Senior Project
Department of Economics

"The Long Term Costs of War: Guatemala's Civil War and its Effects on Labor-Market Earnings"

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May 2011

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Abstract

During 1960 to 1996 Guatemala experienced a thirty-six year long civil war. This war is unique due to department level and timing variation. The initial period (1960-1978) and final period (1986-1996) of the war was considered to be relatively peaceful while the second period (1979-1984) was considered to be the most violent period. 2007 data was obtained from the National Survey of Living Conditions compiled by the Encuesta Nacional de Condiciones de Vida (ENCOVI)[1] combined with the distribution of number of victims and human rights violations across 22 departments is used to examine the effects of the Guatemalan civil war on future adult labor market earnings of children who were ages one to six during the worst period (1979-1984) of the war. The year and department of birth determines an individual's exposure to the war. This study exploits the fact of variation of war intensity across departments and time. The results conclude that the worst period of the Guatemalan civil war disproportionately affects rural men born between 1967-1977 who live in HWI areas.

Introduction

The microeconomic impact of civil war may be extensive and the economic consequences can be long lasting. Individuals living in war zones can suffer injuries, experience property damage, be displaced from their homes, lose their means of survival, or be unable to attend school. According to Chambargawala and Moran (2011) all of these factors can result in a permanent decline of an individual's productivity and earnings and therefore these factors may also increase poverty and inequality throughout the country. Since 1960 almost all civil wars

[1] Due to the use of micro data sets and privacy issues this data was obtained from a third party, the Luxemburg Income Study (LIS).

have occurred in developing countries (Murdoch and Sandler, 2002). This factor is important because developing countries have high poverty rates and low GDP growth.

Between 1960 and 1996 Guatemala experienced a thirty-six year long civil war. This war is unique due to its sheer length and also because the war can be categorized into three periods. The initial period, 1960-1978, was considered to be relatively peaceful, the second period of the war 1979-1984, and was the most violent, and the final period of the war, 1985-1996, was considered to be relatively peaceful.[2] According to the Historical Clarification Commission (CEH) the Guatemalan government was responsible for ninety-three percent of all human rights violations, these violations peaked in 1982 and eighty-three percent of the victims were Mayan. It is estimated that over 200,000 people were killed in the war, more than 500,000 people or 8.3 percent of the 1983 Guatemalan population were displaced, and many Mayan villages were completely destroyed. The Guatemalan government also implemented forced disappearances against the opposition. Forced disappearances account for one out of every five reported testimonies documented in the Recovery of Historical Memory Project (REMHI), and approximately 3,893 civilians were subjects of forced disappearances (Archdiocese of Guatemala 1999). All of these atrocities caused many families and communities to lose property and their means of survival, while a large number of children were abandoned and orphaned. The Mayan community was the most affected (Chambargawala and Moran 2011). In addition, the destruction of both private and public physical capital and infrastructure represented a substantial loss resulting in over six percent of Guatemala's 1990 gross domestic product (GDP) (Chambargawala and Moran (2011).

[2] Peaceful periods of the war are defined by strategic military operations and less violent acts against individuals, while the worst period of the war saw ninety-one percent of the total human rights violations committed and destruction of villages was more prevalent.

Due to the length of the Guatemalan civil war the long-run economic cost of conflict could be expected to be severe. The war caused an increase in military spending and diverted government investments away from public resources such as the health and education systems. Chambargawala and Moran (2011) state that in 1985 public investment in physical capital comprised only two percent of the country's GDP which was the lowest in forty years. The majority of costs were due to the loss of potential production caused by civilian deaths, disappearances, or displacement of individuals. Also some individuals chose to exit the work force and join the Patrullas de Autodefensa Civil (PAC) or opposing guerrilla forces.[3] The CEH estimates that the total measurable cost of the war from 1980 to 1989 was equivalent to zero production for almost fifteen months. This was equivalent to 121 percent of Guatemala's 1990 GDP.

The purpose of this paper is to examine the effects of future adult labor market earnings of primary school age children, seven to twelve years old, during the worst period (1979-1984) of the Guatemalan civil war. There has been extensive investigation of how civil war affects long-run and short-run growth in a variety of countries (Murdoch and Sandler, 2002) and regions of countries (Murdoch and Sandler, 2003). There have also been studies on how terrorist conflict affects economic growth in a particular region of a country (Abadie and Gardeazabal, 2003). Research has been conducted on the effects of early life exposure to civil war in Peru and its effects on future labor-market earnings (Galdo 2010). The effects of Guatemala's civil war on human capital accumulation (Chamarbagwala and Moran 2011) have also been studied. However, this paper is the first attempt to study the effects of the worst period of the Guatemalan civil war on future adult labor market earnings of primary school age children, ages seven to

[3] PAC is the governmental army. While participation was "voluntary" many Guatemalans, especially those who lived in the northwest region of largely indigenous population, were forced to join the PAC or the opposing guerrilla forces.

twelve years old. Children who receive less primary school education may also receive less secondary and high school education. Chambarbagwala and Moran (2011) found that civil war has a negative impact on human capital accumulation; this finding suggests that war may lower adult wages and labor productivity.

