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Universitat d'Alacant
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FUNDAMENTOS del ANÁLISIS ECONÓMICO

Seguridad Social y Educación

Por

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Tesis Doctoral que se presenta para la obtención del grado de Doctor en Economía en el Departamento de Fundamentos del Análisis Económico de la Universidad de Alicante.

Director: Prof. Dr. D. Iñigo Iturbe-Ormaeche Cortajarena.

A mis padres
A Pablo

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Indice

Indice de Tablas

Indice de Figuras

Capítulo 2

Capítulo 3

Resumen

En las últimas décadas, la pirámide poblacional de la mayoría de países de la OCDE ha experimentado un drástico cambio. El actual escenario demográfico de estos páises se caracteriza por bajas tasas de fertilidad y una mayor esperanza de vida. Estas tendencias demográficas han propiciado un rápido envejecimiento de la población.

En este nuevo contexto, surgen algunas preguntas interesantes sobre el futuro del llamado Estado del Bienestar. Especial atención merecen todos aquellos programas en los que el gasto per-cárpita por anciano es muy elevado. En particular, el gasto en pensiones representa un alto porcentaje del Producto Interior Bruto de los países desarrollados. La mayoría de los sistemas públicos de pensiones se financian mediante sistemas de reparto, lo que hace que las actuales tendencias demográficas incidan negativamente en la futura viabilidad de los mismos. Concretamente, la proporción de población en edad de trabajar disminuirá, especialmente en los años posteriores al 2010, cuando la generación del baby boom comience a retirarse. La tendencia a adelantar la edad de retiro empeora esta situación al incrementar todavía más la ratio entre población retirada y población en edad de trabajar.

Se han discutido muchas propuestas para mejorar la posición fiscal de la Seguridad Social. Stiglitz (2000) las clasifica en dos categorías. En primer lugar, aquellas propuestas que sólo conllevan pequeñas modificaciones de los sistemas actuales. Tienen como objetivo de recuperar el equilibrio del sistema, bien reduciendo los gastos, bien aumentando los ingresos. Un ejemplo sería la propuesta de incrementar la edad de retiro. En segundo lugar, una serie de propuestas más drásticas que supondrían cambios estructurales. La reforma más drástica consistiría en sustituir el actual sistema de reparto de prestación determinada por un sistema de capitalización de contribución determinada, en el que las contribuciones de los individuos se contabilizan en cuentas individuales. Estas cuentas podrían ser gestionadas por empresas privadas que invertirían las contribuciones en activos financieros. Una excelente panorámica de las distinas propuestas de reforma del sistema de pensiones puede encontrarse en Gruber and Wise (2001).

A pesar de que muchos expertos han analizado el tema de la reforma de los sistemas de pensiones, ninguno de ellos ha tenido en cuenta cuáles podrían ser las posibles implicaciones de estas reformas en otros programas públicos. El segundo capítulo de esta tesis doctoral se dedica a estudiar los efectos de diferentes reformas del sistema sobre la financiación pública de la educación y, por tanto, sobre el nivel de inversión en capital humano. Es bien conocido que una de las principales causas del crecimiento económico es la inversión en capital humano. En los países industrializados, el gasto público en educación representa, al menos, un 80% del gasto total en educación. Dado que la mayoría de estos países son países democráticos, debe de existir un amplio consenso sobre el hecho de que el gobierno subsidie la educación con dinero del Presupuesto Público.

El objetivo concreto de este capítulo es precisamente estudiar el impacto que las diferentes propuestas de reforma pueden tener sobre el apoyo político de la sociedad a la financiación pública de la educación. Para ello, construimos un modelo de crecimiento endógeno en el que el capital humano es la única forma de crecimiento. Las distintas generaciones están vinculadas a través del Sistema de Seguridad Social y del altruismo. Supondremos que una población heterogénea de trabajadores elige mediante un sistema de votación el subsidio para financiar la educación pública.

El sistema de pensiones que consideramos es un sistema mixto que combina reparto y capitalización. Examinaremos dos diseños diferentes del sistema de capitalización, el primero de ellos se basa en cuentas de retiro individuales obligatorias, el segundo se artícula como un fondo de reserva. Analizamos tres tipos de reformas. Los resultados que obtenemos son altamente sensibles a la posición financiera del votante mediano. En equilibrio, si el votante mediano no ahorra; todos los tipos de reformas que analizamos tienen un efecto negativo sobre el apoyo politíco a la financiación de la educación pública. Por otro lado, si el votante mediano ahorra, el efecto negativo es mayor en el caso de un sistema de retiro basado en cuentas individuales obligatorias que en el caso de un fondo de reserva.

Algunos autores han resaltado el hecho de que la inmigración puede ayudar a mitigar los efectos negativos del proceso de envejecimiento de la población. De hecho, se ha hecho hincapie en la necesidad de atraer trabajadores inmigrantes y, este tema también aparece en la agenda política de la mayoría de gobiernos de los países industrializados. En el caso de España, los efectos del cambio demográfico son especialmente preocupantes, incluso si consideramos las proyecciones poblacionales más favorables hechas por Fernández-Cordón (2000).

En el tercer capítulo de esta tesis, nos centraremos en realizar un análisis cuantitativo del impacto que la inmigración tendrá sobre el Estado del Bienestar en España. Adoptamos un enfoque dinámico con el objeto de capturar los efectos a largo plazo de la entrada de inmigrantes. En concreto, empleamos la metodología de la Contabilidad Generacional, que consiste en calcular, en valor presente, los impuestos netos (impuestos pagados menos transferencias recibidas) que el individuo tipo de cada generación y sexo espera pagar durante el resto de su vida. Esta metodología fue creada por Alan Auerbach, Jagadeesh Gokhale y Laurence Kotlikoff a principios de los años noventa.

El análisis que efectuamos consiste en realizar simulaciones de escenarios alternativos. En cada uno de estos escenarios consideramos una cuota de inmigrantes. En concreto, consideramos los siguientes escenarios. En el escenario de referencia consideramos una inmigracion neta de 30.000 inmigrantes por año, es decir, la actual cuota de inmigración en España. En el segundo escenario, asumimos una inmigración neta de cero después del año base, que para nosotros es 1998. Finalmente, en el tercer escenario, consideramos una entrada neta de 100.000 inmigrantes por año. Al contrario que en el caso de Estados Unidos, el resultado que obtenemos es que aumentar el número de nuevos inmigrantes reduciría sustancialmente la carga fiscal que recaería sobre los futuros individuos nativos. Nuestro resultado está en consonancia con el obtenido para Alemania por Bonin, Raffelhüschen y Walliser (2000). La razón que explicaria estos aparentemente contradictorios resultados es que en España, como en Alemania, el desequilibrio de la política fiscal actual es muy alto, mientra que en Estados Unidos parece que es relativamente pequeño, debido principalmente a que en Estados Unidos, el problema del envejecimiento de la población es menos dramático que en Alemania o España.

Sin embargo, y a pesar de que la mayoría de estudios empíricos realizados para analizar el impacto de la inmigración sobre las economías de los países receptores de inmigrantes, muestran que el efecto sobre el conjunto de la economía es positivo, el rechazo de la población nativa hacía nuevas entradas de inmigrantes es creciente. De hecho, en los últimos años, muchos de los países receptores de inmigrantes han tratado de implementar políticas de inmigración selectivas con el objetivo de atraer inmigrantes con unas determinadas características. No obstante, con una población nativa que es heterogénea en cuanto a la cualifiación que poseen, parece claro que los efectos de la composición de la inmigración que entra en un país no son uniformes ya que dependen de la distribución de habilidades de los inmigrantes y de la población nativa.

En el cuarto capítulo de esta tesis desarrollamos un modelo teórico en el que relacionamos el sistema de pensiones y la inmigración. Consideramos heterogeneidad en cuando a la habilidad no sólo para la población nativa sino también para la población inmigrante. Además, el sistema de pensiones que se ha diseñado nos permite ver la influencia que la estructura particular del sistema de pensiones tiene en las preferencias de los individuos sobre la composición de inmigrantes que desea que entren en el país.

Este modelo nos permite identificar algunas de las causas que pueden originar las reacciones en contra de nuevos inmigrantes. Esta cuestión parece crucial para poder implementar las políticas económicas adecuadas para reducir las tensiones sociales. Nuestro modelo nos permite calcular los efectos conflictivos que la inmigración puede ocasionar a través del sistema de pensiones. En este contexto, también analizamos si es posible implementar alguna reforma del sistema de pensiones que permita conseguir una mejora de Pareto. En este aspecto, el resultado que obtenemos es positivo.

