Working Paper No. 689

Effects of Legal and Unauthorized Immigration on the US Social Security System*

by

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October 2011

*We gratefully acknowledge the support from the SSA through grant number UM11-07 of the Michigan Retirement Research Center, and the useful comments and suggestion of participants at the 2011 MRRC Research Workshop and the 2011 RRC Conference, as well as the applied micro workshop at Stony Brook. Yan Liu and Yi Zhang provided superb research assistance. The usual disclaimer applies.

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Abstract

Immigration is having an increasingly important effect on the social insurance system in the United States. On the one hand, eligible legal immigrants have the right to eventually receive pension benefits but also rely on other aspects of the social insurance system such as health care, disability, unemployment insurance, and welfare programs, while most of their savings have direct positive effects on the domestic economy. On the other hand, most undocumented immigrants contribute to the system through taxed wages but are not eligible for these programs unless they attain legal status, and a large proportion of their savings translates into remittances that have no direct effects on the domestic economy. Moreover, a significant percentage of immigrants migrate back to their countries of origin after a relatively short period of time, and their savings while in the United States are predominantly in the form of remittances. Therefore, any analysis that tries to understand the impact of immigrant workers on the overall system has to take into account the decisions and events these individuals face throughout their lives, as well as the use of the government programs they are entitled to. We propose a life-cycle Overlapping Generations (OLG) model in a general equilibrium framework of legal and undocumented immigrants' decisions regarding consumption, savings, labor supply, and program participation to analyze their role in the financial sustainability of the system. Our analysis of the effects of potential policy changes, such as giving some undocumented immigrants legal status, shows increases in capital stock, output, consumption, labor productivity, and overall welfare. The effects are relatively small in percentage terms but considerable given the size of our economy.

Keywords: Legal and Undocumented Immigration; Social Security; Remittances; Life-cycle Models; OLG Models; General Equilibrium Models

JEL Classifications: J14, J26, J65

1 Introduction

The effect of immigration on the social insurance system is a policy issue of growing importance that needs to be carefully analyzed and discussed by economists and policy makers. Immigration to the United States has grown rapidly for the last four decades. The foreign-born share of the U.S. population went up from 5 to 12.5 percent between 1970 and 2007 (Borjas, 2009). In fact, the foreign born population reached approximately 40.2 million by 2010 with almost 30 percent of the foreign born entering the United States within the last decade (American Community Survey, 2009). Moreover, the immigrant population aged during the time period, and the share of immigrants in the population who are older than age 65 went up from 8 percent during the 1990s to 12.5 percent by 2008.[1] Additionally, as of March 2010 (Passel and Cohn 2011) the number of undocumented immigrants has reached approximately 3.7 percent of the total population, with a total of 11.2 million people, and the number of legal immigrants is around 29 million, at around 9.58 percent of the population. While research on the effects of migrants on local labor markets has attracted considerable attention,[2] the importance of understanding the effect of immigration on public programs is only recently being recognized.[3]

In a Pay-As-You-Go system, increased immigration has a positive effect on the health of the public pension system, at least in the short and medium run. Migrants who work pay their labor taxes, and given that these individuals are generally young, their taxes are used to support the benefits payments of the older generations. The statement is certainly true for legal immigrants. Moreover, as Porter (2005) reports, undocumented immigrants, working under Individual Taxpayer Identification Numbers or sometimes fake Social Security numbers, in many cases also pay Social Security taxes but are unlikely to receive the benefits from their withholdings, suggesting that at least in this dimension, undocumented immigration contributes positively to the

[1] In fact 17 percent of the legal immigrant adults are above age 65, but only 1.3 percent of the unauthorized immigrant adults are above that age, compared with 16.4 percent for U.S. native adults (Passel and Cohn, 2009).

[2] See Greenwood (1975, 1997), Borjas (1994), Friedberg and Hunt (1995), Lucas (1997), and Gallup (1997). HDR (2009) provides an illuminating discussion of current trends and possible policy reforms related to international migration.

[3] See Lee and Miller (1997, 2000), Bonin, Raffelhüschen, and Walliser (2000), Storesletten (2000, 2003), Auerbach and Oreopolis (2000), Wilson (2003), Collado, Iturbe-Ormaetxe, and Valera (2004), Schou (2006), and Sand and Razin (2007).

financial health of the system. The long run effects on the system, however, will depend on whether these immigrants are net contributors to the system given their wage paths, their labor histories, program participation, length of stay in the U.S., and their other needs likely to be covered by the social insurance system in place. To determine this, one needs to take into account several important dimensions. First of all, legal immigrants not only have the right to eventually receive pension benefits, but also disability, health care, and unemployment insurance. In fact, they may be more likely to receive some of these benefits given their characteristics and constraints when they arrive in the United States.[4] Second of all, undocumented immigrants pay some taxes but are in principle not eligible, becoming net contributors to the system. However, they may obtain legal status, in which case their characteristics and comparatively lower health investments will probably make them more costly for the social insurance system. Third, around 30 percent of immigrants migrate back to their countries of origin within 10 years of immigration (Duleep and Dowhan 2008a), possibly losing eligibility to the social programs due to short spells of work in the U.S.[5] We therefore conclude that any analysis that tries to understand the impact of immigrant workers on the overall system has to take into account the decisions and events different types of immigrants face throughout their lives, as well as the use of all the government programs they are entitled to. Empirically, when we look at individual programs, we find that 14 percent of immigrants older than age 25 are participating in Social Security compared to 20 percent of natives in the same age group. This is not surprising due to differences in age distribution as well as the differing rates in length of stay in the United States.

An important issue, and key aspect of our research, when considering possible reforms to the system is the tension between the decisions regarding domestic savings and remittances that immigrants make. In the General Equilibrium framework we present we make this explicit, and analyze the differential effects on the economy between resources saved in the host country versus resources sent back to the country of origin.[6] The former foster

[4]Borjas and Hilton (1996) document the differential usage of public programs by immigrants.

[5]Depending on the country of origin, some legal immigrants might receive Social Security benefits after working for a period in their countries thanks to reciprocity agreements signed by the U.S. According to Passel (1999), only 25 percent of undocumented immigrants stay more than 10 years in the United States.

[6]Cespedes (2011) presents a General Equilibrium model of immigrants from the point

economic growth, while the latter do not improve the economic conditions of the country even if they provide utility to the senders. If documented immigrants save more domestically while undocumented immigrants send a higher proportion of their resources overseas, any reform might have a sizable positive effect on economic growth via savings, but the final effect is a function of the possible increase in the social insurance expenditures linked with creating a framework in which the number of undocumented immigrants who have lived in the U.S. for a long time is minimized.

Regarding remittances, immigrants that are planning to stay longer are less likely to send money back home, and in return save more money to increase their capital and future earnings. This is important information, and when coupled with the evidence from the Mexican Migrant Survey (2005), which indicates that 38 percent of those who do not have legal U.S. identification plan to return back to Mexico within a five year period, points in the direction of the differential savings vehicles we have mentioned above. In terms of orders of magnitude, according to the Mexican Migration Project, 65 percent of immigrants sent back remittances on a monthly basis with the average monthly remittance nearing 263 dollars in real terms.

The objective of the analysis is to understand the long term effects of legal and unauthorized immigration on the financial viability of the U.S. economy in general, and the Social Security system in particular. We present an equilibrium model of the key decisions of immigrants. We analyze their decisions regarding their labor supply productivity, consumption, wealth accumulation, and retirement, and we will account for the different incentive structures and eligibility rules faced by legal and undocumented immigrants regarding their retirement and their unemployment benefits. We propose the equilibrium setting to account for the macroeconomic effects of immigration, given that the general equilibrium effects of migration are particularly important when studying the sustainability of social insurance programs, since changes in wages, labor productivity and interest rates directly affect the government budget through changes in tax revenues and government debt.[7] Additionally, as mentioned earlier, the differential savings strategies of docu-

of view of the country of origin, in which households stochastically face a probability of sending remittances, and then choose them endogenously.