Literature Review

Civil wars and conflict in general may have short term and long term economic consequences on a country's economic growth, as well as education attainment for individuals, and labor market earnings of individuals. The increase need for soldiers, along with rising death tolls caused by conflict, yield less human capital formation, while battles and guerrilla activities may stagnate market exchanges and destroy private and social capital. It is therefore probable that economic growth and development in developing countries may be hindered due to human capital loss, reduced investment, destruction of infrastructure and disruptions in the market Murdoch and Sandler (2002) address the effects of civil war on the steady state income per capita in both the long run (twenty-five year time period) and short run (five year time period) for eighty-five countries that experienced a civil war and their neighboring countries who were not involved in an internal conflict. Murdoch and Sandler found that the presence of a civil war in the host country and countries which they border has a large statistically significant negative effect on short-run income per capita but a minimal statistically significant negative effect on long-run income per capita. These findings are consistent with the neoclassical economic growth theory which states that countries with lower income per capita will experience faster growth than those countries with higher income per capita (Murdoch and Sandler, 2002).

Murdoch and Sandler (2003) conducted a second study which investigated the effects of civil war on a region's long-run (thirty-five year time period) and short-run (five year time

period) growth. The regions which were studied were Africa, Asia, and Latin America. Separate regressions were generated for each country and a pooled fixed effects regression was generated for all three countries. Due to a limited sample size, the Latin American results were poor in both the long run and short run and therefore the effects of civil war in the Latin American region were inconclusive.

Abadie and Gardeazabal (2003) investigated the economic impact of terrorist conflict in the Basque Country. Prior to Abadie and Gardeazabal research, most literature which studied the economic impact of conflict had used cross-sections of countries and pooled data. According to Temple (1999) shortcomings exist with this methodology due to the fact that conflicts in various countries may naturally be different[4]. Therefore Abadie and Gardeazabal chose to conduct a case study comparing the Basque country of Spain to a control region in Spain, which possessed similar economic structure[5]. The authors found that in the long-run, terrorist conflict reduced economic growth in the Basque country relative to the control region. The Basque Country's per capita GDP fell ten percent relative to the control group.

Chamarbagwala and Moran (2011) studied the impact of Guatemala's thirty-six year-long civil war effects on children's human capital accumulation and which demographic groups were worst affected[6]. The sample consisted of three groups, The first cohort were school age children, ages seven to nineteen years old during the initial period of war (1960-1978), the second cohort consisted of school age children during the worst period of the war (1979-1984), and lastly, the

[4] Conflict in countries may naturally differ due to the nature of the war such as ethnically fused or politically fused. Also the economic state of the country and or region may differ from one another.
[5] The authors used a difference-in-differences estimation to examine the effects of conflict in the Basque region compared to the control region.
[6] Chamarbagwala and Moran (2011) investigated schooling obtainment based upon ethnicity, gender and location (urban versus rural).

third cohort was comprised of children who were school aged during the end of the war (1988-1996), which was relatively peaceful.

Despite the possible lack of long-run macroeconomic effects caused by conflict, specific people and or regions may be affected in the long-run[7]. Chamarbagwala and Moran found that there exists a strong negative impact of civil war on the education of rural Mayans. Exposure to civil war had a large long-term negative effect on the education of rural Mayan males and females who were school age between 1960 and 1996. Chamarbagwala and Moran found that rural Mayan males from high war intensity departments from cohort one, two and three obtained 0.27, 0.70, and 1.09 years less education respectively while rural Mayan females from high war intensity departments received 0.12, 0.57 and 1.17 years less education respectively. Rural female Mayans were affected the most. Finally, each successive cohort obtained less and less schooling. Finally, Chamarbagwala and Moran state that the negative impact on human capital accumulation on rural Mayans may result in lower adult wages and labor productivity.

Galdo (2010) studied the effects of early life exposure to civil war in Peru on future labor-market earnings. The author based his study upon the critical programming theory, which suggests that tragic events early in life may have long-term effects in adulthood. Galdo examined the earnings of working-age individuals born between 1974 and 1993 who were thus exposed to civil war in Peru during the first six years of life. He focused on three periods of life, the fetal, the early childhood, and pre-school exposure periods. Galdo concluded that for women, a one standard deviation increase in the intensity of violence during the early childhood years led to a 6.3 percent decrease in monetary earnings and a 2.7 percent decrease in monetary earnings for men.