Chapter 1

Social Security Reforms: Which is the Impact on the Support for Public Education?

1.1 Introduction

Many Western countries are heavily concerned about the medium- and long-run financial viability of their Social Security systems. In the European Union, old-age and survivors pensions represented around 12% of GDP in 1995. Reasonable projections put that fraction around 20% in a few decades (see Boldrin et Al. (1999)).[1] The problem arises from the demographic changes that almost all modern economies have experienced over the last decades: the aging of the population, the increase in life expectancy, and the reduction in the birth rates.

Several proposals have been put forward for improving the fiscal position of Social Security. Stiglitz (2000) classifies them into two categories. In the first place, a group of proposals that only entail modest changes. They try to restore the balance of the system by either cutting expenditures or increasing revenues. An example is the proposal of increasing the age of retirement. In the second place, a group of more drastic reforms that involve significant structural changes. The most drastic reform consists of replacing the current unfunded defined-benefit system, with a funded defined-contribution system, in which individuals make contributions to individual accounts. These accounts could be managed by private companies that invest contributions in assets. See Gruber and Wise (2001) for an overview of alternative reform

[1] See the book by Gruber and Wise (1999) for an excellent description of the problems that pension systems face in several OECD countries.

proposals.

Although many authors have addressed the issue of pension reform, none of them take into account for the implications of reforming the pension system on other public programs. In particular, its effect on the public funding for education and, thus, on the level of investment in human capital. As it is widely known, human capital is one of the main sources of growth in modern economies. Starting from Lucas (1988) and Becker et Al. (1990), endogenous growth models have emphasized investment in human capital as one of the main engines of growth. Other authors have stressed the importance of public educational policy on growth (Glomm and Ravikumar (1992), Eckstein and Zilcha (1994)). In the industrialized countries, public expenditure on education represents at least 80% of total expenditure in educational institutions (see Education at a Glance-OECD Indicators, 1997). As most of these countries are democracies, it must be a widespread agreement on the fact that the government must subsidy education, out of the public budget. So, if the main engine of growth is human capital, and the bulk of the investment in human capital comes from the public budget, it is interesting to study how will the proposals to reform Social Security affect the willingness of the society to finance public education.

The purpose of this paper is precisely to study the implications of reforming the Social Security system on the political support for financing public education and, thus, on the growth rate of the economy. To do so, we construct a model of endogenous growth where human capital is the only source of growth. Generations are linked through the Social Security system, as well as through altruism. We consider that a heterogeneous population of workers chooses the subsidy for public education. They are willing to subsidy public education for two reasons: First, they are altruistic towards their children, who are the direct beneficiaries of public education. Second, their future pensions may depend on the future income of current students. As more resources are devoted to finance public education today, the economy will grow at a higher rate, which, in turn, will make pensions higher in the future.

Our point is that the particular reform of the social security system can influence this support for a publicly financed education. With an unfunded system, pensions of today's workers are directly linked to economic growth, since the return of the system is the growth of the tax base. Their pensions will be paid out of contributions of tomorrow's workers. But tomorrow's workers are today's students. Then, today's workers will be strongly interested in investing in education for the young.[2] If society replaces the current

[2]In a rather different vein, Belletini and Berti-Ceroni (1999) suggest that a pure un-

system with a (privatized) funded system, the link between pensions and growth is broken. Workers are less interested in growth and, thus, less interested in investing in public education.

In particular, we study the effect of reforming a mixed social security system, combining an unfunded PAYGO scheme, and a funded scheme. We examine two different designs for the funded component: A Mandatory Individual Retirement Account (MIRA) scheme, and a "Trust" Fund scheme. With the MIRA scheme, some part of the agents' contribution is used to build individual accounts. With the "Trust" Fund scheme, some part of the agents' contribution is used to set up a fund, which is invested into assets. Our results are highly sensitive to the financial position of the decisive voter, namely, the median voter. If the median voter does not save in equilibrium, we find that all types of reforms considered, are detrimental to the political support for public education. On the other hand, if the median voter has positive savings, the results of the reforms are more negative with the MIRA scheme than with the "Trust" Fund scheme. In fact, in the latter case there is one type of reform that has a non-ambiguous positive effect on public funding for education.

The structure of the paper is as follows. Section 2 sets up the basic model. In Section 3 we describe the pension system. In Section 4 we prove the existence of a voting equilibrium for the tax rate that finances public education. In Section 5 and 6 we explore different reforms of the social security system and see their implications on the budget for public education. Section 7 concludes.

1.2 The Model

Consider an economy populated by a continuum of families made up by one young agent, one middle-aged and one old. Young agents go to school, middle-aged agents work and split their income between consumption and savings for retirement. Old agents live in retirement and consume. The middle-aged agents take all the decisions in our model. Agents within a generation are differentiated by the stock of human capital that they possess. Middle-aged agents care for the stock of human capital that they will transmit to their children. There is no uncertainty.

We consider only two periods, labelled 0 and 1.[3] Those who are young at period 0 become middle-aged at period 1, those who are middle-aged at

funded pay-as-you go (PAYGO) system provides the taxpayers with the right incentives to support growth-oriented policies.

[3]This can be seen as a simplification for the steady state in a multi-period model.

period 0 become old at period 1 and those who are old at period 0 die at the end of that period.

In period 0 every middle-aged agent has one unit of labor time which she supplies inelastically to the labor market. In turn, she earns a pre-tax salary h_0^i, interpreted as her stock of human capital. Human capital is distributed on some interval $[a,b] \subset (0,+\infty)$, according to the distribution function $G(h_0^i)$, with mean h_0 and median h_0^m.

All middle-aged individuals have identical preferences represented by the utility function:

$$u^i(c_0^i, c_1^i, h_1^i) = \ln(c_0^i) + \rho \ln(c_1^i) + \eta \ln(h_1^i), \text{ with } \rho, \eta \in (0,1), \tag{1.1}$$

where c_0^i and c_1^i are the consumption levels of individual i in periods 0 and 1, respectively, and h_1^i is the stock of human capital that she will transmit to her offspring. The parameter ρ represents the subjective discount rate and η represents the degree of altruism towards children.

The Social Security system imposes a payroll tax on wages. In turn, every individual is entitled to a pension benefit when old. In particular, workers pay a fraction λ_0 of their salary in period 0. When retired in period 1, they will get a pension benefit b_1^i. In the next section we will describe the pension system in detail.

Next we describe the technology of human capital accumulation. Following Glomm and Ravikumar (1992), we assume that the stock of human capital of the offspring in period 1 is determined by the stock of human capital of the parent and by the quality of public education, denoted by e. In our model, however, the time spent by parents on child education plays no role. In particular, we assume:

$$h_1^i = \theta e^{\beta} \left(h_0^i\right)^{\epsilon}, \tag{1.2}$$

with $\theta > 0$ and $\epsilon, \beta \in (0,1]$. The coefficient θ measures the productivity of investment in human capital, β is the elasticity of human capital with respect to the quality of public education and ϵ is the elasticity with respect to the stock of human capital of the parent. Note that we are assuming implicitly that the young have no resources to invest in their own education.

The government collects a proportional tax τ on labor income to finance public schools. We assume that the quality of public education e will be simply the tax proceeds:

$$e = \int_0^{\infty} \tau h_0^i dG(h_0^i) = \tau h_0. \tag{1.3}$$

Note that the quality of the public school is the same for all children. >From equations (2) and (3) it is clear that the quality of public education e (or τ) and the rate of growth in the economy are positively related. At this point, we can write the individual constraints as:

$$c_0^i = (1 - \tau - \lambda_0)h_0^i - s_0^i, \tag{1.4}$$

and

$$c_1^i = Rs_0^i + b_1^i, \tag{1.5}$$

where s_0^i represents savings and R is the return on savings. We take R as given at the world level.[4]

1.3 The Pension System

We want to study several possibilities of reforming Social Security. We need, therefore, to model Social Security in a rich enough way. In particular, we consider a mixed pension system financed with a pay-roll tax, which is a fixed proportion of the wage. This mixed pension system combines a pay-as-you-go (PAYGO) scheme and a Mandatory Individual Retirement Accounts (MIRA) scheme.

