Three Shades of Welfare in Applied Economics

by

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Abstract

This dissertation comprises of three essays, organized in chapters, on the broader topic of welfare in applied economics. The first essay studies the implications of high food prices resulting from climate change on food security in small islands, using Mauritius as a case-study. Climate change will adversely impact prices of agricultural commodities. The study derives and calculates the government cost and the welfare effects of an increase in world price of rice on consumers in Mauritius. Using an equilibrium displacement model, this study finds that an increase in the price of rice by 35%, as predicted by the literature on climate change and rice prices, will result in an increase of 28.8% in government spending, representing the additional outlays to support a rice subsidy scheme for food security. Using 2012 as the baseline, the welfare analysis results suggest that consumer surplus for ration rice consumers increases by Mauritian Rupees 626 million (USD 18 million) while consumer surplus decreases by Mauritian Rupees 454 million (USD13 million) for basmati rice consumers.

The second paper focuses on welfare of women in society and hypothesizes that gender wage gap decreases with the implementation of a national gender policy framework (NGPF) from 2007 to 2017 on the island of Mauritius. Using data from the household budget surveys of 2007, 2012 and 2017, the impact of the policy is analyzed using difference-in-differences. The results indicate that no significant changes occurred

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in 2012 in the wage gap between men and women after controlling for human specification, industry, and occupation. The policy impact was significant in 2017 when controlling for industry and occupation.

The final chapter attempts to determine whether negative personal attitudes toward welfare may prevent eligible persons from applying for food stamps in the United States. Using the dataset from the 2002 National Survey of American Families (NSAF), a logistic regression model was run. The findings of this study indicate that negative attitudes towards welfare may prevent people from applying for food stamps. Food insecurity on the other hand, increases the likelihood of applying for food stamps. Demographic variables such as education and marital status also influence the probability of applying for food stamps.

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List of Abbreviations

AIDS   Almost Ideal Demand System

EDM   Equilibrium Displacement Model

FAO   Food and Agriculture Organization

GDP   Gross Domestic Product

IPCC   Intergovernmental Panel on Climate Change

LA-AIDS Linear Approximate Almost Ideal Demand System

NGPF   National Gender Policy Framework

NSAF   National Survey of American Families

Rs   Mauritian rupees

SNAP   Supplemental Nutrition Assistance Program

Chapter 1 Impact of Climate Change on Food Security of Small Islands: The Case of Mauritius

1.1 Introduction

Small island nations have unique characteristics which include a narrow resource base; they are remote from major markets; they tend to depend heavily on volatile export markets; their smallness in size limit the options for diversifying their economies; the export volume of products from small islands are too small to benefit from economies of scale. The economic vulnerability of small islands is well documented in the empirical literature (Ng and Aksoy, 2010; Bruguglio, 1995, 2003, 2008). This vulnerability arises because the economies of small islands are influenced by factors beyond their control, mostly due to economic openness. These nations depend on food imports for their food security. The Food and Agricultural Organization (2017) states that half of small islands import 80 percent or more of their food requirements.

Small islands are vulnerable to world food price changes because high food prices impact their food importing capacity (Ng & Aksoy, 2008; Poonyth & Ford, 2004). Governments in such nations have to take the appropriate measures to protect the most vulnerable against the effect of high food prices and price volatility to ensure food security. In Mauritius, the government subsidizes one type of rice, known as ration rice, as a food security strategy to counteract price volatility effects on lower-income households.

Climate change is a factor that contributes to the problem of high and volatile food prices. Research to quantify the effects of high food prices resulting from climate change on small islands is limited. The chapter on small islands in the Fifth Assessment

report of the IPCC identifies the determination of economic and social costs of climate change impact on small islands as a research and data gap (Nurse et al., 2014). This paper therefore aims to fill this gap in the literature.

The paper uses Mauritius as an example to discuss the implications of high food prices resulting from climate change on food security in small islands. Mauritius is a net-importer of food. Any increase in prices of food on the international market can significantly impact the trade balance, as well as the welfare of households. This study focuses on rice as a commodity that impacts food security of the island. Rice is an important staple consumed by most Mauritians. Climate change may decrease the supply of rice, which may cause price of rice on the international market to rise (Chen et al, 2012). This article derives the welfare effects of an increase in world price of rice on consumers in Mauritius. The government of Mauritius subsidizes ration rice while basmati rice is imported by commercial traders. When the price of basmati rice increases, some consumers will substitute ration rice for basmati rice resulting in an increase in government expenditures to pay for subsidized ration rice.

The price elasticities of demand for rice in Mauritius are estimated using the Linear Approximate Almost Ideal demand System (LA-AIDS) model developed by Deaton & Muellbauer (1980). The effect on rice prices of demand and supply shifts resulting from climate change were obtained from literature (Chen, McCarl, & Chang, 2012; Koizumi & Kanamaru, 2016). The equilibrium displacement model (EDM) framework measures the effect of an increase in the world price of rice associated with climate change on consumers of rice in Mauritius and on government costs of the subsidy scheme. Quantifying the effects of an increase in price of rice on government spending is

of interest because it will assist policy-makers to determine the predicted cost of subsidies on rice and to decide whether to shift to other cost-efficient policy measures.

A background to this study precedes the description of the structural model. The next sections describe the demand and parameter estimations used in the model. The paper concludes with model simulations to isolate the impact of increased rice prices on demand, quantities, and government cost and consumer welfare.

1.2   Background

Global shocks from increased food prices impact the economy of many net food importing small islands. Santeramo, Lamonaca, Contò, Stasi, & Nardone (2017) distinguish between endogenous and exogenous causes influencing food commodity price dynamics. Weather shocks, consequences of natural disasters, price dynamics in energy and petroleum markets and exchange and interest rate dynamics are exogenous drivers that explain price levels and fluctuations in commodities market. Endogenous drivers include political interventions impacting on global consumption and production, storage levels and traded volumes leading to changes in stock levels. Domestic price insulations, production shocks, spillovers from other agricultural commodities and substitutability influence a commodity's price. Speculation in commodity futures markets can also be a potential driver of price volatility. These drivers of food prices can interact in complex ways, each influencing prices to different extent.

Climate can be an important determinant of food price trends and short term variability of prices. Therefore the stability of food systems may be at risk with climate change (Wheeler & von Braun, 2013). Quantitative assessments show that food security will be adversely affected by climate change. However, the extent to which climate

variability and weather extremes will influence food security will depend on how countries respond to those impacts through the food policy environment (Krishnamurthy, Lewis, & Choularton, 2014; Schmidhuber & Tubiello, 2007).

A review of the literature shows that small nations face increasing food import bills coupled with a decrease in agricultural exports leading to declining food importing capacity (FAO, 2013; Ng & Aksoy, 2008; Poonyth & Ford, 2004). The impact of a high food import bill adds pressure on national budgets of small islands for increased foreign exchange to purchase imports, and in addition to implement social protection programs. During the last decades, a number of small islands have switched from being net exporters of agricultural products to net importers (Poonyth & Ford, 2004). In 1990, the Caribbean islands imported 45 percent of the food available. This figure increased to 67.5 percent in 2011. Some Caribbean islands such as St. Kitts and Nevis import 95 percent of available food while in the Pacific, the Cook Islands import 92 percent of the available food (FAO, 2016). Recent food price increases have implications for consumers' ability to meet one of their basic needs, food, and threatens the food security of small island nations (FAO, 2013) . In the Pacific islands, food security, more precisely, food availability is increasingly becoming a function of the ability to pay for food imports. This in turn, at the aggregate level, is a function of national income and therefore the impacts of climate change on food security involves assessing the ability to pay for food imports (Barnett, 2011). Current climate change is expected to be an increasing driver of high food prices and volatility due to the increasing frequency and intensity of extreme climatic events (Ott, 2014).

The effects of climate change scenarios on the overall food and agriculture sector is complex. Numerous studies on the impact of climate change on global food production tend to show a decreasing trend under various scenarios of climate change (Krishnamurthy et al., 2014; Parry, Rosenzweig, Iglesias, Livermore, & Fischer, 2004; Tran, Welch, Lobell, Roberts, & Schlenker, 2012). How climate change will really affect agriculture remains ambiguous (Tran et al., 2012).

Climate change effects on rice

Climate change will affect rice crop growth and yields through direct effects of temperature and carbon dioxide as well as indirect effects such as irrigation, pests, soil fertility and erosion (Aggarwal & Mall, 2011). The general trend is that climate change will negatively impact rice productivity in many of the rice growing areas (Mohanty, Wassmann, Nelson, Moya, & Jagadish, 2013). The IPCC reports that most models predicting the effects of climate change on rice production show that higher temperatures will lead to lower rice yields because of shorter growing periods (Nurse et al., 2014). However, the report also argues that increased atmospheric carbon dioxide may increase rice yields through enhanced photosynthesis. In the lowlands of South and Southeast Asia, floods can affect rice farming through complete or partial submergence or waterlogging conditions (Mohanty et al., 2013). Rising sea levels in delta/coastal regions will increase the risk of flooding and salinity in many rice-growing areas in India (Vasanta, 2013).

There are many studies modelling the impact of climate change on rice yields in South East Asia. However, research that assesses the impacts of climate change on rice prices is limited. Studies that have measured the impacts of climate change on food prices

show that on average, food prices tend to rise with increases in temperature. Some studies forecast that price of rice may increase to as much as 80% above reference level even without climate change (Schmidhuber & Tubiello, 2007). Crop yield effects and sea-level rise will, on average, increase rice price by 10 to 40%, according to a global rice market model representing 26 major rice production/ consumption regions of the world (Chen et al., 2012). In a study that simulated the effects of climate change on yields and prices of agricultural commodities over the period 2000-2050, Nelson et al. (2010) predict that the price of rice on the global market will increase by 32 to 37% with climate change. Similarly, the Rice Economy Climate Change (RECC) model shows that international rice price (milled 5% broken f.o.b Ho Chi Minh price) is projected to increase by 34% in 2030 (Koizumi & Kanamaru, 2016).

Extreme weather events are likely to be occurring at a higher frequency leading to price spikes of food commodities which are not often predictable using models. Although many studies on the impact of climate change on food security have been undertaken, improving the projections of impacts at country level and small scales are crucial since decisions still need to be taken by policy makers confronted with the prospects of climate change impacts on food security, despite uncertainties in current knowledge and future trends (Wheeler & von Braun, 2013).

Importance of rice in small islands

Rice is a staple[1] food in many island nations in the Indian, Pacific and Caribbean regions (Mohanty et al., 2013; Muthayya Sumithra, Sugimoto Jonathan D., Montgomery Scott, & Maberly Glen F., 2014; Rogers & Martyn, 2009). In the Caribbean, the average

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[1] Staple food is defined as the food, among the three main crops, that supplies the largest amount of calories.

consumption of rice is 70 kg per capita annually. Consumption is on the rise in the Pacific island countries of the Solomon Islands, Vanuatu and Fiji (Muthayya Sumithra et al., 2014). Annual national consumption of imported rice in Solomon Islands doubled from 34 kg to 71 kg per capita during 2002 to 2007 and tripled in Samoa from 6 kg to 19 kg (Rogers & Martyn, 2009). Rice imports in the Caribbean increased by 92% over the period 2000 to 2011 and amounted to USD 240 million (FAO, 2013). A better understanding of how rice prices may be affected by climate change is beneficial for small islands to improve and adapt their policies since these island nations depend on rice for their calorific intake, thus meeting food security. The next section describes the case of Mauritius and its consumption of rice over time.

1.3   Case-study: Mauritius

Mauritius is a sub-tropical island located off the east coast of Africa. The island has an area of 788 square miles, with a fairly diversified economy based on agriculture (4% of GDP), mostly sugar exports, manufacturing (20% of GDP), services sector and tourism (76% of GDP). The island is classified as a net food importing country by the World Trade Organization. As part of the African-Caribbean and Pacific group, Mauritius benefitted from preferential market access to the European Union under the Cotonou Agreement in 2000, previously the Lome Convention, which came into force in 1976. The dismantling of these trade preferences resulted in a decrease in the revenue generated by the sugar industry. In 2006, the share of sugar to the agriculture sector in Mauritius was 50.7 per cent which decreased to 23.1 percent in 2016 (Statistics Mauritius, 2016). From 2006 onwards, the balance of trade for food and agriculture has reversed and is widening (Figure 1.1). The food import bill shows an upward trend impacting on the

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economy as foreign exchange spending rises and the percentage spending on food and agriculture to total imports increased and reached 24% in 2016 (Statistics Mauritius, 2017).

The history and culture of the island has led to rice classified as a staple food in the diet of the Mauritian. Maurer (2012) explains how rice unites the Mauritian community across all ethnicities present in the island of Mauritius. Rice is an important staple food to study as the government provides subsidy to ensure food security. The efforts of government to stabilize rice prices are understandable politically and desirable economically (Timmer, 2014). Rice contributes to 16.9 percent of the average daily calorie intake in Mauritius (Leete, Damen, & Rossi, 2013). Since rice is mostly imported in Mauritius, the price of rice tends to fluctuate, with the risk that during price hikes, some households may struggle financially to purchase rice, hence the intervention of government to stabilize prices. Mauritius recently embarked on the cultivation of high value low glycemic rice by private companies with the aim of marketing in the U.S. and Canadian markets. However the production of this type of rice is still at initial stages.

Rice consumed locally is mostly imported from India and Pakistan and to a lesser extent from Thailand and China. Two main types of rice are imported: 1) ration rice, which is sold on the international market as broken rice, is imported solely by the State Trading Corporation and sold at subsidized price. For food security, this rice targets lower-income households in Mauritius and accounts for around 30% of the market share; 2) the other type of rice, locally known as 'basmati' luxurious rice is imported mainly by private importers and accounts for the remaining 70% of the market share. Both types of rice are sold by retailers in Mauritius and anyone can purchase ration rice. However,

given the lower quality of ration rice, higher income earners tend to purchase basmati rice rather than ration rice. The average per capita consumption over the last ten years is 13.95 kg/year for ration rice and 35.94 kg/year for basmati rice. Ration rice is sold at a subsidized price of Rs[2]10.80 /kg which is constant since 2006. The average price of non-subsidized rice price varied from Rs45.00/kg up to Rs75.00/kg during the period 2007 to 2014. Figure 2 illustrates the trend in imports and consumption of rice in Mauritius from 2004 to 2013. The graph seems to show an inverse relationship between the imports of the two types of rice over time, noting a stabilizing trend in imports of ration rice from 2011 onwards.

The improvement of the purchasing power in Mauritius over time may influence the willingness of households to shift towards the consumption of ration rice. The discrepancy between the prices of the two types of rice may cause some consumers to shift to ration rice as Government, through the State Trading Corporation, is now importing better quality ration rice with 5% broken which was previously 35% broken[3].

Government subsidy on rice in Mauritius

Post World War II and prior to independence of the island, the British government introduced a system of food subsidies and guaranteed prices as food was scarce. The policy of rice subsidy was viewed as a 'cost of living subsidy'. The government authorities, with monopoly in the imports of rice, sold the rice at a low stable price, incurring losses in the import of the rice over a number of years. From a macroeconomic perspective, this 'cost of living' subsidy effectively raised the real wage of the worker by reducing his cost of living without raising the money cost of employing labor by

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[2] Rs stands for Mauritian Rupee. Conversion is approximately 1 USD = Rs 33.00
[3] http://www.stcmu.com/products/long-grain-rice

entrepreneurs (Meade, 1961). The mechanism for implementation of the subsidy changed over time. Currently, the State Trading Corporation in Mauritius which still has the monopoly in the imports of 'ration' rice, controls the implementation of the rice subsidy. Part of the cost of the subsidy is derived from charges on imported petroleum products. Current expenditure on rice subsidy in Mauritius amounts to 154 million Mauritian rupees (USD 5 million) (L'Express, 2018). However, there are loopholes that exist in the present system which may lead to excessive cost to government as the subsidized rice is accessible to all consumers, without distinguishing between low- and high-income earners.

