THREE ESSAYS ON IMMIGRATION POLICY AND LABOR MARKET OUTCOMES IN THE US

by

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This dissertation is dedicated to my father, Dr.B.C.Das; my mother, Banani Mukherjee Das; my brother Ankan Mukherjee Das, and all my friends who have supported me throughout this endeavor.

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ABSTRACT

This dissertation consists of three distinct, publishable 'papers' included as separate chapters.

The first article looks at the Optional Practical Training (OPT) program which provides all foreign students on an F-1 education visa, legal, temporary work permit for 12 months after graduation. In 2008, students in the Science, Technology, Engineering and, Mathematics (STEM) fields became eligible for a 17-months extension of OPT period. This paper examines the impact of this extension on the labor market outcomes of domestic STEM graduates.Using a difference-in-difference framework with individual and time fixed effects, we find no reduction in the annual salary of domestic STEM majors after the policy was implemented. We find a statistically significant negative impact of the policy on the typical hours worked in a week. The results are driven largely by Master's level students and are robust to alternative specifications. Thus, we conclude that the OPT extension does not negatively impact labor market outcomes for domestic STEM graduates. Any differential impact of the STEM OPT extension is limited to a reduction in the typical hours worked during a week by STEM graduates.

The second article develops a politico-economic model of native preferences over illegal immigrants. In a referendum like scenario, native agents who may be high or low-skilled and belong to three generations vote on whether to grant amnesty to illegal immigrants or support no change in their immigration status. Individual choices are aggregated to form the collective policy response, using majority-rule. In doing so, the article shows that economic incentives are driving the political impasse on a policy on illegal immigrants. If there were a vote on illegal immigrants, all generations of high-skilled agents vote against amnesty on account of the increased tax burden which are determined by a Utilitarian government. Low-skilled workers prefer amnesty as

it increases the transfers received by them. The gains from additional transfers more than enough compensate for the loss in wages for the low-skilled. Finally, the article shows that an increase in the consumption tax rate can generate welfare gains for a majority of agents in the amnesty steady state and thus break the policy impasse on illegal immigration.

The third article presents a model of the choice between migrating legally or illegally for a potential migrant. We employ a discrete choice dynamic programming framework to model this initial decision of the migrant and the model is calibrated on US data from the Legalized Population Survey I (LPS I) 1988-89, and the Current Population Survey (CPS) 1990. Holding the up-front cost of either immigration routes constant, the model predicts that the choice is not motivated by the desire to enjoy government transfers in the immigrant-receiving country. The key components in the choice are the fraction of legal wages received by illegal immigrants and the probability of being identified and deported.

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CHAPTER I
DO TEMPORARY WORK PERMITS TO FOREIGN STUDENTS HURT DOMESTIC GRADUATES?

1 Introduction

The United States remains the preeminent destination for foreign students seeking a global education. According to the Institute of International Education, the number of international students in the US went from about 583,000 in 2001, to over a million in 2015 (IIE, Open Doors Database 2015). In addition to world class institutions, what makes the US an attractive destination for foreign students is the ability to legally work in the US for 12-months after graduation, under the Optional Training Program (OPT henceforth). In 2015, close to 115,000 (14.1% of all foreign students) were legally employed under the OPT program (IIE, Open Doors Database 2015).

While the OPT is a temporary work permit, it is often considered the first step towards acquiring an H1-B visa, which allows 3 years (extendable by 3 more) of legal work permit to foreign workers. The goal of the OPT program was to allow a smooth transition for foreign students, from college into the labor force. However, it was felt that 12-months was too short of a time to process all the H1-B visa applications, leading to "Cap-Gaps", or back-logs of pending applications (Federal Register, 73 FR 18944, April 08, 2008). Thus, in 2008, the Department of Homeland Security amended its OPT provisions to allow foreign students in the Science, Technology, Engineering, and Mathematics (STEM) fields[1] to extend their OPT period by 17-months, to make it a total of 29-months OPT period. This, according to Demirci (2016), allowed

[1]For a complete list of all majors designated as STEM by the DHS, refer to https://www.ice.gov/sites/default/files/documents/Document/2014/stem-list.pdf

employers longer pay-offs and greater time to assess the match quality of the foreign worker, thus rendering foreign STEM students close substitutes to native STEM students.

Following the structure of Borjas (2003) and assuming an infinite elasticity of substitution between a foreign-born STEM graduate and a native STEM graduate, this article studies the impact of this OPT extension on the labor market opportunities of native STEM graduates. It is important to mention here that the OPT provisions for non-STEM fields remained unchanged at 12-months. This selective application of the policy allows for an identification strategy that mimics a natural experiment and exploits differences in the labor market outcomes of native STEM graduates and non-STEM graduates, before and after the 2008 policy change. We assume an exogenous number of foreign STEM graduates were granted OPT extensions. In line with Borjas (2003), we nest STEM and non-STEM natives into two distinct skill-groups to test how the influx of foreign labor into a specific skills group impacts labor market opportunity of natives in that skills group. The results from such an analysis could be extrapolated to the larger question of the impact of immigration on natives.

Using a difference-in-difference framework with individual and time fixed effects, we find a no reduction in the annual salary of domestic STEM majors after the policy was implemented. We find a statistically significant negative impact of the policy on the typical hours worked in a week. The results are robust to alternative specifications. Thus, we conclude that the OPT extension does not negatively impact labor market outcomes for domestic STEM graduates. Any differential impact of the STEM OPT extension is limited to a reduction in the typical hours worked during a week by STEM graduates. STEM graduates experienced an increase in the probability of being employed after 2008, however, not significantly. Furthermore, the statistically insignificant decline in annual salary can be attributed to reduced hours of work,

rather than an explicit reduction in income. . The results are in line with Demirci (2016) who studies the same policy employing an instrumental variables approach.

Studying the impact of OPT extension on the labor market outcomes of domestic graduates becomes more exigent given that, in March 2016, the OPT period for STEM graduates was further extended to 36-months. The results from this paper could influence future policy direction regarding granting permanent residency to foreign students graduating from a US university, as has been suggested by industry and research and innovation institutions in the US (Georgetown University Roundtable, 2014).

The remainder of the paper is organized as follows. Section II briefly discusses relevant literature and identification strategies adopted by previous research. Section III presents the data and identification strategy. Section IV presents the benchmark results. Section V presents selected robustness checks. Finally, section VI provides some concluding remarks.

2 Literature and Theoretical Framework

The literature on the impact of immigration on natives is vast. However, measuring the true impact of immigration on labor market outcomes, such as wages of natives, has been elusive to researchers and a matter of public debate for decades. A common practice in the literature has been to look at geographic clustering of immigrants and measuring cross-city variations in native's earnings. Card (1990) looks at the 1980 Mariel Boatlift in Miami and compares native outcomes between Miami and other cities under a difference-in-difference framework. He finds no significant impact of the sudden increase in low-skilled labor supply on wages and employment of natives. Ottaviano & Peri (2008) use the Integrated Public Use Microdata Series (IPUMS)

for 1970 and the CPS to estimate that the share of foreign-born workers in the US increased from 5.3% in 1970 to 14.7% in 2005. Under a general equilibrium approach, they find that immigrants are an imperfect substitute to native workforce. They further find a positive and significant impact of immigration on the average wage of a US –born worker between 1990-2004. The estimates are robust across education, experience and gender groups. Others include Altonji and Card (1991) and Borjas (1987), Lalonde & Topel (1991).

While estimates from most such analyses have found some marginal effects of immigration on labor markets, analyzing cross-city variations in native outcomes resulting from immigration has its own pitfalls, particularly in the context of this article. First, certain areas of the country, such as: the New York Metropolitan Area, Boston, Chicago, Houston, Dallas and San Francisco Bay area, receive a disproportionate level of foreign STEM students (Ruiz, 2014). Clearly, an analysis comparing native STEM outcomes in these 'well-off' areas of the country with others would yield spurious estimates for the impact of immigration, since native outcomes would arguably be better in these cities even without immigration. Second, as argued by Borjas, Freeman and Katz (1992), Borjas (2003,04), and Dustmann et al. (2005), in the presence of free factor mobility, natives would move their capital and labor out of a city facing an immigrant influx. This follows that if the influx of foreign STEM graduates does drive down native opportunities in STEM fields in a locale, it would be expected that native STEM workers might move elsewhere. This will in turn disperse the impact of immigration and undermine the ability to identify the impact from looking at effects within localities. Thus, a national level study would be more appropriate to capture the impact of immigration on natives.

Borjas (2003) offers an alternative identification strategy that rests upon differences within skill groups arising from an immigrant worker inflow into a specific skill

group. The argument follows that immigrants with a set of skills will increase the work-force in a specific skill group, while having no impact on other skill groups. Thus, measuring differences between skill groups should give us the impact of immigration. Bound et al. (2015) model the education and employment of natives in a market similarly defined by field of study and find some negative effects on native outcomes. Arguably, STEM and non-STEM graduates possess distinct skills that differentiate them in the labor market. Such a distinction facilitates the nesting of STEM and non-STEM natives into two separate skill groups that experience different levels of immigration because of the said policy.

To the best of our knowledge, Demirci (2016) is the only paper that looks at the impact of the 2008 policy change on domestic students using the number of OPT extension eligible individuals in a field as an instrument for the share of foreign students in the field of major. He finds that while the impact at the bachelor's and doctorate level were not statistically significant, a 1-point increase in the share of foreign students in a field resulted in a statistically significant decrease of 0.3 percentage points in the likelihood of current employment and a 0.7 percentage point decrease in full-year full-time employment for natives with a master's degree.

It is important to note here that the skills of immigrants may not be perfectly transferable. Immigrants may not be familiar with the job market and work practices, may lack resources, or simply face language barriers. However, given that this article focuses primarily on high-skilled immigrants, who have received a certain level of education in the US (a prerequisite for OPT), the condition of non-perfect transferability of skills can be relaxed.

3 Data and Identification Strategy

The identification strategy rests upon within-skill variations- STEM and non-STEM- in native outcomes, before and after the policy was enacted. The exogenous shock to STEM labor supply is akin to a natural experiment. We employ a difference-in-difference strategy under a fixed-effects framework to estimate the impact of the extended OPT period on domestic STEM graduates. The treatment group includes all majors designated as STEM by the DHS, while the control group is all non-STEM majors. We observe the labor market outcomes for both groups, before and after the 2008 policy implementation, which allows for the identification of the impact of the policy on STEM graduates.

We use data on labor force outcomes from the National Survey of College Graduates (NSCG), a biennial survey conducted by the National Science Foundation (NSF) under the US Census Bureau. The survey collects data on recent college graduates in different fields of study, primarily focusing on science and engineering majors. In addition to the field and level of degree received, it also includes data on labor market outcomes including annual salary and weeks worked in a year. The series is compounded with the National Survey of Recent College Graduates (NSRCG) which was discontinued and combined with the NSCG after 2010 and the American Community Survey 2010. With multiple rounds of the survey between 1993 and 2013, the raw dataset has 551,359 observations. For the purposes of this paper, I limit my analysis to the NSCG between 2003 and 2013 and graduates born in the US, which limits the sample to 135,000 individuals over 5 survey rounds.

In view of Ruiz (2014) who points out that impact of this policy change would disproportionately affect recent graduates, with little to no experience, I drop individuals who graduated before 1990. This allows me to limit the age of the respondent in 2008 (year of policy change) to 40. This is in line with Demirci (2016) who uses 24

as the modal age for graduating with a bachelor's degree, 28 for master's, and 31 for doctorates. This further follows from Welch (1979) that workers in adjacent experience/education cells have a greater influence on each other's labor market outcomes, as compared to those in farther cells. Since OPT holders are recent college graduates, it follows that native recent graduates would be most affected by the policy.

Table 1 shows the summary statistics by skill-group for the entire sample. There are 35,428 STEM and 21,728 Non-STEM graduates in this sample. Non-STEM professions also have a higher concentration of women. Both groups are of almost similar age. The mean salary of STEM professions is slightly higher and they work fewer hours as compared to non-STEM professions. Non-STEM majors also have about a percentage point higher average unemployment rate. While over 60.83% of males are STEM graduates, only 46.11% of females are STEM graduates. The average age of both skill-groups is approximately identical. Furthermore, 61.73% of bachelor's degree were STEM, while 48.2% and 45.73% of master's and doctorate graduates were STEM, respectively. Ruiz (2014) points out that Hispanics and blacks have historically been underrepresented in STEM fields. With this in view, I categorize all races, except Whites and Asians, into a single nest, "Others". In addition, I include demographic characteristics like age and its square and gender into the analysis. I further create an experience variable measured as the difference between the year of survey and year of highest degree. Since I don't observe the respondents prior to the surveys, I assume that the respondents were employed in all periods between degree completion and survey year.

Davis-Kean (2005) looks at the influence of parent's education and family income on the child's achievements. Using a national cross-sectional study of children, she finds that socioeconomic factors which drive beliefs and practices were indirectly related to children's academic achievement. Moreover, parent's years of schooling was

found to be a significant factor in educational outcomes for children. The NSCG does not provide any background information about the respondent such as family background, family income, and parents education levels. To accurately control for possible unobserved differences between individuals self-selecting into a field of study, I include individual fixed-effects into the model. Furthermore, unobserved differences in macroeconomic conditions between years may also impact labor market outcomes. The global economy experienced a major recession during the period of analysis which would adversely impact labor market outcomes of individuals. Thus, it becomes imperative to include some measure of the prevailing macroeconomic conditions. I include the annualized growth rate of real GDP and the annualized aggregate unemployment rate for each year in the survey into the analysis. The inclusion of year fixed-effects into the model accounts for the unobserved differences between years. I cluster standard errors at the field of degree level to control for the fact that labor market outcomes may be correlated within a field-groups, but not across.