[7] Such people include, the indigenous, females, and or males along with urban or rural areas.

I aim to expand upon the previous studies of Guatemala by examining what effects do the worst period (1979-1984) of the Guatemalan civil war have on future adult labor market earnings of those individuals born between 1967 1977, and thus were primary school age (7 to 12 years old).

Theoretical Model

The following model is an adaptation of the Chambargwala and Moran (2008) model which estimated the effects of civil war on education attainment of children who were school age during the worst period of the war. This model will be used to analyze the effects of the Guatemalan civil war on future labor market earnings.

$$\log(Y_{ijt}) = \alpha + \beta HWI_j + \gamma(HWI_j * Exposure_t) + \phi X_{ijt} + \delta_t + \varepsilon_{ijt} \qquad (1)$$

$Log(Y_{ijt})$[8] is the dependent variable and is the logarithm of gross income earned in 2007 by individual i in department j born in year t. HWI_j is an indicator for whether the individual lived in a high intensity war department[9] and $Exposure_t$ is an indicator for being born between 1967-1972 and thus primary school age, seven to twelve years old, during the worst period of the war. $HWI_j * Exposure_t$ is an interaction term and is the main variable of interest. This term is important because it measures the effect of the war on the dependent variable for individuals who live in high war intensity departments and were exposed to the worst period of war. X_{ijt} is a vector and includes characteristics such as gender of the individual, ethnicity of the individual (indigenous or nonindigenous), and whether the individual resided in an urban or rural area during the war. In order to control for unobserved heterogeneity δ_t is a fixed effect term for an

[8] By taking the logarithim of gross income one can examine the percentage movement in gross income that results when another variable changes.

[9] High war Intensity (HWI) departments include departments with the highest human rights violations and massacres per 1000 people relative to the 1983 population. These departments include Huehoentenago, Quiche, Baja Verapz , Alta Verapaz, and Peten.

individual's year of birth. This term controls for cohort specific shocks that may create bias results.

A difference-in-difference approach is used to estimate the model. According to Blattman and Miguel (2008) difference-in-differences methods are commonly used to examine the impact of war on microeconomic outcomes. Difference-in-differences methods are based upon the assumption that there are similar fundamental trends in human development in high and low war intensity departments (HWI and LWI respectively) and that in the absence of conflict, trends in human capital accumulation and earned income would be similar across similar departments. However if departments categorized as being HWI show significantly less development than those LWI departments prior to 1979 then lower income levels earned by individuals from HWI departments may not reflect the direct impact of the war but declining socio-economic conditions which may have been a cause of war. Chamarbagwala and Moran (2008) found that when controlling for developmental trends across departments, there is very little difference in the magnitude and significance of the difference-in-differences estimator concerning educational obtainment compared to the difference-in-differences estimator generated without developmental controls. This suggests that the results are not due to pre-war trends in development[10]. In my study, data for developmental controls were unavailable, but Chamarbagwala and Moran (2008) results suggest that the lack of control data should not pose a problem.

Guatemalan's civil war resulted in a large number of people being displaced, therefore like Chambargawala and Moran (2011) I will limit my study to individuals who were born and

[10] From the 1973 Census data was collected concerning the proportion of households without basic services such as water, sanitation, and electricity. Chamarbagwala and Moran found a negative relationship between basic services and education obtainment. Therefore a control variable was created, this variable is an interaction between year of birth and department's level of development

reside in the same department as of 2007. Also I will only include working aged individuals, ages fifteen to sixty-four, in my study.

Based upon the nature of the Guatemalan civil war, Chamarbagwala and Moran (2011) and Galdo (2010) results HWI_j should have a negative effect on gross net income earned and exposure to the war, $Exposure_t$, will intensify this negative impact. The interaction term will also be negatively related to the dependent variable (see tables one and two for a description of each variable and expected signs). It is also predicted that rural indigenous females and males will have lower gross net income than urban nonindigenous females and males.

The data used in the estimation is 2007 data obtained from the National Survey of Living Conditions compiled by the Encuesta Nacional de Condiciones de Vida (ENCOVI)[11]. This data set contains information about individuals' gross income, age, gender, ethnicity, immigration status, and department of residence. Human rights violations and massacres were obtained from the REMI report and the CEH (see table three through seven for descriptive statistics).