In period 0, an individual with a stock of human capital h_0^i contributes $\lambda_0 h_0^i$ to the system. This contribution is split into two parts. An amount $\lambda_0^f h_0^i$ goes to the individual account of individual i. The remainder, $\lambda_0^p h_0^i$, is used to pay the PAYGO benefits to those currently retired in period 0. We assume $\lambda_0^f, \lambda_0^p \geq 0$, and $\lambda_0^f + \lambda_0^p = \lambda_0$. Then, total revenue to the Social Security system in period 0 is:

$$T_0 = \int_0^{\infty} \left(\lambda_0^f h_0^i + \lambda_0^p h_0^i\right) dG(h_0^i) = \lambda_0^f h_0 + \lambda_0^p h_0 = \lambda_0 h_0. \tag{1.6}$$

The amount $\lambda_0^f h_0$ is invested in assets and will serve to pay the MIRA benefits in period 1, while $\lambda_0^p h_0$ is devoted to pay pensions in period 0. In period 1 there will be two sources of funds for paying pensions. First, the amount $R\lambda_0^f h_0$. This is the capitalized value of all individual accounts. Second, the amount $\lambda_1^p h_1$, which comes from total contributions in period 1, T_1. Then, the average pension benefit in period 1 will be:

$$b_1 = R\lambda_0^f h_0 + \lambda_1^p h_1, \tag{1.7}$$

[4]This assumption is called "small open economy" in the literature. It implies that we are considering a small country with free access to international capital markets that faces a fixed world rate of interest (see Galor and Tsiddon(1997)).

where h_1 is the average level of human capital in period 1.

However, different individuals will enjoy different pension benefits. The reason is twofold. First, the existence of individual accounts (the MIRA scheme). Second, the possibility that the PAYGO benefit be partly related to past contributions. In particular, we define the redistributive factor under the PAYGO scheme as a number $D^i(\alpha)$, according to the expression:

$$D^i(\alpha) = \left[\alpha + (1-\alpha)\frac{h_0^i}{h_0}\right], \text{ where } \alpha \in [0,1]. \tag{1.8}$$

To sum up, a worker of period 0 whose stock of human capital is h_0^i, will get the following pension benefit b_1^i in period 1:

$$b_1^i = R\lambda_0^f h_0^i + \lambda_1^p h_1 D^i(\alpha) = R\lambda_0^f h_0^i + \alpha\lambda_1^p h_1 + (1-\alpha)\lambda_1^p \frac{h_1}{h_0} h_0^i. \tag{1.9}$$

The pension benefit has three tiers. First, a MIRA benefit $R\lambda_0^f h_0^i$. Second, a universal pension benefit, $\alpha\lambda_1^p h_1$, which is completely unrelated to past contributions and it is financed on a PAYGO basis. Third, a pension benefit which is also financed on a PAYGO basis, but whose amount is proportional to the past contribution, $(1-\alpha)\lambda_1^p \frac{h_1}{h_0} h_0^i$. Note that, the greater is α, the higher is the level of redistribution within the PAYGO scheme. When $\alpha = 1$, all individuals get the same PAYGO benefit $\lambda_1^p h_1$. When $\alpha = 0$, the pension benefit is strictly proportional to the past contribution.

The pension system is always feasible since:

$$\int_0^\infty b_1^i dG(h_0^i) = R\lambda_0^f \int_0^\infty h_0^i dG(h_0^i) + \lambda_1^p h_1 \int_0^\infty D^i(\alpha) dG(h_0^i) = b_1. \tag{1.10}$$

Summing up, in period 0 the Social Security system is described by four parameters: λ_0^p, λ_0^f, λ_1^p and α. The first and third parameters describe how close is the system to a PAYGO scheme in each period. The second one measures the degree of the system funding in period 0. If $\lambda_0^p = 0$ ($\lambda_0^f = \lambda_0$), the system is fully-funded (FF). If $\lambda_0^p = \lambda_0$ ($\lambda_0^f = 0$), it is a pure PAYGO system. The fourth term describes how redistributive is the PAYGO scheme.

Alternatively, we could also think of a different mixed pension system in which both schemes operate under the same degree of redistribution. Also, it would be possible to design a funded system without privatizing; a part of the pay-roll tax payments could be put into a "trust" fund managed by the government. This is the case in US and Singapore, for example. With this alternative specification of the pension system, an individual i would get in period 1 a pension benefit:

$$b_1^i = [R\lambda_0^f h_0 + \lambda_1^p h_1] D^i(\alpha). \tag{1.11}$$

However, we will take the case with a MIRA scheme as our benchmark. Within this set-up, privatization and prefunding go along the same way. Increasing prefunding in period 0 means increasing λ_0^f which, in turn, means increasing the proportion of the contribution that goes to the individual accounts.

To illustrate the different existing possibilities, we will discuss two polar cases.

Case 1: $\lambda_0^f = 0$ (Pure PAYGO)

This is the system at work in most countries.[5] In this case, the MIRA scheme and the "trust" fund scheme are equivalent. The pension benefit of individual i in period 1 will be:

$$b_1^i = \lambda_1^p h_1 D^i(\alpha) = \alpha\lambda_1^p h_1 + (1-\alpha)\lambda_1^p \frac{h_1}{h_0} h_0^i. \tag{1.12}$$

The average pension depends only on the average stock of human capital in period 1. If $\alpha = 1$, all individuals will receive the same pension benefit which will be the average contribution in period 1:

$$b_1^i = \lambda_1^p h_1. \tag{1.13}$$

This corresponds roughly to the system in Canada and in the Netherlands. If $\alpha = 0$, each individual will receive a pension benefit which will depend, not only on her own contribution to the system, but also on the growth rate of human capital ($\frac{h_1}{h_0}$):

$$b_1^i = \lambda_0^p h_0^i \frac{h_1}{h_0}. \tag{1.14}$$

This is roughly the system at work in Germany and France.

Case 2: $\lambda_1^p = 0$ (Pure FF)

All the revenue that the system collects in period 0 is invested in assets to pay pensions in period 1. In this case, the MIRA pension system and the "trust" fund system are equivalent only if there is no redistribution at all, that is, $\alpha = 0$. Some countries have reformed their systems towards a FF system of this type, like Argentina, Australia, Chile, UK and Mexico. If the

[5] According to Mulligan and Sala-i-Martin (1999), 98% of the social security programs in the world have PAYGO features.

system is of the MIRA type, the pension benefit that individual i will receive in period 1 will be:

$$b_1^i = R\lambda_0^f h_0^i, \tag{1.15}$$

which is exactly the capitalized value of her contribution. On the contrary, if the system were of the "trust" fund type, the pension benefit that individual i would get is:

$$b_1^i = R\lambda_0^f h_0 D^i(\alpha), \tag{1.16}$$

where $D^i(\alpha)$ is the redistributive factor defined in (8).

Note that the pension benefit does not depend on the average stock of human capital in period 1. This is crucial for our results. Workers may lose interest in increasing the future levels of human capital, since this has no effect on the pension benefit that they will enjoy in period 1.

1.4 Equilibrium

Throughout this section, we will consider that all the parameters describing the Social Security system are fixed. Each individual has to take two types of decisions: economic and political. The economic decision consists of choosing a consumption stream. The political decision is the choice of her ideal tax rate, taking into account her consumption decision. Finally, once every individual has chosen her preferred tax rate, we will assume that the society will choose a value for the tax rate with the property of being a Condorcet winner.[6]

As a benchmark, we consider first the case in which individuals can borrow in period 0 against their period 1 pension benefits. In general, this possibility is ruled out by legislation (see Mulligan and Sala-i-Martin (1999)). However, this case is worth to analyze to ease the exposition of the general case, where borrowing against pensions is not allowed.

1.4.1 Individuals may borrow against future pensions

Step 1: How much to save

Each middle-aged agent chooses her savings for period 1, taking the tax rate τ as given. The problem of individual i is to maximize her utility, subject

[6] A given value of the tax rate is a Condorcet winner if it wins in majority voting against any other tax rate that may be proposed.

to the intertemporal budget constraint:

$$\begin{aligned} \max_{\{c_0^i, c_1^i\}} \quad & \ln(c_0^i) + \rho \ln(c_1^i) + \eta \ln(h_1^i) \\ \text{s.t.} \quad & c_0^i + \frac{c_1^i}{R} = y^i, \end{aligned} \tag{1.17}$$

where $y^i = (1-\tau-\lambda_0)h_0^i + \frac{b_1^i}{R}$ is the present value of her income stream. Since optimal savings can be either positive or negative, the following first-order condition is necessary and sufficient for a maximum:

$$\frac{1}{c_0^{i*}} = \rho \frac{R}{c_1^{i*}}, \tag{1.18}$$

which leads to the optimal consumption stream $c_0^{i*} = \frac{1}{1+\rho} y^i, c_1^{i*} = \frac{\rho}{1+\rho} R y^i$. Optimal savings are:

$$s_0^{i*} = \frac{\rho}{1+\rho} y^i - \frac{b_1^i}{R}. \tag{1.19}$$

If $\lambda_0 = 0$, that is, if Social Security would not exist, then $b^i = 0$ for all i, which implies that all individuals would accumulate positive savings. Moreover, savings would be increasing in the stock of human capital.