1.4   Data

The data consists of monthly aggregate retail price and per capita consumption of ration and basmati rice for Mauritius for the period June 2007 to December 2014, totaling 90 observations. All prices and values are measured in Mauritian rupees. Figure 1.3 illustrates the time series plot of rice prices used. The total quantity demanded of ration rice, basmati rice, and flour, as well as monthly retail prices for ration and basmati rice and flour were obtained from Statistics Mauritius. Trade data was obtained from the Mauritius Chamber of Commerce and Industry.

Flour is included, as the AIDS model assumes a two-stage budgeting procedure where consumer preferences are weakly separable. The two staple goods in Mauritius are assumed to be rice and flour. In the first stage, the share of total expenditure to be allocated to staple food and other consumption goods is determined by the consumer. In the second stage, the demand for each staple good is determined by the prices of the good and total expenditure on staples. Since the subsidized rice policy was implemented in

2006, the period covered provides a good indication of consumer responses to price changes. An adjustment of the nominal price to real price using the consumer price index is necessary to capture responsiveness of consumers for measuring the elasticities. Table 1.1 provides the descriptive statistics of the data.

1.5   Analytical framework

Equilibrium displacement models (EDM) are widely used in agriculture to evaluate impacts of exogenous shocks on endogenous variables and social welfare (Piggott, 1992). Using the technique of comparative statics, the results summarize the interaction between the elements of the model from changes in coefficients of the system (Wohlgenant, 2011). EDM can therefore provide useful insights on the importance of influences in the model as well as policy evaluation. The methodology is appropriate for the purpose of this study as research resources are often limiting in small islands to conduct econometric analysis requiring extensive data.

Model

The partial equilibrium model used in this study consists of a set of four structural equations describing the demand for the two types of rice, ration rice and basmati rice and cost to government for subsidizing ration rice in Mauritius:

(1)   Demand for ration rice $\quad\quad\quad\quad Q_1 = D\ (P_1, P_2)$

(2)   Demand for basmati luxurious rice $\quad Q_2 = D(P_1, P_2)$

(3)   Consumer subsidy $\quad\quad\quad\quad\quad S = P_W - P_1 \quad\quad$ if $P_w > P_1$

$$S = 0 \quad\quad\quad \text{if } P_w \leq P_1$$

(4)   Government cost $GC = S.Q_1$ if $P_w > P_1$

                                          $GC = 0$ if $P_w \leq P_1$

Where Q_1 represents the demand for ration rice on the domestic market; P_1 is the price of ration rice on the domestic market which is constant since 2006 and is set by government. P_w is the price of ration rice on the world market; P_2 is the price of basmati rice on the domestic market. GC is the cost to the Government of Mauritius for subsidizing ration rice. The Government cost equals the per-unit subsidy multiplied by the quantity of ration rice consumed at the set price. The subsidy provided by Government, S, is a function of the world price of ration rice and the price of ration rice on the domestic market. The endogenous variables are Q_1, Q_2, S and GC. One key feature of small island nations is that prices of traded goods are exogenous. Therefore P_W, P_2 and P_1 are exogenous variables.

The effect of changes in demand and supply of rice on the government cost can be determined by expressing in EDM form:

(1') $Q_1^* = \eta_{11}\overline{P}_1^* + \eta_{12}\overline{P}_2^*$

(2') $Q_2^* = \eta_{21}\overline{P}_1^* + \eta_{22}\overline{P}_2^*$

(3') $GC^* = \frac{S+P_1}{S}\overline{P}_w^* + (\frac{\eta_{11}S-P_1}{S})\overline{P}_1^* + \eta_{12}\overline{P}_2^*$

(4') $S^* = \frac{P_w}{S}\overline{P}_w^* - \frac{P_1}{S}\overline{P}_1^*$

The above reduced form equations express the endogenous variables in terms of the exogenous variables. The model has four reduced-form equations. Equations (1') and

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(2') indicate that the changes in the equilibrium quantities of rice exchanged in the domestic market depend strictly on demand elasticities and changes in rice prices. Equation (3') measures the net effect of an increase in the price of ration rice and basmati rice on government cost taking into account the cross-commodity substitution effect and demand responses. The effect of changes in the price of ration rice and basmati rice on government cost can be determined where η_{ij} are demand elasticities for product i with respect to price j. From the reduced form equations (1' to 4'), an isolated one percent increase in the price of basmati rice will increase the equilibrium quantity of ration rice exchanged in the domestic market by η_{12} percent, reduce the equilibrium quantity of basmati rice by η_{22} percent, increase the equilibrium cost of the subsidy program by η_{12} percent, and have no effect on the subsidy itself. A one percent increase in world price of ration rice will always have a larger effect on government cost than a one percent increase in the price of basmati rice provided $\eta_{12} < 1$. A less generous subsidy, i.e., an increase in $\bar{P}_1$ always reduces government costs, with the reduction increasing with the absolute value of own-price elasticity of demand for ration rice.

1.6   Demand estimation

Given the paucity of available published data on elasticities of demand required for this study, the parameters had to be estimated. The demand elasticities for use in the model were estimated using the LA-AIDS model. Deaton & Muellbauer (1980) specify the cost or expenditure function belonging to the price independent generalized logarithmic (PIGLOG) class of preferences which defines the minimum expenditure necessary to attain a specific utility level at given prices. These preferences satisfy the necessary conditions for exact aggregation over consumers.

The AIDS model consists of a system of demand equations, in which the budget shares of various commodities are linearly related to the logarithm of real total expenditure and the logarithm of relative prices (Deaton & Muellbauer, 1980). The model provides an arbitrary first-order approximation to any demand system and second-order approximation to any cost function.

The AIDS model calculates the share equations in an n-good system as

(5) $w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(\frac{X}{P})$

where w_i is the share of income spent on i^{th} good, α_i is the constant coefficient in the ith share equation, γ_{ij} is the slope coefficient associated with the jth good in the ith share equation, p_j is the price on the jth good. X is the total expenditure on the system of goods given by

(6) $X = \sum_{i=1}^{n} p_i q_i$

in which q_i is the quantity demanded for the ith good. An important feature of this model is that is allows for testing of the theory, that is, homogeneity and symmetry, by imposing the following set of parametric restrictions:

(7) $\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \gamma_{ji} = 0, \ \sum_{i=1}^{n} \beta_i = 0, \ \gamma_{ij} = \gamma_{ji}$

Deaton and Muellbauer (1980) suggest a linear approximation of the nonlinear AIDS model by specifying a linear price index given by:

(8) $\ln P = \sum_{i=1}^{n} w_i \ln p_i$

This resulting version is known as the LA-AIDS model which is used to determine the Marshallian demand elasticities. In estimation, the basmati rice equation is

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dropped from the system to avoid singularity in the variance covariance matrix.

Elasticities are calculated using the expressions:

Income elasticity

(9) $Ai = \frac{\beta_i}{w_i} + 1$

Own-price elasticity

(10) $E_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i$

Cross price elasticity

(11) $E_{ii} = \frac{\gamma_{ij} - w_i \beta_i}{wi}$

Income/expenditure elasticities are expected to be positive, own price elasticities negative and cross-price elasticities to be positive for normal goods. A negative value for income/expenditure elasticity may imply an inferior good, whereby an increase in income decreases consumption of the good.

Estimation procedures

Unit root tests

Time series may be prone to spurious regression. A cointegration test requires that the series be integrated in the same order. The first step in using time series is to check for unit roots at the stationary level and the first difference. The Augmented Dickey Fuller test results in Table 1.2 show that all variables are stationary at the first difference I(1). At 10% level of significance, all variables are integrated to order 1.

Cointegration tests

The two-step method proposed by Engle & Granger (1987) to test for cointegration is suitable for two variables. For three variables, the Johansen method is preferred (Johansen, 1988). The choice of the number of lags is guided by the Akaike information criteria. The results of the Johansen cointegration tests based on eigenvalue and trace statistics are reported in Table 1.3. The results reject the null hypothesis of no cointegration at the 1 % level of significance. Therefore the variables are cointegrated in the long-run. The results also show that there are two cointegrated vectors.

The model was estimated using seemingly unrelated regression (SUR) and takes into consideration the imposition of parametric restrictions. The SAS 9.4 software was used to fit the regression model using proc model procedure. As monthly consumption data are employed, first order vector autoregressive correlation procedure is used (Berndt & Savin, 1975). A single test of symmetry and homogeneity using the Likelihood Ratio test, the Wald test, and the Lagrangian Multiplier (LM) indicated that we fail to reject symmetry and homogeneity. Also, a joint test for symmetry and homogeneity showed that we fail to reject symmetry and homogeneity. For the estimation, the basmati equation is dropped to avoid singularity in the variance-covariance matrix. However, to ensure estimation parameters are invariant of deleted equation, the model was re-run with the equation for flour dropped. Table 1.4 shows the estimated parameters and R-squared values. Most of the estimated parameters from both models are highly significant at the 1% level. The relatively high R-squared values, ranging from 0.81 to 0.93, together with significant coefficients, suggest that the restricted model provides a good fit. Preliminary tests on the D.W. statistic showed no evidence of serial correlation in both restricted and

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unrestricted equations. The estimated parameters are then used to obtain elasticity estimates. Income and own-price elasticity for flour and basmati rice are consistent with the theory for normal goods. However, ration rice has a negative income/expenditure elasticity which may convey the fact that this type of rice is an inferior good.

The calculation of the Marshallian demand elasticities from the parameter estimates of the LA-AIDS model yielded the results in Table 1.5. The negative demand elasticities for rice and flour are consistent with the expectation that a demand curve will have a negative slope. The elasticity of demand for ration rice with respect to the basmati price is positive, implying that the two are substitutes. This explains the shift of basmati consumers towards ration rice when prices of basmati increase. However, the elasticity of demand for basmati rice with respect to the price of ration rice is negative, indicating that the two goods are complements. The elasticity values reflect a system which is thought to prevail in Mauritius whereby middle- and higher income earners purchase ration rice, albeit in small quantities, resulting in inefficiencies of the present system. The estimated own-price elasticities for basmati rice of -0.413 compares favorably with (Cramer, Wailes, & Shui, 1993) estimates of -0.05 to -0.65 for high quality rice for major importers. The own-price elasticity of ration rice of -0.019 is slightly lower than estimates of -0.1 to -0.5 found by Cramer et al. (1993) for low quality rice. The result may be due to the stability of price maintained by government for subsidized rice. The estimation of the demand elasticity values for Mauritius is crucial to understand the specificities of the market for rice to estimate the government cost associated with subsidization. The elasticities from the estimation and other parameters needed to simulate the model are reported in Table 1.6.

1.7   Impacts of price changes due to climate change on government cost

For any set of values of elasticity, Equation (3') can be used to determine the relative

change in government subsidy cost for changes in the exogenous prices of basmati and

ration rice on the world market. Supply is considered to be perfectly elastic as Mauritius

is a small economy and therefore cannot influence the price of rice. The effect of the

exogenous variables on the government cost can be expressed as:

(12) $GC^* = 3.51\bar{P}_w^* - 2.52\bar{P}_1^* + 0.17\bar{P}_2^*$

The above equation implies that a one per cent increase of the world price of ration rice

P_w, keeping all other parameters constant, results in an increase of 3.51 per cent of

government cost. On the other hand, a one per cent increase in price of subsidized rice on

the local market decreases government cost by 2.52 per cent.

Simulation

An increase in the price of basmati as shown in Panel B (P_2 to P_2'), caused by a decrease

in supply of basmati on the international market because of climate change, causes the

demand for subsidized ration rice to shift to the right from $D_1(P_2)$ to $D_1(P_2$') (Panel A of

Figure 4). However, the climate change affecting the price of basmati rice will also affect

the world price of ration rice, and vice versa. The model predicts that an increase in 1%

in the price of basmati rice and ration rice simultaneously results in an increase in

government cost of 3.68%. The quantity of ration rice will increase by 0.17% with a 1%

increase in the basmati rice price. From the literature, the price of rice on the global

market will rise by around 35% by 2030 due to the impacts of climate change (Koizumi

& Kanamaru, 2016; G. C. Nelson et al., 2010). Therefore an increase of 35% in price of

world rice will cause an increase in 28.8% in government spending, amounting to 100 million Mauritian rupees (using 2012 as baseline year). This amount reflects not only the increase in the amount of subsidy to be spent to cover the difference between the 35% increase in price of imported rice but also the increase in consumption of ration rice due to the substitution of basmati rice consumers to ration rice.

1.8   Welfare effects

Parallel shifts in linear demand and supply functions can be used to geometrically determine the consumer surplus. Alston et al (1995) describe the mechanism for welfare analysis which is used for this study. An increase in the price of basmati rice will benefit ration rice consumers at the expense of basmati rice consumers. The welfare effects are shown in Figure 4. Panel A shows the welfare gain from ration rice consumers. Panel B shows the welfare loss resulting from an increase in the price of basmati rice from climate change effects.

Climate change is expected to cause a decrease in supply of basmati rice. Prices of basmati rice then increase from P_2 to P_2' (Panel B). This is accompanied by an increase in demand for ration rice, moving from Q_1 to Q_1'. Consumer surplus is represented by the shaded area in Panel A. To calculate the consumer surplus, the change in price of ration rice has to be determined, keeping quantity constant.

Consumer Surplus for ration rice consumers therefore is given by the following equation where P_1* and Q_1* represent proportionate changes in price and quantity of ration rice:

(13) $\qquad \Delta CS_1 = (P_1' - P_1)Q_1 + \frac{1}{2}(P_1' - P_1)(Q_1' - Q_1)$

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(14) $$\Delta CS_1 = P_1 Q_1 P_1^* \left(1 + \frac{1}{2} Q_1^*\right)$$

The consumer welfare for basmati rice measures the changes in welfare resulting from a change in price when the supply of basmati rice on the world market increases. The consumer welfare of basmati rice consumers can be expressed as follows:

(15) $$\Delta CS_2 = (P_2' - P_2)Q_2' + \frac{1}{2}(P_2' - P_2)(Q_2 - Q_2')$$

(16) $$\Delta CS_2 = P_2 Q_2 P_2^* \left(1 + \frac{1}{2} Q_2^*\right)$$

The welfare changes were analysed for the base year 2012. The effect of changes in price on consumer welfare for ration rice and basmati rice consumers was computed using the elasticities from the reduced-form equations. Values are reported in Mauritian rupees. The results suggest that welfare change from a rise in the price of basmati rice is positive for ration rice consumers and consumer surplus is negative for basmati rice consumers.

Consumer surplus for ration rice consumers increases by 626 million Mauritian rupees (USD 18 million) with an increase of 35% in the price of basmati rice while consumer surplus decreases by 454 million Mauritian rupees (USD13 million) for basmati rice consumers.

1.9 Concluding remarks

This study addresses an important research gap in small islands which is to quantify the social and economic costs of climate change on food security using Mauritius as a case-study. The findings indicate that government costs to subsidize rice in Mauritius will increase, assuming that the price of rice will increase due to climate change predicted by

the models. This study identifies three policy options available to the government of Mauritius. Firstly, maintain the status quo and ensure that the expenditures to be incurred are budgeted to cover the incremental costs to the government, measured as the adaptation cost to climate change. This scenario will still be subject to leakages and benefits that arise to medium and higher income households. The second alternative is to consider increasing the price of the subsidized rice leading to a decrease in the government cost. For instance, a 10 percent increase in the price of subsidized rice will decrease government cost by 25 percent *ceteris paribus*. However the economic situation of the country will probably dictate the feasibility of this option in the future. The third policy option available to Mauritius is to gradually reform the current policy. This entails that government develop the administrative capacity to effectively deliver means-tested direct transfer programs to alleviate poverty. The recently designed social register of Mauritius can be a tool to be used to target the needy. However the political will for reform that accompanies such a decision remains a challenge for a subsidy system that has become a permanent feature of the economy.