[7]Most research, including Storesletten's (2000) and Wilson (2003) general equilibrium setting, does not account for the endogenous participation of immigrants in social insurance programs. Kemnitz (2003) does account for the presence of unemployment insurance but not other programs.

mented and undocumented immigrants and their effect on economic growth makes this equilibrium framework a key aspect in understanding the effects of possible reforms to the system.

The set up of the problem faced by legal and undocumented immigrants is a multi-period problem in which individuals start their careers in the host country around the age of entering the labor market. Given the empirical evidence, immigrants start with relatively low wages but within a decade legal immigrants can obtain levels of wages more in line with those of natives while undocumented immigrants continue to earn substantially less. From the ACS 2009, we find that immigrants and natives had the same rate of gainful employment at 78 percent, and immigrants (without distinction between legal and undocumented) were making approximately $3,200 less on annual salary and wage income compared to their native counterparts. In the model, immigrants choose work but face unemployment shocks, and choose how much to consume and save. They obtain wages and are subject to unemployment uncertainty, which for the moment we will model in a simplified framework assuming a stationary distribution of employed and unemployed individuals. Wages are taxed independently of the legal status, and legal immigrants may receive a public pension when they reach a certain age and will be covered by unemployment insurance if needed. Undocumented immigrants do not have access to Social Security benefits but can receive unemployment insurance at a slightly lower level (proxying for welfare programs) than natives and legal immigrants.

A key aspect mentioned earlier is the savings behavior of these different types of immigrants.[8] Legal immigrants save mostly through domestic accumulation of capital, which in our model is directly linked with economic growth but they do send a proportion of their savings back to their country of origin in the form of remittances. On the other hand, undocumented immigrants save a bit less but this is mostly reflected through remittances back to their countries of origin. The key results of our model regarding

[8]Since the model should distinguish between documented and unauthorized immigrants, we use Passel's (1999) residual approach to identify and assign status to immigrants in CPS data, the American Community Survey (ACS), and we also use intensively the Mexican Migrant Survey of 2005, and the more recent Mexican Migration Project, and the Latin American Migration Projects. Wages are separately modeled for natives, legal and undocumented immigrants following the empirical evidence from the ACS and the other data sets mentioned.We have benefited from recent work in the area of projecting earnings for immigrants by Duleep and Dowhan (2008a and 2008b).

reforms to the system come from the tension between the positive effects on economic growth of legalizing certain undocumented immigrants because of the increased savings and increased labor productivity of the newly legalized immigrants, versus the possible increased social insurance costs coming from those newly legal immigrants who now have the right to receive the benefits of the system at the same level as legal immigrants and natives.

The model we propose is computationally intensive but manageable, and while apparently some researchers believe that this topic is better analyzed within simple reduced form models, we believe it is essential to set the migration policy reform debate within a framework that can account for the consequences in the general economy of legalizing a proportion of the more than 11 million illegal immigrants we have in our country. A purely empirical exercise, or even a partial equilibrium analysis, would fall short of a proper analysis of immigration reform, so we have chosen to use a state-of-the-art macroeconomic model strongly founded in the empirical and microeconomic evidence regarding immigrants in the United States.

The model we present is a multi-period OLG model in which we have two types of immigrants, which differ in several dimensions. The three key dimensions have to do with savings, usage of the social insurance system, and labor productivity. Legal migrants save a much larger proportion of their income domestically, which has a positive effect on economic growth, while undocumented immigrants choose remittances as their main way to save, which only affect positively the country of origin of those immigrants. Regarding usage of the social insurance system, legal immigrants are in this case the main users, with undocumented immigrants not being able to benefit from it as much. Additionally, these two groups face different wage productivities, with legal migrants able to obtain the same wages as natives thanks to the fact that their abilities are better matched as opposed to undocumented immigrants.

This model allows us to exemplify a key aspect we believe should be part of the debate regarding immigration reform, which is the tension between the contribution to economic growth of legal and undocumented immigrants (through savings and labor productivity), versus the costs they subject the system to through the usage of social insurance provisions. This trade-off is critical to successfully analyze the optimal type of reform, and also to take into account which variables to consider when proposing a path to legalize undocumented immigrants.

We find significant positive effects of legalization on capital stock, output,

consumption levels, labor productivity, and the overall welfare of individuals, even though the unemployment insurance tax and the Social Security tax increase slightly. While the overall effects are small in percentage terms, given the size of our economy, the level effects are considerable and increasing in the rate of legalization.

The structure of the paper is the following. After presenting some empirical evidence on legal and undocumented immigration in Section 2 which will guide the parametrizations in our model, we describe the model in Section 3. In Section 4 we discuss the calibration of the model to the US economy, and Section 5 describes the benchmark results as well as the policy experiments we propose and their consequences for the economy. Section 6 concludes.

2 Important Facts about Immigration

The role of immigration on the Social Security System is two-fold: Legal immigrants contribute taxes to the Social Security Trust Funds. Some return to their country before they work long enough to become eligible for benefits whereas others eventually become beneficiaries of the system. Unfortunately, data is not available on the number of immigrants who emigrate back before becoming eligible to receive benefits from the system. The Social Security Administration, in its projections, assumes that 83 percent of emigrants (estimated to be 30 percent of legal immigrants annually) leave the United States before becoming eligible to receive benefits (Duleep, 1994). Undocumented immigrants, on the other hand, are not able to collect benefits unless they are legalized later while according to Social Security Administration (SSA) actuaries about half of them are assumed to pay social security taxes. Additionally, immigrants support other social insurance programs by paying other forms of taxes and they benefit from some of these programs.

Before discussing the key features of immigration data in our model, we discuss the main stylized facts regarding immigrant population in the United States using data from American Community Survey (2009). Foreign born population reached approximately 40.1 million by 2009 (around 40.2 million by 2010 as discussed in Passet and Cohn 2010) with almost 30 percent of the foreign born entering the United States within the last decade. More than a quarter of the foreign born population was born in Mexico, representing the largest source of immigration to the United States. The immigrant population clusters around prime working age as 79 percent of immigrants were

between ages 18 to 65 while only 60 percent of natives were in this age group in 2009. Immigrants and natives had the same rate of gainful employment at 78 percent. Immigrants are slightly more likely to be unemployed with an unemployment rate of 6.4 percent compared to 6.1 percent of natives (Table 1). However, unemployment was more prominent among recent immigrants as the rate goes up to 7.8 percent among immigrants who entered the United States within the last decade. The same trend holds when we restrict our attention to older individuals (age 40 and over). Only 4 percent of the native population was unemployed in this age group compared to 5.2 percent of immigrants. When it comes to social insurance programs, we observe the opposite trend as immigrants are less likely to be beneficiaries of Social Security income that includes Old Age benefits as well as permanent Disability Insurance (20.1 percent among natives versus 13.7 percent among immigrants, see Table 1). This gap occurs both due to differences in age compositions of natives versus immigrants as well as eligibility requirements. Immigrants are less educated than natives where nearly 27 percent of immigrants lack a high school diploma compared to only 8 percent of natives aged 18 or more (Table 2). Moreover, there is no increase in education attainment for recent immigrants suggesting that the wage gap between immigrants and natives results in lower per worker contributions to Social Security among immigrants compared to natives.