If $\lambda_0 > 0$, it can be the case that savings are decreasing in the stock of human capital. This would happen if the pension benefit is highly proportional to the past contribution, the return of the system is high, and the payroll tax is large enough. In this case, every agent thinks of the contribution that she is paying as savings that the Social Security system is accumulating on her behalf. As the system is highly proportional and the return is high, she will get almost the same return on her contribution than on other forms of saving. Then she will not need to accumulate additional savings. She will have negative private savings in period 0 and will use the Social Security payments in period 1 to consume and to repay their loans. Obviously, if we define her total savings as the sum of her private savings plus her contribution, then savings will be always increasing in the stock of human capital.

To avoid this problem, we will impose additional restrictions on the parameters to guarantee that private savings are an increasing function in the stock of human capital. Consider the following assumption:

(i) $R > \frac{h_1}{h_0}$; (ii) $\lambda_0 < \frac{\rho}{1+\rho}$; (iii) $\lambda_1^p \leq \lambda_0^p$.

Part (i) says that the return on capital is always greater than the rate of growth of human capital. It implies that, on average, a pure PAYGO system gives always a lower return than a pure FF system. This assumption provides the major justification for Social Security reform (see Feldstein (1996), (1998) and Kotlikoff (1996)). If the opposite were true, it would be difficult to argue in favor of a reform of the pension system. Part (ii) imposes an upper bound on the payroll tax or a lower bound in the subjective discount rate. Finally, part (iii) requires that the size of the PAYGO scheme will not rise from period 0 to period 1. We have the following proposition (see the Appendix for a proof).

Proposition 1 *Suppose Assumption 1 holds. Then, there exists a strictly positive number* $\overline{\tau}$, *such that for all* τ *belonging to the interval* $[0, \overline{\tau}]$, *savings will be an increasing function in the stock of human capital. Moreover,* $\overline{\tau} > 1 - \frac{\lambda_0(1+\rho)}{\rho} > 0$.

To illustrate the proposition, we set $\rho = 0.55$ as in Barro and Sala-i-Martin (1999). Part (ii) of Assumption 1 implies $\lambda_0 < 0.355$. Then, if $\lambda_0 = 0.1$, we have that $\overline{\tau} > 0.72$. If $\lambda_0 = 0.2$, $\overline{\tau} > 0.44$. If $\lambda_0 = 0.3$, $\overline{\tau} > 0.15$. This gives us an idea about the range of admissible values of the parameters. In the sequel, we will assume that $\tau < \overline{\tau}$ and, thus, savings will be increasing in the stock of human capital. Another implication of Assumption 1 is that if the savings of an individual with human capital h_0^i are strictly positive, the savings of all individuals with a stock of human capital greater than h_0^i will be also positive.

Step 2: Choosing the tax rate

Given her optimal consumption decision, each individual has to choose her ideal tax rate. We plug the optimal values c_0^{i*} and c_1^{i*} into the utility function and we use the private budget constraints (1.4) and (1.5), the human capital accumulation rule (1.2) and the government budget constraint (1.3) to obtain the indirect utility function $U^i(\tau)$. Eliminating constant terms, we have:

$$U^i(\tau) = (1+\rho)\ln(y^i(\tau)) + \eta \ln(h_1^i(\tau)). \tag{1.20}$$

The ideal tax rate for individual i, which we call τ^i, will be:

$$\begin{aligned} \tau^i = \quad & \arg\max\left[(1+\rho)\ln(y^i(\tau)) + \eta\ln(h_1^i(\tau))\right] \\ & s.t.\ 0 \leq \tau \leq 1. \end{aligned} \tag{1.21}$$

The first order condition for an interior maximum is:[7]

$$\eta\frac{\beta}{\tau^i} = -(1+\rho)\frac{\frac{\partial y^i(\tau^i)}{\partial \tau}}{y^i(\tau^i)}. \tag{1.22}$$

The term in the left-hand side is decreasing in τ, while the term in the right-hand side is increasing in τ. Moreover, the latter is increasing in the

[7] It is easy to check that $U(\tau)$ is strictly concave on τ.

stock of human capital, implying that relatively richer individuals will prefer lower tax rates. Note that in an interior maximum, it must be that $\frac{\partial y^i(\tau^i)}{\partial \tau} < 0$. That is, the individual chooses τ^i such that the positive marginal effect through the human capital that she will transmit to her child, exactly offsets the negative marginal effect on her intertemporal income. As all functions $U^i(\tau)$ are strictly concave on τ, and there is a monotonic relationship between the stock of human capital of an individual and her preferred tax rate, there is a Condorcet winner τ^*, which corresponds to the ideal tax rate of that individual whose stock of human capital is the median of the distribution, namely h_0^m. That is, $\tau^* = \tau^m$. The Condorcet winner will be always strictly positive. In particular, it will be always above some threshold value $\tau_{\min}$, defined as $\tau_{\min} = \frac{\eta\beta}{1+\rho+\eta\beta}\left(1 - \lambda_0^p\right)$. To see this, we need to prove that all the agents have ideal tax rates greater than $\tau_{\min}$. From the first order condition (1.22), we check that as h_0^i tends to infinity, the term in the right-hand rises, but it is bounded above by:

$$(1+\rho)\frac{1}{1-\tau-\lambda_0^p}. \tag{1.23}$$

Equating this term with the left-hand side of (1.22), we obtain the above value of $\tau_{\min}$. In particular, if $\lambda_0 = 0$ (and thus $\lambda_0^p = 0$), we would have $\tau_{\min} = \frac{\eta\beta}{1+\rho+\eta\beta}$, which would be precisely the Condorcet winner in a world *without* Social Security.

1.4.2 Introducing borrowing constraints

Here we will study the case in which savings are constrained to be non-negative. In the sequel, therefore, we will impose the constraint that $s_0^i \geq 0$. We will refer to those individuals for which the constraint is binding as *saving-constrained* individuals. Our main finding is that when an individual is not allowed to borrow against her pension, her reaction will be to prefer a lower tax rate.

Now the savings decision is as follows:

$$s_0^{i*}(\tau) = \begin{cases} \frac{\rho}{1+\rho}y^i - \frac{b_1^i}{R} & \text{if } \tau \leq \widehat{\tau}^i \\ 0 & \text{if } \tau > \widehat{\tau}^i, \end{cases} \tag{1.24}$$

where $\widehat{\tau}^i$ is defined implicitly by setting $s_0^i = 0$ in the first-order condition (1.18). So, it is defined by:

$$\rho(1-\widehat{\tau}^i-\lambda_0)h_0^i - \frac{1}{R}b_1^i\left(\widehat{\tau}^i\right) = 0. \tag{1.25}$$

This cut-off value of the tax rate for individual i has the following interpretation. Suppose that borrowing is allowed. Then, individual i would like to borrow against her pension benefit whenever $\tau > \widehat{\tau}^i$. As this is banned, her savings will be zero when $\tau > \widehat{\tau}^i$. We can check that $\widehat{\tau}^i$ grows along with the stock of human capital.[8] This implies that, when the tax rate is low, only individuals with a low stock of human capital are saving-constrained. In particular, when $\tau = 0$, all individuals have positive savings since $s_0^{i*}(\tau = 0) = \frac{1}{1+\rho}\left[\rho(1-\lambda_0) - \lambda_0^f\right] h_0^i$, which is strictly positive by Assumption 1. As the tax rate gets higher, the proportion of saving-constrained individual rises.

Our next task is to see which is now the preferred tax rate of every agent. To do this, we have to study the shape of the indirect utility function, since this function is different than the one defined in (1.20). The reason is that, for values of τ above $\widehat{\tau}^i$, the individual is saving-constrained.

Define $U^{ir}(\tau)$ as the function that we obtain if we set $s_0^i = 0$. In particular:

$$U^{ir}(\tau) = \ln[(1-\tau-\lambda_0)h_0^i] + \rho \ln[b_1^i(\tau)] + \eta \ln[h_1^i(\tau)]. \tag{1.26}$$

Now, the indirect utility function of i will be the following function $V^i(\tau)$:

$$V^i(\tau) = \begin{cases} U^i(\tau) & \text{for } \tau \leq \widehat{\tau}^i \\ U^{ir}(\tau) & \text{for } \tau > \widehat{\tau}^i. \end{cases} \tag{1.27}$$

We can prove that $V^i(\tau)$ is single-peaked. To do it, we consider the extension of the function $U^{ir}(\tau)$ to the whole interval $[0,1]$. It has the following properties:

i) It is a strictly concave function.

ii) It is always strictly below $U^i(\tau)$, except at $\widehat{\tau}^i$, where both functions coincide.

iii) It attains a maximum at τ^{ir}, where τ^{ir} is implicitly defined by the first-order condition $U^{ir\prime}(\tau^{ir}) = 0$. This first order condition can be written as:

$$\eta \frac{\beta}{\tau^{ir}} = -\rho \frac{\frac{\partial b_1^i(\tau^{ir})}{\partial \tau}}{b_1^i(\tau^{ir})} + \frac{1}{1-\tau^{ir}-\lambda_0}. \tag{1.28}$$

Again, the higher is the stock of human capital, the lower is τ^{ir}.