Tables

Table 1-1   Descriptive statistics for rice demand variables, 2007-2014

Variable	Label	Mean	Standard Deviation	Minimum	Maximum
Prices:					
Ration rice	P_1	12.125	1.098	10.501	14.613
Basmati rice	P_2	63.463	7.435	45.046	75.929
Flour	P_3	14.931	1.023	13.023	17.498
Quantities:					
Ration rice	Q_1	1.112	0.101	0.871	1.318
Basmati rice	Q_2	3.009	0.356	2.630	3.677
Flour	Q_3	6.335	0.971	4.011	7.255
Shares:					
Ration rice		0.045	0.005	0.037	0.063
Basmati rice		0.637	0.055	0.544	0.729
Flour		0.318	0.054	0.222	0.409

Note: Prices are in Mauritian Rupees per kilogram. Quantities are in kilogram per capita. There are 90 sample observations.

Source: Statistics Mauritius and Mauritius Chamber of Commerce and Industry

Table 1-2   ADF unit root test

Variable	Stationary level			First Difference Stationary		
	Zero mean	**Single mean**	**Trend**	**Zero mean**	**Single mean**	**Trend**
Ration Rice	-1.684*	-2.414	-2.061	-3.707***	-4.531***	-4.811***
Basmati Rice	-3.100***	-3.052**	-2.987	-5.267***	-5.285***	-5.385***
Flour	-2.844**	-2.827*	-3.396*	-5.849***	-5.812***	-5.938***

*, **, *** indicates statistically significant at 10%, 5% and 1% respectively.

Table 1-3   Johansen Trace tests for co-integration

	Trace Statistics		
H0: Rank = r	Eigenvalue	Trace Statistics	P-value
0	0.2193	38.4854	0.0004
1	0.1641	16.4577	0.0092
2	0.0057	0.5078	0.5389

Source: Author's calculation

Table 1-4   LA-AIDS model parameter estimates for monthly rice demand

	Price Coefficient						
	Ration rice	*Basmati rice*	*Flour*	*Expenditure*	*Intercept*	R^2	*D.W*
Ration rice	0.042***	-0.023***	-0.019***	-0.049***	0.317***	0.820	2.06
	(0.008)	(0.006)	(0.006)	(0.008)	(0.044)		
Basmati rice	-0.024***	0.284***	-0.260***	0.860***	-0.458	0.936	1.95
	(0.006)	(0.032)	(0.031)				
Flour	-0.018***	-0.260***	0.279***	0.190***	-0.775**	0.933	1.94
	(0.006)	(0.031)	(0.031)	(0.055)	(0.312)		

Numbers in parentheses are the standard errors for the parameter estimates, **, *** indicate significance at the 5% and 1% level, respectively. DW denotes the individual equation Durbin-Watson statistic.
Source: Author's calculation

Table 1-5   Marshallian and expenditure elasticities for the LA-AIDS model

	Marshallian Price Elasticities			
	Ration rice	**Basmati rice**	**Flour**	**Income/Expenditure elasticity**
Ration Rice	-0.019	0.170	-0.063	-0.088
Basmati Rice	-0.027	-0.413	-0.339	0.779
Flour	-0.085	-1.196	-0.315	1.596

Source: Author's calculation

Table 1-6   Parameter and baseline (2012) values to calibrate the model

Definition	Parameter	Values
Elasticity of demand for ration rice	$-\eta_{11}$	0.019
Elasticity of demand for basmati rice	η_{22}	-0.413
Cross price elasticity of demand	η_{12}	0.170
Quantity demanded ration rice (millions of Kg)	Q_1	17.97
Quantity demanded basmati rice (millions of Kg)	Q_2	41.27
Domestic price of ration rice (Rs/kg)	P_1	10.80
World Price of Basmati rice (Rs/kg)	P_2	35.51
World Price of Ration Rice (Rs/kg)	P_W	15.11
Subsidy (Rs per kg)	S	4.31
Government Cost (Rs million)	GC	77.49

Source: Statistics Mauritius, Mauritius Chamber of Commerce and Industry and Elasticities from author's calculation

Figures

Figure 1-1 Trends in agriculture imports and exports for Mauritius, 1980-2016
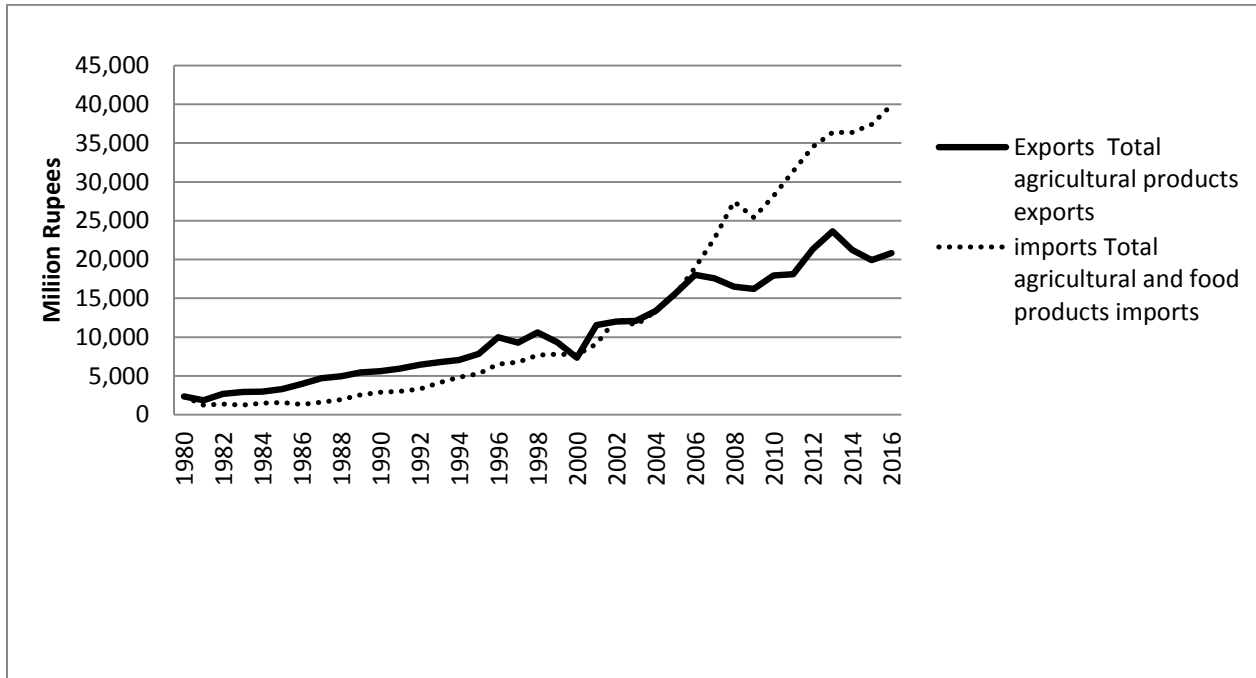
Source: Statistics Mauritius

Figure 1-2 Trends in imports and consumption (in tons) of ration and basmati rice in Mauritius, 2004-2016

Trends in Quantity of Import and Consumption (in tons) of 'Ration' subsidized rice and 'Luxurious' Basmati rice in Mauritius

- - - Import Ration rice
- - - Import Luxurious rice
—— Domestic utilization Ration rice
—— Domestic utilization Luxurious rice
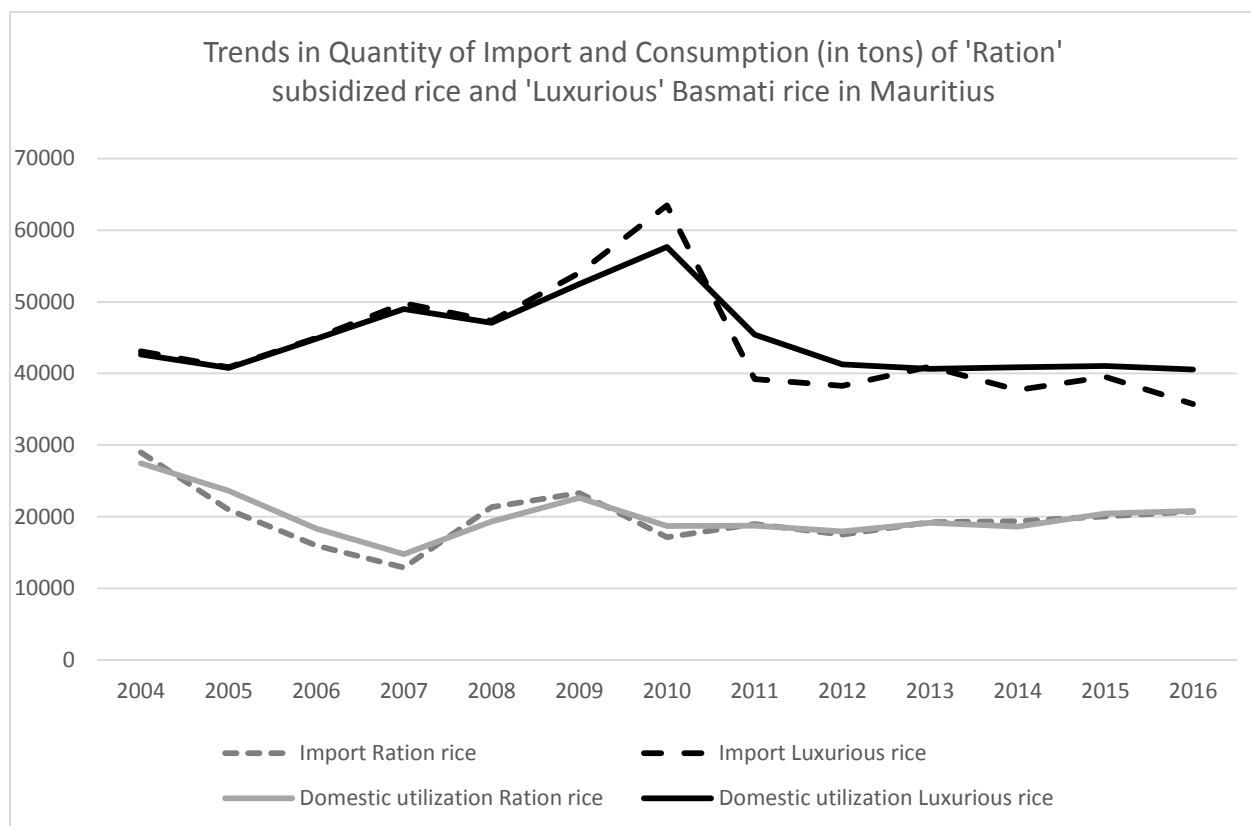
Source: Statistics Mauritius

Figure 1-3 Trend in prices of two types of rice in Mauritius
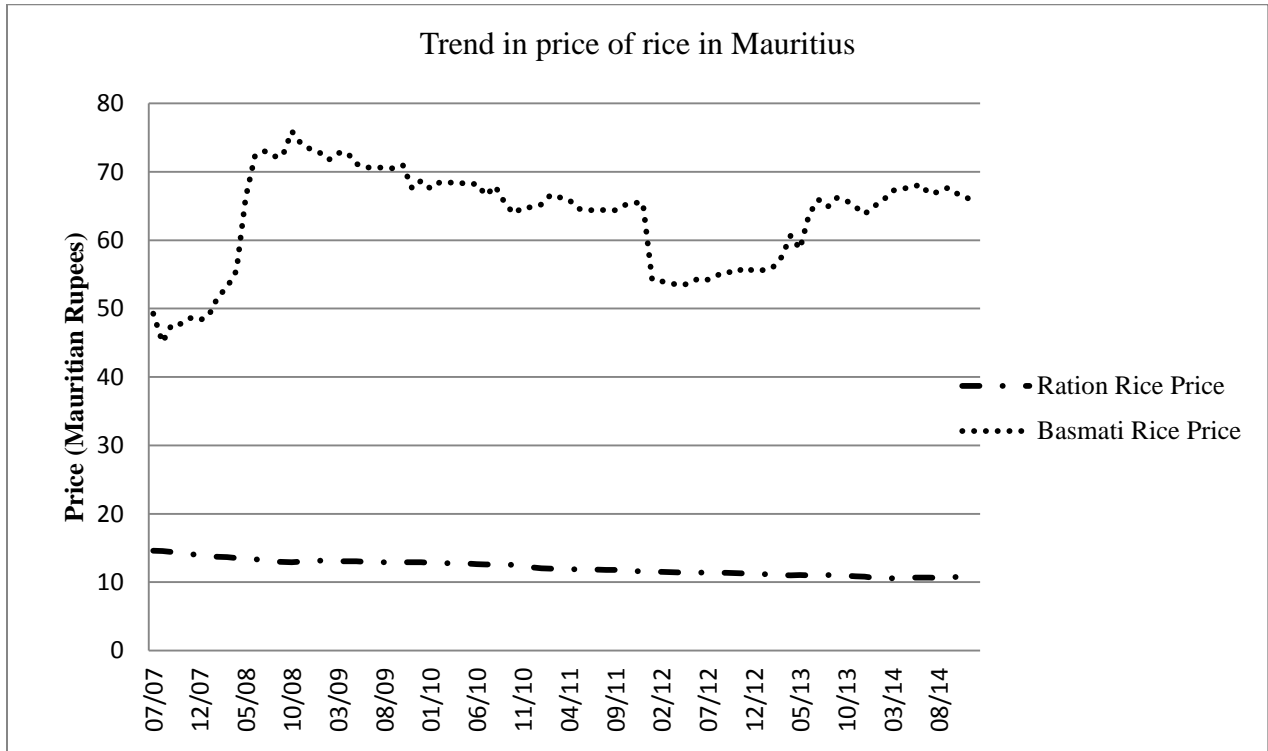
Source: Statistics Mauritius

Figure 1-4   Welfare effects of Climate change with changes in rice prices in Mauritius

Panel A. Market for ration rice in Mauritius

$\Delta CS_1 > 0$

Demand shift as a result on increase in price of Basmati rice

P_W

P_1

S'

S

Q_1 $Q'_1 D_1(P_2)$ $D_1(P_2')$ $Q_{ration\ rice}$
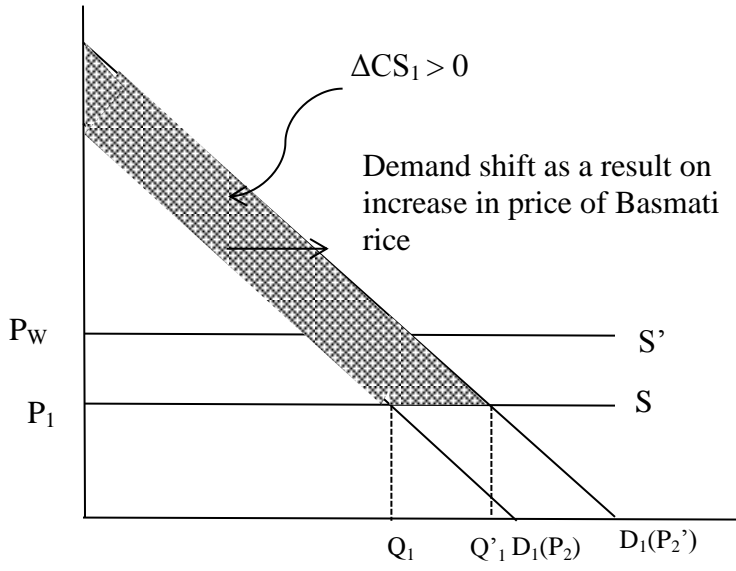
Panel B. Market for basmati rice in Mauritius