For the analysis of role of immigration in the model, we need three measures. First is the amount of remittances, which reduces the available capital in the United States and varies between unauthorized and legal immigrants and will be further discussed in the next chapters. Unfortunately, there is no single data source available to measure the amount of remittances sent from the United States. We will rely on information from two companion data sets: the Mexican Migration Project (MMP), which started in 1982 to study the migration patterns of Mexicans within Mexico and the United States and the Latin American Migration Project (LAMP), which employs the same methodology to add Latin America and the Caribbean to the analysis and is a more recent study. In both projects, interviewers gathered a complete life history for the household head that returned to his home country. Datasets provide detailed information on past migration experiences in the United States including earnings, taxes paid as well as savings and remittances. Moreover, interviewers administered identical questionnaires to households in the United States, from the same communities in those countries who did not return to their country of origin. Jointly these two datasets contain ten

countries including Mexico, Puerto Rico, Dominican Republic, Nicaragua, Costa Rica, Peru, Haiti, Guatemala, Columbia, and El Salvador. While these datasets are far from complete to give us the whole picture of remittances, these communities correspond to countries that sent more than half of immigrants that are currently settled in the United States. Combining two datasets, we have 9,328 observations. Table 3 shows rates of remittances and savings as well as average monthly remittances and savings with positive values adjusted for inflation to 2008 prices. Nearly two-thirds of all households sent monthly remittances with the average remittance being 404 dollars per month among the households who sent remittances. Sending remittances is more common among unauthorized immigrants with nearly three quarters of households with unauthorized heads sent back money home compared to 55 percent among legal immigrants. Average remittances are 12 dollars higher among legal immigrants who actually send home money. On the other hand, legal immigrants save 296 dollars more on average per month nearly doubling the savings of unauthorized immigrants. Therefore, legal immigrants keep relatively more of their overall savings within the United States compared to undocumented immigrants. This is a key feature we will model in our theoretical framework, where the key parameters are the proportion of savings that are remittances. Our calculations show that, on average, legal immigrants send 40 percent of their savings as remittances whereas undocumented immigrants send 62 percent of their savings. This substantial difference will be one of the keys in our model and one of our contributions in this study, since any legalization of immigrants will result in a higher proportion of savings staying in the US, promoting capital formation and economic growth. Similar trends to those describe are apparent when we look at educational attainment as well as years resided in the United States. More educated immigrants are less likely to send remittances back home and more likely to save with a higher average amount compared to less educated immigrants. Similarly, the longer an immigrant stays in the United Stated, the less likely that s/he sends money back home while saving more.

Another important aspect in our model has to do with the labor productivity of the different types of immigrants. The best empirical approximation to this issue is wages, and for that we again have access to the Mexican Migration Project, which we have analyzed ourselves, and the work of Passel and Cohn (2011) who also analyze this issue. As discussed directly in Figure 22 of Passel and Cohn (2011), and Table 4 below using the ACS 2009 and the MMS 2005, the wages of undocumented immigrants are substantially lower

than for legal immigrants and natives, even after considering only those who have been in the U.S. for a long period of time as done in Passel and Cohn (2011). While different data sources would provide slightly different pictures of these differences, we assume that undocumented immigrants only have access to 80 percent of the potential wages of other types of immigrants and natives. This can vary by age as we see in Table 4, and in future versions of our work we might consider implementing these age specific productivity profiles.

3 The Model

3.1 Overview of the Model: Modeling Immigration

We solve and simulate an extended version of the OLG Life-Cycle model (popularized in the profession by the seminal work of Auerbach and Kotlikoff' book in 1987) in a General Equilibrium framework, in which individuals maximize expected discounted life time utility, which in this case depends on consumption and leisure, and individuals face some of the key incentives from social insurance programs, such as retirement incentives, and unemployment insurance. We formally acknowledge that individuals face several sources of uncertainty, including life-time and employment uncertainty. Individuals own the firms of the economy that produce output with constant returns to scale, and maximize profits leading to competitive factor prices, capital and labor. The government collects taxes to provide goods and services, including a Social Security and Unemployment Insurance system.

In terms of the role of migration in this model there are three key features, which we discuss in turn below.

First, both legal and undocumented immigrants differ from natives in that part of their savings is in the form of remittances. These remittances are very important in the model for reasons that will be obvious once we introduce the formal model below, and a feature rarely exploited in migration models (Cespedes 2011 is an exception). One interesting aspect of these remittances is that while immigrants think of them as savings (which do provide utility, however, as we will explain below) from the point of view of the US economy they are (strictly speaking) not, because they are not factored into the capital accumulation of the economy, and therefore do not help promote economic growth. In a sense, these savings disappear from the system. Remittances

are a tough problem to tackle given the empirical evidence we have gathered so far, especially given the fact that we would need them measured for legal and undocumented immigrants. Given the data we have discussed in the previous section we will assume that legal immigrants remit a fraction $R_{i,L}$ of their resources to their home country, and undocumented immigrants remit a fraction $R_{i,U}$. In the data the latter is substantially higher than the former. A generalization of this set up would allow remittances to be a continuous choice similar to consumption, something we might consider when extending our already complex model. The key policy move we will discuss later would allow the conversion of some undocumented immigrants to legal immigrants, in our model that will mean that some individuals would switch from making remittances a fraction $R_{i,U}$, to making them a fraction $R_{i,L}$, which in turn would increase the capital stock in the economy, with the positive consequences (which we will describe later) that this has on the economy.

Second, only natives and legal immigrants can receive Social Security retirement benefits, but everyone in the economy pays Social Security taxes. This means that undocumented immigrants do face these taxes (which in principle could be just a fraction of what others pay) but do not get anything out of them. Similarly, everyone in the economy pays unemployment insurance taxes and gets unemployment insurance which is a fraction of their average wages, but undocumented immigrants get a lower replacement rate than natives and legal immigrants. Again, here we are trying to exemplify the fact that undocumented immigrants cannot completely benefit from the social insurance system in place in the economy even if they help support it with their taxes.

Third, the labor productivity of undocumented immigrants will be assumed to be lower than that of natives and legal immigrants, again following the empirical evidence we have presented in the previous section. In particular we will assume, as discussed above, that the labor productivity of undocumented is 80 percent of that of natives and legal immigrants.

The key consequences of our theoretical model regarding policy changes, comes from the tension between the *positive* effects of a move of some individuals to legal status, which leads to more real savings in the economy and higher labor productivity, and therefore more capital accumulation, which leads to lower interest rates and higher growth, and the *negative* ones in the form of additional Social Security payments, and higher unemployment insurance payments. Making this trade-off explicit, is the main contribution of our work.

3.2 Model Details

The economy is populated by households, firms and a government. Households are distinguished by their status $m \in \{0, 1, 2\}$, where $m = 0$ denotes natives, $m = 1$ denotes unauthorized immigrants and $m = 2$ denotes legal immigrants. We will consider a model with no immigration flows, namely, we assume a population distribution with an exogenous share of agents in each status. An important distinction between immigrants and natives is that we assume that a proportion of the immigrants' savings are sent abroad as remittances and this proportion is higher for unauthorized immigrants. Given this, the proportion of immigrants will play an important role for the economy wide savings rate.

Households make investment/savings decisions and are subject to employment and mortality shocks. Firms rent capital and labor from the households to produce output. The government sets payroll taxes (Social Security and Unemployment taxes) for the workers and it provides both Social Security benefits to the retirees and unemployment benefits to the unemployed as long as their status is $m \in \{0, 2\}$. Only a proportion γ of unauthorized immigrants pay taxes but none of the unauthorized immigrants retire or receive Social Security benefits. We denote the set of unauthorized immigrants that pay taxes by I_u, which in the initial version of the model will be set to one for simplicity. Moreover, they receive lower unemployment benefits than the other unemployed agents, which are a proxy for other state welfare programs.

Demographics. Time is discrete. In each period, there are I overlapping generations of agents and population grows at the rate of n. Agents start deriving utility at age 1 and can live up to a maximum of age I. Retirement for agents with status $m \in \{0, 2\}$ is mandatory at age I_r, with $1 < I_r < I$.[9] Unauthorized immigrants do not retire. Agents of age $i < I_r$ are called *workers* and those with age $i \geq I_r$ are called *retirees*. Each agent faces a positive probability of early death which is exogenous and independent of other household characteristics. The probability of surviving from age $i - 1$ to age i is denoted by $s_i \in (0, 1)$, with $s_1 = 1$ and $s_{I+1} = 0$. If we denote by

[9] This is an important simplification since it allows us not to model the claiming and labor supply decision that accompanies the withdrawal from the labor force. Rust and Phelan (1997), French (2005), van der Klaauw and Wolpin (2008), Iskhakov (2010), and French and Jones (2001) make excellent contributions to the structural retirement literature in a partial equilibrium setting. While İnmohoroğlu and Kitao (2009a and 2009b), and Erosa, Fuster, and Kambourov (2011) present a General Equilibrium model with endogenous retirement.