The function $V^i(\tau)$ can have three different shapes, depending on the relationship between τ^i (the preferred tax rate without restrictions on savings) and $\widehat{\tau}^i$. First, suppose $\tau^i < \widehat{\tau}^i$. Then, $V^i(\tau)$ is single-peaked since, to the right of $\widehat{\tau}^i$, $V^i(\tau) = U^{ir}(\tau)$ and $U^{ir}(\tau)$ is a decreasing function to the right

[8]This is guaranteed by Assumption 1. See Appendix.

of $\widehat{\tau}^i$. The preferred tax rate is still τ^i. Second, suppose $\tau^i > \widehat{\tau}^i$. To the right of $\widehat{\tau}^i$, $V^i(\tau) = U^{ir}(\tau)$. As both $U^i(\tau)$ and $U^{ir}(\tau)$ are strictly concave and $U^i(\widehat{\tau}^i) = U^{ir}(\widehat{\tau}^i)$, the preferred tax rate of i will be τ^{ir}, and not τ^i. Moreover, we can prove that $\tau^{ir} < \tau^i$. This follows from comparing the first order conditions (1.22) and (1.28).[9] Third, suppose $\tau^i = \widehat{\tau}^i$. In this case we have also $\tau^i = \tau^{ir}$. The preferred tax rate of this agent is τ^i.

Summing up, $V^i(\tau)$ is single-peaked. Furthermore, again the preferred tax rate is a decreasing function of the stock of human capital. Thus, the decisive agent will be again that individual whose stock of human capital is the median of the distribution.

It is interesting to see the intuition behind the fact that $\tau^{ir} < \tau^i$. When some individual cannot borrow, her consumption in period 0 is lower and her consumption in period 1 is higher than in her unrestricted optimum (when borrowing is possible). The only way of getting closer to her (unrestricted) optimal consumption stream, is by choosing a lower tax rate in period 0.

Finally, we want to characterize the Condorcet winner τ^*. To do this, we define as $\widehat{h}_0$ the stock of human capital of that individual for whom $\tau^i = \widehat{\tau}^i$. We can do this, because we know that τ^i decreases in the stock of human capital, while $\widehat{\tau}^i$ rises in it. If they cross for some level of human capital, we call it $\widehat{h}_0$ (see Figure 1). If $\widehat{\tau}^i < \tau^i$ for all i, we set $\widehat{h}_0 = +\infty$. If $\widehat{\tau}^i > \tau^i$ for all i, we set $\widehat{h}_0 = 0$. When $\widehat{h}_0 \in (a, b)$, the population is split into two groups, those with $h_0^i < \widehat{h}_0$ and those with $h_0^i > \widehat{h}_0$. If the stock of human capital of the median voter h_0^m is above $\widehat{h}_0$, then we will have $\tau^* = \tau^m$, exactly the same than in the case without constraints on savings. This is the case represented in Figure 1. The bold line represents the preferred tax rate of each agent. Note that τ^* is lower than the preferred tax rate of the individual whose stock of human capital is $\widehat{h}_0$. This means that less than half of the population will be constrained. In particular, only those below h_0' in the figure. On the contrary, if h_0^m is below $\widehat{h}_0$, we will have $\tau^* = \tau^{mr} < \tau^m$. In this case, more than half of the population will be saving-constrained, and the existence of borrowing constraints reduces the tax rate to finance public education.

By inspection of the first-order condition (1.28), we can prove the existence of an upper bound for τ^{ir}, and thus for τ^*. To see it, note that the first term in the right-hand side is an increasing function in the stock of human capital. In particular, as the level of human capital tends to zero, that term

[9] If the agent is saving-constrained, the term in the right-hand side of equation (1.28) is larger than the term in the right-hand side of equation (1.22).

goes to $\rho \frac{\beta}{\tau}$. We call $\tau_{\max}$ the value of the tax rate that solves:

$$\eta \frac{\beta}{\tau_{\max}} = -\rho \frac{\beta}{\tau_{\max}} + \frac{1}{1 - \tau_{\max} - \lambda_0}. \tag{1.29}$$

Solving (1.29), we get $\tau_{\max} = \frac{\beta(\rho+\eta)}{1+\beta(\rho+\eta)}(1 - \lambda_0)$, which is an upper bound for τ^*.

In Table 1 we gather some numbers to illustrate the admissible range of τ^*. To do it, we fix $\rho = 0.55$, $\lambda_0 = 0.25$ and $\beta = 0.25$.

Table 1

	$\lambda_0^f = 0$		$\lambda_0^f = 0.1$	
	$\tau_{\min}$	$\tau_{\max}$	$\tau_{\min}$	$\tau_{\max}$
$\eta = 0$	0	0.09	0	0.09
$\eta = 0.1$	0.01	0.10	0.01	0.10
$\eta = 0.25$	0.03	0.12	0.03	0.12
$\eta = 0.5$	0.05	0.15	0.06	0.15

In the next two sections, we will study several proposals for reforming the pension system. In Section 5 we will focus on our benchmark scenario (a mixed pension system that combines a PAYGO scheme with a MIRA scheme). In Section 6 we will analyze the case in which the system is a "trust" fund scheme.

1.5 Social Security Reform

The aim of this paper is to study the effect that a reform of the pension system has on the budget for public education. This budget is determined by the tax rate that society chooses. Most of the proposed reforms of Social Security entail a reduction of the PAYGO scheme and an increase of the MIRA scheme. The reason for this, it is argued, is that the MIRA scheme yields, on average, a higher return than a PAYGO system. Within our model this means that $R > \frac{h_1}{h_0}$, which was included as Part (i) of Assumption 1. However, there are two caveats in order. First, even when a funded scheme pays a higher return *on average*, this does not mean that all individuals get a higher return with a funded scheme. If the original PAYGO scheme is highly redistributive (α is very high), moving towards a funded scheme will likely hurt those individuals with low levels of income. We will discuss this below, when presenting the particular examples of reform. Second, the reform has always transition costs. Simply comparing the return on assets and on Social Security taxes is misleading. It amounts to comparing only two steady states of two different worlds (see Diamond (2000)). While the working cohort contributes more towards the funded scheme, somebody has to pay for current pension benefits. To illustrate these issues, we will consider three different possibilities of reform. The three proposals entail an increase in the size of the MIRA scheme, starting in period 0. They differ in the proposed change in the PAYGO scheme. In the first reform, there is a reduction in the PAYGO scheme in both periods of the same size of the increase in the MIRA scheme. In the second reform, the PAYGO scheme is reduced only in period 1. In the third reform, the PAYGO scheme remains unchanged.

1.5.1 First Type of Reform

This proposal turns resources from the PAYGO scheme to the MIRA scheme, without changing the total contribution to the system. If no additional resources are used, this implies an immediate reduction of the pension benefits paid to the retired people in period 0. Although we believe that this reform is hardly feasible, we want to study it because, at first sight, it seems that it will have little or no impact on the support for public education.

As an example, suppose that the initial pay-roll tax is 20%, from which a 5% goes to the MIRA scheme, and a 15% goes to the PAYGO scheme. This means that initially, $(\lambda_0^p, \lambda_0^f) = (\lambda_1^p, \lambda_1^f) = (0.15, 0.05)$. After the reform, workers are required to increase their contributions to the MIRA scheme. In addition, the part that goes to the PAYGO scheme is reduced. For example, $(\lambda_0^{p\prime}, \lambda_0^{f\prime}) = (\lambda_1^{p\prime}, \lambda_1^{f\prime}) = (0.13, 0.07)$. *Total contribution has not changed, that* is, $\lambda_0' = \lambda_1' = \lambda_0 = 0.2$.