$\Delta CS_2 < 0$

P_2'

P_2

S

S

Price shift due to decrease in world rice supply

D

Q'_2 Q_2 $Q_{basmati\ rice}$

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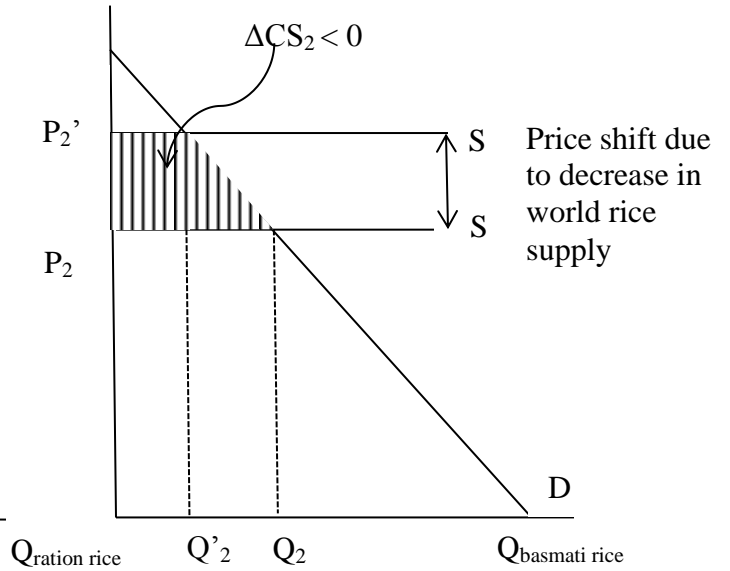
Chapter 2 Gender Wage Gap in Small Islands: Effect of a Policy in Mauritius

2.1   Introduction

The gender wage gap is an area of labor economics that has been thoroughly studied around the world. Many empirical studies show that women and men face unequal treatment in the workplace, especially in terms of wages. Reducing gender inequality is often recommended as an efficient tool in economic development. Small island nations are characterized by limited natural resources and their comparative advantage often lies in their human capital. Overcoming the challenges of competition in a globalized world implies that such nations cannot afford to under-utilize human capital. Unleashing additional and valuable human capital resources into the economy contributes to making the economy more productive, thus helping it attain its potential (World Bank Group, 2018). Eliminating gender discrimination by diminishing the wage gap is one of the ways these small island nations can stimulate productivity. This paper will show how successful a small island like Mauritius has been in promoting gender wage equality and economic growth.

Mauritius committed itself to the Beijing Declaration and Platform for Action in 1995, aimed at achieving equality, development and peace for women worldwide. In 2005, the government of Mauritius instituted a full-fledged Ministry of Gender Equality, Child Development and Family Welfare, dedicated to promoting gender equality. The government of Mauritius adopted a National Gender Policy Framework (NGPF) in 2008 with a vision to empower women, with action plans for the various stakeholders. The NGPF "calls upon the government, private institutions, media and civil society to work

together to achieve equality and equity in a holistic manner" (UNDP, 2009). A dedicated Gender Unit within the Ministry of Gender equality, Child Development and Family Welfare serves as the institutional and coordinating mechanism to monitor implementation of gender mainstreaming strategies to ensure women empowerment and promote gender equality. The implementation of the NGPF requires each ministry within the government to develop its own sector-specific gender policy and mainstream gender in program design, performance indicators and budgetary allocations. Focal points were identified and trained within each ministry at both the administrative and technical levels to support the implementation of gender-responsive policies. Women centers and community centers conducted sensitization campaigns to disseminate information on gender equality and gender issues.

In this paper, we hypothesize that over the period 2007-2017, the gender wage gap decreases with the implementation of the NGPF. Contrary to past studies on the gender wage gap in Mauritius, this study makes a significant contribution to the existing literature by filling a crucial missing gap to assess the impact of an important policy framework, which is geared to empower women and improve gender parity in Mauritius. Using a natural experiment setting, difference-in-differences is used to study the effect of the policy framework on the gender wage gap in Mauritius. The results indicate that with time, the policy framework is leading to a narrowing of the wage gap and improving gender parity on the island.

The structure of the paper continues with Section 2 which reviews the literature on the gender wage gap. Section 3 describes the labor market structure in Mauritius. Section 4 is a description of the data used for this study. Section 5 explains the empirical framework.

Section 6 reports the main findings of this study. Finally, Section 7 provides a discussion and a conclusion.

2.2   Literature review

The gender wage gap is an area of research intensively investigated with constantly emerging innovative methodologies (Blau & Kahn, 2017; Fortin, 2008; Goraus, Tyrowicz, & van der Velde, 2017). The traditional factors influencing the gender wage gap include differences in employee and employer characteristics such as education, work experience, employer size and differences in occupational and industrial structures of employment. Differences in wages between men and women may also be the result of institutional environment on the labor market (Majchrowska & Strawinski, 2018) . Women's relative skills and degree of discrimination can be affected by laws, regulations and government policies directed at combining work and family. New fields of research among economists study the impacts of norms, psychological attributes and non-cognitive skills on the gender wage gap (Blau & Kahn, 2017; Fortin, 2005, 2008; Strain & Webber, 2017). Other research focuses on biological influences, including the brain structure and hormonal influences on gender inequality in labor markets (Marianne, 2011).

There is a growing interest in studying the gender gaps in Mauritius recently. This section reviews some of the existing literature on the subject and their major findings. Nordman & Wolff (2009) used matched employer-employee data collected in 2005 to measure wage gaps in manufacturing firms in African countries, including Mauritius. The study found that the wage gap exists all along the wage distribution and that gender wage inequality is a matter of concern in Mauritius. In another study using quantile regression,

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the same authors found evidence of a gender wage gap along the wage distribution in the manufacturing sector of Mauritius. At lower levels of income, the gap was estimated at 0.53 log points. The gap decreased to 0.44 log points in the third quartile of the wage distribution (Nordman & Wolff, 2010). Tandrayen-Ragoobur & Pydayya (2016) studied the magnitude of the wage gap between public and private sector employment using the Continuous Multi-Purpose Household Budget Survey from 2006 to 2013. Their findings suggested that the disparity in wages is more pronounced in the private sector. They also find the presence of sticky floors, which means larger differences in wages at the bottom of the wage distribution. A recent study showed the private sector is characterized by a large and pervasive negative gender wage differential, which increases as one moves towards the bottom of the wage distribution (World Bank Group, 2018). In the public sector, the bulk of the wage difference is concentrated in the lower half of the distribution. On average, in the public sector, women have a moderate wage premium from higher educational levels.

2.3   Labor market structure in Mauritius

Mauritius has made steady economic progress since its independence in 1968 and is often referred to as the "Mauritian Miracle" and the "African Success Story" (Frankel, 2010; Romer, 1992; Stiglitz, 2011). From a monocrop economy based on sugar, Mauritius diversified into manufacturing and tourism in the 1980s. During the last three decades, the economy shifted away from primary and secondary production to one with a dominant service sector. These changes in the economy are leading to changes in the labor market structure, with the country migrating from a labor-intensive to a knowledge-based labor market to respond to the needs of an increasingly important service sector,

including finance and tourism (David & Petri, 2013; Sulla et al., 2015; Yao & McDonald, 2003). This trend is accompanied by an increase in demand for medium to high-skilled workers (Svirydzenka & Petri, 2014). The role of women in the Mauritian economy is relevant to this study. The question that comes to mind is whether women have participated in this economic progress so far and will they have a bigger role in the future?

Labor force participation is crucial in understanding developments in women's wages because receipt of wages is conditional on employment and also because women's labor force attachment is a key factor influencing the gender wage gap (Blau & Kahn, 2017). An analysis of the labor market structure in Mauritius is important to understand how the female participation rate evolved over time and the subsequent impact on the gender wage gap. Figure 2.1 shows that female labor participation rate is well below average compared to other small islands and Sub-Saharan African countries. A low female labor participation can be costly to societies and is a signal of a low level of women's empowerment (Almasifard, 2018). Therefore, the implementation of the NGPF adopted by Mauritius is a necessary step to optimize the unused economic and social potential of women on the island. Mauritius saw an improvement in women entering the labor force from 1990-2017 (Figure 2.2). The female participation rate increased from 2005 onwards while the male participation rate showed a decrease over that same period (Figure 2.3). However, despite the improvement in female participation over the years, the disparity between men and women persists.

The factors that seem to influence female labor participation in Mauritius are outlined in a recent study covering the period 2004 to 2015 (World Bank Group, 2018).

Female participation tends to peak between the ages of 25 and 35 and, after that becomes more volatile. In contrast, men reach a high participation rate, well above 90 percent, from 25 to 60 years of age. The female participation rates improved among younger cohorts indicating progressive structural expansion across the new generations. Marital status of women impacts labor participation, with married women having considerably lower participation rates compared to single women by an average of 20 percentage points. The statistics seem to suggest that marriage, during the school-to-work transition, may deter women from entering the labor market. Similar trends are observed during life-cycle events pertaining to pregnancy. Education is another driver of women's participation in the labor force. Women with postsecondary or tertiary education are likely to participate in the labor market almost as much and as long as men do, reaching rates of around 90 percent. And finally, cultural values and social norms that view women in a traditional role of provider for children and elderly care, household chores and other non-market activities tend to dominate the empowering effect of education among women with less than postsecondary education.

2.4 Data

Household Budget Surveys are conducted every five years in Mauritius. This study benefits from the use of the most recent data to analyze the impact of the policy framework. Household Budget Surveys implemented in 2012 and 2017 are used and compared to 2007, the year prior to the implementation of the policy. These data sets are representative of the whole island. The questionnaires used in all three years are more or less identical and the survey uses the same sampling procedures; therefore the data are

comparable for analysis. Two pooled cross-sectional data sets are created, one merging 2007 and 2012 and another merging 2007 and 2017.

The variables used in this study are defined in Table 2.1. The dependent variable in the models is obtained by taking the logarithm of hourly wages, limited to the heads of households and spouses. The year 2017 is set as the base year to convert nominal wages in 2007 and 2012 to real wages. The age range of the respondents in this study is limited to those between 18 and 60 years, which corresponds to the working age in Mauritius. An education dummy variable is created to capture those with twelve years of education or more, which corresponds to higher education. The education variable is included in the wage equations, as earning is a positive function of educational attainment. The experience of the respondent is captured by age. The hours worked variable describes the number of hours worked in the last week the survey was conducted and is a dependent variable to explain wages in the model. The marital status of the respondent is a dummy variable with one equal to married and zero otherwise. A set of dummy variables is created for industry and occupation.

Table 2.2 provides the descriptive statistics for the variables used in this study by gender and year. The wages for women relative to men in both years show clearly that a gender gap exists. T-tests indicate that the mean wages of men are statistically different from those of women. Figure 2.4 shows the kernel distribution of the log-wage of male and log-wage female across 2007, 2012 and 2017. We observe an improvement of the wages of women compared to that of men over time. There are important differences in education level across gender and year in Mauritius. It is interesting to note that women have, on average, higher education levels than men in all three years. The table shows

that the number of hours worked are generally higher for men than women in all three years.

Table 2.3 explores the trends in occupation by observing gender differences during the period of study. Increasing employment in managerial and professional jobs may be an indicator of increasing human capital (Blau & Kahn, 2017). These jobs require higher levels of training and commitment, and therefore an increase in female representation tends to indicate a rising human capital and market commitment.

2.5   Empirical framework

The economic rationale for studying the wage gap is that social welfare maximization occurs when all productive resources, including human resources, are fully utilized. Gender wage gaps are of interest to economists, as they provide a better picture of the strength of the wage-productivity link, the drivers of productivity and occupation selection among others (Strain & Webber, 2017). Gender discrimination leads to a lower efficiency, as skilled labor is wasted.

Using a natural experiment setting, the implementation of the NGPF adopted by the government of Mauritius is assumed to change the environment in which individuals operate. Natural experiments are a good alternative to traditional statistical studies for analyzing the gender wage gap. This study uses difference-in-differences to determine whether the NGPF decreases the gender wage gap. The sample is broken down into a control group before the policy change, a control group after the change, a treatment group before the change and a treatment group after the policy change. We assume the gender policy framework geared towards improving gender equality will not affect the wages of men, and therefore, the latter form a suitable control group. The treatment group

consists of women targeted by the policy change. One important assumption in difference-in-differences is the common trend assumption implying that men and women were on the same wage trajectories prior to the policy. The figure 2.5 indicates that this assumption is plausible.

To control for systematic differences between the control and treatment groups, two years of data are used, one before the policy change and one after the change. Pooled cross-sectional data merging 2007 and 2012 are compared with that of 2007 and 2017 to give a better indication of the impact of the policy over a longer time. The reason for the extended period of the study is because it reflects the time for implementation of such a policy framework. Institutions and government ministries are required to take necessary actions to implement the policy. This process can be cumbersome and time-consuming before changes in wage structures are observed.

Traditional Mincerian equations, by convention, express wages in logarithm form and a set of characteristics that influences earnings. The dependent variable specified in the wage equation is the natural log of wages. The hourly wage variable was found to be rightly skewed. The natural log transformation of hourly wage reduces any issue of heteroscedasticity and corrects for any skewness in the distribution of wages to approximately conform to normality and limits the effect of outliers. The 'logwage' variable was found to be normally distributed[4]. The independent variables include controls for education, age, working experience, marital status, and a set of dummies to control for industry and occupation variables. The age variable and its quadratic are often used in wage specification to substitute for potential working experience. A female dummy variable is included in the wage equation. Y2012 is a dummy variable equal to

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[4] Skewness = 0.428 and Kurtosis = 0.630

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one if the observation comes from year 2012 and zero if it comes from 2007. Industry

dummy variables include 13 categories: agriculture, manufacturing, utilities (water and

electricity), construction, retail, transport, accommodation, information and

communication technologies, finance, science, administration, education industry and

social services (representing service activities such as working for NGOs, social and

cultural organizations). Occupation dummy variables are set according to National

Standard Classification of Occupations (NASCO), which are managers, professionals,

technicians, clerks, workers and operators. The omitted category is elementary workers.

The log wage equation is given by:

Log-wage = β_0 + $\beta_1$female + $\beta_2$education + $\beta_3$age + $\beta_4$agesquare + $\beta_5$maritalstatus + δ_0Y2012 + δ_1Y2012 x female + Industry variables + Occupation variables + u

$$(1)$$

δ_1 is the difference-in-differences estimator, as it estimates the effect of the NGPF

(captured by Y2012) on the log-wage for the treated group (female) using male group as

a control.

Without other factors in the regression $\hat{\delta}_1$ will be:
$$\hat{\delta}_1 = \left(\bar{y}_{female,2012} - \bar{y}_{female,2007} \right) - \left(\bar{y}_{male,2012} - \bar{y}_{male,2007} \right)$$

$$(2)$$

The above equation is also run to compare the gender wage gap between 2007 and 2017

using a Y2017 dummy variable. The bar denotes average, the first subscript denotes the

treated group and the second subscript denotes the year, the treated group being female

while the control group is male. We test the hypothesis that $\hat{\delta}_1 > 0$. The interaction of the

dummy variable with key explanatory variables allows seeing the effect of that variable

over the two time periods. The intercept for 2012 then is $\beta_0 + \delta_0$. Similar notations are

used for comparing 2007 and 2017. The log-wage differential between women and men

is given by the coefficient β_1. After the implementation of the policy, the coefficient δ_1 captures the effect of the policy.