ψ_i the conditional probability to live from period $i-1$ to i, with $\psi_1 = 1$, the unconditional survival probability is calculated from $s_1 = 1$ and

$$s_i = s_{i-1}\psi_i,\ i > 1$$

For example, $s_2 = \psi_2$, $s_3 = \psi_2\psi_3$, ...Due to the probability of death, there are accidental bequests, which are distributed (as assets) among the members of all generations with status $m \in \{0, 2\}$ in the amount t_r. The share of individuals of age i in the population is μ_i, with $\sum_{i=1}^{J} \mu_i = 1$.

Preferences. Agents maximize expected discounted lifetime utility

$$E \sum_{i=1}^{I} \beta^{i-1} \left(\Pi_{k=1}^{i} s_k\right) u\left(c_i, R_i\right)$$

where c_i is consumption, R_i represents the total value of remittances sent abroad, β is the time-discount factor and E is the expectation operator. The instantaneous utility function $u(.,.)$ is strictly increasing and strictly concave in all arguments. Notice that we need to include the remittances in the utility function because otherwise agents see them as a tax on savings, which leads to unrealistically low capital accumulation.

Labor Endowments. Each period, agents below the mandatory retirement age face a stochastic employment opportunity. We assume that an unemployed agent of age i and status $m \in \{0, 2\}$ receives unemployment benefits that are equal to a fraction $\phi \in (0, 1)$ of their wage when employed at age i. Unauthorized immigrants receive a fraction of their wage when employed of $\phi^u < \phi$. Note that unauthorized immigrants do not usually receive unemployment benefits, but we use this as a proxy for other state level welfare programs.

Unemployment insurance is financed with a tax of τ_u on the employed. We let $l \in \{1, \phi, 0\}$ denote the employment state for agents with $m \in \{0, 2\}$ so that the agent is employed if $l = 1$, unemployed if $l = \phi$ and retired if $l = 0$[10]. Similarly, we let $l = \{1, \phi^u\}$ for agents with $m = 1$. The employment shock l is generated by a stationary Markov transition matrix Π^{ϵ} that is identical across agents and over the life cycle, where $\Pi_{ll'}$ is the probability of state l' given l.

[10] Alternatively, this state can also be interpreted as a productivity shock.

If an agent of age i is employed, he supplies one unit of labor and has a labor efficiency of ϵ_i for agents with $m \in \{0, 2\}$ and of $\epsilon_i^u = \rho\epsilon_i$ with $\rho < 1$ for agents with $m = 1$. The total wage income of an individual of age i is given by:

$$w_i = \begin{cases} w\epsilon_i l & \text{if } i < I_r \text{ and } m \in \{0, 2\} \\ w\epsilon_i^u l & \text{if } m = 1 \\ 0 & \text{if } i \geq I_r \end{cases}$$

where w is the aggregate wage rate.

Government Policy. The government runs a Pay-As-You-Go Social Security program in order to provide retirement income. We assume that the retirement system is self-financed. In order to finance retirement benefits, the government collects payroll taxes τ_s from the labor earnings of workers. The Social Security funds are distributed to all retirees who are either natives or legal immigrants. The benefit for an individual of age i is given by:

$$b_i = \begin{cases} 0 & \text{if } i < I_r \text{ or } m = 1 \\ b & \text{if } i \geq I_r \text{ and } m \in \{0, 2\} \end{cases}$$

where b is a fraction θ of the average lifetime employed income for agents with status $m \in \{0, 2\}$:

$$b = \theta \frac{\sum_{i=1}^{I_r - 1} w\epsilon_i l}{I_r - 1}$$

As explained above, unauthorized immigrants do not receive Social Security benefits.

Disposable Income.

The disposable income of an individual with status $m \in \{0, 2\}$ and age i is equal to:

$$q_i = \begin{cases} w\epsilon_i (1 - \tau_u - \tau_s) & \text{if } i < I_r \text{ and } l = 1 \text{ and } m \in \{0, 2\} \\ w\epsilon_i \phi & \text{if } i < I_r \text{ and } l = \phi \text{ and } m \in \{0, 2\} \\ b & \text{if } i \geq I_r \text{ and } m \in \{0, 2\} \\ w\epsilon_i^u (1 - \tau_u - \tau_s) & \text{if } l = 1 \text{ and } m = 1 \text{ and } i \in I_u \\ w\epsilon_i^u & \text{if } l = 1 \text{ and } m = 1 \text{ and } i \notin I_u \\ w\epsilon_i^u \phi^u & \text{if } l = \phi^u \text{ and } m = 1 \end{cases}$$

Asset Structure. Households own financial assets a, which represent claims to capital and debts when they are negative. Capital depreciates at

the constant rate δ. We assume that households face a borrowing limit of $A \geq 0$. This implies that financial assets must satisfy:

$$a \geq -A$$

Production Technology. There is a representative firm that produces output with the constant returns to scale technology:

$$Y = AK^{\rho}L^{\alpha}$$

where A is total factor productivity (TFP), K is aggregate non-housing capital and L is the total labor supplied.

The firm solves a static problem by hiring factors from the households to maximize period profits:

$$\max_{\{L,K\}} AK^{\rho}L^{\alpha} - wL - (r+\delta)K$$

The optimality conditions determine the factor prices $w = \alpha AK^{\rho}L^{\alpha-1}$ and $r = \rho AK^{\rho-1}L^{\alpha} - \delta$ competitively.

Household Problem. In what follows, we write the problem of the household recursively, with primes denoting a variable next period. An agent is characterized by the individual set of state variables $s = (i, l, a, m)$, with $s' = (i+1, l', a', m')$, where i is the age, e is employment state, a is the asset wealth and m is the status as a native or immigrant of different types, with $m' = m$. The maximization problem of households can be written recursively as follows:

$$\begin{aligned} V(i,l,a,m) &= \max_{\{c\geq 0, a'\}} \{u(c_i, R_{i,m}) + \beta s_{i+1} EV(i', l', a', m)\} \text{ s.t.} \quad (1) \\ c_i + a' &= q_i + (1+r)(a(1-r_{i,m}) + t_r|1-m|) + b|1-m| \\ R_{i,m} &= r_{i,m}a' \quad (2) \\ a' &\geq -A \end{aligned}$$

where $r_{i,m}$ represents the proportion of savings that is sent abroad by an agent of age i and status m, where $r_{i,0} = 0$ and $r_{i,1} > r_{i,2}$.

The Bellman equation (1) represents the problem of a household. A household chooses consumption c and financial assets a'. The first constraint is the budget constraint. The first term on the right hand side is the net

income from providing labor supply to the market, multiplied by the idiosyncratic productivity shock e and net of payroll taxes. The second term is the asset income from financial assets, which earns a return of r. The third term denotes the Social Security benefits b_i and the last term is the transfer from accidental bequests. The last constraint is the borrowing constraint. The solution to the dynamic programming problem above yields optimal decision rules $c_i = g_c(i, l, a, m)$, $a' = g_a(i, l, a, m)$.

3.3 Recursive Competitive Equilibrium

Definition. Given the government parameters τ_s, θ, τ_u, ϕ, ϕ^u, a recursive competitive equilibrium is defined as the set of value functions $V(i, l, a, m)$, optimal decision rules $g_c(i, l, a, m)$, $g_a(i, l, a.m)$, aggregate stocks of capital K and labor L, prices r, w transfers t_r, Social Security benefits b_i and a measure $\lambda_i(l, a, m)$ of agents of each age with state s such that:

1. The value function $V(i, l, a, m)$ is the solution to the household's problem defined above and $g_c(i, l, a, m)$, $g_a(i, l, a, m)$ are the associated policy functions.