This leads us to the following benchmark regression:

$$Y_{it} = \alpha_i + \beta_1(STEM)(Post)_t + \beta_2(STEM) + \beta_3(Post) + \delta(X)_{it} + \zeta(Z)_t + \varphi_t + \omega_i + \varepsilon_{it} \tag{1}$$

where Y_{it} is the outcome of interest for individual i at time t. The variable STEM is a dummy capturing differences between the treatment and control groups, prior to the policy change. Post is a time dummy capturing factors that would impact the outcome variable even in the absence of the policy change. STEM*Post is a dummy indicating observations in the treatment group after the policy change. Thus, β_1 is our parameter of interest capturing the impact of the policy change on STEM graduates. Here, X_{it} is a matrix of demographic characteristics including race, gender, age, age squared, experience and the highest degree earned. We include dummies for gender and race.

Further, Z_t is a matrix of two measures of the prevailing macroeconomic conditions for each year included in the survey; annual GDP growth rate and annual aggregate unemployment rate. Finally,φ and ω are time and individual fixed-effects respectively and ε is the independently and identically distributed error term. Standard errors are clustered at the field of degree level.

While annual salary and typical hours worked in a week are continuous variables, labor force status takes the form of a binary outcome variable. To accurately model labor force status, I employ a fixed-effect logit model, with lf, the latent variable, defined as:

$$lf = \left\{ \begin{array}{ll} 1 & Employed \\ 0 & Unemployed \end{array} \right\} \tag{2}$$

This specification allows us to derive a closed form probability that person i is employed at time t, which is the likelihood contribution of person i at time t. This specification further implies that there is no direct interpretation of the estimates, but rather, we are interested in the marginal effect, which gives us the impact of the policy change on the probability of being employed for a domestic STEM graduate.

We can derive the probability of a native STEM graduate being employed at time t as:

$$Pr(Y_{it} = 1|LF = 1) = \frac{exp(\alpha_i + \beta_1(STEM)(Post)_t + \beta_2(STEM) + \beta_3(Post) + \gamma(Macro) + \delta(X)_{it})}{1 + exp(\alpha_i + \beta_1(STEM)(Post)_t + \beta_2(STEM) + \beta_3(Post) + \gamma(Macro) + \delta(X)_{it})} \tag{3}$$

where all specifications remain as in *equation* 1.

4 Results from Benchmark Regression

Table 2 shows the benchmark regression results for the model for the three dependent variables. We run four model specifications. The results from the preferred model with both individual and year fixed-effects and standard errors clustered at the field of study level are presented.

The first column has log annual salary as the dependent variable. Annual salary is calculated using the CPI-U multiplier available from the Bureau of Labor Statistics which converts the nominal dollar figures from each survey year to constant 2009 dollars, making the variable suitable for multivariate analysis. The difference-in-difference estimate indicates a statistically insignificant 0.028 percentage point reduction in the annual salary for a domestic STEM graduate as a result of the extended OPT period. Asians earn 0.107 percentage point more as compared to under-represented minorities in STEM fields and the estimate is statistically significant at the 0.05 significance level. Whites earn a statistically significant 0.083 percentage points less as compared to under-represented minorities. Under alternative specifications, described in the following section, it appears that master's and doctorate students are the ones driving the decline in post-policy implementation salary for STEM majors. The results are in line with Demirci (2016) who finds a decrease in the earnings at all degree levels after the policy was implemented, with the estimates for master's degree being significant. Experience has a positive and statistically significant 0.004 percentage point impact on salary.

Column three of table 2 gives the results for the model with typical hours per week worked as the dependent variable. The model suggests a 0.58 percentage points decrease in the typical hours per week worked for STEM graduates after the implementation of the policy. The estimate is statistically significant at the 5 percent significance level.

Column two of table 2 shows the results with labor force status of the respondent as the dependent variable, which takes the form of a binary outcome variable. I thus employ a logit fixed effects model. The estimate indicates a marginal increase of 0.138 percentage points in the probability of being employed for domestic STEM graduates after the implementation of the policy. The impact is, however, not statistically significant. Whites experience an increase the probability of being employed by 0.677 percentage points respectively, compared to under-represented minorities. Being female statistically and significantly decreases the likelihood of being employed by 0.208 percentage points, compared to males.

Overall, the results indicate a negative impact of the policy on the labor market outcomes for natives. While there is no statistically significant impact on annual salary and in the probability of being employed, as reported in their labor force status, domestic STEM graduates experience a statistically significant reduction in their typical hours worked during the week. In particular, a one-point increase in the number of foreign STEM graduates offered OPT extension causes a 0.58 percentage point reduction in the typical hours worked during a week for domestic STEM graduates. The statistically insignificant reduction in the annual salary of domestic STEM graduates could, thus, be seen as a result of reduced hours of work, rather than an explicit reduction in earnings.

4.1 Benchmark Results by Highest Degree Earned

While the results above indicate an overall marginal negative effect of the policy, it could perhaps be more informative to study the impact on natives with different levels of degree. The Student Exchange and Visitor Program (SEVP, 2014) and Ruiz (2014) point out that a significant majority of OPT applicants were master's students,

who received degrees in high-demand STEM fields such as Information Technology. Thus, differentiating natives by the level of degree allows us to study the how different education groups within a skill group were impacted and further isolate the impact of the policy.

Table 3 gives results from the benchmark regression by degree level. The dependent variable in Columnl A is the log of annual salary, Column B has labor force status as the dependent variable and Column C has typical hours worked/week as the dependent variable. Only the estimates for the typical hours worked/week at the master's and doctorate students were significant. This is line with Demirci (2016) who also finds that Master's students were driving the adverse impact on native opportunities. All doctorate students were employed and thus there was no variation in their labor force status.

5 Robustness

The results indicate that most of the decline in annual salary can be attributed to the reduced hours of work at every level of degree. Furthermore, doctoral students experience the largest decline in the hours worked during a week, followed by master's degree holders. This is indicative of the fact that employers are searching for high-skilled professionals with higher degrees in STEM fields which are being satisfied by the increasing number of foreign students acquiring higher degrees and being granted the OPT extension.

As a further robustness check, we limit the sample to observations where the occupation of the respondent is not closely related to the field of study. The United States Customs and Immigration Services (USCIS), which processes all applications for OPT and H1-B, requires that the nature of employment must be closely related

to the field of study, wherein the skill sets developed during the course of study are directly applicable in the workplace. Thus, limiting the sample to respondents whose work is not closely related to the field of study serves as a counterfactual, since foreign students would not be eligible for OPT in this case and thus there is no exogenous shock to the labor supply. For this analysis, I further limit the sample to respondents who reported their labor force status as employed since the assumption here is that the respondent is employed in an occupation unrelated to their field of degree. This limits the dataset to 8,092 observations.

The first column in Table 4 has the log of annual salary as the dependent variable. The difference-in-difference estimate indicates a 0.025 percentage point increase in the annual salary of domestic STEM graduates after the policy was implemented. The estimate is not statistically significant. Whites and Asians in this sample earn 0.009 and 0.103 percentage points more respectively, as compared to under-represented minorities with only the estimates for Asians being significant. Females earn 0.256 percentage points less than males.

The second column has the number of hours typically worked in a week as the dependent variable. The difference-in-difference estimate indicates a 0.008 percentage point increase in the hours typically worked in a week for this sample of respondents. The estimate is however not statistically significant. Females experience a decrease of 0.409 percentage points in the typical hours worked during a week as compared to males.

Clearly, the estimates in this sub-sample are in the opposite direction, indicating an increase in typical hours worked during the week. Although, the estimates are not statistically significant, the estimates indicate no negative impact of the extended OPT period on graduates employed in a field unrelated to their field of highest degree.

Finally, the identification strategy relies on a singular event in time, it may be

useful to examine shorter periods around the event. This allows us to capture incremental effects of the policy and is akin to changing the bandwidth in a regression discontinuity design. We thus limit the time-period to 2006-2010. Doing so limits the number of number of observations to 44,571.

Table 5 gives the results for this analysis. The first column has log of annual salary as the dependent variable. The difference-in-difference estimate indicates a 0.022 percentage point reduction in the annual salary of domestic STEM graduates, as a result of the extended OPT period. The estimate is, however, not statistically significant. Asians earn 0.102 percentage points more, as compared to under-represented minorities, while Whites earn 0.097 percentage points less as compared to under-represented minorities with both the estimates being statistically significant. Females earn 0.255 percentage points less than males.

The second column has the labor force status of the respondent as the dependent variable. Here again, the model of choice is the logit model described earlier. We see a 0.011 percentage point increase in the probability of being employed, following the implementation of the policy for a domestic STEM graduate. The estimate is however, not statistically significant. Being Whites increases the probability of being employed by 0.739 percentage points while being Asians increases the probability of being employed by 0.146 percentage points, with only estimates for Whites being statistically significant. Being females reduces the probability of being employed by 0.194 percentage points

The third column has the typical hours worked per week as the dependent variable. Domestic STEM graduates experience a decrease of 0.461 percentage points in the typical hours worked in a week. The estimate is, however, not statistically significant. Whites experience a decrease of 2.12 percentage points as compared to under-represented minorities.

While the estimates from the above robustness are in the direction of the estimates from the benchmark model, they are not statistically significant. This could be indicative of the fact that there was perhaps no immediate and significant impact of the OPT extension on labor market outcomes of domestic STEM graduates. This impact became more prominent as the number of foreign students applying for extension went up in the years following 2008 and firms became more informed of the processes involved.

6 Conclusion

In this paper, we analyze the impact of extending the Optional Practical Training (OPT) period for foreign STEM graduates on the labor market outcomes of domestic STEM graduates. An extension in the OPT period allows firms longer period to analyze the match quality of the foreign student. Therefore, assuming foreign students to be perfect substitutes to domestic students, we expect a negative impact of the extended OPT period on the labor market outcomes for domestic STEM students.

Under a difference-in-difference framework with individual and time fixed-effects, we find a reduction in the annual salary of domestic STEM majors after the policy was implemented, however, the estimate is not statistically significant. We find a statistically significant negative impact of the policy on the typical hours worked in a week. The results are robust to alternative specifications. Thus, we conclude that the OPT extension does not incentivize firm to hire foreign workers and does not negatively impact labor market outcomes for domestic STEM graduates. Any differential impact of the STEM OPT extension is limited to a reduction in the typical hours worked during a week by STEM graduates. STEM graduates experienced an increase in the probability of being employed after 2008, however, not significantly.

Furthermore, the statistically insignificant decline in annual salary can be attributed to reduced hours of work, rather than an explicit reduction in income.

This finding could be used to inform policy decisions regarding high-skilled immigration and could assuage some concerns described earlier from the industry and employers who have advocated for granting permanent residency to high-skilled immigrants in certain fields, due to the lack of interest from domestic students. Furthermore, it could alleviate concerns among some quarters about the negative impact of immigration on opportunities for natives.[4] Davis-Kean, Pamela E. 2005. "The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment." Journal of Family Psychology. Volume 19, No. 2, Page 294-304.

A key limitation of this analysis is the absence of data on location of employment. The NSCG categorizes the location of employment simply by within US or outside US. As alluded to earlier, Ruiz (2014) highlights that certain areas of the country receive a disproportionate amount of foreign STEM workers. Areas such as the New York Metropolitan Area, Boston, Chicago, Houston, Dallas and San Francisco Bay area are the largest recipients of foreign STEM students. With data on the specific location of employment, it would be possible to incorporate a third source of variation into the model, allowing for a triple difference, based on the location of employment.

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Appendix A: Chapter I Tables

Table 1.1: Descriptive Statistics

	STEM	**Non-STEM**
Observations	35,428	21,786
Females	39.24	53.95
Mean Age	32.15	32.52
Mean Salary (log)	11.09	11.01
Employed	97.64	96.77
Mean Hours Worked/Week	5.57	6.31
Asian	5.45	5.17
White	72.72	67.54
Bachelor's	68.19	47.33
Master's	23.91	41.79
Doctorate	1.17	1.66
Professional	6.73	9.22

Table 1.2: Impact of STEM OPT-extension on labor market opportunities for domestic STEM graduates

Variable	Log Annual Salary	Labor Force Status	Typical Hours/Week
DiD	-0.028 (0.018)	0.138 (0.109)	-0.585* (.265)
Age	0.074* (0.016)	0.274* (0.092)	-0.653* (0.246)
Age Squared	-0.0008* (0.0002)	-0.004* (0.001)	0.010* (0.003)
Experience	0.004* (0.001)	0.051* (0.009)	-0.123* (0.025)
Asian	0.107* (0.021)	0.073 (0.102)	-0.313 (0.309)
White	-0.083* (0.010)	0.677* (0.056)	-1.919* (0.154)
Male	0.259* (0.009)	0.208* (0.053)	-0.106 (0.131)

*** 5% significance level; standard errors are in parenthesis.**

Table 1.3: Impact of STEM OPT-extension on labor market opportunities for domestic STEM graduates by highest degree earned

	Log Annual Salary	Labor Force Status	Typical Hours/Week
Bachelor's	-0.005 (0.025)	0.067 (0.139)	-0.452 (0.375)
Master's	-0.019 (0.030)	0.313 (0.212)	-0.865* (0.441)
Doctorate	-0.284 (0.148)	-	-4.705* (2.335)

*** 5% significance level; standard errors are in parenthesis.**

Table 1.4: Impact of STEM OPT-extension on labor market opportunities for domestic STEM graduates in jobs closely related to field of highest degree

Variable	Log Annual Salary	Typical Hours/Week
DiD	-0.016 (0.013)	0.008 (0.018)
Age	0.117* (0.011)	-0.004 (0.016)
Age Squared	-0.001* (0.0001)	0.00009 (0.0002)
Experience	0.012* (0.001)	-0.012* (0.001)
Asian	0.103* (0.015)	-0.012 (0.021)
White	0.009 (0.007)	0.002 (0.010)
Male	0.256* (0.006)	0.409* (0.008)

*** 5% significance level; standard errors are in parenthesis.**

Table 1.5: Impact of STEM OPT-extension on labor market opportunities for domestic STEM graduates for the period 2006-2010

Variable	Log Annual Salary	Labor Force Status	Typical Hours/Week
DiD	-0.022 (0.022)	0.011 (0.155)	-0.461 (0.332)
Age	0.055* (0.019)	0.353* (0.103)	-0.988* (0.281)
Age Squared	-0.0005 (0.0002)	-0.005* (0.001)	0.015* (0.004)
Experience	0.002 (0.001)	0.057* (0.010)	-0.147* (0.028)
Asian	0.102* (0.023)	0.146 (0.113)	-0.582 (0.338)
White	-0.097* (0.011)	0.739* (0.062)	-2.120* (0.172)
Male	0.255* (0.010)	0.194* (0.060)	-0.075 (0.149)

*** 5% significance level; standard errors are in parenthesis.**

CHAPTER II
ON THE POLITICAL ECONOMY OF IMMIGRATION AMNESTY

1 Introduction

The United States has in the past, granted a one-time, large-scale amnesty to illegal immigrants. The Immigration Reform and Control Act (IRCA) 1986 effectively legalized about 3 million illegal immigrants. Three decades later, there are an estimated 11 million illegal immigrants residing in the country, as of 2015 (Pew Research Centre, 2015[1]). The estimated number of illegal immigrants as a fraction of the US labor force has also increased during this period, reaching about 8 per cent in 2014, according to the Pew Research Centre (2015). The persistence in this trend has led many to question the effectiveness of regularization programs (see OECD 2000) to control illegal immigration. Yet, many developed countries like the UK and France, which are facing a similar influx of undocumented immigrants, have permanent programs for amnesty. For example, the UK allows undocumented immigrants to apply for residency after 14 years of continuous stay (Levinsohn, 2005). So why has the US been unable to formulate a cogent policy on illegal immigrants since 1986? This paper seeks to explain the underlying dynamics of the voting population that contribute to this policy impasse.