This reform entails some costs also in period 1. Some poor workers will lose with this reform despite they pay the same total contribution to the system in period 0. The reason is that the PAYGO scheme makes some redistribution, while the MIRA scheme does not. In particular, those individuals whose stock of human capital h_0^i is below:

$$\frac{\alpha h_1}{R - (1-\alpha)\frac{h_1}{h_0}}, \tag{1.30}$$

will be worse-off after the reform. The denominator in (1.30) is positive by Assumption 1. As this expression is an increasing function in α (the degree of redistribution), the higher is α the more workers will be worse-off after this reform.

Now we turn to analyze the effect of this reform on the equilibrium level of the tax rate that finances public education. We have two cases, depending

on whether the median voter is saving-constrained or not:
(i) The median voter is not saving constrained. The result will depend crucially on whether the median voter gets a larger pension benefit under this reform or not. To see this, consider the first order condition (1.22). The term in the left, $\frac{\beta}{\tau^i}$, does not change after this reform. The term $\partial y^i/\partial \tau$ becomes lower, since reducing the PAYGO scheme makes public education less productive in terms of future pension benefits. Then, the effect on the equilibrium level of the tax will depend on whether y^i is greater after the reform or not. But, as the after-tax income of individual workers in period 0, $(1-\tau-\lambda_0)\,h_0^i$, is unaffected, y^i will be greater if and only if the pension benefit is greater. In particular, if the median voter gets a lower pension benefit after the reform, she will prefer a lower level of the tax rate to maintain her initial optimal consumption pattern. This will be the case if her stock of human capital is below the threshold level defined in (1.30). On the other hand, if her pension benefit is higher, the optimal level of the tax rate will depend on which one of the two effects dominates.
(ii) The median voter is saving constrained. We check the first order condition (1.28). Under this reform, only the first term in the right hand side of the condition changes. In particular, the right-hand side rises with this reform, implying that the tax rate preferred by the median voter is always lower after the reform. Since this reform moves her away from her optimum, she chooses a lower tax rate to get closer to it.

Interestingly, even when the burden of the transition is paid mainly by the old generation, the effect on the subsidy for public education may be negative.

1.5.2 Second Type of Reform

Here the PAYGO scheme is reduced, but only in period 1. Following with the above example. Starting with $(\lambda_0^p, \lambda_0^f) = (\lambda_1^p, \lambda_1^f) = (0.15, 0.05)$, assume that, after the reform, we have $(\lambda_0^{p\prime}, \lambda_0^{f\prime}) = (0.15, 0.07)$ and $(\lambda_1^{p\prime}, \lambda_1^{f\prime}) = (0.13, 0.07)$. Then, the total contributions in each period are $\lambda_0^\prime = 0.22$ and $\lambda_1^\prime = 0.2$, respectively.

With this reform, pensions paid to the currently retired in period 0 do not change. On the other hand, workers' after-tax income in period 0 is reduced as they have to pay higher taxes. In addition, poor workers, i. e., again those with a stock of human capital below the threshold level $\frac{\alpha h_1}{R-(1-\alpha)\frac{h_1}{h_0}}$, will get lower pension benefits. Rich workers get higher pension benefits, but not so high as to offset the increase in their contributions. That is, the increase in pension benefits is less than actuarially fair.

With respect to the effect that this reform has on the support for public education, we see that it has always a negative impact. The reason is that the term in the right hand side of both first order conditions (1.22) and (1.28) rises after this reform.

1.5.3 Third Type of Reform: An "Incremental Reform"

In this third reform, the PAYGO scheme does not change. For example, consider a change from $(\lambda_0^p, \lambda_0^f) = (\lambda_1^p, \lambda_1^f) = (0.15, 0.05)$ to $(\lambda_0^{p\prime}, \lambda_0^{f\prime}) = (\lambda_1^{p\prime}, \lambda_1^{f\prime}) = (0.15, 0.07)$. Total contributions have increased from 0.2 to 0.22.

In period 0 pensions of the old generation in period 0 remain unchanged. In contrast, current workers have to pay a greater contribution today, $\lambda_0^\prime$, but their pension benefits also increase in such a way that they have the same disposable income. Thus, this reform is simply a way of increasing savings in period 0, and it implies to sacrifice consumption today for consumption tomorrow. However, some workers may be worse-off after the reform. This is the case of those workers who are saving-constrained. They would like to increase consumption in period 0, at the cost of reducing consumption in period 1, but they cannot do it, since borrowing is not allowed. And this reform takes income from period 0 and transfers it to period 1, moving this group of individuals away from their optimum.

The impact of this reform on the subsidy to finance public education will depend on whether the median voter is saving-constrained or not:
(i) The median voter is not saving constrained. By inspection of the first order condition (1.22), we see that neither the term on the left or the term on the right change. This means that the reform has no impact on the tax rate for financing public education.
(ii) The median voter is saving constrained. We study the first order condition (1.28). The first term in the right hand side of that condition rises, since the pension benefit is greater, while the term in the numerator remains constant. Also the second term in the right hand side rises. Then, the tax rate preferred by the median voter is lower after the reform.

To sum up, the only case in which increasing the funded scheme could have a positive effect on public education is the first type of reform. To obtain this result, two conditions are necessary: (i) The median voter cannot be constrained in her savings. (ii) Her pension benefit must rise after the reform. Looking at the expression (1.30), this will be more likely to happen when the redistribution parameter α is small, and/or the difference between the average return of the funded scheme (R) and the return of the PAYGO scheme ($\frac{h_1}{h_0}$) is large.

1.6 The "Trust" Fund Alternative

So far, our benchmark case has been a mixed Social Security system combining a funded MIRA scheme with a PAYGO scheme. Alternatively, we can consider what would happen if the initial mixed pension system were of a "trust" fund type. Recall that in this case both schemes, the funded and the unfunded one, are subject to the same redistribution factor. In particular, an individual with a stock of human capital h_0^i would get a pension benefit in period 1 of:

$$b_1^i = [R\lambda_0^f h_0 + \lambda_1^p h_1][\alpha + (1-\alpha)\frac{h_0^i}{h_0}]. \tag{1.31}$$

It is worth to point out that, under this specification, the link between pension benefits and past contributions becomes weaker. However, the universal pension benefit, which is unrelated to past contributions, is greater. The degree of redistribution inherent to the system increases with respect to the MIRA specification. Under this design of the system, we study the effect of the three proposals of reform.

With the first type of reform we have two different situations, depending on whether the median voter is saving-constrained or not. When the median voter is not saving-constrained, the effect is not clear at all. In the first order condition (1.22), we see that, after this reform, the term $\partial y^i/\partial\tau$ becomes lower, while y^i rises. Then, the overall effect will depend on which effect dominates. However, if the median voter is saving-constrained, the effect is always negative.

With the second proposal we have again two possibilities. When the median voter is not saving-constrained, we have no clear effect. Contrary to the situation with the MIRA scheme, here it is not true that the present value of her income stream shrinks for all individuals after the reform. In particular, for all individuals with a stock of human capital h_0^i such that:

$$\frac{h_0^i}{h_0} < D^i(\alpha)\frac{R - \frac{h_1}{h_0}}{R}, \tag{1.32}$$

will be the opposite, since they will be better-off. Then, the final result is not clear. Once again, if the median-voter is saving-constrained the impact of this reform on the tax rate will be negative.

Finally, we study the "incremental" reform. The only term in condition (1.22) that can change with this reform is y^i. In particular, if the present value of the income stream of the median voter y^m rises, she will prefer a higher level of the tax rate. And this will be the case if, and only if, the stock of human capital corresponding to the median voter, h_0^m, is less than the mean stock of human capital, h_0. As this is a well-known property of most real-world income distributions, we find that this example of reform will likely have a positive impact on the support for public education. Once again, we find that, when the median voter is saving-constrained, the impact of the reform is negative.

In general, the effect of increasing funding under the "Trust" Fund scheme on the subsidy to finance public education, is less negative. The reason is that now the benefits from increasing funding are subject to redistribution. With the third type of reform, in particular, the poor are who benefit the most. However, note that the result is again negative if the median voter is saving-constrained.

1.7 Conclusions

This paper studies the effects that three alternative proposals for reforming Social Security have on the tax rate that society devotes to finance public education. Our results suggest that this effect is highly sensitive to the situation of the median voter. In particular, if the median voter is saving-constrained, we find that all six different types of reform considered in the paper entail a negative effect on the educational tax rate. It is possible, however, to get a positive effect on the support for public education in the case of a median voter with positive savings. Nevertheless, according to Feldstein (1996), individuals do little saving for retirement, mostly due to the existence of Social Security. The median financial assets of households with heads aged 55-64 was only $8,300 in 1991, substantially less than six months income. This means that the most plausible case from an empirical point of view is the situation in which the median voter is saving-constrained, giving more support to the situation in which the reform of Social Security has a negative impact on education. The lesson that we draw is that, when proposing reforms of Social Security, it must be analyzed carefully if this reforms could have negative impacts on other public programs.