2. The representative firm maximizes profits, leading to the competitive factor prices

$$r = \rho A K^{\rho-1} L^{\alpha} - \delta$$

$$w = \alpha A K^{\rho} L^{\alpha-1}$$

3. The following market clearing conditions are satisfied:

$$L = \sum_{i=1}^{I_r-1} \sum_{a} \sum_{m:m\in\{0,2\}} \mu_i \lambda_i(a, l=1, m)\, \epsilon_i + \sum_{i=1}^{I} \sum_{a} \mu_i \lambda_i(a, l=1, m=1)\, \epsilon_i^u$$

$$K' = \sum_{i=1}^{I} \sum_{l} \sum_{a} \sum_{m} \mu_i \lambda_i(a, l, m)\, g_a(i, a, l, m)\, (1 - R_{i,m})$$

where $R_{i,m}$ represents the proportion of income that is sent abroad by an agent of age i and status m, where $R_{i,0} = 0$ and $R_{i,1} > R_{i,2}$.

4. The agent measures $\lambda_i(a, l, m)$ and μ_i satisfy:

$$\mu_{i+1} = \frac{s_{i+1}\mu_i}{1+n} \text{ and } \sum_i \mu_i = 1$$

$$\lambda_i\left(a',l',m'\right)=\sum_l\sum_{a:a'=g_a(i,a,l,m)}\sum_m\Pi^{\epsilon}_{ll'}\Pi_{mm'}\lambda_{i-1}\left(a,l,m\right)$$

where the initial measure $\lambda_1\left(a,l,m\right)$ is given and

$$\Pi_{mm'}=\left[\begin{array}{ccc}1&0&0\\0&1&0\\0&0&1\end{array}\right]$$

reflects that immigration status does not change for any agent.

5. The Social Security program and the unemployment insurance are self financed:

$$\begin{aligned}&\tau_s\sum_{i=1}^{I_r-1}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i\left(a,l=1,m\right)w\epsilon_i\\&+\gamma\tau_s\sum_{i=1}^{I}\sum_a\mu_i\lambda_i\left(a,l=1,m=1\right)w\epsilon_i^u\\=&\sum_{i=I_r}^{J}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i\left(a,l,m\right)b\\&\tau_u\sum_{i=1}^{I_r-1}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i\left(a,l=1,m\right)w\epsilon_i\\&+\gamma\tau_u\sum_{i=1}^{I}\sum_a\mu_i\lambda_i\left(a,l=1,m=1\right)w\epsilon_i^u\\=&\sum_{i=1}^{I_r-1}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i\left(a,l=\phi,m\right)\phi w\epsilon_i\\&+\sum_{i=1}^{I}\sum_a\mu_i\lambda_i\left(a,l=\phi^u,m=1\right)\phi^u w\epsilon_i^u\end{aligned}$$

Note that this implies that

$$\tau_u=\frac{0.06\left[\phi\left(0.8672+0.0958\right)\sum_{i=1}^{I_r-1}\mu_i\epsilon_i+\phi^u 0.037\sum_{i=1}^{I}\mu_i\rho\epsilon_i\right]}{0.94\left[\left(0.8672+0.0958\right)\sum_{i=1}^{I_r-1}\mu_i\epsilon_i+\gamma 0.037\sum_{i=1}^{I}\mu_i\rho\epsilon_i\right]}$$

$$\tau_s = \frac{b \sum_{i=I_r}^{J} \sum_a \sum_{m:m\in\{0,2\}} \mu_i \lambda_i (a, l=0, m)}{w \left[\sum_{i=1}^{I_r-1} \sum_a \sum_{m:m\in\{0,2\}} \mu_i \lambda_i (a,1,m) \epsilon_i + \gamma \sum_{i=1}^{I} \sum_a \mu_i \lambda_i (a,1,1) \epsilon_i^u \right]}$$

Where we introduce the assumption that the stationary employment distribution results in a stationary unemployment rate of 6 percent, and we introduce the proportion of the population in each status that indicates whether the agent is a native, a legal immigrant, or an unauthorized immigrant. Here we use the calculations from Passel and Cohn (2011) that indicate that the 11.2 million undocumented immigrants represent 3.7 percent of the population (as of March of 2010), while the 29 million legal immigrants represent 9.58 percent of the population, and the rest are natives representing 86.72 percent of the total population of the U.S.

6. Accidental bequests satisfy:

$$\sum_i \sum_l \sum_a \sum_m \mu_i \lambda_i (a,l,m) g_a (i,a,l) (1 - R_{i,m}) (1 - s_{i+1}) = tr$$

Using the market clearing conditions, it is easy to show that the aggregate resource constraint of the economy is:

$$C + K' = (1-\delta) K + Y$$
$$\text{where } C = \sum_i \sum_a \sum_l \sum_m \mu_i \lambda_i (a,l,m) g_c(i,a,l,m)$$

4 Calibration and Solution Method

4.1 Calibration

In the model, one period represents one year. Period 1 in the model corresponds to the actual age group of 21 and agents can live for a maximum of $I = 65$ periods, implying that death is certain after period 65 (age of 85). I_r is set to 45, implying that agents in the native and legal immigrant category retire at the actual age of 65. The annual population growth n is set at 1.2 percent, corresponding to the average annual population growth in the US over the last 50 years. The survival probabilities s_i are taken from the Life Tables of the Social Security Administration.

The Social Security tax is set to match a replacement ratio θ of 40 percent over the average wage income and the unemployment insurance ratio is set

to $\phi = 30percent$ of the employed wage for agents with status $m \in \{0, 2\}$, and $\phi^u = 20percent$ for undocumented immigrants.

Regarding the preferences, the instantaneous utility function takes the following form:

$$u(c, R) = \frac{c^{1-\sigma}}{1-\sigma} + A_R R$$

where the risk aversion parameter σ is set to 2. The parameters δ, β and α are calibrated to match long run ratios computed from NIPA data to ensure that our economy conforms to the US ratios of $\frac{I}{Y} = 0.24$ and $\frac{K}{Y} = 2.8$ in the postwar period, as well as to the capital income share in the US data. The parameter A is chosen to be 1, just as a normalization, and A_R is normalized to 10. In what follows, we describe the construction of these ratios.

For simplicity, we assume that the growth rate of output is zero. This implies that the cross-sectional efficiency profile is the same as the longitudinal profile for a given household. We look at averages for the years 1947 to 2008. We define the capital stock K to include private fixed assets, the stock of inventories and the stock of consumer durables. Accordingly, I includes private investment, changes in inventories, consumer durable spending and net exports.

Our definition of Y in the above ratios captures GDP. Given our treatment of consumer durables as capital stock, we also need to add the flow of services from consumer durables to our measure of Y. These flows are imputed in a manner identical to Cooley and Prescott (1995), explained below.

The above calculations determine the four ratios mentioned above. For the computation of the capital share in the production function, we follow Cooley and Prescott's (1995) approach closely. In particular, we first look at GDP. Using *Gross Domestic Income* Table 1.10, we define Labor Income (LI) to be compensation of employees, Unambiguous Capital Income (UCI) to be rental income, corporate profits, interest and business current transfers and Ambiguous Capital Income to include all the rest (i.e., proprietor's income, taxes on production and imports, less subsidies and the current surplus of government enterprises). We also define depreciation (DEP) to be the consumption of fixed capital. A preliminary share of capital income in private income excluding housing θ_p can then be calculated as

$$\theta_p = \frac{UCI + DEP}{GDP - ACI}$$

Using this share we calculate capital income in measured GDP excluding

housing as $\theta_p(GDP)$ and use this to impute the return to capital as

$$i = \left(\theta_p \left(GDP\right) - DEP\right)/K$$

We then look at consumer durables and estimate their depreciation rate by computing the investment to stock ratio and subtracting the growth rate of real GDP (an average of $3.3 percent$). The return i and the individual depreciation rates are then used to impute the value of service flows from consumer durables. The imputed flow is added to our measure of Y. The capital share is then recomputed by adding this flow to capital income and to GDP, which yields the share α.