This article develops a politico-economic model of native preferences over illegal immigrants so that the primitives generating this policy impasse can be understood. In a one-time *referendum,* natives make the choice between granting amnesty to undocumented immigrants, or remaining in status-quo, i.e. no change in the immigration status of the undocumented agent. Under a dynamic, 3-period overlapping

[1]Based on augmented American Community Survey data (IPUMS).

generations (OLG), computable general equilibrium framework, the conditions under which a majority of the native population, will vote in favor of an amnesty are shown. The native agent makes this decision based on purely economic incentives, i.e. the impact of either choices on their discounted lifetime utility. The key economic incentives here are the short-term and long-term fiscal implications of an immigration amnesty. The winning policy is established via majority-rule voting i.e. a majority of native agents of all generations, vote in favor of either policy. The resulting tax-rate is determined by a Utilitarian government, which seeks to maximize the sum of the discounted lifetime-utilities of all native agents. The government is assumed to influence the decision of the native agent only through such monetary transfers.

The role of illegal immigrants currently residing in a country, is distinct from that of new legal immigrants. Unlike legal immigrants, illegal immigrants work in the "shadow" economy, where they face discrimination due to their status[2], and by definition, are not subject to any income taxation. While they may pay some taxes in the form of consumption tax or VAT at the point-of-sale, they represent a cost to the exchequer[3], albeit limited. Thus, the impact of a policy choice regarding new legal immigrants is also distinct from that of illegal immigrants, currently residing in the country.

In the case of an amnesty, the contention of the model is that the native *high-skilled* might bear the higher tax-rate to support the newly-legalized, and largely *low-skilled* immigrants. At the same time, it is possible that the native *low-skilled* could benefit from the increase in government subsidies and transfers, on account of the higher

[2]Illegal immigrants experience a restricted access to the labor market, and are subject to exploitation. That they can be paid below the market clearing wage rate is an incentive for firms to hire illegal workers, in the absence of sanctions from the government.

[3]The US Government Accountability Office (GAO) found that in FY 1995, $1.1 billion from the Aid to Families with Dependent Children (AFDC) went to families with an illegal immigrant as the head of the houehold (HEHS-98-30, Nov 1997). More recently, the Survey of Income and Program Participation (2012) found that 62% of illegal immigrant household were receiving some form of welfare.

tax collection. On the other hand, it is also possible that the high-skilled may favor legalization at the same time the low-skilled favor it. Presumably, more low-skilled workers should increase the marginal product of capital, thus increasing the income of the relatively capital-rich high-skilled workers. It would also be expected that the low-skilled wage rate would fall from the influx of more legal low-skilled workers.

Studying an OLG economy where illegal immigrant are naturalized, allows the quantification of the impact of immigration on different sections of society including - skilled workers, unskilled workers, young, middle-aged and old workers, thus adding to our understand of the impact of immigration on the native population. Additionally, it gives us some insight into the reasons for the policy impasse- the idea being that if current citizens rationally expect a higher tax rate in the future, because of the newly legalized and relatively poorer immigrants, then they may rationally vote against granting amnesty. For these computational exercises, this research relies on the calibrations of previous, well-established papers. Examples in the literature include Borjas (2003), Machado (2013), and Ottaviano and Peri (2012).

It is important to note here the importance of the dynamic nature of the problem faced by the agents, which makes this research a non-trivial exercise. Today's decisions have important implications for future periods, and all such decisions would involve inter-temporal resource reallocations. To account for these dynamics, this research follows Dolmas and Huffman (2004) who point out the importance of changing factor prices because of immigration and the resulting reallocation of resources over time. The agents in this economy will rationally forecast the future implications from a change in status of illegal immigrants today. This would include evaluating their future tax burden and the future benefits of legalization. In a sense, agents in this model dynamically program.

This article makes an important addition to the literature. This is the first paper

that explicitly envisions a referendum like scenario on the question of illegal immigration. It explicitely shows that economic incentives are driving the political impasse on illegal immigration. The article establishes a hung verdict by the electorate, where half the voting population votes in favor of amnesty, while the other half votes against and provides the conditions under which natives would prefer granting amnesty to (or deporting) illegal immigrants.

The remainder of the paper is setup as follows. Section 2 briefly mentions some related literature. Section 3 describes the economic environment and the problem of the economic agents, firms and the government. The fourth section, describes the political equilibrium achieved under majority-rule. Section 5 describes the transition economy. Section 6 provides some quantitative results and finally section 7 has some concluding remarks.

2 Literature Review

There is some body of work that has developed similar models to study questions regarding immigration. Dolmas and Huffman (2004) study a similar question regarding the level of new legal immigration and future taxes and redistributive policy, in which immigrants, if admitted, arrive in the second period. This paper differs from theirs in that it considers an economy which is already home to an illegal migrant population, at the beginning of period 1, who may actively partake in the labor market. There are also important distinctions in the underlying structure of the economy and the labor market, which are necessitated by the presence of illegal immigrants and a degree of substitutability they enjoy with low-skilled natives. Additionally, the

difference in the role played by legal and illegal immigrants in an economy, warrants a study of the consequences of legalizing illegal immigrants. Machado (2013) studies the impact of an immigration amnesty in a 2-period OLG setup. While he also looks at the cases of deportation and new legal immigration, the paper is crucially missing a political mechanism, which ultimately decides the immigration policy. Benhabib (1996) develops a simple model where natives decide on immigration policies that restrict the type of immigrants by capital (physical and human). He shows that as long as the median capital is sufficiently close to the average capital, natives would approve of an immigration policy if immigrants bring some amount of capital.

In addition to economic incentives, several non-economic factors also play a role in natives' preferences over immigration. Benhabib (1996) enumerates the non-economic incentives, that play an important role in the decision of natives over immigration. The focus of this article is exclusively on the economic incentives that drive natives' preference over immigration. Such an analysis allows for alternative policies to be studied to break the impasse and possibly be welfare improving for all agents. Borjas (2003) looks at the impact of immigration on native populations by nesting the native populations into specific skill groups and then measuring the impact of immigration into each specific skills-group. Although, his paper does not consider the question of illegal immigrants in the economy, the paper gives us important insights into questions over the degree of substitutability between natives and immigrants, of different skills-type.

3 The Economic Environment

The economic environment can be described as a closed economy, with an exogenous illegal migrant population, I_t at time t. At each time period t, there are a continuum of native agents who live for 3 periods. There is no population growth. Natives and illegal immigrants are assumed to have homogenous preferences over a single consumption good, c_t. The price of consumption good c is normalized to unity. Lifetime utility is given by time-separable, logarithmic function

$$log(c_{j,1}) + \beta log(c_{j,2}) + \beta^2 log(c_{j,3}), \tag{1}$$

where $j = H, N, I$ are the total high-skilled natives, low-skilled natives and, illegal immigrants in the economy, respectively. Illegal immigrants may be employed in certain industries[4], pay some taxes and, afford some subsidies from the state. They however, only receive a fraction of the legal wages and government transfers and, are not subject to income taxation. The discrimination faced by illegal immigrants in the labor market, is of particular relevance. Machado (2013) finds that the net fiscal effect of an immigration amnesty, depends strongly on the discrimination illegal workers face ex-ante. The literature cites various reasons for such discrimination including, the lower productivity of illegal workers, status-based discrimination and, employer's risk of legal sanctions passed on to the worker.[5] The policy choice for natives in period 1 is to decide whether to grant amnesty to or deport the illegal immigrants residing in the country. Once a policy choice is made, natives (and newly legalized immigrants if granted amnesty), are subject to a new level of taxation, given by θ' and the resulting transfers, g', which are determined by a utilitarian government,

[4]Industries with some of the highest concentration of illegal workforce include: farming, maintenance, construction, food preparation and transportation. (Pew Research Centre, 2012)

[5]see Chiswick (1988), Chau (2001), Rivera-Batiz (1999).

maximizing the weighted sum of the individual utilities of all agents.

The labor market consists of high-skilled natives, low-skilled natives and, illegal immigrant workers. While clearly imperfectly substitutable with high-skilled natives, there may be some degree of substitutability that illegal immigrants enjoy with low-skilled natives. That illegal immigrants are low-skilled, is not an implausible assumption. Martin (1996) describes the typical migrant as a young, low-skilled individual usually from rural areas. However, natives maintain an advantage over immigrants through their language skills, generally higher education and familiarity with labor market institutions (Orrenius and Zavodny, 2004). The literature on the elasticity of substitution between natives and immigrants is largely inconclusive, with varying estimates depending on the underlying assumptions about the labor market and the initial capital-labor ratio in the economy. This article assumes low-skilled natives and illegal immigrants to be close substitutes.

It would be worthwhile to mention here that since they are already in the country, illegal immigrants may also own some capital. Although a strong assumption, illegal immigrants are assumed to face a competitive capital market and can save at the same rate as natives[6]. Thus, the total capital stock in the economy at time period t is given by the relationship

$$K_t = 2/3Hk_t^H + 2/3Nk_t^N + 2/3Ik_t^I, \tag{2}$$

where k_t^J is the sum of the savings of the young and middle-aged agents of type j, from time $t-1$. Note that at any time period t, there are 2 agents of each type who work and save, while the 1 agent is retired and lives off of their savings and transfers. As can be seen from this relationship, *ceteris paribus* while under an amnesty there is

[6]This is a necessary simplifying assumption, as it would otherwise require the inclusion of other channels through which the illegal immigrant's savings enter the economy.

no change in the total capital stock in the economy, a deportation reduces the total capital stock by IK_t^I. At the same, considering that most illegal immigrants are poor, an amnesty may not induce any significant foreign capital flowing into the country. In that sense, the model does not envision new foreign capital flowing into the country as a result of any policy choice and thus, studying the consequences of international capital flows would be redundant, in the context of this analysis.

The tax collected by the government is assumed to be remitted back to agents in the form of lump-sum transfers. For ease of computation, transfers are assumed to be uniform across native agents, while illegal immigrant receives a fraction of native transfers.

3.1 Problem of the Native Agent

Natives supply labor inelastically and receive their marginal product as wages, in addition to the lump-sum government transfers, which they use for current consumption and savings for the next period. Period 1 budget constraint is thus given by

$$(1+\upsilon)c_{j,1} + s_{j,2} = (1-\theta)w_{j,1} + g,$$

where $j = H, M$. ν is the consumption tax, θ is the income tax rate and g are lump-sum government transfers. Agents in period 1 vote over the fate of illegal immigrants at the beginning of period 1, before their consumption decision. In period 2, agents again supply labor inelastically and receive their marginal product as wages. They also receive returns on their savings from period 1 and some public transfers, which they use for consumption in period 2 and savings for period 3. In period 3, agents retire and receive their savings returns and public transfers, which they consume entirely and leave no bequest. The periods 2 and 3 budget constraints for a native agent are given

$$(1+\upsilon)c_{j,2} + s_{j,3} = (1-\theta)(R_2 s_{j,2} + w_{j,2}) + g$$

and

$$(1+\upsilon)c_{j,3} = (1-\theta)R_3 s_{j,3} + g,$$

where R is the type-independent, return on savings. For simplicity, these returns are assumed to be taxed at the same rate as the income tax rate. In period 2, native agents and newly legalized immigrants (if amnesty were the majority choice in period 1) are subject a new level of taxation decided by the utilitarian government. Maximizing the natives problem subject to their lifetime budget constraint, yields the following decision rules for native agents

$$c^*_{j,1} = \frac{\psi}{(1+\nu)(1+\beta+\beta^2)} \tag{3}$$

$$c^*_{j,2} = \beta R_2(1-\theta)\frac{\psi}{(1+\nu)(1+\beta+\beta^2)} \tag{4}$$

$$c^*_{j,3} = \beta^2 R^2(1-\theta)^2\frac{\psi}{(1+\nu)(1+\beta+\beta^2)} \tag{5}$$

$$s^*_{j,2} = (1-\theta)w_{j,1} + g - \frac{\psi}{(1+\beta+\beta^2)} \tag{6}$$

$$s^*_{j,3} = \frac{(1+\nu)c^*_{j,3} - g}{(1-\theta)R}, \tag{7}$$

where $\psi = (1-\theta)[w_{j,1} + \frac{w_{j,2}}{R(1-\theta)}] + [g + \frac{g}{R(1-\theta)} + \frac{g}{R^2(1-\theta)^2}]$ is the lifetime earnings of a legal J type agent. Thus, the lifetime indirect utility function of an agent of type J can be derived as

$$V_{j,t} = log(\frac{\psi}{(1+\nu)(1+\beta+\beta^2)}) + \beta log(\frac{\beta R(1-\theta)\psi}{(1+\nu)(1+\beta+\beta^2)}) + \beta^2 log(\frac{\beta^2 R^2(1-\theta)^2\psi}{(1+\nu)(1+\beta+\beta^2)}). \tag{8}$$

3.2 Problem of the Illegal Immigrant

An exogenous illegal migrant population resides in the country at the beginning of period 1. Illegal immigrants are assumed to have similar preferences over consumption as natives (eq. 1). At the beginning of period 1, illegal immigrants supply labor inelastically and receive a fraction of the legal low-skilled wages, which they use for consumption and savings for period 2. Although not subject to income tax, illegal migrants may afford some subsidies from the state. Here again, they only receive a fraction of the transfers received by natives. Albeit illegal, they do pay the constant consumption tax on consumption. The period 1 budget constraint for an illegal immigrant is given by

$$(1+\upsilon)c_{I,1} + s_{I,2} = \gamma w_{N,1} + \xi g,$$

where $\gamma \in [0,1]$ is a fraction of the legal low-skilled wages and $\xi \in [0,1]$ is the fraction of government transfers received by illegal immigrants.γ and ξ represent the degree of discrimination faced by illegal immigrants in the labor market. The policy choice resulting from the vote in period 1 is known at the beginning of period 2. Under a deportation, the migrant do not remain in the country anymore. Under an amnesty, the newly legalized migrant would now receive their full marginal products as wages and be subject to income taxation. Thus their budget constraints are identical to those of the native. However, under a policy-choice of remaining in status-quo (for reasons such as the cost associated with documenting all illegal immigrants), migrants would continue to receive a fraction of their marginal product.