Regression 1 estimates the elasticity of gross income of individuals who were born between 1967 to 1977 in HWI departments relative to their counterparts, which are individuals who were not born between 1976 to 1977 in LWI departments. Regressions 2 and 3 estimates the elasticity of gross income of men and women respectively who were born between 1967 to 1977 in HWI departments relative to men and women not born between 1967 to 1977 in LWI departments.

In order to correct for heterogeneity a difference-in-difference-in-differences estimation is used. The difference-in-differences variable is interacted with rural and indigenous indicators.

[11] Due to the use of micro data sets and privacy issues this data was obtained from a third party, the Luxemburg Income Study (LIS).

Regression 4 estimates the elasticity of gross income of rural and indigenous men who were born between 1967 to 1977 in HWI departments relative to urban and nonindigenous men not born between 1967 to 1977 in LWI departments.

Regression 5 estimates the elasticity of gross income of rural and indigenous women who were born between 1967 to 1977 in HWI departments relative to urban and nonindigenous women not born between 1967 to 1977 in LWI departments.

Results

Table eight presents the regression results for equation one. Columns one, two, and three present the difference-in-differences results for all individuals, males, and then females, and columns four and five present the difference-in-difference-in-differences results for rural and indigenous males and females respectively. The interaction term, Exposure*HWI, is not statistically significant for all individuals, males, or females. The worst period of the Guatemalan civil war had no effect on future adult labor market earnings of all individuals, males, or females born between 1967 to 1977 in HWI areas relative to those not born between 1967 to 1977 in LWI areas.

Individuals living in HWI departments earn 13.7 percent less than individuals living in LWI departments. Males living in HWI departments earn 10.6 percent less than males living in LWI departments while females in HWI departments earn 27.4 percent less than females living in LWI departments. Individuals who are between the ages of 30 to 40 years old and thus were born between 1967 to 1977 earn 25.5 percent more than those not in this age group. Males 30 to 40 years old and females 30 to 40 years old earn 31.1 percent and 11 percent more than those males and females not in this age group respectively. This may be due to the fact that the prime working age in Guatemala is mid adulthood. All indigenous earn 41.8 percent less than

nonindigenous, while indigenous males earn 32.5 percent less than nonindigenous males and indigenous females earn 66 percent less than nonindigenous females. HWI areas have a large indigenous population compared to LWI areas, and in general the indigenous often do not receive more than a primary school education leading to a possible disadvantage in labor market earnings. Indigenous men may earn less than nonindigenous do to the prevalence of low paying farming occupations. Indigenous females may earn less than nonindigenous females because fewer indigenous females may be present in the labor force than nonindigenous females. Indigenous females are often responsible for maintaining the home and taking care of the family. Also indigenous females are less likely to go to school than indigenous men due to responsibilities at home and may also have less educational obtainment then nonindigenous females. Rural individuals earn 68 percent less than urban individuals. Rural men earn 61 percent less than urban men while urban females earn 82.6 percent less than urban females. Rural workers may earn less than their urban counterparts due to low paying farming occupations. Finally Men earn 58.4 percent less than women.

When estimating equation one using the difference-in-difference-in-differences estimator the key interaction terms of interest are Exposure*HWI*Rural and Exposure*HWI*Indigenous. The interaction term, Exposure*HWI*Rural, is statistically significant however the interaction term, Exposure*HWI*Indigenous is surprisingly not statistically significant. Both of these interaction terms are not statistically significant for females. This may be due to a limited sample size. The Guatemalan civil war had no effect on future adult labor market earnings of indigenous men or women who were born between 1967 to 1977 in HWI departments relative to nonindigenous men or women who were not born between 1967 to 1977 who reside in LWI

departments. However rural men born between 1967 to 1977 in HWI departments earn 46.9 percent less than urban men not born between 1967 to 1977 in LWI departments.

Conclusion

The worst period of the Guatemalan civil war disproportionately affects rural men born between 1967-1977 who live in HWI areas. According to the 2011 World Development Report for every three years of violent conflict a country experiences, poverty reduction lags behind by 2.7 percent and some countries experience an increase in poverty. Therefore post-war policies need to focus on the poor. In order to combat the negative effects of conflict it is necessary to provide the most afflicted areas with proper nutrition, health care, and counseling. Infrastructure such as roads and schools need to be reconstructed. Adult education programs, such as occupational training programs need to be implemented in order to aid older individuals who may have not completed school due to war. Finally, technology, such as higher yielding crops and improved farming techniques may be beneficial in the rural areas in order to help rural individuals obtain higher output and thus higher incomes.