Correcting for selection bias

Participation of women in the labor force raises the issue of selection bias, as women may self-select to work. Selection issues arise because we do not observe wage offers for people who are not currently employed and a smaller share of the female population is employed than the male population (Blau & Kahn, 2017). Selection bias is likely to be a more serious issue for women's than men's wages because the closer the wage sample is to 100 percent of the underlying population, the smaller the selection bias (Mulligan & Rubinstein, 2008).

In this study, the impact of selection bias on gender wage gap uses a standard Heckman two-step selectivity bias correction for the wage equation. The idea behind this method is that self-selection can be treated as an omitted variable problem and solved by recovering that variation from the available data (Goraus, Tyrowicz, & van der Velde, 2017). Selection bias is a complex issue and no consensus on a correction method has been reached yet. Studies on the subject not only focus on different data set or time period, but also uses different approaches to correct for selection (Blau & Kahn, 2017). One issue with the Heckman two-step estimator is that an exclusion restriction (that is, a variable that affects labor supply but does not affect wages) is needed.

Consider the latent response model of the form

$$Y^* = X'\beta + \varepsilon \qquad (5)$$

where ε has a mean of zero and is identically distributed given X.

Under standard OLS conditions, β could be consistently estimated if (Y^*, X) are from a random sample. However, if Y^* can only be observed when the binary indicator D is equal to one, then sample selection arises. D is given by

$$D = 1\{\eta \leq Z'\gamma\} \tag{6}$$

Where X is a subset of Z and $1\{.\}$ is an indicator function. The scalar observable η is independent of Z and possibly correlated with ε.

Let $Y = DY^* \tag{7}$

A random sample from (Z, D, Y) is available but not observed when $D = 0$

Y^* denotes the wages (in logs)

X are the determinants of wages (such as education)

D denotes labor force participation

      $D_i = 1$ if $D^* \geq 0$

      $D_i = 0$ if $D^* < 0$

      Prob $(D_i = 1) = \Phi(Z'\gamma)$

      Prob $(D_i = 0) = 1 - \Phi(Z'\gamma) \tag{8}$

Z contains determinants of labor force participation that are not necessarily included in the wage equation, such as the number of children, which captures the costs associated with working but is unrelated to potential wages. Since the latent outcome Y^* is not observed for non-participants, the $E(Y^*|X)$ cannot be estimated directly. Using data from only those participating in the labor market, the conditional mean $E(Y^*|D = 1, Z)$ is instrumental in developing a selection correction method.

Heckman (2009) proposes a two-stage estimator. The first stage is identified by a probit regression of D on Z from which the inverse Mills ratio λ (where $\lambda = \Phi(Z'\gamma)/\Phi$ $Z'\gamma$)) is obtained. λ is then used in the second step to correct for sample selection bias. A

significant value of the inverse Mills ratio rho, the correlation coefficient, indicates that the error terms of the two models are correlated. Therefore, sample selection bias exists. In this case, D is a dummy variable for labor force participation; the independent variables Z include a variable for number of children, a dummy variable for female, a proxy for experience captured by age, a dummy for marital status, and variables for the three levels of education which are primary, secondary and tertiary. The second step equation is estimated through a linear regression of log-wage on the independent variables, including the female x year interaction term.

2.6 Results

The results of the difference-in-differences models comparing 2012 and 2017 with that of 2007 are reported and discussed. To test for selection bias in labor force participation, we examine the relationship between the residual for the two stages in the Heckman two-stage correction difference-in-differences model. If the unobserved variable in the error term of the selection model is correlated with the unobserved variable in the error term of the stage 2 model, we have biased estimates if they are not corrected for. The unobserved variable in the error term in the labor force participation model is affecting the log-wage model in stage 2. Table 2.3 summarizes the results of the difference-in-differences models correcting for selection bias. The inverse Mills ratios (rho) for all models are significant, indicating the presence of self-selection bias. The negative rho indicates that the unobserved variable in the error terms are negatively correlated with one another. The Wald test reveals that the joint models are preferred to the independent probit and linear regression models.

In the difference-in-differences model comparing 2007 and 2012, the coefficients of the interaction term are negative and not significant. Therefore, no effect of the policy is observed in 2012, even after controlling for occupation and industry.

In the model comparing 2007 and 2017, the difference-in-differences results show roughly a four percent wage premium to women controlling for industry and occupation. We can therefore conclude that there is an improvement in the gender wage gap in Mauritius over time. However, we should be cautious with the interpretation of this result over a ten-year period. The overall wage premium observed in the difference-in-differences may be the result of other confounding factors, such as younger cohorts of educated women entering the job market, which cannot be attributed solely to the NGPF. The results also indicate that within occupation and industry discrimination occurs.

Robustness check

One limitation of studying the period between 2007 and 2012 is that it coincides with the global financial crisis of 2008. To disentangle the potential confounding effect of the crisis on the labor market, the gender wage gap in the public sector is analyzed using difference-in-differences. It is assumed that the crisis will not affect those working in the public sector. In support of this argument, we note that public officers received an increase in remuneration under the Pay Research Bureau in 2008. The results are summarized in Table 2.5. The coefficients of the interaction terms are negative and significant in the two comparisons. It appears that there is a persistent gender wage gap in the public sector both in the shorter run and longer run.

Results from alternative methods

One caveat of the difference-in-differences method used is the estimation of the gender wage gap at the means. To overcome this, we tried other sets of regression specifications. Quantile regression estimates were obtained for the 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles for log-wages of men and women in the public and private sector. Quantile regression allows us to examine features of the wage distribution rather the mean. Figure 2.6 shows the trends in wage gap across the wage distribution for the three years under study. There is a clear indication that the public sector wage gap is much narrower than the private sector. In 2017, the gender wage gap for both private and public sectors are smaller across the wage distributions compared to 2012. These trends indicate an improvement in the wage gap between men and women over the years in Mauritius.

2.7   Discussion

Overall, the results of this study are indicative of some effect of the NGPF on the gender wage gap. The time frame of the research extends from 2007 to 2017 implying that other factors may confound the results. Moreover, even if we assume that the policy is entirely responsible for the decrease in the wage gap, the policy did not help women move into higher-paid occupations. Therefore, a shift of occupations from lower to higher paying jobs, such as those falling under managers and professionals may contribute to promoting gender wage equality. Based on current statistics, the younger cohorts of better educated women joining the labor market will narrow the gender wage gap. A World Bank study found that women are severely disadvantaged in access in the Mauritian labor market (World Bank Group, 2018). The explanation provided is that women's access to the labor market does not rest upon socioeconomic and demographic characteristics, but

rather on cultural values and social norms. Women still have a traditional role as providers of children and elderly care along with household chores and other nonmarket activities. These traditional roles dominate the effects of education among those with less than postsecondary educational attainment (World Bank Group, 2018). On the other hand, Norman and Wolff (2008) describe gender discrimination in Mauritius to be the result of gender-specific occupations, which prevents women from having access to certain well-paid occupations. The authors argue that the high gender wage gap observed in Mauritius may be the result of the emergence of more capital-intensive sectors that offer higher wages, particularly if these sectors mainly turn to a male workforce. Recent legislation on the introduction of a minimum wage by the government of Mauritius at the beginning of 2018 will affect women at the lower end of the wage distribution, although the law is not gender specific. As the economy is driven by the service sector, ensuring appropriate skills through education and training of women to meet the demand on the labor market can lead to better wages for women. Other policies directed at addressing the issues of combining work and family will influence the wage gap between men and women, such as paternity leave introduced in the Employment Rights Acts. The creation of a more competitive labor market through policies which increase flexibility, upgrade employment through promoting and facilitating technical and vocational education, adopt strong and sustainable policies at the national levels for job creation, promote entrepreneurship, training and retraining programs and increase economic freedom will address the issue of gender wage gap in upper middle-income countries (Almasifard, 2018).

Research finds compelling evidence that beliefs about gender roles are an essential element in the analysis of female labor participation (Fortin, 2015). The psychological attitudes of women, such as their anticipated treatment in the labor market affect their aspirations (Blau & Kahn, 2017). Further research on the impact of norms, psychological attributes, and non-cognitive skills on the gender wage gap is highly recommended as a follow-up of this study for Mauritius because female labor force participation, which in turn influences the wage gap between men and women in Mauritius, appears to be still driven by social norms and values.

2.8 Conclusion

The difference-in-differences model comparing 2007 and 2017 shows that the positive impact of the NGPF on gender wage gap is now being felt as opposed to five years ago. Assessing the impacts of the NGPF is necessary to gauge the status of such policies on specific indicators, in this case, the gender wage gap. More targeted policies should be identified which would contribute to narrowing the wage gap at all levels. The question that now remains to be answered is where are the bottlenecks that delay the impacts of such policies even though commitments at higher levels exist? The complex nature of the interactions between social and economic systems needs to be understood by policy-makers and decision-makers to tap into the unused potential of women, which can contribute significantly in raising productivity, growth, and development in a small economy like Mauritius.

Table 2-1   List of variables

	Variable Name	Description
	Log-wage	Log hourly wages received by individual household member limited to head of household or spouse
	Female	1 = Female dummy
	Education	1 = Higher education for those with more than 12 years schooling and 0 for those with less
	Age	Age of individual ranging from 18 to 64
	Agesquare	Age square is a proxy for experience
	Hoursworked	Hours worked on a weekly basis in the week prior to Household budget survey
	Marital status	1 = Married
Industry	Agriculture	1 = Agriculture sector
	Manufacturing	1 = Manufacturing sector
	Utilities	1 = Utilities sector including water and energy
	Construction	1 = Construction sector
	Retail	1 = Retail sector
	Transport	1 = Transport sector
	Accommodation	1 = Accommodation and food service activities
	ICT	1 = Information and Communication technology sector
	Finance	1 = Financial and insurance activities
	Science	1= Professional, scientific and technical activities
	Administration	1= Administrative and support service activities
	Education industry	1= Education field
	Social services	1 = Social work activities
Occupation	Managers	1 = Work as managers and have responsibilities in the job
	Professionals	1 = Professionals in fields like science, engineering, mathematics
	Technicians	1 = Technicians
	Clerks	1 = Clerks
	Workers	1 = Service and sales workers
	Operators	1 = Plant and Machine operators and laborers

Table 2-2   Summary statistics

	2007		2012		2017	
	Men	Women	Men	Women	Men	Women
Logwage	4.279	3.869	4.664	4.219	4.919	4.551
(Hourly in Rs)	(0.639)	(0.784)	(0.713)	(0.828)	(0.728)	(0.831)
Age	43.002	40.562	45.137	42.308	45.436	42.888
(years)	(9.158)	(9.427)	(8.847)	(9.287)	(8.990)	(9.057)
Marital status	0.927	0.825	0.924	0.831	0.904	0.821
dummy	(0.259)	(0.380)	(0.266)	(0.37)4	(0.295)	(0.384)
Education dummy	0.111	0.158	0.138	0.184	0.156	0.211
	(0.314)	(0.364)	(0.345)	(0.38)8	(0.363)	(0.408)
Public	0.246	0.182	0.235	0.242	0.208	0.233
	(0.431)	(0.386)	(0.424)	(0.428)	(0.406)	(0.423)
Agriculture	0.098	0.066	0.094	0.054	0.085	0.043
	(0.297)	(0.248)	(0.291)	(0.226)	(0.279)	(0.204)
Manufacture	0.142	0.226	0.148	0.187	0.003	0.001
	(0.350)	(0.418)	(0.355)	(0.390)	(0.052)	(0.029)
Utilities	0.026	0.016	0.017	0.003	0.138	0.151
	(0.160)	(0.126)	(0.131)	(0.058)	(0.345)	(0.358)
Construction	0.005	0.001	0.156	0.005	0.164	0.010
	(0.073)	(0.031)	(0.363)	(0.071)	(0.370)	(0.101)
Retail	0.154	0.007	0.119	0.124	0.125	0.135
	(0.361)	(0.082)	(0.324)	(0.330)	(0.331)	(0.342)
Transport	0.120	0.113	0.090	0.015	0.088	0.016
	(0.325)	(0.317)	(0.286)	(0.122)	(0.283)	(0.124)
Accommodation	0.045	0.051	0.059	0.069	0.062	0.068
	(0.207)	(0.219)	(0.236)	(0.254)	(0.241)	(0.252)
ICT	0.097	0.017	0.015	0.009	0.016	0.012
	(0.296)	(0.128)	(0.123)	(0.09)5	(0.126)	(0.109)
Finance	0.030	0.036	0.023	0.034	0.027	0.034
	(0.171)	(0.187)	(0.149)	(0.181)	(0.163)	(0.182)
Science	0.137	0.078	0.018	0.021	0.024	0.016
	(0.344)	(0.268)	(0.134)	(0.144)	(0.154)	(0.124)
Administration	0.037	0.101	0.157	0.103	0.151	0.124
	(0.190)	(0.301)	(0.364)	(0.304)	(0.358)	(0.330)
Education	0.021	0.046	0.036	0.086	0.036	0.096
Industry	(0.143)	(0.210)	(0.186)	(0.281)	(0.187)	(0.295)
Social Work	0.047	0.155	0.052	0.207	0.051	0.218
	(0.212)	(0.362)	(0.223)	(0.405)	(0.220)	(0.413)
Managers	0.046	0.034	0.063	0.038	0.056	0.038
	(0.210)	(0.180)	(0.244)	(0.192)	(0.230)	(0.191)
Professionals	0.034	0.034	0.057	0.091	0.062	0.104
	(0.180)	(0.180)	(0.231)	(0.287)	(0.242)	(0.305)
Technicians	0.087	0.121	0.100	0.098	0.111	0.094
	(0.282)	(0.326)	(0.300)	(0.297)	(0.314)	(0.292)
Clerks	0.047	0.124	0.042	0.103	0.048	0.097
	(0.211)	(0.330)	(0.200)	(0.304)	(0.214)	(0.296)
Workers	0.413	0.223	0.460	0.243	0.459	0.285
	(0.492)	(0.416)	(0.498)	(0.429)	(0.498)	(0.452)
Operators	0.364	0.385	0.266	0.348	0.251	0.308
	(0.481)	(0.487)	(0.442)	(0.476)	(0.434)	(0.462)
Observations	4344	2057	3909	2397	3680	2417

This table reports summary statistics broken down by year and gender. Standard deviations are reported in parentheses below the mean value. Source: Household Budget Surveys 2007, 2012 and 2017.

Table 2-3   **Incidence of managerial or professional jobs by gender**

Year	Men	Women	Difference: men-women
Managerial jobs			
2007	4.6%	3.4%	1.2%
2012	6.3%	3.8%	2.5%
2017	5.6%	3.8%	1.8%
Professional jobs			
2007	3.4%	3.4%	0%
2012	5.7%	9.1%	-3.4%
2017	6.2%	10.4%	-4.2%

Source: Household Budget Surveys 2007, 2012 and 2017.