Under a status-quo-ist policy choice, the illegal migrants budget constraints for periods 2 and 3 are given by

$$(1+\upsilon)c_{I,2} + s_{I,3} = R_2 s_{I,2} + \gamma w_{N,2} + \xi g$$

and

$$(1+\upsilon)c_{I,3} = R_3 s_{I,3} + \xi g.$$

3.3 The Labor Market

The labor market is expressed in efficient labor units, consisting of high-skilled natives, low-skilled natives and illegal immigrants. While the market faced by natives is perfectly competitive, the market for illegal immigrants is not, since they earn less than their marginal product. Legal immigrants, who may be high or low skilled, are assumed to be assimilated and part of the native population[7]. Illegal immigrants are assumed to be close substitutes to low-skilled natives. The total workforce in the economy is expresses as a nested CES function, which was introduced in Borjas (2003) and has been used extensively in the literature. The CES structure of the labor market allows the direct interaction of each labor type with capital in the production process and allows clear identification of the wage impact of an amnesty or deportation on natives. The structure additionally allows to study how the elasticity of substitution between natives and immigrants, can influence natives' preferences over illegal immigrants.

The total units of low-skilled labor force is expressed as

$$L_t = [(\tau_L)(N_t)^{\frac{\sigma_L\text{-}1}{\sigma_L}} + (1-\tau_L)(I)_t^{\frac{\sigma_L\text{-}1}{\sigma_L}}]^{\frac{\sigma_L}{\sigma_L\text{-}1}}, \tag{9}$$

where τ_L is the relative productivity of the native low-skilled worker and σ_L is the elasticity of substitution between low-skilled natives and illegals immigrants. N and I are native low-skilled and illegal populations, respectively. Following from this, the total labor units available in the economy is expressed as

[7]Since we are primarily concerned with the economic incentives driving native's preferences over illegal immigrats, we can assume this without any loss of generality.

$$Q_t = [(\tau_H)(H_t)^{\frac{\sigma_H - 1}{\sigma_H}} + (1 - \tau_H)(L_t)^{\frac{\sigma_H - 1}{\sigma_H}}]^{\frac{\sigma_H}{\sigma_H - 1}}, \tag{10}$$

where τ_H is the relative productivity of native high-skilled workers and σ_H is the constant elasticity of substitution between high and low-skilled workers, who are imperfect substitutes. H and L are the total stock of high and low-skilled workers in the economy, respectively.

3.4 The Firms Problem

The economy produces a single aggregate good following a Cobb-Douglas production function, using both capital and labor (natives and illegal workers) as inputs in the production process. The firms production function can be expressed as

$$Y_t = AK_t^{\alpha} Q_t^{1-\alpha},$$

where A is a constant technology parameter. K_t and Q_t are as defined in equations (2) and (3) respectively. α is capital's share of output in the production process. A representative firm's profit maximization function can thus be defined as

$$\max_{H,N,I} \ \Pi = AK_t^{\alpha} Q_t^{1-\alpha} - w_{H,t} H_t - w_{L,t}[N_t + \gamma I_t] - R_t K_t. \tag{11}$$

Here, firms must choose the optimal number of workers of each type to employee in the production process. It is further assumed that firms can hire illegal workers easily without the fear of sanctions or penalties from the government. The absence of controls on hiring illegal workers is not entirely implausible and may explain the rise in the share of illegal population in the US labor force (Pew Research Centre, 2015).

Maximizing (11) with respect to H and N yields the market clearing wage-rate for natives and illegal workers as

$$w_{H,t} = A * K_t^{\alpha} * (1-\alpha) * (\frac{\partial Q_t}{\partial H_t})^{-\alpha}, \tag{12}$$

$$w_{N,t} = A * K_t^{\alpha} * (1-\alpha) * (\frac{\partial Q_t}{\partial N_t})^{-\alpha}, \tag{13}$$

and

$$w_{I,t} = \gamma w_{N,t}. \tag{14}$$

The rental rate of capital can be derived as

$$R_t = \frac{Y_t}{K_t}[1 - \frac{w_{H,t} * H_t}{Y_t} - \frac{w_{N,t} * N_t}{Y_t} - \frac{\gamma w_{N,t} * I_t}{Y_t}]. \tag{15}$$

As can be seen from relationship (15), in theory, for all $\gamma < 1$, the return to capital owners should go down assuming no change in the available capital stock. Thus, it would appear that the middle-aged in period t, who would be the old in period $t+1$ and depend on their savings returns to finance consumption expenditures, would suffer the most welfare loss if illegal workers are legalized. As Machado (2013) also shows, a high level of labor market discrimination prior to legalization (low γ) would result in greater decrease in the returns to capital.

3.5 The Government

The government is assumed to follow a Utilitarian or Benthamite social welfare function, which strives to maximize the total social welfare in the economy. In other words, the social planner is trying to maximize the weighted sum of the individual utilities of all agents, in each generation.

The governments raises revenues in the form of a consumption tax (ν) and a direct income tax (θ). The government remits its revenues back to agents in the form of lump-sum transfers, g[8]. Furthermore, the government is assumed to only influence natives' choices through fiscal policy i.e. monetary transfers. The government's welfare function is given by

$$WF_t = \sum_{t-2}^{t} \{\eta(V_{H,t}) + (1-\eta)(V_{L,t})\}, \tag{16}$$

where η is the weight associated with high-skilled workers, and is measured as the ratio of high-skilled workers to the total legal labor force. $V_{J,t}$ is the lifetime indirect utility of an agent of type J at time t, as defined in (8).WF is the social welfare function and is a function of the weighted sum of individual utilities of all agents in generation t. The government maximizes this social welfare function, subject to the following budget constraint-

$$g_t = \frac{\theta_t[2/3w_{H,t}H_t + 2/3w_{N,t}N_t + 2/3R_tS_{H,t}H_t + 2/3S_{N,t}N_t] + \nu[C_{H,t} + C_{N,t} + C_{I,t}]}{H + N + \xi I}, \tag{17}$$

where $C_{j,t} = \sum_{t-2}^{t} c_{j,t}$ and is the sum of the consumption of the *young, middle-aged*, and *old*, of type j, at time t. $S_{j,t} = s^2_{j,t-1} + s^3_{j,t-1}$ is the sum of the savings of the *young* and *middle aged* from time $t-1$. Keep in mind that at any time period t, there are 2 agents of type j each (*young* and *middle-aged*) who work, receive wages, and pay income tax. There are also 2 agents of each type (*middle-aged* and *old*) whose savings brought forward from time $t-1$ are taxed.[9]

[8] The lump-sum transfer can be thought of as a single public good, which natives have complete access to and illegal immigrants have restricted access to.

[9] It is assumed that wage income and capital gains are taxed at the same rate θ, for computational ease.

3.6 Calibrations

The theoretical model developed above, is calibrated on US data. Each period in the model is assumed to be 20 years. The discount factor β =.45 and capitals share of output α = 0.3, which is the consensus figure in the literature for the US. The literature provides many estimates for the elasticity of substitution between high and low-skilled workers. This paper uses the estimates from Borjas (2003) and sets σ_H = 1.3. As mentioned earlier, the literature on the elasticity of substitution between natives and immigrants is largely inconclusive, with various estimates depending on the underlying assumptions about the labor market. The paper uses σ_L= 20, indicating a high degree of substitutability between illegal immigrants and low-skilled natives, based on estimates from Ottaviano and Peri (2012). The relative productivity of high-skilled workers is measured as the wage-premium enjoyed by someone with a college degree, over their high school graduate counterparts, and is set at τ_H =.84[10]

The relative productivity of a low-skilled worker is set as τ_L = .6, such that low-skilled natives enjoy a slight nativity premium over illegal immigrants. While illegal immigrants are not subject to direct income taxations, they do pay the consumption tax on consumption. The consumption tax rate is set at ν=.05[11]. The initial tax rate is set at θ=.35.

In the benchmark case, the discrimination that illegal workers face in the labor market and their limited access to public transfers are set as γ = .7 and ξ = .3, respectively (see Machado (2013)). Estimate for the illegal immigrant population I = 11.1 million is taken from the Pew Research Centre (Hispanic Trends 2014) and is based on the American Community Survey (ACS) data from the Integrated Public Use Microdata Series (IPUMS). As is common in the literature, high and low-skilled

[10]US estimate for college wage premium are based on calculations by Jonathan James at the Federal Reserve Bank of Cleveland and uses data from the Current Population Survey.

[11]The consumption tax is measured as the average of the sales tax in 50 US states.

workers are distinguished by educational attainment, whereby someone with a college degree (associate or bachelors) or higher is classified as high-skilled. Data on US labor force by educational attainment is obtained from the Current Population Survey of the Bureau of Labor Statistics (BLS, 2016). About 50 per cent of the total US labor force of 160 million had a college degree or higher in 2016.

4 Defining the Policy Equilibria

This section describes the equilibria achieved under alternate policy choices, assuming a majority decision is achieved. The mechanism follows a recursive, first-order Markov process, where equilibrium prices and quantities are determined by current choices (Krussel et al., 1996). In particular, native agents are aware of the impact of their current choices on future prices and quantities and formulate their current decisions accordingly. These individual choices are aggregated using majority-rule, to form the collective policy response of native agents. The source of the dynamics in the formulation of a collective policy outcome, are the competing interests of the *young, middle-aged* and, *old* agents of both type. No inter-generational skills mobility is allowed, thus ensuring that an agent of type $j = H, N$ at time t, is of the same type at time $t+1$, only older by a generation[12]. This creates important inter-generational linkages, which the native agent must consider while making their decisions.

The key contribution of this paper is to develop a voting mechanism, that determines the outcome of a referendum on illegal immigrants. In addition to their consumption-savings decision at the beginning of period 1, native agents also vote on the policy choice on illegal immigrants. Natives must choose between a policy choice

[12]This is a necessary simplifying assumption as inter-generational skills mobility would require human-capital accumulation, which is not considered in the model.

of *status-quo* (allow illegal immigrants to remain in country without any change in status), given by $\varphi = 0$, or a policy choice of granting amnesty to illegal immigrants, given by $\varphi = 1$. Individual choices are aggregated to achieve the collective policy response Φ. Once the vote is cast and Φ is known, the utilitarian government makes a choice of θ, consistent with the implied values of economic state variables from policy choice Φ. Natives are fully aware of the impact of either choices on θ, the resulting redistribution g and, other economic state variables, when making their decisions.

4.1 The Status-Quo Steady State

The equilibrium achieved under a status-quo-ist policy choice, i.e. no change in the status of illegal immigrants, is described in this section. Prices and quantities in this economy are determined competitively, as described in the previous section. The economy's current state is given by $x \in \{S_{j,t}, H_t, N_t, I_t, \theta, R, w_{H,}, w_{N,}\}$, where $S_{j,t} = s^2_{t-1} + s^3_{t-1}$ are the savings of the *young* and *middle-aged* brought forward from the previous period, respectively, and together determine the level of capital available in the economy at time t. The economy remains in this current state x, under no change in the policy on illegal immigrants (*status-quo),* $\varphi = 0$. Natives are assumed to be completely aware of these implied steady-state values, from the policy choice of remaining in *status-quo*, when making their decisions. Thus, the native's choice of policy on illegal immigrants, would depend on how these implied steady-state values impact their lifetime utility.

From (8), the problem of the *young* or *middle-aged* agents at time t, can be written as:

$$V(x, , j) = max\{log(c_{j,1}) + \beta log V(x, j)\}, \tag{18}$$

subject to the budget constraints described in the previous section. V is the value

function of the dynamic programming problem and is a function of the current state of the economy x, and the agents own type, j. Wages, w_j, in this economy are skills or type-specific and are determined competitively, as given by (12) and (13). A policy choice of *status-quo* implies no change in the number of legal, *low-skilled* workers and the capital-labor ratio in the economy remains the same, as the pre-policy ratio. Thus, there is also no change in the competitive wage rates for natives.

The old agent is retired and is assumed to consume their entire income and leave no bequest. In particular, their income depends on the return on savings R, which is taxed at θ, and government transfers, g. The problem of the *old* agent at time t can be written as:

$$V(x, j) = max\{log(c_{j,3})\}. \tag{19}$$

Since this is the last period of their lives, the *old* only care about the impact of the policy choice on their current consumption. Thus, we have:

1. Agents maximize their consumption-savings decisions, given by their lifetime indirect utility (8),
2. Factor prices are determined competitively, as in (12), (13) and, (15),
3. The evolution of capital follows $K_t = s^2_{t-1} + s^3_{t-1}$,
4. The labor market clears, and
5. The tax rate θ is determined by a Utilitarian government maximizing total welfare.