Income levels are also related to educational obtainment. This study did not control for educational inequalities that may exist between the oldest and youngest individual in the working population. Also this study did not examine the effects of civil war on the incomes of those who migrated. Individuals who may have migrated may still experience negative effects of war on their incomes. Therefore future studies should control for educational factors among individuals and also examine how civil war affects the incomes of those individuals who migrated.

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Appendix

Table 1

Variable	Description	Expected Sign
$\log(Y_{ijt})$	dependent variable, logarithm of gross income earned in 2007 by individual i in department j born in year t	Not Applicable
HWI_j	Dummy variable for whether the individual lived in a high intensity war department. If the individual lived in a high war intensity department then HWI = 1 otherwise HWI = 0	Negative
$Exposure_t$	Dummy variable indicator for being born between 1967-1972 and thus were primary school age, seven to twelve years old. If born between 1967-1972 then $Exposure_t = 1$ else $Exposure_t = 0$	Positive
HWI_j*$Exposure_t$	Interaction term	Negative
X_{ijt}	Gender: If individual is a male then male = 1 else male = 0 Ethnicity: If individual is indigenous then indigenous = 1 else indigenous = 0 Location If the individual lives in a rural area then rural = 1 else rural = 0	Male: Positive Indigenous: Negative Rural: Negative
δ_t	Fixed effect terms for an individual's year of birth	Not Applicable
ϵ_{ijt}	Error term for individual i in department j at time t	Not Applicable

Table 2

Variable	Description	Expected Sign
$\log(Y_{ijt})$	dependent variable, logarithm of gross income earned in 2007 by individual i in department j born in year t	Not Applicable
HWI_j	Dummy variable for whether the individual lived in a high intensity war department. If the individual lived in a high war intensity department then HWI = 1 otherwise HWI = 0	Negative
$Exposure_t$	Dummy variable indicator for being born between 1967-1972 and thus were primary school age, seven to twelve years old. If born between 1967-1972 then $Exposure_t = 1$ else $Exposure_t = 0$	Positive
$Exposure_t * HWI_j$	Interaction term	Negative
$Exposure_t * HWI_j * Rural$	Interaction term	Negative
$Exposure_t * Rural$	Interaction term	Negative
$HWI_j * Rural$	Interaction term	Negative
$Exposure_t * HWI_j * Indigenous$	Interaction term	Negative
$Exposure_t * Indigenous$	Interaction term	Negative
$HWI_j * Indigenous$	Interaction term	Negative
X_{ijt}	Gender: If individual is a male then male = 1 else male = 0 Ethnicity: If individual is indigenous then indigenous = 1 else indigenous = 0 Location If the individual lives in a rural area then rural = 1 else rural = 0	Male: Positive Indigenous: Negative Rural: Negative

δ_t	Fixed effect terms for an individual's year of birth	Not Applicable
ϵ_{ijt}	Error term for individual i in department j at time t	Not Applicable

Table 3 Descriptive Statistics for All Individuals (Difference-in-Differences Estimation)

Variable	N	Mean	Std. Deviation	Min	Max
Age	11335	30.5307455	12.0608533	15.00	64.00
Wage	11335	14386.84	21853.44	12.00	910350.00
ln(Wage)	11335	8.9452833	1.2667746	2.4849066	13.7215844
Exposure	11335	0.2309660	0.4214693	0.00	1.00
HWI	11335	0.1549184	0.3618428	0.00	1.00
Rural	11335	0.5708866	0.4949714	0.00	1.00
Indigenous	11335	0.3655051	0.4815927	0.00	1.00
Male	11335	0.7114248	0.4531199	0.00	1.00
Exposure*HWI	11335	0.0343185	0.1820540	0.00	1.00

Table 4 Descriptive Statistics for Males (Difference-in-Differences Estimation)

Variable	N	Mean	Std. Deviation	Min	Max
Age	8064	30.8462302	12.2821502	15.00	64.00
Wage	8064	15228.70	23653.22	25.00	910350.00
ln(Wage)	8064	9.0743878	1.1593790	3.2188758	13.7215844
Exposure	8064	0.2287946	0.4200828	0.00	1.00
HWI	8064	0.1665427	0.3725901	0.00	1.00
Rural	8064	0.6166915	0.4862226	0.00	1.00
Indigenous	8064	0.3799603	0.4854067	0.00	1.00
Exposure*HWI	8064	0.0365823	0.1877457	0.00	1.00

Table 5 Descriptive Statistics for Females (Difference-in-Differences Estimation)