Table 2-4   **Results of difference-in-differences with selection model**

	2007 vs 2012					2007 vs 2017			
	1	**2**	**3**	**4**		**5**	**6**	**7**	**8**
Y2012	0.321***	0.335***	0.289***	0.303 ***	Y2017	0.178***	0.182***	0.146***	0.154***
	(0.016)	(0.016)	(0.014)	(0.015)		(0.016)	(0.018)	(0.014)	(0.015)
Female	-0.105***	-0.104***	-0.231***	-0.221***	Female	-0.107***	-0.118***	-0.228***	-0.284***
	(0.021)	(0.021)	(0.020)	(0.021)		(0.021)	(0.021)	(0.021)	(0.024)
Y2012 x female	-0.025	-0.024	-0.002	-0.002	Y2017 x female	0.026	0.020	0.058**	0.054**
	(0.024)	(0.024)	(0.021)	(0.022)		(0.025)	(0.025)	(0.022)	(0.022)
Education	1.023***	0.853***	0.526***	0.452***	Education	0.966***	0.797***	0.513***	0.461***
	(0.017)	(0.017)	(0.018)	(0.018)		(0.017)	(0.018)	(0.018)	(0.018)
Age	-0.011*	-0.003	0.006	0.011*	Age	-0.0001	0.008	0.014**	0.025***
	(0.006)	(0.006)	(0.005)	(0.005)		(0.006)	(0.006)	(0.005)	(0.005)
Age square	0.033***	0.022**	0.009	0.002	Age square	0.020***	0.010	0.002	-0.0135**
	(0.007)	(0.007)	(0.006)	(0.018)		(0.007)	(0.006)	(0.006)	(0.006)
Marital status	0.208***	0.178***	0.140***	0.125***	Marital status	0.194***	0.160***	0.133***	0.101***
	(0.020)	(0.020)	(0.018)	(0.018)		(0.020)	(0.019)	(0.018)	(0.018)
Intercept	3.853***	3.583***	3.474***	3.333***	Intercept	4.001***	3.785***	4.154***	8.781***
	(0.121)	(0.118)	(0.107)	(0.107)		(0.122)	(0.0.120)	(0.261)	(0.241)
Industry	No	Yes	No	Yes	Industry	No	Yes	No	Yes
Occupation	No	No	Yes	Yes	Occupation	No	No	Yes	Yes
Industry and Occupation	No	No	No	Yes	Industry and Occupation	No	No	No	Yes
Rho	-0.610***	-0.598***	-0.504***	-0.487***	Rho	-0.596***	-0.580***	-0.486***	-0.313***
	(0.018)	(0.019)	(0.025)	(0.027)		(0.018)	(0.019)	(0.025)	(0.040)
No. of Observations	9810	9810	9810	9810	No. of Observations	9628	9628	9628	9628
Wald Test	1181.3***	1004.4***	401.93***	331.29***	Wald Test	1059.5***	871.48***	364.09***	165.9***

Source: Household Budget Surveys 2007, 2012 and 2017.
Standard errors in parentheses. ***p<0.01, **p < 0.05, *p<0.1

Table 2-5   Robustness check: difference-in-differences limited to the public sector

	9	10		11	12
Y2012	0.126***	0.094***	Y2017	0.310***	0.274***
	(0.023)	(0.019)		(0.025)	(0.021)
Female	-0.027**	-0.130***		0.032***	-0.100**
	(0.032)	(0.027)		(0.033)	(0.029)
Y2012 x female	**-0.089**	**-0.061***	Y2017 x female	**-0.103**	**-0.079**
	(0.043)	(0.036)		(0.046)	(0.039)
Education	0.650***	0.283***		0.631***	0.244***
	(0.022)	(0.021)		(0.023)	(0.023)
Age	0.043***	0.048***		0.050***	0.052***
	(0.010)	(0.008)		(0.010)	(0.009)
Age squared	-0.023***	-0.035***		-0.030***	-0.038***
	(0.011)	(0.010)		(0.012)	(0.010)
Marital status	0.078**	0.041*		0.015	-0.008
	(0.036)	(0.027)		(0.039)	(0.033)
Intercept	3.289***	3.126***		3.186***	3.046***
	(0.218)	(0182)		(0.225)	(0.190)
Control for occupation	No	Yes		No	Yes
R-squared	0.299	0.519		0.328	0.533
No. of observations	2633	2633		2552	2552

Source: Household Budget Surveys 2007, 2012 and 2017.
Standard errors in parentheses. ***p<0.01, **p < 0.05, *p<0.1

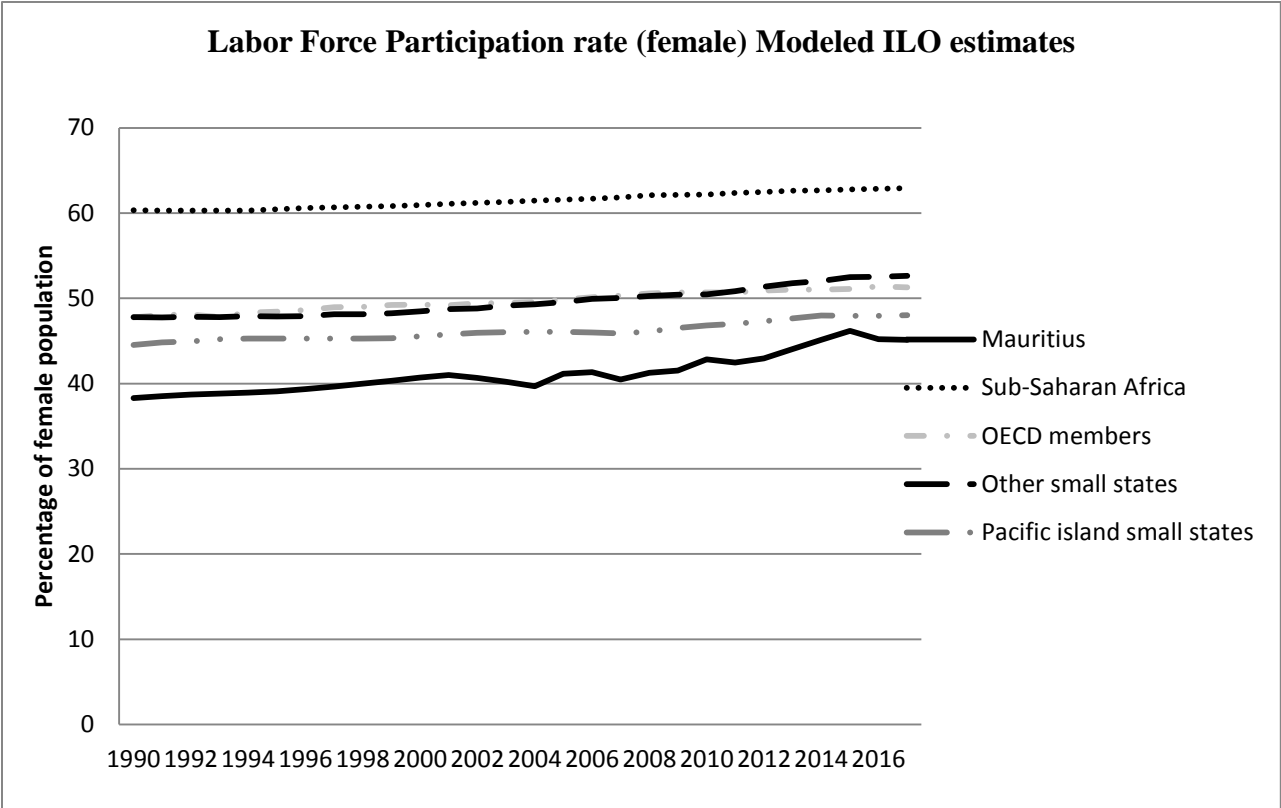**Labor Force Participation rate (female) Modeled ILO estimates**

Figure 2-1 Labor force participation rate of female in countries, 1990-2017.
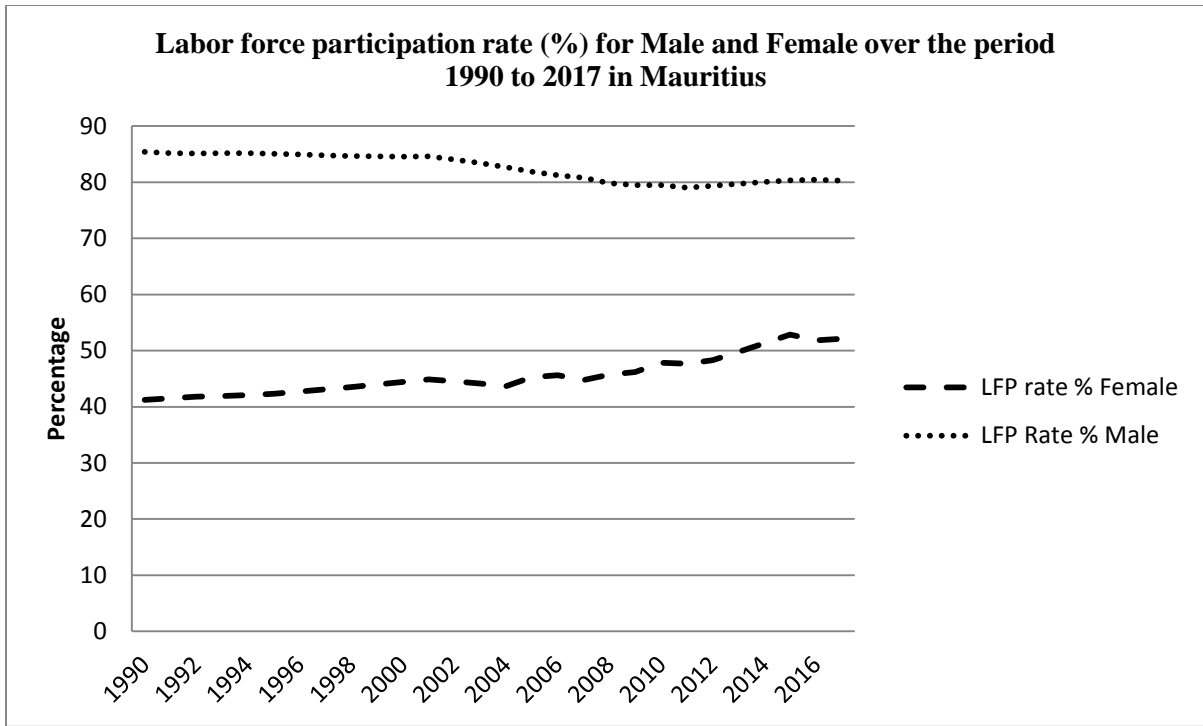
Source: World Bank

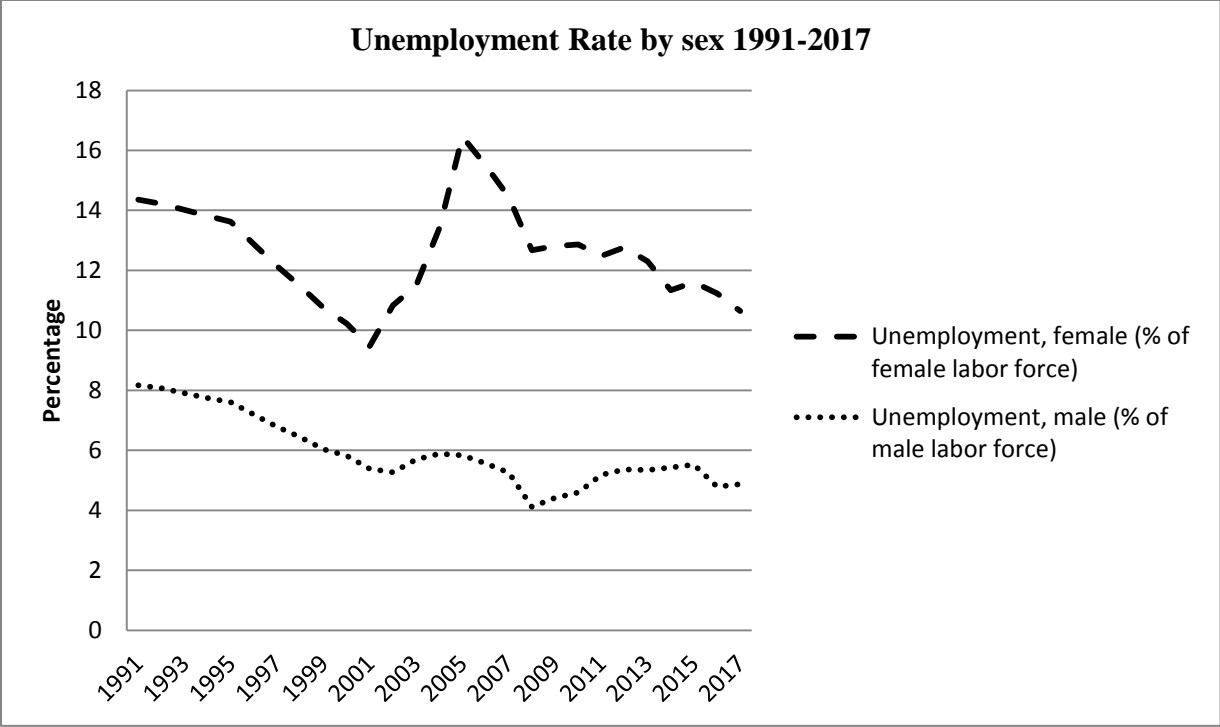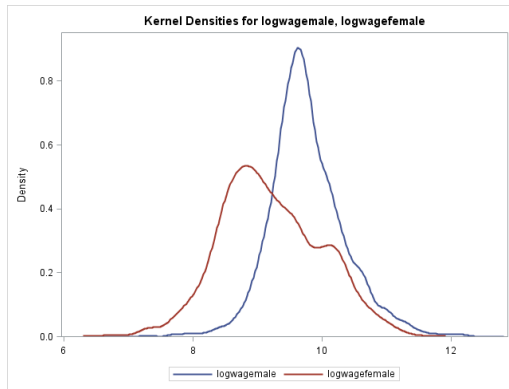**Figure 2-2 Labor force participation rate in Mauritius, 1990-2017**

Source: World Bank

Unemployment Rate by sex 1991-2017

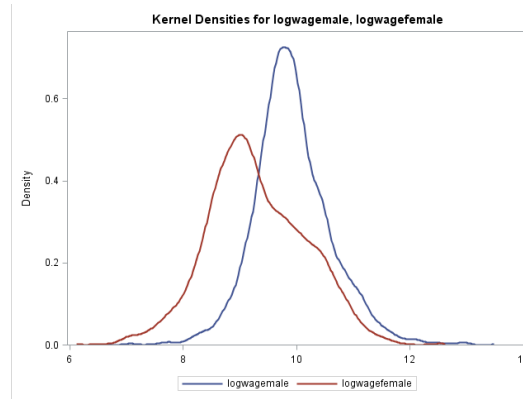**Figure 2-3 Unemployment rate, 1991-2017**

Source: World Bank

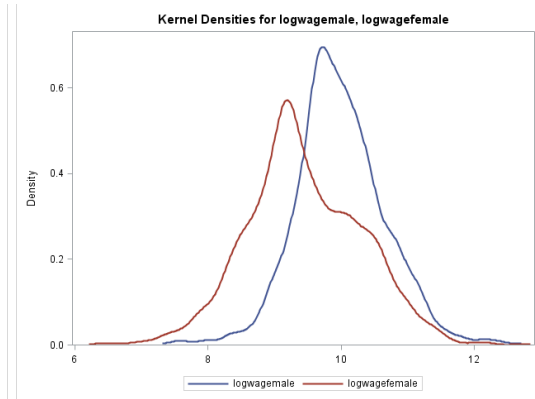*2007*   *2012*   *2017*

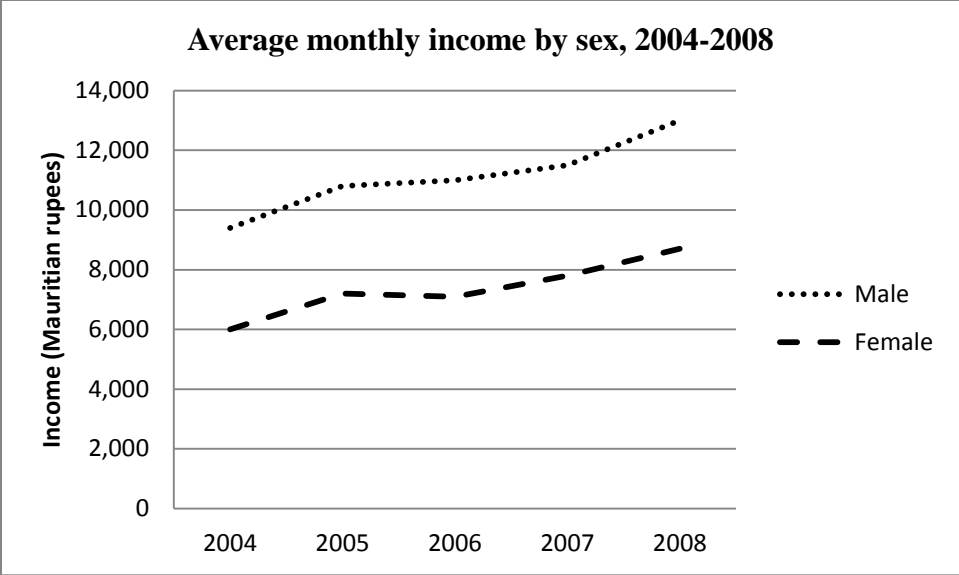**Figure 2-4 Kernel distribution of log-wage male and log-wage female, 2007-2017**