4.2 The Amnesty Steady State

The alternate steady-state, achieved under a policy choice of amnesty, or $\varphi = 1$, is described in this section. The proposed equilibrium in this economy is achieved

with the benchmark policy choice of granting amnesty to half (1/2) of the illegal immigrants (with no population growth, $I_t = 1/2I_{t-1}$ and $N_t = N_{t-1} + 1/2I_{t-1}$). Equilibria under other degrees of amnesty (1/4, 3/4, 1/3, 2/3) are also studied and the conditions on the primitives that satisfy equilibrium conditions are met.

The total capital stock in this economy K_t is predetermined in the short-run, by the savings of the *young* and the *middle-aged* from the previous period. An amnesty does not change the amount of available labor in this economy. It however, changes the wages received by formerly illegal immigrants. In particular, firms must now pay the competitive wages to the newly legalized immigrants, which reduces the returns to capital owners. Using (15), the change in the return to capital owners can be written as:

$$\triangle R = \frac{(1-\gamma)W_N I_t}{K_t}. \tag{20}$$

As can be seen from (20), the higher is the degree of pre-policy discrimination in the wages received by illegal immigrants (lowerγ), higher is the decline in the returns to capital. This is also a key result in Machado (2013). However, if an amnesty induces a decrease in savings and thus the available capital stock, the impact of an immigration amnesty on the returns to capital are *ex ante* ambiguous. In addition to receiving the competitive wages, the hitherto illegal immigrant are now subject to income taxation and receive full benefits from the state. Thus, the tax base is bound to increase, under amnesty. Additionally, if this increase in tax revenue is large enough, the government may consider lowering the tax-rate rate, while simultaneously increasing transfers. Thus,

1. Agents maximize their consumption-savings decisions, given by their lifetime indirect utility (8),
2. Wages are determined competitively, as in (12), (13),

3. The evolution of capital follows $K_t = s^2_{t-1} + s^3_{t-1}$,
4. The evolution of R follows (20),
5. The labor market clears, and
6. The tax rate θ is determined by a Utilitarian government maximizing total welfare.

4.3 The Choice of a Utilitarian Government

While native agents vote on their preferred policy over illegal immigrants, the government decides the resulting tax-rate from any policy choice. The new tax rate is implemented in the second period, after the vote on illegal immigration in the first period. The government is assumed to be Utilitarian and chooses a tax-rate that satisfies

$$WF_t = max \sum_{t-2}^{t} \{\eta(V_{H,t}) + (1-\eta)(V_{L,t})\}, \tag{21}$$

subject to budget constraint described in the previous section. WF is the government's welfare function. η is the weight associated with high-skilled workers. Thus, if $\eta = .5$, there are an equal number of high-skilled and low-skilled workers in the economy and the government weights them equally in its maximization problem. Thus, the decision to grant amnesty to a large number of low-skilled workers, would increase the weight of low-skilled workers in the governments welfare function. This, in theory, should lead to an increase in the tax rate, to fund welfare programs for the low-skilled.

5 The Political Economy of Illegal Immigration

Having described the equilibria achieved under alternate policy choices, this section describes the political equilibrium and the formulation of a collective policy choice. In particular, this section looks at the conditions under which agents would vote in favor of or against an immigration amnesty.

Under a policy choice of $\varphi = 0$, the economy remains in the *status-quo* steady steady and agents evaluate their lifetime utility as described in section 3.1. Under the alternate policy choice of $\varphi = 1$ however, agents must now formulate a set of new current choices which satisfy the equilibrium path implied by the alternate steady state. In other words, the future choices of the current voting generation living under the alternate steady state feed into their decisions today. Since this is a *one-shot* amnesty (see Levinson, 2005) and the vote happens only once, the key here would be to determine how a native agent is affected by transitioning from the *status-quo* steady state, to the amnesty steady state.

Thus, a *young* and the *middle-aged* agents during transition solve

$$\pi(x, j) \equiv arg\ max_{\varphi}\ \tilde{V}(x, j, \varphi). \tag{22}$$

These individual policy choices are aggregated using majority-rule to get the collective policy response as:

$$\Pi(x) = arg\ max_{\varphi \in \{0,1\}} \int_{j:\pi(x,j)=\varphi} x(dj). \tag{23}$$

In this economy, a political equilibrium is reached when agents make current political choices which are dictated by the future values of economic variables, which in turn are determined by these current political choices.

5.1 Transition Dynamics

The economy is assumed to be a continuum which is currently in *status-quo*. If $\varphi = 1$, the economy transitions to the alternate steady state, 1-period hence. This transition requires the agents to internalize future prices and quantities implied by the equilibrium path and formulate new current choices. Figure 1 describes the economy as it transitions to the alternate steady state. Note that for the agent, it's as if the vote occurred at time $t = 0$, and at the beginning of $t = 1$, the economy is in the amnesty steady state. Agents must now decide which policy they prefer. A utility gain during transition, would mean a vote in favor of amnesty, and vice versa.

Thus, if

$$U_{j,transition} \geq U_{j,status-quo,} \tag{24}$$

a j type agent derives higher lifetime utility from transitioning from *status-quo* to the amnesty steady state, and thus votes in favor of amnesty. In order to derive quantitative results, the economy is simplified to include 1 agent of each type j, from each generation. Thus, there are 6 agents- young, middle-aged and, old high skilled agents; young, middle-aged, and old low-skilled agents, who vote and determine the policy on illegal immigrants. Clearly, a policy choice would require 4 out of 6 agents to vote in favor of it, thus ensuring majority-rule.

6 Quantitative Results

Some quantitative results are presented in this section. The case of half (50 per cent) of the illegal population being legalized is considered for the benchmark case. Initial parameter values are set as described in section 3.6. Figure 2 shows the effective tax rate, at each level of legalization. The tax rate increases at each level of legalization,

peaking at over 24 per cent in the benchmark case, before falling but still remaining above the *status-quo* tax rate. The formerly illegal immigrants now receives full benefits from the state ($\xi = 1$) which increases the burden on the state, thus increasing the tax rate. Additionally, an amnesty leads to a decline in the ratio of high-skilled-to-low-skilled workers in the government's welfare function, and thus the government weights the welfare of its low-skilled citizens more ($\eta < 0.5$). With legalization, the tax base increases simultaneously, which eventually leads to a decline in tax rate as a higher fraction of the illegal population is regularized. This increase in the tax base is however not large enough to completely offset the increased burden on the state.

Figure 3 describes how factor prices respond to an immigration amnesty. The capital-labor ratio in this economy declines (Panel D), as more illegal immigrants are regularized. The aggregate savings in the economy initially fall due to amnesty and then increase again, but this increase isn't large enough to maintain the initial capital-ratio ratio (keep in mind that Q_t is not changing). As a result, wages for both high and low-skilled workers decline (Panels A and B) and the returns to capital owners increase (Panel C). However, as savings in the economy decline and capital becomes relatively more expensive, the demand for low-skilled workers who are substitutes to capital increases, and this leads to low-skilled wages eventually increasing as more people are regularized.

The lifetime utilities of native agents generated by transitioning from the status-quo steady state to the amnesty steady state, at different level of legalization are presented in figure 4. The relatively rich agents of all generations are made worse-off due to amnesty, as shown in panels A, C, and E. For each level of legalization, there is a monotonic decrease in the utility of the high-skilled agents in this economy. This loss in welfare for the high-skilled could be attributed to the higher taxes and lower wages. Although the high-skilled, who depend more on their savings returns experience an

increase in their returns, the increase is not large enough to compensate for the loss of wages and higher taxes. The relatively poor agents receive higher transfers now, which more than compensates for the loss in wages and leads to a welfare gain at each level of legalization, as shown in panels B, D, and F. It is important to note here that figure 3 is reflective of the reason for the policy impasse on illegal immigrants. If there were a referendum, the vote would be split right in the middle, with 3 agents each voting in favor and against amnesty, and a majority outcome would be difficult to retrieve without some tie-breaking mechanism.

Table 1 gives the welfare adjustments during transition experienced by native agents at each level of legalization. The working age high-skilled populations are hurt the most. More specifically, in the benchmark case of half the population of illegal immigrants being legalized, a young high-skilled worker experiences a 28.84 per cent welfare loss as they transition to the amnesty steady state. The losses are highest for the middle-aged high-skilled workers, who see a 42.46 per cent welfare loss during transition. As high-skilled income goes down, they save less. The increase in returns to capital are not sufficient to compensate for the losses from lower wages and higher taxes. The retired (old) high-skilled agent experiences a 13.22 per cent decline in welfare in the benchmark case. The gains are equally stark for the low-skilled agent. In the benchmark case, a young low-skilled worker sees a 74.68 per cent welfare gain due to amnesty. The gains are the most for the old high-skilled workers who experience an over 100 per cent gain in welfare.

6.1 A fixed Income Tax-rate

Clearly, the higher tax burden resulting from an immigration amnesty plays an important role in natives' preferences over illegal immigrants. Thus, it would be pertinent to understand native's preferences when the tax rate does not change as a result of

an amnesty. Keep in mind that the resulting tax rate is determined by the government following (21). Under this regime however, the goverment does not evaluate a new tax rate and both natives and newly legalized immigrants face the pre-amnesty (status-quo) tax rate. This could also be interpreted as no change in η in the government's welfare function. The exercise allows us to understand how the expected fiscal implications of an immigration amnesty impact native's decisions today.

Under this regime, the native agents evaluate a new lifetime utility generated from transitioning between the two steady-states, while keeping the tax-rate unchanged at the pre-amnesty level. Interestingly, when there is no change in the income tax-rate, the outcome of a vote on illegal immigration is reversed. More specifically, low-skilled agents of all generations now dislike amnesty, as it reduces the transfers received by them. At the same time, high-skilled young and middle-aged agents prefer amnesty, while the old dislike it.

This would indicate that native's preferences are almost entirely driven by the fiscal implications of an immigration amnesty. With no change in the tax-rate, it would be possible to achieve a majority support *against* amnesty, or in favor of remaining in status-quo. This is perhaps reflective of today's political realities concerning immigration policy, especially in the United States. In the US, the Democratic party which claims to champion the cause of the poor (low-skilled) would like to grant an immigration amnesty as it could potentially help them politically. But without raising the income tax rate, such a support from its constituents would not be possible. At the same time, the Republican party which supposedly champions the cause of the rich (high-skilled) are against amnesty as it raises the tax on it's constituents. They would be in favor of an amnesty only if it has no effect on the resulting tax rate.

6.2 When is Amnesty Preferred?

The above results indicate that given the current state of the economy, majority support for any policy choice is difficult to achieve. This section looks at the conditions under which a majority support for amnesty is possible. The benchmark case of half the population of illegal immigrants being legalized is considered. Utility generated gives the *payoffs* received by each agent from either policy choices. Agents are aware of these pay-offs to themselves and to all other agents, when making their decision. As a rule, it is assumed that if a majority outcome is not achieved, the economy remains in *status-quo*. Under this circumstance, voting to remain in *status-quo* is a dominant strategy for the high-skilled natives. They are strictly better-off choosing *status-quo*, irrespective of the decision of the low-skilled agents. The low-skilled agents lack a dominant strategy. They would be better-off voting for amnesty, if and only if at least 1 of the high-skilled agents voted for it as well. Thus, the key to gaining majority support for amnesty would be to make at least 1 high-skilled agent better-off under amnesty or at least indifferent between the two policies.

6.2.1 Distributional Equity with Higher Consumption tax

A higher income tax rate under the amnesty steady state necessarily disproportionately impacts the *high-skilled*, as a tax on income is a tax on the total product generated in the economy for redistributive purposes. While not perfect, a consumption tax has often been regarded as an alternative to income taxation.[13]. The model shows that a higher consumption tax could potentially allow the smoothening of the tax-burden between *high* and *low-skilled* workers due to amnesty, and thus be welfare improving for at least 1 *high-skilled* agent.

Figure 5 gives the utility of the old high-skilled under the amnesty steady state

[13]See Warren (1980) for a comprehensive comparison between the impact of income and consumption taxes on equity.

under different consumption tax regimes for the benchmark case. The model predicts a decline in welfare loss to the old high-skilled with increasingly higher consumption tax, with the old experiencing a welfare *gain* under amnesty at a consumption tax rate of 11 per cent. While the old experience a welfare loss during the transition, they are in fact made better-off in the steady state under this regime. A higher consumption tax shifts a portion of the tax burden from the high-skilled to the low-skilled and simultaneously leads to a decline in the effective income tax rate. At the same time, the higher consumption tax is not large enough to offset the gains from increased transfers to the low-skilled, thus ensuring their support for amnesty.

Table 2 gives the steady state effects on economic agents when faced with an exogenous increase in the consumption tax rate from 5 per cent to 11 per cent in the benchmark case. The old high-skilled agent experiences a welfare gain under the amnesty steady state with 11 per cent consumption tax rate. The last column of table 2 gives the effective income tax rate. As can be seen, the income tax rate falls from the initial status-quo steady state level to 21.72 per cent under the amnesty regime with a higher consumption tax. Thus, it could be argued that while the old high-skilled experience a welfare loss as they transition to the amnesty steady steady state, it is possible to make them better-off in the steady state with an increase in the consumption tax rate. Clearly, 4 out of 6 agents can in fact be made better-off in the amnesty steady state.

7 Concluding Remarks

This article develops a politico-economic model of voter preferences over the fate of illegal immigrants. In a referendum like scenario, native agents, who may be high or low-skilled and belong to 3 generations, vote on whether to grant amnesty to illegal immigrants, or support no change in their immigration status. Their choice of either

policy is motivated purely by economic incentives, i.e. the impact of either policy on the value of their discounted lifetime utility. The key is to determine how agents are impacted by transitioning from the *status-quo* steady state to the amnesty steady state. A welfare gain during transition would imply a vote in favor of amnesty, and vice versa. Individual choices are aggregated to form the collective policy response of all agents using majority-rule.