A possible criticism to our model is that only middle-aged agents take decisions about the financing of public education. In the case of young agents, this can be easily justified if they are under the legal age to vote. In addition, we can consider countries where there exists a mandatory education period and entry to labor markets is restricted for young agents. On the other hand, we put aside the role played by the currently retired in the choice of fiscal policies, because we wish to focus on the possible effects that these reforms have on the accumulation of human capital. In fact, assuming that the old agents vote adds complexity to the model and does not change the qualitative results on the political support for public education.

Appendix: Proof of Proposition 1

To check whether optimal savings are increasing in the stock of human capital, we compute $\frac{\partial s_0^{i*}}{\partial h_0^i}$:

$$\frac{\partial s_0^{i*}}{\partial h_0^i} = \frac{1}{1+\rho}\left[\rho(1-\tau-\lambda_0) - \frac{1}{R}\frac{\partial b_1^i}{\partial h_0^i}\right]. \tag{1.33}$$

Savings will rise with the stock of human capital if:

$$(1-\tau-\lambda_0) > \frac{1}{R\rho}\frac{\partial b_1^i}{\partial h_0^i} = \frac{1}{R\rho}\left[R\lambda_0^f + \lambda_1^p(1-\alpha)\frac{h_1}{h_0}\right]. \tag{1.34}$$

When $\tau = 0$, the condition is:

$$1 - \lambda_0 > \frac{\lambda_0^f}{\rho}, \tag{1.35}$$

since $h_1(\tau = 0) = 0$. But part (ii) of Assumption 1 implies equation (1.35). When $\tau > 0$, the left-hand side of equation (1.34) is a decreasing function in τ, while the right-hand side is an increasing function in τ, since h_1 is increasing in τ. Then, there is a cut-off value for the tax rate τ, that we call $\overline{\tau}$, such that condition (1.34) is true for all values of τ below $\overline{\tau}$. By part (i) of Assumption 1, the right-hand term in equation (1.34) is always lower than $\frac{1}{\rho}[\lambda_0^f + \lambda_1^p(1-\alpha)]$ which, in turn, by (iii), is also lower than $\frac{\lambda_0}{\rho}$. As the right-hand side is always lower than $\frac{\lambda_0}{\rho}$, $\overline{\tau}$ will be always above that value of τ that solves $1-\tau-\lambda_0 = \frac{\lambda_0}{\rho}$, which is $1 - \frac{\lambda_0(1+\rho)}{\rho}$. By part (ii) of Assumption 1, we obtain that $1 - \frac{\lambda_0(1+\rho)}{\rho} > 0$. ■

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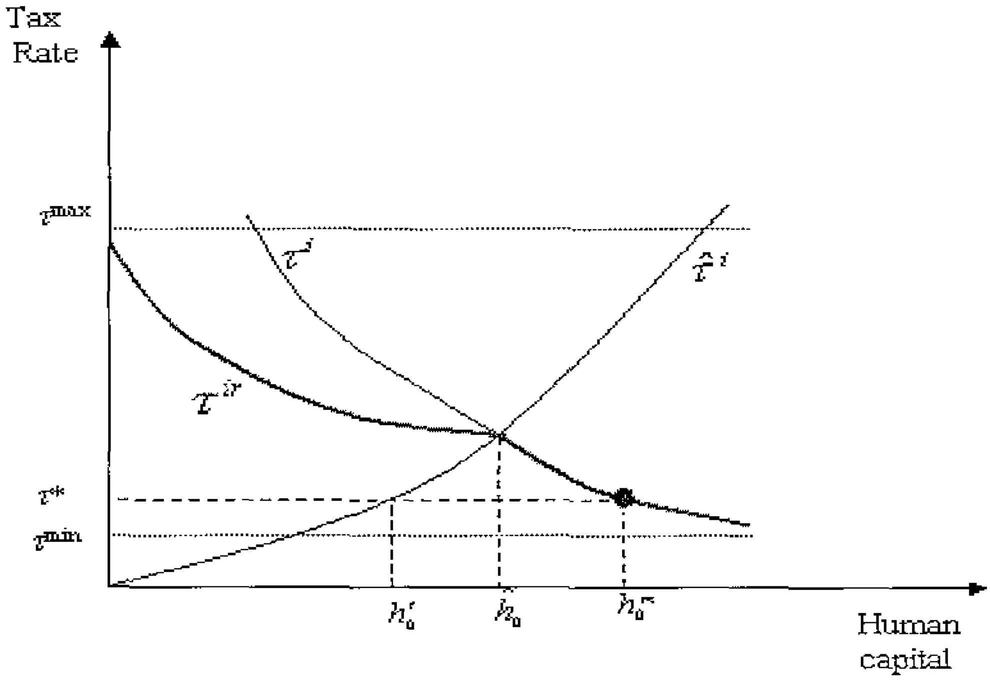

Figure 1: Borrowing constraints: Charaterizing the Condorcet winner.

Chapter 2

Quantifying the Impact of Immigration on the Spanish Welfare State

2.1 Introduction

Over the last decades, the demographic scenario in the developed countries has changed dramatically. Declining fertility and increased longevity bring about population decline and population aging, and this tendency is expected to worsen in the future. According to population projections by the United Nations (1999), 33 countries will reduce in population during the period 2000-2050. The population of the European Union (EU) will decrease from 371.9 million people in 1995 to 331.3 million by 2050, a 10.9% loss. Also in the EU, the proportion of people aged 65 and over will rise from 15.6% in 1995 to 29% by 2050. For Spain, the perspectives are particularly worrying. According to the UN projections, total population will decline from 39.6 million in 2000 to 30.2 million in 2050, a 24% loss. The proportion of people aged 65 and over will rise from 17% in 1995 to 37% in 2050. Even if we consider the more optimistic projections made by Fernández-Cordón (2000), the expected population in 2050 will be 34.5 million, a 13.6% loss and the proportion of people aged 65 and over will reach 33% by 2050.

These projected changes in the Spanish population raise serious concerns about the viability of the current fiscal policy. On the one hand, the aging of the population will deteriorate the national budget, since the elderly are net beneficiaries of the tax-transfer system. In particular, expenditure in pension benefits and health care will rise. Furthermore, the decline in fertility will reduce the proportion of net tax payers across the population.

Recently, some authors have argued that the inflow of immigrants could attenuate the negative effects of population aging. This opinion reflects the popular belief that a large inflow of immigrants makes the population of the host country younger. The reason is that the age structure of immigrants is younger than that of the natives, as Table 1 shows for the case of Spain, confirming the popular belief. We are not merely interested in the pure demographic impact of immigration, but also in the economic impact it will have in Spain. Specifically, we wish to study the quantitative effect of immigration on the Spanish fiscal policy in the long run. We therefore need to adopt a dynamic perspective.[1]

Some previous studies have used a dynamic framework to capture the long-run impact of immigration. Most of these studies have focused on the US economy. Borjas (1995) gives an estimate of the benefits that the host country derives from immigration, mainly from production complementarities between immigrant workers and other factors of production. According to Borjas, although there are some benefits from immigration, they are relatively small. The book by Smith and Edmonston (1996) is a thorough study of the various effects of immigration. In particular, they study its long-run fiscal impact. They conclude that the effect an immigrant makes, varies greatly depending on his age on arrival. Immigrants who arrive at the ages of 10 to 25 produce the most positive effects for natives. On average, they find that the effect is strongly positive at the federal level, but negative at the state and local levels. Lee and Miller (2000), arrive at similar conclusions. Storesletten (2000) calibrates a general equilibrium overlapping generations model, explicitly taking into account the differences between immigrants and natives. The reason for using a general equilibrium approach is that the inflow of immigrants might well increase interest rates and decrease wages, due to the increase in the labor/capital ratio.[2] He computes the net government gain, in present value, of admitting one additional immigrant. He finds that the optimal policy should be to increase the inflow of middle-aged, high- and medium-skilled immigrants. If, however, the age and skills of the new immigrants were at the level of current immigrants already living in the US, an increased inflow of immigrants would not help to balance the budget in the long-run.

The study closest to ours is that of Auerbach and Oreopoulos (2000), which analyzes the dynamic effects of immigration within the framework of

[1]Surveys on the empirical effects of immigration in the host country have been presented by Borjas (1994), LaLonde and Topel (1996), and Smith and Edmonston (1996).

[2]However, the empirical evidence seems to suggest that the effect of immigration on wages and unemployment rates of natives is negligible. See Lalonde and Topel (1996) and Smith and Edmonston (1996), and Dolado, Jimeno and Duce (1997) for the case of Spain.