Variable	N	Mean	Std. Deviation	Min	Max
Age	3271	29.7529807	11.4618955	15.00	64.00
Wage	3271	12311.49	11.4618955	12.00	280000.00
ln(Wage)	3271	8.6270018	1.4509451	2.4849066	12.5425449
Exposure	3271	0.2363192	0.4248854	0.00	1.00
HWI	3271	0.1262611	0.3321942	0.00	1.00
Rural	3271	0.4579639	0.4983060	0.00	1.00
Indigenous	3271	0.3298685	0.4702371	0.00	1.00
Exposure*HWI	3271	0.0287374	0.1670930	0.00	1.00

Table 6 Descriptive Statistics for Males (Difference-in-Difference-in-Differences Estimation)

Variable	N	Mean	Std. Deviation	Min	Max
Age	8064	30.8462302	12.2821502	15.00	64.00
Wage	8064	15228.70	23653.22	25.00	910350.00
ln(Wage)	8064	9.0743878	1.1593790	3.2188758	13.7215844
Exposure	8064	0.2287946	0.4200828	0.00	1.00
HWI	8064	0.1665427	0.3725901	0.00	1.00
Rural	8064	0.6166915	0.4862226	0.00	1.00
Indigenous	8064	0.3799603	0.4854067	0.00	1.00
Exposure*HWI	8064	0.0365823	0.1877457	0.00	1.00
Exposure*HWI*Rural	8064	0.0281498	0.1654110	0.00	1.00
Exposure*Rural	8064	0.1424851	0.3495687	0.00	1.00
HWI*Rural	8064	0.1226438	0.3280483	0.00	1.00
Exposure*HWI*Indigenous	8064	0.0272817	0.1629133	0.00	1.00
Exposure*Indigenous	8064	0.0890377	0.2848158	0.00	1.00
HWI*Indigenous	8064	0.1199157	0.3248830	0.00	1.00

Table 7 Descriptive Statistics for Females (Difference-in-Difference-in-Differences Estimation)

Variable	N	Mean	Std. Deviation	Min	Max
Age	3271	29.7529807	11.4618955	15.00	64.00
Wage	3271	12311.40	16422.92	12.00	280000.00
ln(Wage)	3271	8.6270018	1.4509451	2.4849066	12.5425449
Exposure	3271	0.2363192	0.4248854	0.00	1.00
HWI	3271	0.1262611	0.3321942	0.00	1.00
Rural	3271	0.4579639	0.4983060	0.00	1.00
Indigenous	3271	0.3298685	0.4702371	0.00	1.00
Exposure*HWI	3271	0.0287374	0.1670930	0.00	1.00
Exposure*HWI*Rural	3271	0.0140630	0.1177686	0.00	1.00
Exposure*Rural	3271	0.0959951	0.2946296	0.00	1.00
HWI*Rural	3271	0.0736778	0.2612857	0.00	1.00
Exposure*HWI*Indigenous	3271	0.0183430	0.1342090	0.00	1.00
Exposure*Indigenous	3271	0.0755121	0.2642562	0.00	1.00
HWI*Indigenous	3271	0.0767349	0.2662111	0.00	1.00

Table 8

Variable	All Individuals (DD)	Males (DD)	Females (DD)	Males (DDD)	Females (DDD)
Intercept	9.03363 (363.60)***	9.52573 (422.35)***	9.22730 (243.47)***	9.50880 (368.66)***	9.19147 (219.76)***
HWI	-0.13678 (-3.82)***	-0.10613 (-2.74)***	-0.27390 (-3.35)***	-0.18419 (-2.29)**	-0.30320 (-2.13)**
Interaction=Exposure*HWI	-0.00530 (-0.07)	-0.07117 (-0.90)	0.15349 (0.92)	0.46565 (2.61)***	0.70924 (2.50)***
Interaction=Exposure*HWI*Rural				-0.46914 (-2.48)***	-0.22269 (-0.60)
Interaction=Exposure*Rural				-0.09197 (-1.43)	-0.03191 (-0.27)
Interaction=HWI*Rural				0.17422 (2.06)**	0.20181 (1.18)
Interaction=Exposure*HWI*Indigenous				-0.19891 (-1.07)	-0.44209 (-1.15)
Interaction=Exposure*Indigenous				-0.04026 (-0.59)	-0.37405 (-2.87)***
Interaction=HWI*Indigenous				-0.08655 (-1.03)	-0.22036 (-1.28)
Exposure	0.25524 (9.00)***	0.31073 (9.80)***	0.11021 (1.88)*	0.37800 (7.03)***	0.22803 (2.72)***
Indigenous	-0.41831 (-17.44)***	-0.32351 (-12.21)***	-0.66000 (-12.89)***	-0.29582 (-8.99)***	-0.53439 (-8.51)***
Male	0.58379 (23.74)***				
Rural	-0.68025 (-29.99)***	-0.61495 (-24.34)***	-0.82640 (-17.44)***	-0.60083 (-19.42)***	-0.82887 (-14.42)***
N	11335	8064	3271	8064	3271
F	315.84	197.99	120.72	92.19	57.06
Adjusted R^2	0.1429	0.1089	0.1547	0.1106	0.1587