The article establishes that a contributing factor to the policy impasse on illegal immigrants in the US is the underlying dynamics of voter preferences. In particular, if there were a vote on illegal immigrants, the populous would be split right in the middle, with half the population voting in favor of and the other half voting against amnesty. High-skilled agents do not like amnesty, as it leads to higher taxes and reduced wages. Although, the return to capital increases with amnesty, the increase is not large enough to compensate them for their losses. The middle-aged high-skilled agents suffer the largest welfare loss, with a decrease of over 42 per cent in welfare during transition in the benchmark case. The low-skilled are made better-off with amnesty. Their utility is monotonically increasing as more people are regularized and thus support amnesty.

The preferences of natives are entirely driven by the fiscal implications of any policy choice and is reflective of the political realities concerning immigration policy. While the Democrats in the US would like to grant an amnesty to illegal immigrants, they cannot do so without raising the income tax rate. At the same time, the Republicans would grant amnesty only if it results in no change in the tax rate. With these confounding factors in mind, the article proposes an increase in the consumption tax rate to smoothen the tax burden between *high* and *low-skilled* workers. With a consumption tax rate of 11 per cent, it is possible for the old *high-skilled* agents to be made better-off under the amnesty steady state and thus could allow for a majority

support in favor of such a policy.

The likelihood of such an increase in the consumption tax rate is however a matter of deep contention amongst economists as has been pointed out in Warren (1990). To quote Larry Summers on the issue:

"Liberals think it's regressive and conservatives think it's a money machine." (Rosen 52)

However, as this article has shown, a small increase in the consumption tax rate could possible solve the problem of illegal immigrants currently residing in the country, all the while making a majority of native agents better-off.

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Appendix B: Chapter II Figures

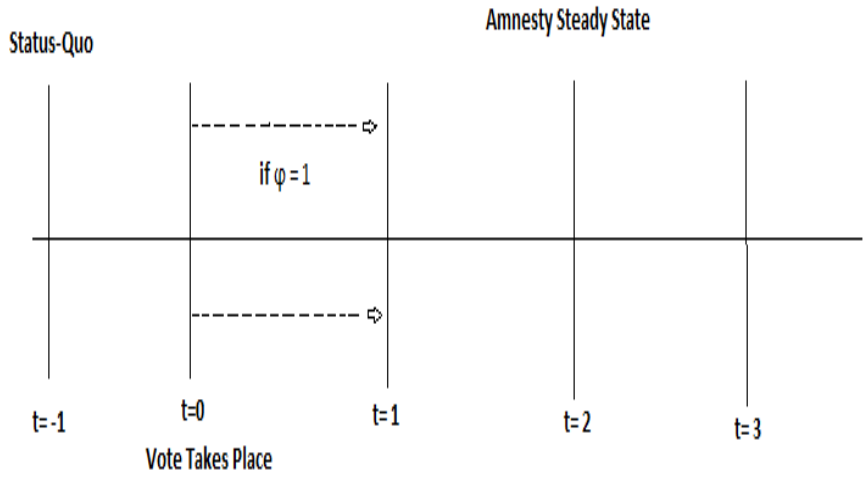

Figure 2.1: The Transition Economy

Figure 2.2: Effective Tax-Rate Determined By a Utilitarian Government

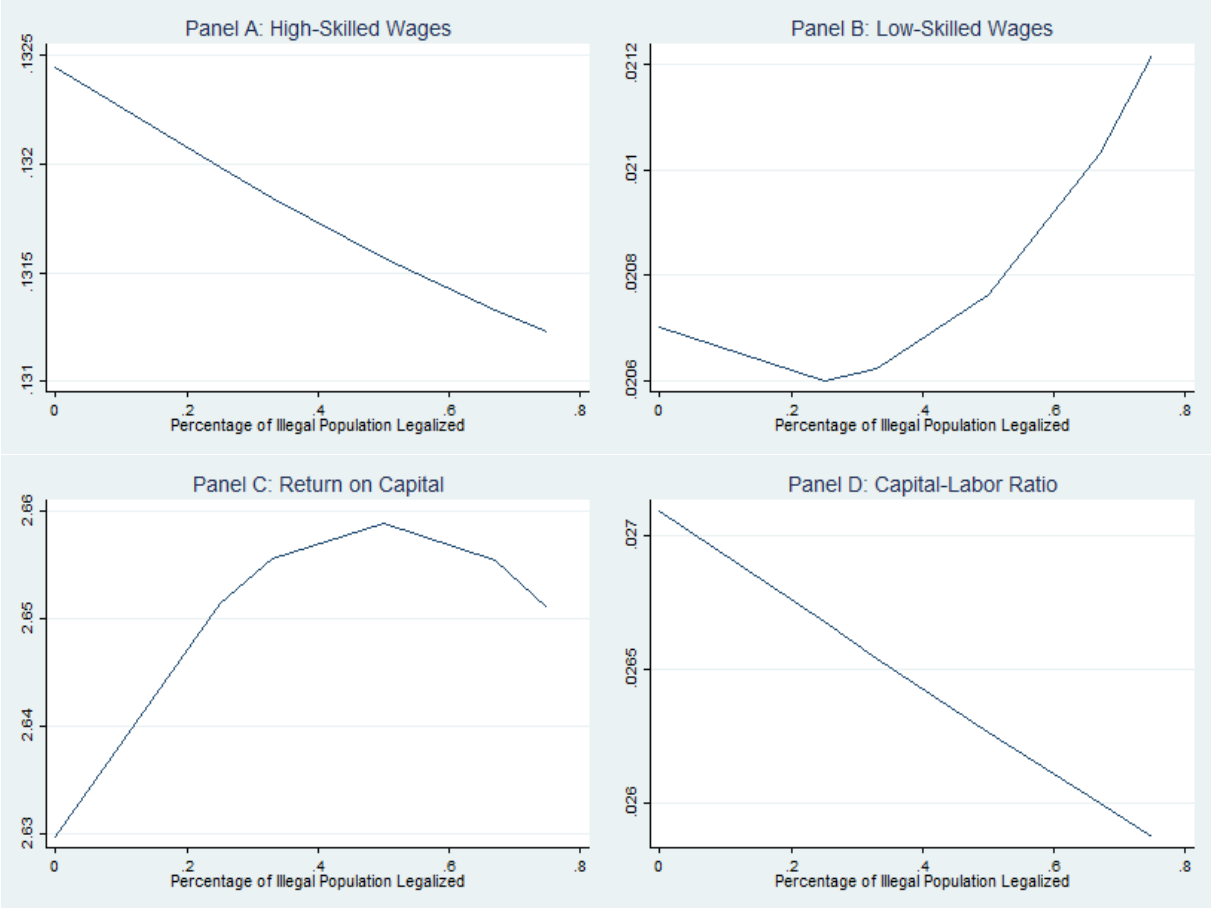

Figure 2.3: The Behavior of Factor Prices

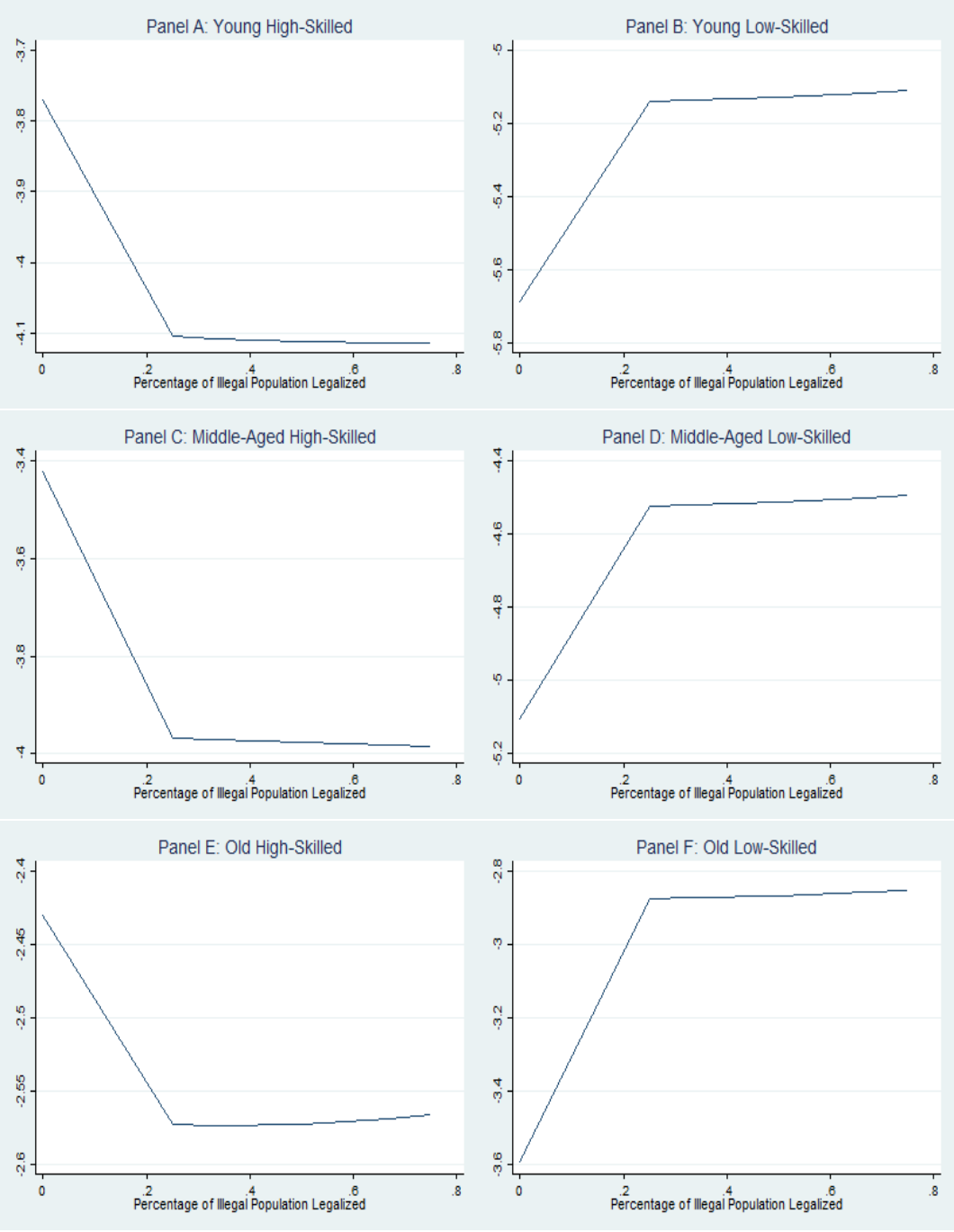

Figure 2.4: Lifetime Utility of Native Agents

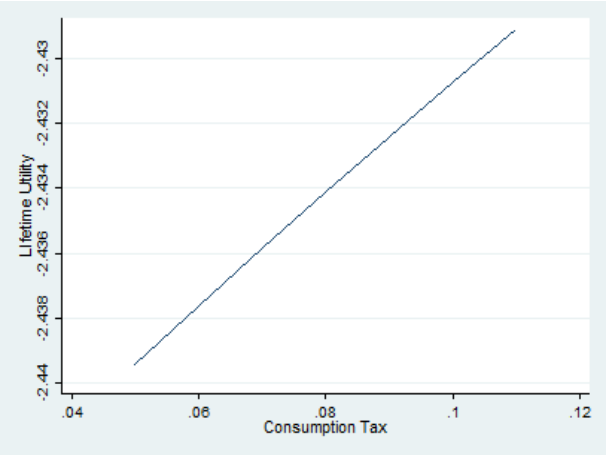

Figure 2.5: The Effect of an Increase in Consumption Tax on the Utility of Old High-Skilled Under Amnesty

Appendix C: Chapter II Tables

Table 2.1: Welfare Adjustments During Transition

Fraction Legalized	*YHS*	*YLS*	*MHS*	*MLS*	*OHS*	*OLS*
.25	-.2824	+.7250	-.4185	+.7866	-.1326	+1.0387
.33	-.2849	+.7308	-.4208	+.7925	-.1331	+1.0446
.50	-.2884	+.7468	-.4246	+.8076	-.1322	+1.0594
.67	-.2901	+.7690	-.4273	+.8272	-.1291	+1.0786
.75	-.2904	+.7825	-.4283	+.8390	-.1232	+1.0901

Table 2.2: Utility of Native Agents under Alternate Regimes of Consumption Tax Rate in the Benchmark Case

Consumption Tax Rate	*YHS*	*YLS*	*MHS*	*MLS*	*OHS*	*OLS*	*Income Tax Rate*
Status Quo(0.05)	-3.7715	-5.6868	-3.4242	-5.1048	-2.4304	-3.5894	0.23525
Amnesty(0.05)	-3.7966	-5.6895	-3.4414	-5.1023	-2.4394	-3.5849	0.2484
Amnesty(0.06)	-3.7941	-5.6833	-3.439	-5.0966	-2.4376	-3.5808	0.24315
Amnesty(0.07)	-3.7918	-5.6772	-3.4367	-5.091	-2.4358	-3.5768	0.23793
Amnesty(0.08)	-3.7894	-5.6711	-3.4344	-5.0855	-2.4341	-3.5728	0.23273
Amnesty(0.09)	-3.7872	-5.6651	-3.4321	-5.08	-2.4324	-3.5688	0.22756
Amnesty(0.10)	-3.7849	-5.6592	-3.4299	-5.0745	-2.4307	-3.5649	0.22241
Amnesty(0.11)	-3.7827	-5.6534	-3.4277	-5.0692	-2.4291	-3.5611	0.21729

CHAPTER III
TO IMMIGRATE - LEGALLY OR ILLEGALLY?

1 Introduction

This articles presents a model of the choice between immigrating legally or illegally for a potential immigrant. Legal immigration may be defined as immigration that has been authorized by the immigrant-receiving country while illegal immigration is immigration undertaken without the authorization of the immigrant-receiving country.

The impact of immigration status on the earnings of immigrants has been a matter of study for some time[1]. That illegal immigrants earn a lower wage than their legal counterparts is also well established in the literature. This discrimination faced by illegal immigrants in the labor market can be attributed to their lower productivity due to language barriers and unfamiliarity with labor market institutions, status-based discrimination, and employer's risk of legal repercussions passed on to the worker.[2] As international migration trends remain positive and high (Migration Data Portal, 2017) , it becomes necessary to understand the initial choice of a migrant between migrating legally verses illegally, as it has a direct bearing on their earnings in the migrant receiving country. This paper explains these economic incentives that drive a potential migrant's choice between the legal route and the illegal route to migrate. A clear policy implication of this analysis is the identification of incentives that would encourage legal rather than illegal immigration.

