin-American market.