Diff-in-Diff (all)

```
Data combh;
Set &GT06h (keep=casenum D7 D20);
Run;

Proc Sort Data=combh;
By Casenum;
Run;

Data combp;
Set &GT06p (keep=casenum ppnum page psex pethnat pimmigr pgwage);
Run;

Proc Sort Data=combp;
By casenum;
Run;

Data comb;
Merge combh combp;
By Casenum;
If pimmigr ~= '1' then delete;
If pgwage = '0' then delete;
Run;


Data comb2;
Set comb (keep= casenum ppnum page psex pethnat pimmigr pgwage D7 D20);

if page >=65 then delete;
if page <=14 then delete;
If page <= 40 and page >=30 then exposure = 1;
Else exposure = 0;
Run;

Proc Sort Data=comb2 Out = Comb3;
By Decending page;
Run;

Data comb4;
Set comb3 (keep= casenum ppnum exposure psex
pethnat pimmigr pgwage D7 D20 page);

If D7 = 13 or D7 = 14 or D7 = 15 or D7 = 16 or D7 = 17 then HWI = 1;
Else HWI = 0;

If D20 = 2 then rural = 1;
Else rural = 0;

If pethnat = 30 then delete;
If pethnat ~= 29 then indigenous = 1;
Else indigenous = 0;

If psex = 1 then male = 1;
Else male = 0;

interaction = exposure*HWI;


lnpgwage = log(pgwage);

Run;
```

```
Data comb5;
Set comb4 (keep= casenum ppnum  pgwage lnpgwage exposure HWI interaction rural
indigenous male page);
run;

proc means data = comb5;
run;

proc reg data = comb5;
model lnpgwage = HWI interaction exposure indigenous male rural;
run;
```