The paper employs a discrete choice dynamic programming framework (see Keane, Todd, and Wolpin, 2011) to model the immigrant's initial decision. If the immigrant

[1] see Chiswick (1978), Massey (198), Rivera-Batiz (1999) and others)
[2] see Chiswick (1988), Chau (2001), Rivera-Batiz (1999).

decides to immigrate legally, there is a probability of them being denied entry. However, once granted entry, they face no uncertainty about their future and earn their true marginal product each period hence. The illegal immigrant faces a high up-front cost but guaranteed entry. However, once in the country, they face a probability of being identified and deported. In addition, the immigrant also has the choice of not immigrating and remaining in their home country. Note that this would also apply to a situation where a legal immigrant was denied entry or an illegal immigrant was deported. The immigrant chooses the option that affords them the highest discounted lifetime utility. The structural model is simulated using data from the Legalized Population Survey 1 (LPS 1 of 1989) and the Current Population Survey (CPS 1990).

Most studies looking at the differences between legal and illegal immigrants have employed an empirical approach using available data. For example, Rivera-Batiz (1999) also uses the LPS and the CPS to compare the earnings of legal and illegal Mexican immigrants in the US. They find that that a legal Mexican migrant in the US earned significantly higher than their illegal counterpart and that illegal immigrants experienced significant wage gains in the years following legalization. Borjas and Tiende (1993) using the Legalization Application Processing System (LAPS) file and the CPS find similar differences between the earnings of legal and illegal immigrants. Dustmann, Fasani, and Speciale (2017) analyze the impact of legal status on an immigrant's consumption behavior. They use a unique survey data of both legal and illegal immiigrants in Italy and find that an illegal migrant consumed 40% less than their legal counterpart and about a quarter of this difference can be explained by illegal immigrants having a lower income. These empirical models while informative, cannot be however generalized to the global immigrant population. Additionally, they do not tell us anything about why the immigrant made their initial choice of

immigrating legally or illegally. The structural model presented in this paper seeks to fill this gap in the literature and understand the primitives that guide the immigration decision. These primitives then allow for the generalizability of our findings and simulate behavioral responses to policies and welfare implications.

2 Baseline Equation

$$log(W_{it}^{CPS}) = \alpha + \beta X'_{it} + C_c + T_t + \epsilon_{it}$$

where

- $log(W_{it}^{CPS})$ is the log income from wages and salary of person i in the CPS at time t. i is a set of all individuals who are naturalized citizens by 1990. The set further includes only individuals from 4 countries (Mexico, Colombia, Guatemala, El Salvador) who entered the US between 1982-84.
- X_{it} are observable individual controls (sex, age, highest grade of schooling, experience, marital status, english proficiency, number of own children).
- C_c is the country of origin dummy and T_t is the year of immigration dummy
- ϵ_{it} is the error term.

3 Data

For this analysis, we combine two datasets- the Legalized Population Survey 1[3] of 1989, which collected information on illegal immigrants who had just received their temporary legal status under the IRCA of 1986 and the Current Poulation Survey (CPS) 1990 which provides data on legal immigrants.

In the LPS 1, 6,193 individuals were interviewed who had received temporary legal status and were waiting for their permanent residency papers under the IRCA of 1986. It focused on their characteristics and experiences prior to and at the time of application in 1987-88. The definition of "illegal immigrants" includes not just those who have entered the country illegally, but also those who may have entered the country legally and overstayed the stipulated time. In the LPS 1, 21.81 % of the respondents reported to have entered the country with valid visa/papers. They fell out of status (i.e, became illegal immigrants) after entering the US and were so on January 1st, 1982. Since we are interested in modeling the initial choice of the migrant, we drop these individuals from the LPS as their initial choice was in fact to migrate legally. We then narrow the sample size to individuals from Mexico, El Salvador, Guatemala, and Colombia since these countries form the majority of recipients of IRCA. We further narrow the sample to only those individuals who entered the US just prior to the cut-off date to be eligible for IRCA, i.e, January 1st, 1982. Thus, we have a sample of individuals who entered the US illegally between 1979-1981 and were residing in the US as of 1982. They further belong to one of the above mentioned four countries and have been granted legal status under IRCA as of

[3]The Legalized Population Survey (LPS) was conducted in two waves. LPS 1 took place between February and June of 1989, while LPS 2 was conducted between April and September of 1992. An illegal immigrant was eligible for legalization under the IRCA if they were an illegal immigrant in the US as of January 1st, 1982. For our analysis, we only use LPS 1 as it provides information on illegal immigrants immediately after being legalized and thus should not reflect much of the effects of legalization.)

1989.

In the CPS, the raw dataset consists of 1,048,575 individuals. 89.61 % of individuals responded as "born citizens" and 0.94 % responded as "born abroad of American parents". 3.71% reported being "naturalized citizens", while 5.74 % reported being "not a citizen". There we no individuals who reported their status being "not a citizen but have received first papers" (which in 1990 could mean those who got IRCA). There were also no "foreign born with unreported citizenship status". For our analysis, we will only focus on indivduals who reported being "naturalized citizens" in 1990. We further limit the analysis to only those individuals who reported year of immigration between 1982-1984. By limiting the set to only naturalized citizens who entered between 1982-1984, we ensure that we only capture those individuals who must have entered legally[4]. Finally we limit the dataset to individuals who reported their birthplace as one of the following countries- Mexico, El Salvador, Guatemala, and Columbia. Thus, we have a sample of legal immigrants from the 4 countries who were naturalized citizens of the US in 1990 and who entered the US between 1982-84.

3.1 Descriptive Statistics

Table 1 gives the summary statistics for the two data-sets. The gender distribution of the sample is almost similar between the two data sets. While both groups have a similar average age, it is to be noted that the illegal immigrant pool has a higher frequency of younger immigrants, while the age of the legal immigrant is more evenly distributed. We create a variable EDUC which gives the number of years of schooling. Thus, EDUC = 11 if the agent has less than a high school degree, EDUC = 12 if the agent has a high school degree, EDUC = 14 if the agent has a 2-year college

[4]see https://www.congress.gov/bill/99th-congress/senate-bill/1200

degree, EDUC =16 if the agent has a 4-year college degree and, EDUC=17 if agent has more than 4-year college degree. The mean educational attainment between the two groups is similar although legal immigrants are slightly more educated. Almost 80% of the illegal immigrants have less than a high-school degree as compared to about 65% of legal immigrants. Legal immigrants are also more likely to have a 4-year college and higher degree as compared to their illegal counterparts. Illegal immigrants also experience more unemployment. INCOME (INC) is the income from wages and salaries and is 1 if income is greater than 0 but less than $6,000, 2 if income is between $6-11,999, 3 if income is between $12-19,999, 4 if income is between $20-29,999, and 5 if income is $30,000 and above. Legal immigrants have a slightly higher income, with a significantly larger proportion earning more than $30,000 annually compared to illegal immigrants. Note that illegal immigrants receive a higher welfare income than legal immigrants. The variable EXP is the on-the-job training and experience acquired by the migrant and is calculated as age - EDUC - 6, following Keane and Wolpin (1997). Legal immigrants on average have almost 7 additional years of experience compared to their illegal immigrant counterparts. Similar proportions of both legal and illegal immigrants are married although illegal immigrants have slighly more children. Illegal immigrants also have lower proficiency in English.

4 The Basic Dynamic Programming Model

The consumption and savings decisions faced by immigrants upon arrival and in the subsequent periods are contingent upon the initial discrete-choice of travelling legally or illegally (or in fact staying back in the home country). We define the decision-space for the agent as $d \in \{1, 2, 0\}$ where $d = 1$ if migrate illegally, $d = 2$ if migrate legally and, $d = 0$ if they stay back in the home country. We model this choice following the

DCDP method in Keane et al. (2011). We now formally discuss the model.

The agent derives their utility from the sum of the discounted lifetime rewards associated with either choices which includes their consumption choices and some unobservables. Let $V(\Omega_{i,t})$ be the lifetime value function for an agent faced with these choices. We thus have:

$$V(\Omega_{i,t}) = \max_{d\in 1,2,0} \left\{ -C_1 + V^1(\Omega_{i,t}),\ -C_2 + qV^2(\Omega_{i,t}) + (1-q)\left[return_t^0 + \beta E_t V(\Omega_{i,t+1})\right], V^0(\Omega_{i,t}) \right\}, \tag{1}$$

where C_1 and C_2 are the respective one-time fixed costs associated with immigrating illegally and legally for the agent. Here $V^1(\Omega_{i,t})$ is the time t value that accrues to an agent who makes the choice of immigrating illegally while $V^2(\Omega_{i,t})$ is the time t value that accrues to an agent who chooses to immigrate legally. If the agent decides to immigrate legally, they face a probability q of getting the visa. Thus, with a probability q, the agent receives the value of being a legal immigrant in the US and with probability $1-q$, the agent is denied the visa and stays back in the home country. Here $return_t^0$ is the 1-period return of staying back in the home country. Additionally, $V^0(\Omega_{i,t})$ is the value function associated with staying back in the home country. Also, $\Omega_{i,t}$ are the states for the person i at time t. We now discuss in more detail the respective value functions associated with all the choices faced by the agent.

4.1 Value Function (d=1)

We first begin by mapping the value function associated with the choice of migrating illegally ($d = 1$). This can be formally written as:

$$V^1(\Omega_{i,t}) = \max_{c_{i,t}, s_{i,t+1}} \left\{ log(c^1_{i,t}) + \beta \left(pE_t V^1(\Omega_{i,t+1}) + (1-p) E_t V^0(\Omega_{i,t+1}) \right) \right\}, \quad (2)$$

where $V^1(\Omega_{i,t})$ is the value function for person i who has successfully immigrated illegally at time t. The variable $c^1_{i,t}$ is the consumption in the first period after immigration. Here E_t is the expectation operator and β is the discount factor. The parameter p is the probability of not being identified and deported. The agent maximizes this value function with respect to the following budget constraint:

$$c^1_{i,t} + s^1_{i,t+1} = \gamma w_{i,t} + \xi g_{i,t} + (1+r) s^1_{i,t-1}, \quad (3)$$

where $c^1_{i,t}$ is the consumption of the agent in period t and $s^1_{i,t+1}$ is the savings for the next period. The right-hand side of the above equation gives all sources of potential income for the agent in the US including - $w_{i,t}$ which are the legal wages or salary, $g_{i,t}$ which are lump-sum government transfers and $s^1_{i,t-1}$ which are the savings from the previous period, which in the year of immigration includes savings brought from their home country. Note that illegal immigrants only receive a fraction of their true marginal product owing to their "illegal" status which is captured by the parameter γ. The parameter ξ captures the fraction of government transfers received by illegal immigrants. Note that while they are denied the true marginal product of their labor, they do not pay any income taxes.

4.2 Value Function (d=2)

Now let us consider the value of immigrating legally, $(d = 2)$. We have:

$$V^2(\Omega_{i,t}) = \max_{c_{i,t}, s_{i,t+1}} \left\{ log(c^2_{i,t}) + \beta E_t V^2(\Omega_{i,t+1}) \right\} \tag{4}$$

where $V^2(\Omega_{i,t})$ is the value function for person i who immigrated legally at time t. Again, $c^2_{i,t}$ is the consumption in the first period after immigration. Here E_t is the expectation operator and β is the discount factor. The budget constraint associated with immigrating legally is given by:

$$c^2_{i,t} + s^2_{i,t+1} = (1-\theta)w_{i,1} + g_{i,1} + (1+r)s^2_{i,t-1}, \tag{5}$$

where $c^2_{i,t}$ is the consumption of the agent in period t and $s^2_{i,t+1}$ is the savings for the next period. Here θ is the income-tax rate, $w_{i,t}$ are the legal wages and salary and $g_{i,t}$ are lump-sum government transfers. Finally, $s^2_{i,t-1}$ are the savings from the previous period.

4.3 Value Function (d=0)

In addition to the choice of immigrating (legally or illegally), we assume that the agents also have a choice of staying back in their home. As mentioned earlier, this scenario also applies in the event of a legal agent being denied a visa or an illegal agent being detected and deported. We assume that their is no uncertainty associated with staying back in the home country and that the agent is aware of their lifetime returns given by:

$$V^0(\Omega_{i,t}) = return^0_t,$$

where $return^0_t$ is as defined in section 4. For ease of computation, the return to staying at home is normalized to zero.