Given that we do not explicitly model a government, we have to choose how to deal with the government sector in the data. Our treatment implicitly assigns all government expenditures (consumption and investment) to private consumption. An alternative approach would be to only focus on private GDP and completely exclude the government sector from our calculations.[11] Following this approach, and assuming that capital and labor shares are the same in the government and in the private sector, has a negligible effect on our calibrated parameters.

We assume that the population growth rate is equal to $n = 0.012$, corresponding to the US population growth in the postwar period, and we construct the depreciation rate for capital given our targets,

$$\delta = \frac{\frac{I}{Y}}{\frac{K}{Y}} - n = \frac{0.237}{2.8} = 0.0726$$

To calculate the deterministic earnings profiles, we have used CPS data for natives. We assume that legal immigrants have the same earnings profiles as natives and the profile for unauthorized immigrants is 80 percent of the profile for natives and legals. First, we construct hourly earnings data following the same procedure as Heathcote et. al (2010). Subsequently, we follow Hansen's (1993) procedure to obtain life-cycle productivity profiles by age for each year.

We assume that the share of unauthorized and legal immigrants is 3.7 percent and 9.58 percent of the total population, respectively. We therefore impose the following initial conditions:

[11] Silos (2007) takes this approach.

$$\begin{aligned}
\lambda_1(1,1,0) &= 0.94 \times 0.8672 \text{ and } \lambda_1(1,\phi,0) = 0.06 \times 0.8672 \\
\lambda_1(1,1,2) &= 0.94 \times 0.0958 \text{ and } \lambda_1(1,\phi,2) = 0.06 \times 0.0958 \\
\lambda_1(1,1,1) &= 0.94 \times 0.037 \text{ and } \lambda_1(1,\phi^u,1) = 0.06 \times 0.037
\end{aligned}$$

Note that the following has to be true:

$$\begin{aligned}
\sum_{i=1}^{I}\sum_{a}\sum_{l}\lambda_i(a,l,1) &= 0.037 \\
\sum_{i=1}^{I}\sum_{a}\sum_{l}\lambda_i(a,l,2) &= 0.0958 \\
\sum_{i=1}^{I}\sum_{a}\sum_{l}\lambda_i(a,l,0) &= 0.8672
\end{aligned}$$

This also implies that, for all i

$$\begin{aligned}
\sum_{a}\sum_{l}\lambda_i(a,l,1) &= 0.037 \\
\sum_{a}\sum_{l}\lambda_i(a,l,2) &= 0.0958 \\
\sum_{a}\sum_{l}\lambda_i(a,l,0) &= 0.8672
\end{aligned}$$

We assume an employment rate of 94 percent. The transition probability matrix for the employment probability is chosen so that the probability of employment is equal to

$$\sum_{i=1}^{I_r-1}\sum_{a}\sum_{m:m\in\{0,2\}}\lambda_i(a,l=1,m) + \sum_{i=1}^{I}\sum_{a}\lambda_i(a,l=1,m=1) = 0.94$$

Therefore,

$$\Pi = \begin{bmatrix} 0.94 & 0.06 \\ 0.94 & 0.06 \end{bmatrix}$$

This also implies that the aggregate labor supply is given by:

$$\begin{aligned} L &= \sum_{i=1}^{I_r-1}\mu_i\epsilon_i\sum_a\sum_{m:m\in\{0,2\}}\lambda_i(a,1,m)+\sum_{i=1}^{I}\mu_i\epsilon_i^u\sum_a\lambda_i(a,1,1) \\ &= \sum_{i=1}^{I_r-1}\mu_i\epsilon_i\sum_a\sum_{m:m\in\{0,2\}}\lambda_i(a,1,m)+\rho\sum_{i=1}^{I}\mu_i\epsilon_i\sum_a\lambda_i(a,1,1) \\ & 0.94\left[(0.8672+0.0958)\sum_{i=1}^{I_r-1}\mu_i\epsilon_i+0.037\rho\sum_{i=1}^{I}\mu_i\epsilon_i\right] \end{aligned}$$

and the unemployment tax rate can be written as follows

$$\begin{aligned} \tau_u &= \frac{\sum_{i=1}^{I_r-1}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i(a,\phi,m)\phi\epsilon_i+\sum_{i=1}^{I}\sum_a\mu_i\lambda_i(a,\phi^u,1)\phi^u\epsilon_i^u}{\left[\sum_{i=1}^{I_r-1}\sum_a\sum_{m:m\in\{0,2\}}\mu_i\lambda_i(a,1,m)\epsilon_i+\sum_{i=1}^{I}\sum_a\mu_i\lambda_i(a,1,1)\epsilon_i^u\right]} \\ & \frac{0.06\left[\phi(0.8672+0.0958)\sum_{i=1}^{I_r-1}\mu_i\epsilon_i+\phi^u 0.037\rho\sum_{i=1}^{I}\mu_i\epsilon_i\right]}{0.94\left[(0.8672+0.0958)\sum_{i=1}^{I_r-1}\mu_i\epsilon_i+0.037\rho\sum_{i=1}^{I}\mu_i\epsilon_i\right]} \end{aligned}$$

We now need to calibrate the parameters related to immigration. Remittances will be calibrated using data from the Mexican Migration Project and the Latin American Migration Project. The data consist of the proportion savings and remittances by each immigrant type. 74 percent of the unauthorized immigrants and only 55 percent of legal immigrants send remittances. Moreover, the percentage of remittances out of total savings is 62 percent and 40 percent for the unauthorized and legal immigrants respectively. Given this, we set $r_0 = 0$, $r_1 = 62percent$ and $r_2 = 40percent$. To calibrate the efficiency profiles of the unauthorized immigrants we have used data from the same sources. The data indicate that the wages of unauthorized immigrants are between 70 percent and 80 percent of the wages of natives and legal immigrants. Given this, we will set $\rho = 0.75$ for the ages in which natives and legal work, and for the ages 65 to 85 we extrapolate the productivity linearly. For the benchmark case, we assume that all unauthorized immigrants pay taxes, implying that $\gamma = 100percent$. Later on we will relax this assumption. Finally, we set $\phi^u = 20percent$ for agents with status $m = 1$.

4.2 Solution Method

To solve the model, we use a value function iteration algorithm. First, we guess a value for K and tr. This allows us to calculate the factor prices w and r. Since the efficiency of labor is exogenous, we can also calculate the aggregate labor supply L, the unemployment tax τ_u, the Social Security benefits b and the Social Security tax rate τ_s. Second, we guess initial value functions and policy functions for workers and retirees conditional on their status and we solve the individual problem backwards starting from their last period of life. Note that the wealth of a retiree is equal to

$$\omega_i = b\left|1-m\right| + \left(1-\tau_s-\tau_u\right) w\epsilon_i \left(1-\left|1-m\right|\right)$$

whereas the wealth of a working agent is equal to:

$$\begin{aligned}
\omega_i &= \left(1+r\right)\left(a\left(1-r_{i,m}\right)+t_r\right) + \left(1-\tau_s-\tau_u\right) w\epsilon_i \text{ if } l=1 \text{ and } m\in\{0,2\} \\
\omega_i^u &= \left(1+r\right)\left(a\left(1-r_{i,m}\right)+t_r\right) + \left(1-\tau_s-\tau_u\right) w\epsilon_i^u \text{ if } l=m=1,\ i\in I_u \\
\omega_i^u &= \left(1+r\right)\left(a\left(1-r_{i,m}\right)+t_r\right) + w\epsilon_i^u \text{ if } l=1 \text{ and } m=1 \text{ and } i\notin I_u \\
\omega_i &= \left(1+r\right)\left(a\left(1-r_{i,m}\right)+t_r\right) + \phi w\epsilon_i \text{ if } l=\phi \text{ and } m\in\{0,2\} \\
\omega_i^u &= \left(1+r\right)\left(a\left(1-r_{i,m}\right)+t_r\right) + \phi w\epsilon_i^u \text{ if } l=\phi^u \text{ and } m=1
\end{aligned}$$