Figure 2-5 Average monthly income by sex, 2004-2008

Source: Continuous Multi-Purpose Household Survey (CMPHS), Statistics Mauritius

Gender Wage Gap in the public sector at different percentiles for 2007, 2012 and 2017

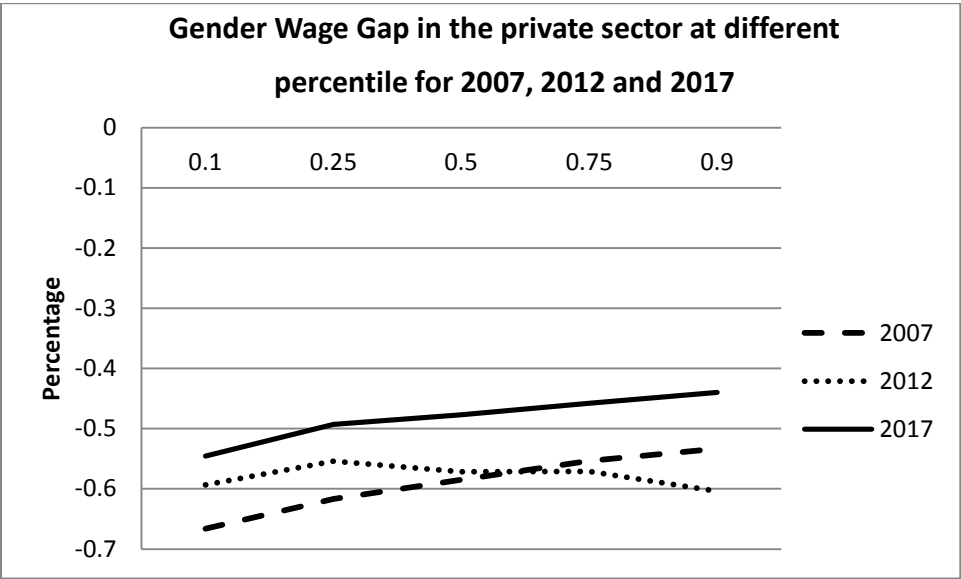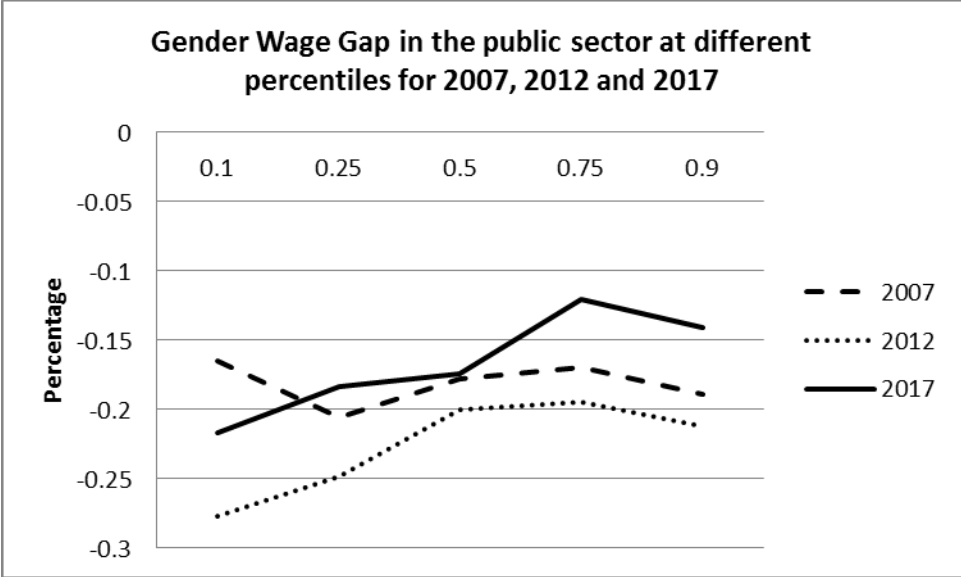Gender Wage Gap in the private sector at different percentile for 2007, 2012 and 2017

Figure 2-6 Trends in gender wage gaps across wage distribution in public and private sectors, 2007-2017

Chapter 3 Do Personal Attitudes towards Welfare Influence Food Stamp Participation?

3.1   Introduction

In 2017, 11.8 percent of U.S. households were food insecure during at least some part of the

year, with more than a third of these (4.5 percent of the U.S. population) reporting very low food

security (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2018) . The link between food insecurity

and a host of undesirable health outcomes has been well established. Among women, in

particular, food insecurity is associated with depression and anxiety (Bronte-Tinkew, Zaslow,

Capps, Horowitz, & McNamara, 2007; Leung, Epel, Willett, Rimm, & Laraia, 2015; Whitaker,

Phillips, & Orzol, 2006), dyslipidemia (Tayie & Zizza, 2009) and the metabolic syndrome

(Parker, Widome, Nettleton, & Pereira, 2010). Problems in children may include greater

likelihood of anemia, asthma and behavioral problems (Alaimo, Olson, Frongillo Jr, & Briefel,

2001; Eicher-Miller, Mason, Weaver, McCabe, & Boushey, 2009; Kirkpatrick, McIntyre, &

Potestio, 2010; Melchior et al., 2012). Food insecurity has also been associated with poorer

management of chronic diseases, such as diabetes (K. Nelson, Cunningham, Andersen, Harrison,

& Gelberg, 2001).

Concern about the short-term and long-term consequences of food insecurity has resulted

in the creation of an array of government programs designed to mitigate this problem. The

largest of these is the Supplemental Nutrition Assistance Program (SNAP, formerly the Food

Stamp Program), which served over 42 million people in nearly 20 million households at a cost

of approximately $68 billion in 2017 (USDA, 2018). Research has shown the effectiveness of

SNAP in reducing food insecurity and its related health problems (Executive Office of the

President, 2015). Because of the program's efficacy in alleviating the myriad problems

associated with food insecurity, under-enrollment in the program by eligible households is an area of concern.

Many empirical studies have investigated the causes of under-enrollment in welfare programs in general and in food stamps in particular. Lack of knowledge about potential benefits, transaction costs in terms of time spent applying or transportation to the welfare office, and stigma have all been cited as reasons for under-enrollment (Andrade, 2002; Bartlett, Burstein, & Andrews, 2004; Gundersen et al., 2011). To give a different twist to the numerous studies that have been undertaken to study food stamp participation and welfare, the purpose of this research is to assess whether negative attitudes towards welfare deter food stamp participation among potentially eligible beneficiaries. Assessing the extent to which such negative attitudes deter enrollment in food stamps/SNAP is important because of the known negative effects of food insecurity on health and well-being.

This study uses the 2002 round of the National Survey of American Families (NSAF) which, according to our knowledge, is the only survey that contains questions pertaining to 'attitudes' of respondents and food stamp participation. In our study, negative attitudes of participants towards welfare are captured in a "stigma index." Findings from this study should add to the body of knowledge concerning why some eligible participants do not apply for food stamps/SNAP.

3.2   Background on Food Stamps/SNAP

The modern Food Stamp Program began as a pilot program in the early 1960s, with a permanent program authorized in 1964, although establishment nationwide took an additional decade. The original program required participants to purchase stamps, with the cost of the bundle of stamps dependent on household income. The purchase requirement was eliminated by the Food Stamp

Act of 1977. Initially, food stamps were literally stamps; that is, paper coupons that could be used to purchase food for home preparation. The current form of delivery, electronic benefits transfer (EBT) on a card, was fully implemented nationwide by 2004. (Most states had fully implemented EBT by 2002.) Food Stamp/SNAP benefits can only be used to purchase food that is to be prepared and consumed at home[5].

Although the Personal Responsibility and Work Opportunities Reconciliation Act of 1996 (e.g. "welfare reform") did not impose the strict time limits on all food stamp receipt that were imposed on cash welfare benefits, the act had provisions that significantly affected the program, particularly for households with no minor children at home. Under this law, unemployed adults with no minor children faced a time limit of three out of 36 months, although this provision was later modified to allow waivers in case of high overall unemployment rates in a state. Under this same law, most legal immigrants were removed from eligibility. Further, the maximum allowed benefit was reduced and other changes making it more difficult to qualify (or easier to be disqualified once qualified) were implemented.

Since its full establishment in the 1970s, the Food Stamp Program/SNAP has been an entitlement program, meaning that all who meet the eligibility requirements can receive benefits. Benefit levels are set based on the USDA's Thrifty Food Plan, the estimated cost of a nutritious low-cost diet when all food is assumed to be prepared and consumed at home. Although the Thrifty Food Plan estimates are tailored to families of different ages and sex, food stamps/SNAP benefits are calculated based on a reference family consisting of one adult male, one adult female, one child 6 to 8 years old, and one child 9 to 11 years old and then adjusted for family size. The maximum monthly allotment, for a household with no countable income, is then

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[5] In some areas, restaurants can be authorized to accept SNAP benefits from qualified homeless, elderly, or disabled people in exchange for low-cost meals. (Source: https://www.fns.usda.gov/snap/eligible-food-items)

adjusted downward for income as the family is expected to contribute 30 percent of its net income toward food purchases.

Eligibility requirements have varied over the program's history. However, a cut-off level of 130 percent of gross income has been in effect for many years. In addition, applicants face eligibility requirements in terms of net income (gross income minus certain allowed deductions) and assets. Some of the eligibility requirements are set by the states, within limits, while others, such as the gross income limit, are in effect nationwide.

Take-up rates for the program among eligible households have varied considerably over the program's history. From 1994 to 2001, the period marked by welfare reform, the percentage of eligible households receiving food stamps fell from 75 percent to 54 percent (Ganong & Liebman, 2013). By 2016, however, participation rates have risen markedly to 85 percent of eligible households (Cunnyngham, 2018). The large increase in take-up since its low in 2001 has been explained by an increase in outreach efforts, policy changes, and the drawn-out nationwide recession with an uneven recovery (Ganong & Liebman, 2013).

Stigma and the Take-Up of Welfare Programs

There have been two main approaches to the study of the reasons for non-participation in welfare programs among the eligible population, one being from a sociological and psychological point of view (see for example, Kerr, 1983) and the other based on economic models. The economics literature typically employs a utility framework including costs and benefits as a basis for elucidating the reasons for participating or not participating in welfare programs. Under this type of model, non-participation in a welfare program can be explained in terms of the costs associated with claiming the benefits, including both transaction costs (time

and money spent on transportation to the welfare office, time spent filling out forms and so on) and the psychological cost of shame and stigma.

Research studies on welfare participation support the view that there is a psychological cost or stigma which deters eligible participants from applying for or benefitting from social welfare programs. Rogers-Dillon (1995), for example, argued that food stamps label the user as a welfare recipient and constitute what Goffman (1963) terms as "stigma symbols." The latter describes stigma as "an attitude that is deeply discrediting." The theoretical framework of Rogers-Dillon's work suggests that the perception that welfare recipients are "cheating tax-paying citizens" is at least in part a result of the history and design of the American welfare system.

Weisbrod (1970) distinguished between marginal and total stigma. The author explained that people will decide to receive benefits if the marginal stigma is smaller than the expected value of benefits; hence participation will likely be greater for those who have previously claimed benefits. By contrast, stigma will be greater for those whose have not previously claimed benefits or seen themselves as poor.

Moffitt (1983) developed a conceptual model of stigma of two types, "flat" and "variable" where the "flat" stigmatization would result in the same cost regardless of the size of the benefit, and the "variable" would be dependent on the benefit size. Applying his model to cash welfare programs, he found evidence that stigma arose from participation at any level, not from the size of the benefit.

Andrade (2002) reviewed the literature on the economics of welfare participation and welfare stigma. Interestingly, he stated that (at that time) "theoretical models of welfare take-up and welfare stigma are almost non-existent." The reason the author provided for the non-

existence of theoretical model was that direct quantification of stigma is difficult and also that this subject lies between economic theory and the other social sciences (such as psychology and sociology) rendering economists (of the time) less interested in the issue.

Under-enrollment in the Food Stamp Program (FSP) in particular has been analyzed in a number of studies. Ranney & Kushman (1987), building on the framework provided by Moffitt (1983), developed a model for FSP participation that included the possibility of welfare stigma. They found that food stamps increase food expenditures more than an equivalent amount of cash. Further, results of their FSP participation model indicate stigma has significant effects.

Ponza, Ohls, Moreno, Zambrowski, & Cohen (1999) conducted a survey of both current recipients and eligible non-participants. Of the eligible non-participants, only 7 percent cited stigma as their most important concern. However, nearly half of these eligible non-participants did respond positively to at least one of the survey questions about perceptions of stigma from food stamps. Among current recipients, those dissatisfied with the program were likely to report both high participation costs and feelings of stigma associated with the program. In a similar survey conducted among eligible non-participants in 2000-2001, Bartlett et al. (2004) found that 69 percent of respondents reported that they would apply if they knew they were eligible, but 27 percent said they would never apply. Of those who said they would never apply, 44 percent cited stigma-based reasons and 61 percent cited the costs of application or participation (Barlett et al, 2004).

Gundersen, Kreider, & Pepper (2011) in a review of the economics of food insecurity describe three main factors for not participating in the FSP: first, there may be stigma associated with receiving FSP/SNAP, ranging from a person's own distaste for receiving food stamps, to the possible negative reaction of case workers; second, transaction costs can diminish the

attractiveness of SNAP participation and third, the benefit level can be quite small, for some families as low as $17 a month.

Nicoll (2015) provides a good review of why some eligible households do not participate in welfare programs limited to SNAP, temporary assistance for needy families (TANF) and earned income tax credit (EITC) although they are eligible. The author categorizes participation in welfare programs in terms of different factors. Program factors relate to the features of the policy design and implementation and include aspects such as the amount of benefits received in the program, the transaction costs and the knowledge about eligibility and application procedures. Next, household factors such as demographic characteristics of the individual or household will influence participation in welfare programs. These will include race/ethnicity, immigration status, woman-headed households, levels of education, age, health status of household members, marital status, presence of children in households, employment status and income levels. Finally, macro-cultural factors focus on the attitudes towards the U.S discourse on poverty and public antipoverty programs that affect the perceptions of those eligible to participate in them. Research on macro-cultural factors has mainly focused on the notion of "welfare stigma."

3.3   Data

The 2002 round of the National Survey of American Families (NSAF) was used for this study. Interviews were conducted with over 40,000 families, yielding information on over 100,000 people under the age of 65. The survey sample is representative of the US as a whole and therefore allows for national level analysis. Although the data were collected a number of years ago, the survey includes a number of questions about welfare use, household structure, and

attitudes that cannot be found in more recent studies. Further, insights into the impact of stigma on program use would be useful, regardless of the time in which the data were collected.