5 Characterization of the Optimal Choices

We solve the basic dynamic programming problem of the agent using a recursive, first-order Markov process (see Krussel et al., 1996) where the future consumption and savings choices of the agent are determined by current choices. From the data, the youngest agent in the CPS survey is eighteen years old while the oldest is eighty. We thus solve the problem from the point of view of an eighteen years old agent who is looking sixty two periods in the future and solving backwards to arrive at their current decision. We assume that at age seventy, the agent retires and lives off of his savings and transfers. At the age of eighty the agent dies and thus consumes everything. So:

$$S_{62} = 0$$

Solving $V(\Omega_{i,t})$ recursively for the optimal savings choices made by the immigrant, we have:

$$S_{61} = \frac{\beta}{(\beta+1)}\left[W_{61} + (1+r)S_{60}\right] - \frac{W_{62}}{(\beta+1)(1+r)}$$

where the first part of the equation is the agents current income while the second part of the equation is the discounted value of their future income. Solving recursively for choices in the prior periods gives:

$$S_{60} = \frac{\left[1+\frac{\beta}{1+r}\right]\beta}{\left[1+\frac{\beta}{1+r}\right]\beta+1}\left[W_{60} + (1+r)S_{59}\right] - \frac{1}{\left[1+\frac{\beta}{1+r}\right]\beta+1}\left[\frac{W_{61}}{1+r} + \frac{W_{62}}{(1+r)^2}\right],$$

$$S_{59} = \frac{\left[1 + \frac{\beta}{1+r} + \left(\frac{\beta}{1+r}\right)^2\right]\beta}{\left[1 + \frac{\beta}{1+r} + \left(\frac{\beta}{1+r}\right)^2\right]\beta + 1}\left[W_{59} + (1+r)S_{58}\right] - \frac{1}{\left[1 + \frac{\beta}{1+r} + \left(\frac{\beta}{1+r}\right)^2\right]\beta + 1}\left[\frac{W_{60}}{1+r} + \frac{W_{61}}{(1+r)^2} + \frac{W_{62}}{(1+r)^3}\right]$$

and so on. We can thus derive a formula for the optimal savings choice for the agent at each time period as:

$$S_q = \frac{\left[\sum_{j=1}^{62-q}\left(\frac{\beta}{1+r}\right)^j\right]\beta}{\left[\sum_{j=1}^{62-q}\left(\frac{\beta}{1+r}\right)^j\right]\beta + 1}\left[W_q + (1+r)S_{q-1}\right] - \frac{1}{\left[\sum_{j=1}^{62-q}\left(\frac{\beta}{1+r}\right)^j\right]\beta + 1}\left[\sum_{j=1}^{62-q}\frac{W_{62-j+1}}{(1+r)^{62-q-j+1}}\right]. \tag{6}$$

where $q \in \{1, 2, ..., 61\}$. Similarly, solving for the optimal consumption choices of the agent we have:

$$c_{62} = W_{62} + (1+r)S_{61},$$

$$c_{61} = \frac{1}{1+\beta}\left[W_{61} + (1+r)S_{60}\right] + \frac{1}{1+\beta}\left[\frac{W_{62}}{1+r}\right],$$

$$c_{60} = \frac{1}{\left[1 + \frac{\beta}{1+r}\right]\beta + 1}\left[W_{60} + (1+r)S_{59}\right] + \frac{1}{\left[1 + \frac{\beta}{1+r}\right]\beta + 1}\left[\frac{W_{61}}{1+r} + \frac{W_{62}}{(1+r)^2}\right],$$

and so on. By backward induction, we can again derive a formula for the optimal consumption choice for the agent at each time period as:

$$c_q = \frac{1}{\left[\sum_{j=1}^{62-q}\left(\frac{\beta}{1+r}\right)^j\right]\beta+1}\left[W_q+(1+r)S_{q-1}\right]+\frac{1}{\left[\sum_{j=1}^{62-q}\left(\frac{\beta}{1+r}\right)^j\right]\beta+1}\left[\sum_{j=1}^{62-q}\frac{W_{62-j+1}}{(1+r)^{62-q-j+1}}\right]. \tag{7}$$

where $q \in \{1, 2, ..., 61\}$.

6 Simulation Results

This section discusses the results from the simulation exercise. Again, we solve the problem from the point of view of an eighteen year old agent who will retire at seventy and die at eighty. Note that to qualify for social security benefits as an immigrant, one has to have atleast 40 qualifying hours of work credit, which is equivalent to 10 years of work[5]. Thus, an agent immigrating after the age of sixty and retiring at seventy would not have enough work credit hours to qualify for social security benefits. They would however, still receive some returns from the government. These are considerations that would be made by a potential immigrant before deciding to immigrate. Figure 1 describes the lifetime earnings opportunity at any age for an immigrant. An eighteen years old immigrant has fifty two years of work ahead of them during which time they earns their marginal product. At seventy, they retire and for the next 10 years, live off of government transfers and die at eighty. A similar analysis can be made for immigrants of each age.

The up-front cost for a potential immigrant to immigrate is defined as a fraction of their initial savings, which in effect lowers the amount of savings brought by the immigrant into the immigrant-receiving country. The amount of initial savings is assumed to be fifty percent of the expected wages in the immigrant-receiving country.

[5]see https://www.ssa.gov/ssi/spotlights/spot-non-citizens.htm

The up-front cost itself however, varies depending on the route chosen by the immigrant. If the cost to immigrate legally is higher, immigrants may choose to travel illegally. The reverse would be true if the cost of doing it illegally is higher.

In the benchmark case, the up-front costs, $C_1$and C_2, for both illegal and legal immigration respectively, are assumed to 0.2 or 20 percent of initial savings. The parameters γ and ξ are assumed to be 0.75 and the probability of an illegal immigrant not being identified and deported is assumed to 0.75.

6.1 Fraction of Legal Wages

The illegal immigrant receives only a fraction, γ, of their true marginal product or their legal wages. Clearly, when making the choice to immigrate, the immigrant would consider the impact of their decision to immigrate legally or illegally on their future income. Strict enforcement of laws against hiring illegal immigrants may push γ low enough for the immigrant to either choose the legal route, or stay back in their home country altogether. Conversely, a high γ may encourage more illegal immigration. For the benchmark calibrations, we use the same values for all parameters as in section 6.1 except γ. Here we start with a high $\gamma = 0.90$. As can be seen in table 3.2, when illegal immigrants receive 90 percent of the legal wages, only 59.25 percent immigrants choose the legal route. As expected, as the level of labor market discrimination faced by illegal immigrants increases, more and more immigrants choose the legal route. When immigrants only receive 10 percent of the legal wages if illegal, more than 86 percent choose the legal route. Clearly, the level of labor market discrimination faced by illegal immigrants is an important determinant in the choice between legal and illegal immigration. The demographic profile of the 2 types of immigrants remain similar.

6.2 Fraction of Transfers

Table 3.3 gives the results for this section.The illegal immigrant also receives only a fraction of the government transfers[6], ξ. For the benchmark case, all other parameters again remain as in section 6.1 except ξ. When $\xi = 1$, 61.75 percent of the immigrants choose the legal route. However, as the fraction of government transfers received by illegal immigrants decreases, we only observe a small increase in the number of immigrants choosing the legal route. In fact, below $\xi = 0.5$, the number of immigrants choosing the legal route is almost constant. This may be indicative of the fact that choice of immigration routes are not primarily driven by the expectation of availing government transfers in the immigrant receiving country. Again, the demographic profile of the 2 types of immigrants remain similar.

6.3 Probability of Identification and Deportation

It may also be informative to look how the probability of being identified and eventually deported may determine the initial choice of immigration route. Table 3.4 gives the results for this analysis. We define p as the probability of *not* being identified and deported. Here again, the parameters are as in section 6.1 for the benchmark case except p. We begin with a situation where there is no chance of an illegal immigrant, once in the country, to be identified and deported, $1 - p = 0$. In this case the model predicts that no immigrant would choose the legal route. At the same time, with a 50 percent or higher chance of being caught and deported, no one chooses to immigrate illegally. Clearly, identification and deportation plays a significant role in discourag-

[6]The US Government Accountability Office (GAO) found that in FY 1995, $1.1 billion from the Aid to Families with Dependent Children (AFDC) went to families with an illegal immigrant as the head of the houehold (HEHS-98-30, Nov 1997). More recently, the Survey of Income and Program Participation (2012) found that 62% of illegal immigrant household were receiving some form of welfare.

ing illegal immigration. Again, the demographic profile of the 2 types of immigrants remain similar.

7 Conclusion

This articles presents a model of the choice between immigrating legally or illegally for a potential immigrant. We employ a discrete choice dynamic programming framework (see Keane, Todd, and Wolpin, 2011) to model the immigrant's initial decision. If the immigrant decides to immigrate legally, there is a probability of them being denied entry. However, once granted entry, they face no uncertainty about their future and earn their true marginal product each period hence. The illegal immigrant faces a high up-front cost but guaranteed entry. However, once in the country, they face a probability of being identified and deported. In addition, the immigrant also has the choice of not immigrating and remaining in their home country. Note that this would also apply to a situation where a legal immigrant was denied entry or an illegal immigrant was deported. The immigrant chooses the option that affords them the highest discounted lifetime utility.

The structural model is simulated using data from the Legalized Population Survey 1 (LPS 1 of 1989) and the Current Population Survey (CPS 1990). The analysis is limited to immigrants from 4 countries - Mexico, El Salvador, Guatemala, and Colombia, which make up the largest share of the illegal immigrant population in the US.

The article presents some key results that could inform the direction of future policy regarding immigration, in particular, illegal immigration. Holding the up-front cost of either choices constant, it appears that the choice is not motivated by the desire to enjoy government transfers. The key components in the choice are the fraction of

legal wages received by illegal immigrants and the probability of being identified and deported. When immigrants receive 90 percent of the legal wages, about 41 percent choose the illegal route whereas when the fraction is 10 percent, only 13 percent choose the illegal route. Similarly, when the probability of being identified and deported is 0, all immigrants choose the illegal route. At the same time, with a 50 percent or higher chance of being caught and deported, no one chooses to immigrate illegally.

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Appendix D: Chapter III Figures

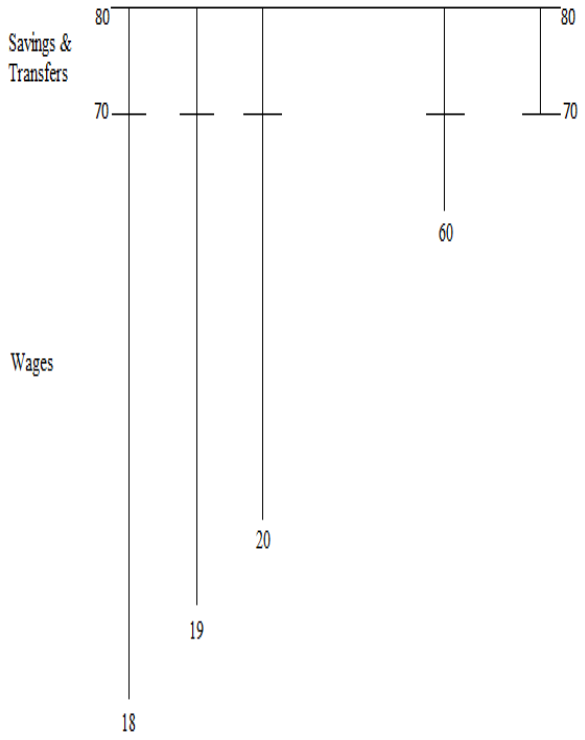

Figure 3.1: Lifetime Earnings

Appendix E: Chapter III Tables

Table 3.1: Summary Statistics

	LPS (1979-1981)			CPS (1979-1981)			CPS (1982-1984)		
	Full Sample	Male	Female	Full Sample	Male	Female	Full Sample	Male	Female
Observations	1,600	876	724	10,616	6,717	3,900	2,359	1684	675
Mean age	30.77	29.84	31.89	31.94	31.87	32.07	29.21	28.74	30.41
Mean EDUC	11.34	11.37	11.30	11.70	11.64	11.80	11.62	11.57	11.76
% with less than high school degree	79.00	76.46	82.07	61.70	64.36	57.13	64.69	66.63	59.85
% with high school degree	14.95	16.92	12.57	22.18	21.54	23.28	21.53	20.96	22.96
% with 1-2 years of college	1.78	1.74	1.83	3.49	2.46	5.28	10.22	9.20	12.74
% with 4 years of college	0.47	0.54	0.39	2.33	2.19	2.56	2.46	2.20	3.11
% with more than 4 years of college	0.36	0.43	0.26	1.28	1.34	1.18	1.10	1.01	1.33
% Employed	79.81	93.22	63.67	84.13	88.25	77.03	86.73	90.56	77.19
Mean income (Employed)	2.14	2.37	1.74	2.57	2.74	2.22	2.35	2.45	2.04
% income < $6,000	19.57	10.29	36.11	15.79	11.88	23.50	17.55	13.57	29.17
% income > = $6,000 and < $12,000	50.81	48.91	54.06	32.18	28.24	39.95	41.06	40.26	43.38
% income > = $12,000 and < $20,000	25.60	34.75	9.40	32.13	35.21	26.07	29.37	32.39	20.54
% income > = $20,000 and < $30,000	3.33	4.96	0.43	13.68	16.45	8.22	8.36	9.70	4.41
% income > = $30,000	0.70	1.09	-	5.19	7.00	1.63	2.83	3.15	1.92
Mean Welfare Income	0.13	0.12	0.14	0.01	0.01	0.02	0.02	0.01	0.02
Mean EXP (age - education -6)	13.42	12.46	14.58	14.24	14.23	14.26	11.59	11.17	12.64
% in Agriculture and Allied Sectors	26.31	35.47	8.14	10.64	13.28	6.10	15.26	18.17	8.00
% in Construction	8.84	13.14	0.33	9.97	15.08	1.15	12.38	16.57	1.93
% in Manufacturing	19.98	17.57	24.75	27.61	26.85	28.90	25.40	24.53	27.56
% in Transportation and Allied Sectors	3.16	4.59	0.33	3.25	4.22	2.02	2.41	2.43	2.37
% in Professional Services	3.82	2.64	7.17	7.93	4.32	14.13	5.05	3.14	9.78
% Married	58	54.79	61.88	63.74	66.10	59.67	56.51	55.29	59.56
Number of Children in Household (mean)	1.16	0.85	1.54	1.61	1.55	1.72	1.08	0.96	1.38
% Cannot Speak English at all	15.81	11.30	21.27	8.87	7.56	11.13	13.65	12.71	16.00

Table 3.2: Decision Based on Fraction of Legal Wages Received by Illegal Immigrants

Fraction of Legal Wages (γ)	% Immigrating Legally
0.90	59.25
0.80	61.25
0.70	63.50
0.60	65.00
0.50	68.00
0.40	71.00
0.30	74.75
0.20	79.25
0.10	86.50

Note: $\xi = p = 0.75$; $C_1 = C_2 = 0.20$

Table 3.3: Decision Based on Fraction of Government Transfers Received by Illegal Immigrants

Fraction of Government Transfers (ξ)	% Immigrating Legally
1	61.75
0.75	62.00
0.50	63.25
0.25	63.25
0	63.50

Note: $\gamma = p = 0.75$; $C_1 = C_2 = 0.20$

Table 3.4: Decision Based on the Probability of Being Identified and Deported

Probability of Being Identified and Deported $(1-p)$	% Immigrating Legally
0	0
0.25	62
0.50	100
0.75	100
1	100

Note: $\gamma = \xi = 0.75$; $C_1 = C_2 = 0.20$