Third, we calculate the invariant distribution recursively and we use that to calculate the cross-sectional asset profiles, which can be used to compute the new aggregate capital and bequests. Fourth, we calculate the deviation between the guesses for capital and bequests and the new calculated values. If they are bigger than the tolerance level, we update the aggregates, go back to step 2 and iterate until convergence. Last, we do welfare calculations. To do this, we need to compute the the expected lifetime utility of a newborn conditional on status as follows:

$$\begin{aligned}
&\sum_a \lambda_i\left(a, l=1, m=0\right) V_w\left(i=1, a=0, l=1, m=0\right) \\
&+\sum_a \lambda_i\left(a, l=\phi, m=0\right) V_w\left(i=1, a=0, l=\phi, m=0\right) \\
=\ & 0.94 V_w\left(i=1, a=0, l=1, m=0\right) + 0.06 V_w\left(i=1, a=0, l=\phi, m=0\right)
\end{aligned}$$

$$
\begin{aligned}
&\sum_{a} \lambda_i \left(a, l=1, m=0\right) V_w \left(i=1, a=0, l=1, m=2\right) \\
&+ \sum_{a} \lambda_i \left(a, l=\phi, m=2\right) V_w \left(i=1, a=0, l=\phi, m=2\right) \\
= \;& 0.94 V_w \left(i=1, a=0, l=1, m=2\right) + 0.06 V_w \left(i=1, a=0, l=\phi, m=2\right)
\end{aligned}
$$

$$
\begin{aligned}
&\sum_{a} \lambda_i \left(a, l=1, m=0\right) V_w \left(i=1, a=0, l=1, m=1\right) \\
&+ \sum_{a} \lambda_i \left(a, l=\phi^u, m=1\right) V_w \left(i=1, a=0, l=\phi^u, m=1\right) \\
= \;& 0.94 V_w \left(i=1, a=0, l=1, m=1\right) + 0.06 V_w \left(i=1, a=0, l=\phi^u, m=1\right)
\end{aligned}
$$

5 Numerical Results and Policy Experiments

The results of our model are in terms of economic aggregates as well as the welfare of households. In this section we discuss the comparison between the benchmark model with migration that we presented in the last section, and modified versions of the model in which some undocumented immigrants are legalized. Notice that this is exogenous, as it would be in reality as a function of a legislative move by Congress.

The main policy experiment we have set ourselves to analyze has to do with the consequences of some form of legalization process that makes some undocumented immigrants eligible to become legal immigrants in our country. In our model, the initial proportion of natives and the two types of immigrants are fixed, but the policy experiment can be understood as introducing the possibility of some flexibility in the transitions from undocumented status to legal status.

In principle, any move to legalization in this framework will have three consequences with different effects for the government and the economy. First, legalization is expected to translate into higher savings because those legal immigrants remit a smaller proportion of their resources back to their countries, even if that can be partially offset by the fact that newly legalized immigrants might have to save a bit less than before because now they can receive Social Security and a higher unemployment insurance benefit. By definition, in our model this is exogenous, and this larger capital in the

economy has the positive consequence of lowering the interest rate, increasing the tax base and promoting growth. The economic intuition behind the remittances assumption has to do with the way legal immigrants perceive their attachment to the country, and the likelihood of using their new status to reunite with some family members originally left in the country of origin. The empirical evidence we have presented is in line with these assumptions irrespective of length of stay in the country. Moreover, we find that remittances are higher among those who have been in the U.S. for a shorter period compared to immigrants who stay in the U.S. longer. Since legal immigrants usually stay much longer in the U.S., we expect that legalization will reduce the amout of remittances newly legalized immigrants will send to their country. Second, legalization will bring a higher usage of social insurance programs, including (but not limited in reality) to unemployment insurance and retirement benefits, which is expected to affect the tax rates and the level of benefits. Third, since legal immigrants are more productive than undocumented immigrants as their skills are better matched, the move towards legalization increases the labor supply in the economy and therefore the overall output in the economy, but puts downward pressure on wages, and upward pressure on the interest rate.

Whether legalization of some undocumented immigrants translates into a welfare improving strategy for the country will mainly depend on the relationship between the decline in remittances (and their impact on the economy), and the increase in usage of social insurance programs. This trade-off should be taken into account when discussing legalization policies, and the search for some kind of optimal path to solving the undocumented problem in our country.

Our results shown in Table 5, indicate that legalization of a proportion of undocumented immigrants has a positive effect on economic aggregates as well as welfare. We show in the table three set of results, including the benchmark model with migration using the current (as of March of 2010) distribution of natives, legal immigrants and undocumented immigrants, and experiments of legalization of 30 percent, and 50 percent of undocumented immigrants. Notice that the particular values in levels shown in the table do not have a direct interpretation, since the quantities are normalized, and what we are trying to match are the capital to output ratio, and the investment to output ratio prevalent in the U.S. economy (2.8 and 0.24, respectively). In the table, we can see that those ratios in the model are in all cases very close to our benchmarks.

Legalization leads to increases in capital stock, output, consumption, and labor productivity in all cases. The increases are, however, rather small, of the order of one to two tenths of 1 percent. This should not be surprising since even a 50 percent legalization policy means that only around 1.8 percent of the population will be changing status. Legalization leads to higher capital through the lowering of remittances which compensate for the reduction in precautionary savings due to provision of better social insurance to the newly legalized immigrants. However, legalization results in higher taxes since now the government pays a higher total level of unemployment insurance and Social Security benefits to the newly legalized. Labor supply goes up because newly legalized immigrants are more productive since they have access to better jobs after legalization. As the inputs in the economy increase, output and aggregate consumption go up. On the other hand, the labor supply effect dominates the capital effect on prices in the case of 50 percent legalization. As a result, wages go down while interest rates go up. Social Security benefits are not affected if 30 percent of undocumented immigrants are legalized, but when 50 percent of immigrants are legalized, benefits go down slightly.

While the percentage changes seem very small, we cannot forget that we are talking about effects on a very large economy. When we look at the changes in levels, we estimate that a 50 percent legalization rate would contribute around 36 billion dollars to the economy by increasing the output, providing positive overall welfare to the households. The effects of legalization on aggregates and welfare increase considerably with a high legalization policy.

Interestingly, the welfare effects we find have curious wrinkles to them. We look at welfare changes for four different groups: (1) natives, (2) previous legal immigrants, (3) newly legalized immigrants, and (4) remaining unauthorized immigrants. We find that while natives, previous legal immigrants, and remaining unauthorized immigrants are slightly worse off, as their welfare declines by between 0.1 to 0.2 percent, these losses are negligible compared to newly legalized immigrants' welfare gain in the size of more than 24 percent in both experiments. As a result, the overall welfare of the economy increases by 0.2 percent when 30 percent of unauthorized immigrants are legalized and 0.34 percent when 50 percent of unauthorized immigrants are legalized. Therefore, we conclude that newly legalized households gain substantially as a result of the policy change as they leave the unauthorized state in which they have no access to Social Security benefits and only a fraction of the unemployment insurance. These gains will also

have indirect positive effects on a portion of natives and legal immigrants as most unauthorized immigrants live in mixed households where some of the members of the household are legal while some are not. On the other hand, this composition effect suggests that a welfare redistribution policy would be necessary if the goal of the policy is to make everyone better off, including additional taxes and fees on newly legalized immigrants.[12]

Our results, however, should be taken with caution since we do not model a number of details of the social insurance system that could dampen the positive effects we find, like the access to federal programs that comes with legalization (such as the Social Security Disability Insurance, the Supplemental Security Income, Medicare, and other programs). Additionally, we do not model the possibility that newly legalized immigrants would bring family members to the country which could start relying on the social insurance program almost immediately. On the other hand, we have made the assumption that all undocumented immigrants pay taxes. Social Security Administration (SSA) actuaries, for example, assume only half of unauthorized immigrants pay Social Security taxes. If modeled more in line with this estimate, we would find larger positive effects. Overall, we consider these results as preliminary but reasonable, and a starting point in the debate on legalization looming in the near future.