Information on a broad array of government programs, fiscal capacity and demographic characteristics can be found in the survey data. The data were collected by random digit dial telephone sample supplemented by an area probability sample of non-telephone households. Interviews were conducted with the "most knowledgeable adult" (MKA). In households with children, in addition to the MKA, one or two additional adults under the age of 65 who did not have any of their own children under the age of 18 living with them were sampled and interviewed if such people lived in the household. The dataset contains variables to account for the survey design: stratification, clustering, and weights. (See Abi-Habib, Safir, & Triplett, 2004, for additional information on survey methods.) Studies are still using NSAF data (see Oreski, Oreski, & Klicek, 2017; Morris, 2014; Ziol-Guest & Dunifon, 2014).

The respondents retained for this study were comprised solely of families with minor children. Families without children were not retained because of the time limits for food stamp eligibility placed on unemployed adults without children, making that population subgroup significantly less likely than those with children to apply for food stamps. Because of eligibility rules following the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), immigrant families were also excluded. The data were limited to respondents where the MKA was a female. In studies on food stamp participation, it has been found that men are more likely than women to commit an error of omission when asked about food stamp/SNAP receipt (Bollinger & David, 1997, 2005). Thus, to minimize the effect of reporting bias, only women respondents were retained for this study.

The process to apply for food stamps varies across states. O'Brien, Pendergast, Thompson, Fruchter, & Aldeen (2001) reviewed the procedures for applying for food stamps across states in the United States and discussed "red tape" barriers preventing eligible potential applicants from benefitting from food stamps. From their work, a proxy variable for the transaction cost to apply for food stamps across the 50 states and the District of Columbia was calculated by multiplying the application page length and the error rate for the financial year 1999. The variable was included in the logistic regression to account for differences in applying for food stamps across states.

In this data set, income is coded as 50 percent of poverty, 100 percent of poverty, and 150 percent of poverty. We used in our analysis families at or below 150 percent of poverty. Because the gross income limit for food stamps is 130 percent of poverty, the data would likely contain some people who weren't eligible for the FSP at the time the interviews were conducted. However, given that among low-income families income tends to fluctuate, and given that our dependent variable was having ever-applied for food stamps, the higher of the two possible choices seemed more reasonable for this study. There were 4,255 observations in the sub-sample of interest.

A 0-1 variable for food stamp application was created and represented whether the MKA or anyone in the household had ever applied for food stamps. We use application, not participation, as the dependent variable because stigma most directly affects the willingness to apply, while participation also depends on meeting eligibility requirements.

Food insecurity is an important driver in the decision to apply for food stamps (Nord, 2009). At the same time, the FSP is in itself designed to reduce food insecurity. Thus, the relationship between food insecurity and food stamps is complicated by selection bias. As such,

studies that have attempted to derive the impact of the FSP on reducing food insecurity have faced the difficulty of accounting for self-selection (Gundersen et al., 2011). Our paper does not attempt to correct for possible selection bias because of the difficult in finding good instruments in this data. In this case, however, we are examining the impact of food security on the decision to apply for food stamps, rather than the other way around. It is likely that food security levels for households participating in food stamps would be higher than otherwise, but research has found that food stamps alone are unlikely to move a household from a food insecure to a food secure status, but rather serve to reduce to some extent the degree of food insecurity. Thus, the simultaneity bias of food security and food stamp participation is not expected to be large (Ratcliffe, McKernan, & Zhang, 2011)

In the United States, since the mid-1990s, food insecurity has typically been measured by the USDA's "food security module," a set of questions concerning behaviors and experiences regarding various types of food hardship. For the adult measure of food insecurity, there are 10 questions (see (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). The NSAF survey does not contain the full 10-question food security module, nor does it have variables for levels of food insecurity. Instead the survey contains only 3 of the 10 questions in the USDA module. Personal correspondence with Mark Nord (2006) provided a method of using the available questions to determine whether or not the social family was food secure. Four categories of food insecurity can be determined: fully food secure, marginally food secure, low food security and very low food security.

Table 3.1 summarizes the frequency of respondents in each of these categories. The table shows that 84 percent who never applied for FSP were fully food secure, 6 percent were marginally food secure and 11 percent had low or very low food security levels. Among

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respondents who applied for food stamps, 48 percent were fully food secure, 11 percent reported marginally food secure and 40 percent reported low or very low food security.

Stigma Index

The NSAF survey contained the following questions that pertain to welfare, answers to which were used to develop a stigma index:

Here are some opinions that people have expressed about welfare and about working. For each of the following statements, please tell me whether you strongly agree, agree, disagree or strongly disagree.

   a. *Welfare makes people work less than they would if there wasn't a welfare system.*

   b. *Welfare helps people get on their feet when facing difficult situations such as unemployment, a divorce, or a death in the family.*

   c. *Welfare encourages young women to have babies before marriage.*

The stigma index in this study refers to the negative attitudes of respondents towards welfare. A score of 1 to 4 is given corresponding to the responses of "strongly disagree" "disagree" "agree," and "strongly agree," respectively for questions a and c. For the second question, to which agreement indicates a positive attitude toward welfare, the scoring is reversed. Table 3.2 provides summary statistics for these responses. A total score of greater or equal to 6 was used to represent respondents with strong negative attitudes toward welfare.

3.4   Conceptual framework

The economic approach to welfare participation compares the net utility of benefiting from food stamps/SNAP with the utility of not participating in the program. When the former is anticipated to be greater than the latter, the household will apply to participate in the program.

Using the framework of Blundell, Fry, & Walker (1988), a household will apply to participate in the program if

$$U_p [y_i + B(y_i,z_i^*), z_i) - C(y_i,z_i)] > U_{np} (y_i,z_i) \qquad (1)$$

Where y is the income of household, $B(y_i,z_i^*)$ is the benefit from the program, z_i^* is a vector of characteristics determining decision to participation, $C(y_i,z_i)$ is the disutility of applying to the program and U_p and U_{np} are respectively the utilities of participation and non-participation. The probability of participation ($P_i = P(U_p - C - U_{np}) > 0$) will be decreasing in y_i (for given levels of B_i and z_i) and increasing in B_i (for given levels of y_i and z_i).

This framework is similar to the one employed by Gundersen, Jolliffe, & Tiehen (2009), who modeled the participation decision in terms of anticipated costs (stigma and transaction costs) and anticipated benefits (increased household ability to purchase food) of participation. For our study, with its focus on stigma as a deterrent to applying for food stamps, the decision variable of interest is whether the respondent has ever applied for food stamps. Explanatory variables (that is the elements of z) include stigma, as well as other household characteristics.

3.5   Regression

Logistic regression was used to determine the explanatory variables which maximize the likelihood of applying for food stamps. Logistic regression employs binomial probability theory whether an event/person belongs to one group rather than the other:

$$\frac{p_i}{1-p_i} = \exp\{x_i'\beta\} \qquad (2)$$

where x_i is a vector of covariates and β is a vector of regression coefficients.

Demographic variables found in the literature relevant to food stamp participation are marital status, employment, race and education (Rank & Hirschl, 2005; Mykerezi & Mills, 2010); Grieger & Danziger, 2011). Therefore these variables are incorporated in the model.

The logit model estimated is of the form:

$$FDSTP_i = \beta_0 + \beta_1 SI + \beta_2 FI + \beta_3 EDU + \beta_4 EMP + \beta_5 MARSTAT + \beta_6 BLACK + \beta_7 AGE +$$

$$\beta_8 NUMCHD + \beta_9 COST + \varepsilon \tag{3}$$

$FDSTP_i$ is a 0-1 variable indicating whether there was a food stamps application. SI is a continuous variable which from 3 to 12, higher values indicating stronger negative attitudes toward welfare. This newly created 'stigma index' captures the negative attitudes towards welfare. FI is a 0-1 variable that takes the value 1 for low food security and very low food security and zero for food security and marginally food security; EDU is a binary variable, where 1 indicates higher than a vocational certificate, and 0 otherwise; EMP is a binary variable where 1 indicates the respondent is employed, 0 otherwise; marital status is a binary variable where 1 indicates a married respondent, 0 otherwise, and BLACK takes the value 1 for black, non-Hispanic respondents and 0 otherwise. AGE is the age of the sampled respondent; NUMCHD is a continuous variable ranging from 0 to 8 and indicates the number of children under 18 in the household. COST is a proxy variable capturing the transaction cost for applying for food stamp across states in the U.S. derived from mu application page length and error rate. The data was obtained from O'Brien et al. (2001). Table 3.3 provides summary statistics for the variables used for the regression.

3.6   Results

A comparison of the mean value of the stigma index reveals that among those who had applied for food stamps, the 'stigma index' had an average value of 6.88 compared to 7.23 for those who had not. Higher values correspond to more negative attitudes toward welfare. The difference was small, but statistically significant.

The results of the regression are reported in table 3.4. After controlling for other factors, a negative coefficient implies that higher stigma is a significant deterrent to food stamp application. The interpretation of the estimates of logistic model is illustrated using table 3.5. Thus, after controlling for other factors, respondents who have a strong negative attitude towards welfare are less likely to apply for food stamps. The results of the regression show that people who are married and better educated are less likely to apply for food stamps. Age is also found to be a significant determinant of likelihood to participate in food stamp, with older people being less likely to participate. African Americans appear to be more likely to apply for food stamps. A higher number of children in the households increase the likelihood of seeking food stamps. The proxy variable for transaction cost across states is statistically insignificant. Food insecurity was found to be a significant driver in the applicant ever having applied for food stamps.

Robustness Check

To determine whether the stigma variable may be endogenous to the model, a suitable instrument had to be identified. From the survey, an index was created using responses to questions pertaining to the attitudes of the respondents towards motherhood. The 'attitude towards motherhood' variable was found to be significantly correlated with the stigma variable (correlation coefficient = 0.183). The model was re-run using survey correction. The test indicates the likelihood of simultaneity between the stigma index and application of food stamp

(Table 3.5). The resulting parameter estimates from the model after controlling for endogeneity and other determinants of food stamp application were consistent with the previous model confirming that negative attitudes towards welfare decreases the likelihood of applying for food stamps.

Limitations of this study include the possibility of simultaneous equation bias from including food insecurity as an explanatory variable. Further, results are limited by potentially incorrect responses to the survey questions regarding application for food stamps. Previous research has found that incorrect responses to questions about food stamp receipt are non-trivial and are asymmetric so that false negatives are more common than false positives (Bollinger and David, 2005). To complicate this problem, those with high stigma indices may be more likely than those with low indices to deny applying for food stamps even if they had done so. To counteract this problem would require use of administrative data that includes attitude questions. Another limitation of this study is that food insecurity and attitudes toward welfare were measured over the previous 12 months, while the question about application for food stamps spanned the person's entire (adult) life.

3.7   Concluding remarks

The current high rates of take-up for food stamps/SNAP have been attributed at least in part to public outreach efforts (Ganong and Liebman, 2013). However, at the same time, media portrayals of poverty and welfare have become increasingly negative, which could result in increases in feelings of stigma associated with program use. Rose & Baumgartner (2013) analyzed media "framing" of poverty over the period 1960 to 2008 and found that "generous" (e.g. more positive) frames heavily dominated media coverage during the era of the "War on Poverty," but that "stingy" frames became more prevalent during the 1970s and subsequent

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years. In their research, the two "stingy" frames involved "cheating," a frame which was found most commonly in the 1970s and early 1980s, and "laziness," which has grown dramatically in prevalence from that same time period on.

Results of our study provide evidence that individuals' negative attitudes toward welfare decrease the likelihood of applying for food stamps/SNAP. Among families with children, those with high stigmatization were found to be about half as likely to report ever having applied for food stamps as those with less negative views. These findings are important because research has shown that food stamp/SNAP benefits reduce household food insecurity and the negative health outcomes associated with it.

Table 3- 1   Food security status of respondents

	Fully food secure	Marginally food secure	Low food security	Very low food security
Never applied for FSP (%)	83.77	5.55	8.03	2.65
Applied for FSP (%)	48.45	11.12	25.19	15.25

Responses adjusted by survey weights.
Source: National Survey of American Families, 2002

Table 3- 2   Summary of responses to questions about welfare

	Strongly agree	Agree	Disagree	Strongly disagree
a. Welfare makes people work less than they would if there wasn't a welfare system (%)	21.48	47.20	26.27	5.05
b. Welfare helps people get on their feet when facing difficult situations such as unemployment, a divorce, or a death in the family (%)	18.37	67.24	11.31	3.08
c. Welfare encourages young women to have babies before marriage (%)	10.50	28.75	49.73	11.01

Responses adjusted by survey weights.
Source: National Survey of American Families, 2002

Table 3- 3   Summary statistics

Variable	Respondents who have never applied for FSP (N=1073) 26.8%		Respondents who have applied for FSP (N=2926) 73.2%	
	Mean	**Std Error of Mean**	**Mean**	**Std Error of Mean**
Stigma Index	7.234	0.078	6.879	0.041
Food Insecurity	0.227	0.018	0.509	0.015
Education	0.441	0.021	0.296	0.013
Employment	0.498	0.025	0.485	0.015
Marital Status	0.495	0.026	0.279	0.014
Black non-Hispanic	0.191	0.018	0.354	0.016
Age	35.372	0.498	33.996	0.293
Number of children	1.315	0.060	1.579	0.034
State cost proxy	121.357	3.843	114.017	3.283

Analysis performed in SAS PROC SURVEYMEANS, adjusting for sample design and survey weights
Source: National Survey of American Families, 2002

Table 3- 4   Parameter estimates for the probability of applying for food stamps

Variable	Parameter	Std Error	Odds Ratio	95% Wald Confidence Limits	
Intercept	2.522***	0.381			
Stigma	-0.128***	0.036	0.88	0.82	0.945
Food Insecurity	1.257***	0.133	3.514	2.693	4.585
Education	-0.588***	0.114	0.556	0.442	0.698
Employment	-0.170	0.123	0.844	0.66	1.078
Marital Status	-0.780***	0.135	0.458	0.35	0.6
Black Non-Hispanic	0.595***	0.146	1.813	1.354	2.427
Age	-0.023***	0.008	0.977	0.961	0.994
Number of children	0.237***	0.060	1.267	1.124	1.427
State cost proxy	-0.001	0.001	0.999	0.998	1.001
Observations	3,999				

Logistic regression results from SAS PROC SURVEYLOGISTIC, corrected for sample design and sampling weights. *** significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level. Significance based on Wald Chi-Square.
Source: National Survey of American Families, 2002

Table 3- 5   Parameter estimates for the probability of applying for food stamps after correcting for endogeneity

Variable	Outcome	Selection
Intercept	3.899***	5.405***
	(0.212)	(0.204)
Stigma	-0.533***	
	(0.055)	
Food Insecurity	0.424***	-0.094
	(0.107)	(0.089)
Education	-0.168***	0.070
	(0.078)	(0.080)
Employment	-0.006	0.178**
	(0.065)	(0.073)
Marital Status	-0.252***	0.029
	(0.088)	(0.079)
Black Non-Hispanic	0.259***	0.144*
	(0.058)	(0.803)
Age	-0.002***	0.019***
	(0.005)	(0.004)
Number of children	0.088***	-0.008
	(0.031)	(0.030)
Mother's Attitude		0.087***
		(0.020)
athrho	1.008***	
	(0.235)	
lnsigma	0.444	
	(0.017)***	
Observations	3,985	

Probit model with endogenous regressor correcting for survey results from STATA.
Standard errors are given in parentheses. *** significant at the 0.01 level, ** significant at the 0.05 level, * significant at the 0.10 level.
Source: National Survey of American Families, 2002

Table 3- 6   Probabilities of applying for food stamps under different scenarios

	Probability of applying for food stamp	
	Low stigma individual	**High stigma individual**
30 years old, married, black with 2 children	0.73	0.58
30 years old, single, non-black with 2 children	0.76	0.45
45 years old, black, with 4 children, married	0.74	0.59
45 years old, black, with 4 children, single	0.82	0.70

Source: National Survey of American Families, 2002

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