Diff-in-Diff (male)

```
Data combh;
Set &GT06h (keep=casenum D7 D20);
Run;

Proc Sort Data=combh;
By Casenum;
Run;

Data combp;
Set &GT06p (keep=casenum ppnum page psex pethnat pimmigr pgwage);
Run;

Proc Sort Data=combp;
By casenum;
Run;

Data comb;
Merge combh combp;
By Casenum;
If pimmigr ~= '1' then delete;
If pgwage = '0' then delete;
Run;


Data comb2;
Set comb (keep= casenum ppnum page psex pethnat pimmigr pgwage D7 D20);

if page >=65 then delete;
if page <=14 then delete;
If page <= 40 and page >=30 then exposure = 1;
Else exposure = 0;
Run;

Proc Sort Data=comb2 Out = Comb3;
By Decending page;
Run;

Data comb4;
Set comb3 (keep= casenum ppnum exposure psex
pethnat pimmigr pgwage D7 D20 page);

If D7 = 13 or D7 = 14 or D7 = 15 or D7 = 16 or D7 = 17 then HWI = 1;
Else HWI = 0;

If D20 = 2 then rural = 1;
Else rural = 0;

If pethnat = 30 then delete;
If pethnat ~= 29 then indigenous = 1;
Else indigenous = 0;

If psex = 2 then delete;


interaction = exposure*HWI;


lnpgwage = log(pgwage);

Run;
```

```
Data comb5;
Set comb4 (keep= casenum ppnum  pgwage lnpgwage exposure HWI interaction rural
indigenous page);
run;

proc means data = comb5;
run;

proc reg data = comb5;
model lnpgwage = HWI interaction exposure indigenous rural;
run;
```

```
Diff-in-Diff (female)

Data combh;
Set &GT06h (keep=casenum D7 D20);
Run;

Proc Sort Data=combh;
By Casenum;
Run;

Data combp;
Set &GT06p (keep=casenum ppnum page psex pethnat pimmigr pgwage);
Run;

Proc Sort Data=combp;
By casenum;
Run;

Data comb;
Merge combh combp;
By Casenum;
If pimmigr ~= '1' then delete;
If pgwage = '0' then delete;
Run;


Data comb2;
Set comb (keep= casenum ppnum page psex pethnat pimmigr pgwage D7 D20);

if page >=65 then delete;
if page <=14 then delete;
If page <= 40 and page >=30 then exposure = 1;
Else exposure = 0;
Run;

Proc Sort Data=comb2 Out = Comb3;
By Decending page;
Run;

Data comb4;
Set comb3 (keep= casenum ppnum exposure psex
pethnat pimmigr pgwage D7 D20 page);

If D7 = 13 or D7 = 14 or D7 = 15 or D7 = 16 or D7 = 17 then HWI = 1;
Else HWI = 0;

If D20 = 2 then rural = 1;
Else rural = 0;

If pethnat = 30 then delete;
If pethnat ~= 29 then indigenous = 1;
Else indigenous = 0;

If psex = 1 then delete;


interaction = exposure*HWI;


lnpgwage = log(pgwage);

Run;
```

```
Data comb5;
Set comb4 (keep= casenum ppnum  pgwage lnpgwage exposure HWI interaction rural
indigenous page);
run;

proc means data = comb5;
run;

proc reg data = comb5;
model lnpgwage = HWI interaction exposure indigenous rural;
run;
```

```
Diff-in-Diff-in-Diff (Male)

Data combh;
Set &GT06h (keep=casenum D7 D20);
Run;

Proc Sort Data=combh;
By Casenum;
Run;

Data combp;
Set &GT06p (keep=casenum ppnum page psex pethnat pimmigr pgwage);
Run;

Proc Sort Data=combp;
By casenum;
Run;

Data comb;
Merge combh combp;
By Casenum;
If pimmigr ~= '1' then delete;
If pgwage = '0' then delete;
Run;


Data comb2;
Set comb (keep= casenum ppnum page psex pethnat pimmigr pgwage D7 D20);

if page >=65 then delete;
if page <=14 then delete;
If page <= 40 and page >=30 then exposure = 1;
Else exposure = 0;
Run;

Proc Sort Data=comb2 Out = Comb3;
By Decending page;
Run;

Data comb4;
Set comb3 (keep= casenum ppnum exposure psex
pethnat pimmigr pgwage D7 D20 page);

If D7 = 13 or D7 = 14 or D7 = 15 or D7 = 16 or D7 = 17 then HWI = 1;
Else HWI = 0;

If D20 = 2 then rural = 1;
Else rural = 0;

If pethnat = 30 then delete;
If pethnat ~= 29 then indigenous = 1;
Else indigenous = 0;

If psex = 2 then delete;


interaction = exposure*HWI;

interaction2 = exposure*HWI*rural;
interaction3 = exposure*rural;
interaction4 = HWI*rural;

interaction5 = exposure*HWI*Indigenous;
```

```
interaction6 = exposure*indigenous;
interaction7 = HWI*indigenous;

lnpgwage = log(pgwage);

Run;

Data comb5;
Set comb4 (keep= casenum ppnum  pgwage lnpgwage exposure HWI interaction
interaction2 interaction3 interaction4 interaction5 interaction6 interaction7 rural
indigenous page);
run;

proc means data = comb5;
run;

proc reg data = comb5;
model lnpgwage = HWI interaction interaction2 interaction3 interaction4 interaction5
interaction6 interaction7 exposure indigenous rural;
run;
```

```
Diff-in-Diff-in-Diff (Female)

Data combh;
Set &GT06h (keep=casenum D7 D20);
Run;

Proc Sort Data=combh;
By Casenum;
Run;

Data combp;
Set &GT06p (keep=casenum ppnum page psex pethnat pimmigr pgwage);
Run;

Proc Sort Data=combp;
By casenum;
Run;

Data comb;
Merge combh combp;
By Casenum;
If pimmigr ~= '1' then delete;
If pgwage = '0' then delete;
Run;


Data comb2;
Set comb (keep= casenum ppnum page psex pethnat pimmigr pgwage D7 D20);

if page >=65 then delete;
if page <=14 then delete;
If page <= 40 and page >=30 then exposure = 1;
Else exposure = 0;
Run;

Proc Sort Data=comb2 Out = Comb3;
By Decending page;
Run;

Data comb4;
Set comb3 (keep= casenum ppnum exposure psex
pethnat pimmigr pgwage D7 D20 page);

If D7 = 13 or D7 = 14 or D7 = 15 or D7 = 16 or D7 = 17 then HWI = 1;
Else HWI = 0;

If D20 = 2 then rural = 1;
Else rural = 0;

If pethnat = 30 then delete;
If pethnat ~= 29 then indigenous = 1;
Else indigenous = 0;

If psex = 1 then delete;


interaction = exposure*HWI;

interaction2 = exposure*HWI*rural;
interaction3 = exposure*rural;
interaction4 = HWI*rural;

interaction5 = exposure*HWI*Indigenous;
```

```
interaction6 = exposure*indigenous;
interaction7 = HWI*indigenous;

lnpgwage = log(pgwage);

Run;
```