6 Conclusions

It might seem relatively unimportant in comparison with some of the worries that have kept the country busy in the last three years, when the world economy has gone (and it is still going) through one of its worst periods in recent memory and widespread instability seems to have settled in financial markets, but immigration issues will continue to be present in our everyday lives, and likely to be on the agenda of our policy makers. The reality is that millions of individuals and families currently living in our borders came to our country searching for a better life, but they did not necessarily follow the procedures established by our government to do so. These millions of undocumented immigrants contribute to our economy, but also maintain a

[12] The welfare calculations are in terms of compensating variations as a percentage of consumption, with negative numbers indicating that the group is worse off and therefore should be compensated, and positive numbers indicating that the group is better off, and therefore is willing to pay to get the policy implemented.

weak attachment to it. It is natural to ask whether some kind of legalization process should be considered given that a large proportion of undocumented immigrants have been in the country for a long period of time and have grown their families here. In many cases, undocumented immigrant are parents or grandparents of American citizens (in fact 73 percent of the children of undocumented immigrants are U.S. citizens according to Passel and Cohn 2009). Even if welfare improvements of the legalization process would only occur for newly legalized agents, the policy is still well worth considering as it has indirect positive effects to natives and legal immigrants living in these mixed households.

Our research tries to bring to the forefront some of the economic consequences of legalization, mainly the likely increase in capital stock thanks to the fact that newly documented immigrants will likely invest in our country a higher proportion of their resources now that their immigration status is no longer a major stigma for their economic behavior. On the other hand, this newly gained status will give them rights that will translate into a higher usage of our social insurance system.

Our findings indicate that legalization would have a positive effect on the economic aggregates as well as on the welfare of households, due to substantial gains in welfare of newly legalized immigrants despite a small loss in welfare for other groups. Higher rates of legalization have a larger positive effect on the overall economy. While the percentage increases in the aggregates is small, a 50 percent legalization rates is expected to contribute around additional 36 billion dollars to the economy. While most of the welfare increases are expected to come from the improvements for the legalized immigrants, a proper redistribution could help contribute to the higher welfare of everyone in the economy.

Our results, however, should be taken with some caution since our model, with all its complexities, still does not model a number of details of the social insurance system that could depress the positive effects we find, like the access to federal programs that comes with legalization such as the Social Security Disability Insurance, the Supplemental Security Income, Medicare, and other possible programs. On the other hand, we have made some strong assumptions about the taxation of undocumented immigrants, which if modeled more in line with some estimates by the Social Security Administration (Feinleib and Warner 2005) would suggest our positive effects could get bigger. Overall, we consider this set of results as reasonable, and a starting point in the careful modeling of the consequences of legalization of immigrants for

our economy, especially with a debate on legalization looming in the future. We hope our research provides a step in the direction of having a framework to evaluate and discuss the consequences of possible migration reform.

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Table 1: Participation in Social Insurance Programs of Immigrants by Period of Entry (American Community Survey, 2009)

			age 25 and over			
Program	**Native**	**Immigrant**	**Prior to 1980**	**1980-1989**	**1990-1999**	**2000-2009**
Social Security	20.1	13.7	36.9	8.6	4.5	1.9
Welfare	1.4	1.5	1.2	1.7	1.7	1.3
Pensions	9.9	4.9	13.7	2.6	1.2	0.9
SSI	2.1	2.2	3.3	2.8	2.2	0.7
Percentage Unemployed	6.1	6.4	4.2	6.5	7.1	7.8
Not in Labor Force	33.1	31.7	45.2	23.1	25.3	31
			age 40 and over			
Program	**Native**	**Immigrant**	**Prior to 1980**	**1980-1989**	**1990-1999**	**2000-2009**
Social Security	31.7	23.0	40.4	12.1	9.6	5.2
Welfare	1.1	1.5	1.11	1.6	2.1	1.9
Pensions	15.9	8.2	15.0	3.5	2.4	2.6
SSI	2.6	3.6	3.4	3.7	4.6	2.0
Percentage Unemployed	4	5.2	4	5.9	5.9	7
Not in Labor Force	40.6	37.7	48.4	26.7	29.1	36.5

Table 2: Educational Attainment of Immigrants (and Natives) by Period of Entry (ACS 2009)

Educational Attainment	**Native**	**Immigrant**	**Prior to 1980**	**1980-1989**	**1990-1999**	**2000-2009**
6 Years or Less	1.0	13.8	12.2	15.2	14.0	13.6
7 to 12 Years	7.3	13.3	10.8	13.5	14.4	13.8
High School Graduate	61.5	43.0	46.1	43.6	43.1	40.1
More than High School	30.2	29.9	30.9	27.8	28.5	32.5

Table 3: Remittances and Savings of Immigrants from MMP and LAMP, in 2008 Dollars

	Remittances		**Savings**	
	Percentage	Amount	Percentage	Amount
All Immigrants	0.65	404	0.50	515
Immigration Status				
Unauthorized	0.74	400	0.49	377
Legal	0.55	412	0.51	673
Education				
Less than 12	0.67	396	0.49	493
12 and above	0.52	494	0.54	688
Years in the U.S.				
0-5 Years	0.73	384	0.47	382
5-10 Years	0.72	450	0.59	512
10 Years and above	0.55	414	0.54	663

Table 4: Earnings of Natives and Immigrants

Average Earnings of Natives and Immigrants by age, ACS 2009 (in 2008 dollars)

Age Group	**Natives**	**Immigrants**	**Immigrant/Native Ratio**
18-29	17,738	16,567	93%
30-39	37,914	31,029	82%
40-49	43,656	36,743	84%
50-59	41,470	34,355	83%
60 and over	12,760	12,681	99%
All	28,989	26,667	92%

Average Earnings of Documented and Undocumented Mexican Immigrants by age, MMS 2005 (in 2008 dollars)

Age Group	**Documented**	**Undocumented**	**Undocumented/Documented Ratio**
18-29	20,200	17,431	86%
30-39	20,430	16,886	83%
40-49	20,781	17,224	83%
50-59	19,981	15,335	77%
60 and over	18,413	12,844	70%
All	20,354	17,210	85%

Table 5: Benchmark Results of the OLG-GE Model with Migration, and Legalization Policy Experiments

Variables	**Benchmark**	**30% Legalization**	**50% Legalization**
K (Capital)	3.3847	3.3898	3.39
L (Labor)	0.7604	0.7617	0.7626
Y (Output)	1.2262	1.2282	1.2292
C (Consumption)	0.9416	0.9431	0.9442
W (Wages)	1.0965	1.0965	1.0961
Int (Interest Rate)	4.33%	4.33%	4.34%
Utax (Unemp. Tax)	1.89%	1.9%	1.9%
S.S.tax (S.S. Tax)	7.95%	8.03%	8.08%
S.S. (S.S. Benefits)	0.4371	0.4371	0.437
Welfare Change: Natives	—	-0.1%	-0.16%
Welfare Change: Undocumented Immigrants	—	-0.1%	-0.18%
Welfare Change: Old Legal Immigrants	—	-0.05%	-0.11%
Welfare Change: Newly Legalized Immigrants	—	24.07%	23.99%
Welfare Change: All Legal Immigrants	—	2.47%	3.80%
Welfare Change: All	—	0.2%	0.34%
K/Y ratio	2.7603	2.7586	2.7614
I/Y ratio	0.2352	0.23349	0.2333