Generational Accounting. They also find that the effects of current immigration to the US, in fiscal terms, are relatively modest. The effect is positive but extremely small, relative to the size of the overall fiscal imbalance. Finally, Bonin, Raffelhüschen and Walliser (2000) perform a similar exercise for Germany. Contrary to previous studies, they find a positive and significant effect of immigration on the intertemporal government budget.

In this paper, we also use Generational Accounting, which was originally developed by Alan J. Auerbach, Jagadeesh Gokhale and Laurence J. Kotlikoff in the early nineties.[3] Generational Accounting is a new method to assess the long-term fiscal position of the government. It is a useful tool for assessing the size of the redistribution between present and future generations. It calculates, in present value, what the typical member of each generation and sex can expect to pay in net taxes (taxes net of transfer payments received), in his/her remaining lifetime. The book by Auerbach, Kotlikoff and Leibfritz (1999) presents Generational Accounting analyses for 17 different countries.

There are also some previous works on Generational Accounting in Spain. In particular, the work by Berenguer, Bonin and Raffelhüschen (1999), which is part of a larger study supported by the European Commission, analyzes several European countries. The methodology of Generational Accounting was also applied by Bonin, Gil and Patxot (2001) to the study of the Spanish pension system and by Abío, Berenguer, Bonin, Gil and Patxot (2001) to the reduction of current deficit.

In this paper, we focus on the effects of immigration on the Spanish Welfare State. We simulate alternative scenarios by considering different quotas of immigrants. In particular, we consider three different scenarios. In the benchmark scenario we assume a net immigration of 30.000 individuals per year, which is the current quota in Spain. In the second scenario we assume that net immigration is zero after the base year. Finally, in a third scenario, we consider an "increased" net immigration of 100.000 individuals per year. Contrary to Auerbach and Oreopoulos (2000), we find that increasing the number of new immigrants would substantially lower the burden on future natives. This result is in line with the evidence for Germany, presented in Bonin, Raffelhüschen and Walliser (2000). We believe that the reason for this apparently contradictory result is due to the fact that in Spain, as in Germany, the imbalance in the current fiscal policy is very high, while in the US it seems to be relatively small, mainly because, in the US, the problem of an aging population is less dramatic than in Germany or Spain.

The structure of the paper is as follows: In Section 2, we briefly de-

[3]A detailed description of the Generational Accounting methodology can be found in Auerbach, Gokhale and Kotlikoff (1991) and Auerbach, Gokhale and Kotlikoff (1994).

scribe the methodology of Generational Accounting and we explain how to accommodate immigrants in that framework. In Section 3, we present the assumptions concerning population projections and fiscal projections for the period that we are analyzing. In Section 4, we present our main results concerning the overall dynamic effect of immigration in the three scenarios considered. Finally, in Section 5, we summarize and conclude.

2.2 Methodology

Generational Accounting is based on the government's intertemporal budget constraint, which can be expressed as follows:

$$\sum_{s=t}^{\infty} \frac{T_s}{(1+r)^{s-t}} = \sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + B_t, \tag{2.1}$$

where t is the base year, T_s is total tax revenue in year s, G_s is government expenditure in year s, B_t is the government's outstanding net debt in year t, and r is the real interest rate. Equation (2.1) is an identity. It states that all government expenditure will be paid out of taxes, either today or in the future. Following the Generational Accounting methodology, government expenditure is split into government consumption and government transfers to the individuals. Government transfers represent that part of G_s that can be attributed to particular individuals. For example, pension benefits paid by the social security administration, unemployment benefits, and also in-kind transfers such as education and health services. All the remaining expenditure (i.e., that cannot be attributed to particular individuals), is included under the name of government consumption.

The next step is to assign government transfers and tax payments to every generation by age, sex and nativity.[4] In the terminology of Generational Accounting, this means constructing the accounts for current and future generations. The account in year t of a generation born in year k, is the present value of the stream of taxes (net of transfers) that they will pay to the government over their remaining life span. We call it $N_{t,k}$. If the maximum length of life is D, the accounts of existing generations in the base year are $N_{t,t}, N_{t,t-1}, .., N_{t,t-D}$. The first one ($N_{t,t}$) is the account of those born in the base year, while the last one ($N_{t,t-D}$) is the account of those born D years ago, i.e., the oldest generation alive in the base year. The accounts of future generations are $N_{t,t+1}, N_{t,t+2}$, etc. As such, we can rewrite identity

[4] To ease notation, we will skip sex and nativity subscripts in this presentation.

(2.1) as:

$$\sum_{s=0}^{D} N_{t,t-s} + \sum_{s=1}^{\infty} N_{t,t+s} \equiv \sum_{s=t}^{\infty} \frac{G_s}{(1+r)^{s-t}} + B_t, \tag{2.2}$$

where now, G_s denotes government consumption in the year s. The intertemporal budget constraint in (2.2) expresses the fact that the total liabilities of government cannot exceed the sum of the present value of net payments made by current and future generations. The first term in the left-hand side represents the total amount of net taxes paid by existing generations, while the second term represents total contributions of future generations. The account of a generation born in year k can be written as follows:

$$N_{t,k} = \sum_{j=\max\{t,k\}}^{k+D} P_{j,k} T_{j,k} (1+r)^{-(j-t)}, \tag{2.3}$$

where $P_{j,k}$ is the number of individuals born in year k who are still alive in year j, and $T_{j,k}$ represents the average net tax payments made in year j by a member of the generation born in year k. As we take t as our base year, the summation begins in year t, for generations born before the base year. For those born in year $k > t$, the summation begins in year k.

We shall now explain how the different terms in Equation (2.2) are estimated. To estimate government consumption, we first calculate per capita government consumption in the base year, from the government's accounts. Secondly, we assume that per capita government consumption grows along with productivity at rate g per year. Finally, we use our population projections to calculate $G_t, G_{t+1}, .., G_{t+k}$, etc. Government debt is directly obtained from the government's accounts.

The left-hand-side of Equation (2.2) is estimated using two different approaches that differ on how the changes in fiscal policy needed to restore the balance of the government's intertemporal budget constraint are implemented. The first approach is the traditional approach employed in the literature of Generational Accounting. It consists of estimating the accounts for existing generations under the assumption that current fiscal policy will remain fixed for those generations. The sum of the accounts for future generations is then calculated as a residual from Equation (2.2). This approach implies that future generations will absorb the entire adjustment required to fill the gap in the intertemporal budget constraint. We believe that this is a useful benchmark, since it provides information on the size of the existing imbalance. The main flaw in this approach, however, is that it seems implausible that fiscal policy will change only for those generations born after the base year, while it remains unchanged for those generations born in the base year or earlier. We therefore explore an alternative approach proposed by Auerbach and Oreopoulus (2000), in which fiscal policy is assumed to change immediately, and any imbalance arising from Equation (2.2) will be paid by both current and future generations.

Under both approaches, we first estimate the average net tax payments for all living generations in the base year. This means estimating the terms $T_{t,t}, T_{t,t-1}, .., T_{t,t-D}$ of Equation (2.2). To do so, we use micro-data and the aggregate figures derived from the government's accounts.

In the traditional approach, per capita net tax payments for currently living generations are projected through productivity growth. That is, the average net tax payment of an individual aged s in year $t+k$ ($T_{t+k,t+k-s}$), is simply the average net tax payment of an individual aged s in year t ($T_{t,t-s}$) multiplied by $(1+g)^k$. We then use population projections together with these estimates to calculate the accounts for all living generations in the base year. As mentioned above, once we have estimated the present value of government consumption, government debt and the accounts for currently living generations, we obtain the sum of the accounts for future generations as a residual. The next step is to divide the burden among the future generations. We use the following procedure. We study how much fiscal policy should be changed in order to restore the balance of the government's intertemporal budget constraint. In particular, we calculate which is the proportional increase in all taxes and/or the cut in all transfers that future generations will pay and/or receive to balance the intertemporal government budget constraint. If no change is needed, this means that the government's long-run fiscal position is balanced. If an increase in taxes and/or a decrease in transfers is needed, this means that current fiscal policy is not sustainable. Under this method, the change in fiscal policy can have a different impact on males as on females, and on natives or immigrants.

Under the alternative approach, fiscal policy is assumed to change immediately. We first calculate the burden on existing and future generations under the current fiscal policy. Then, we consider a proportional increase in all taxes and/or a cut in all transfers that all generations will pay and/or receive until the intertemporal government budget constraint is balanced.

2.3 Assumptions Underlying Generational Accounts Calculations

To produce generational accounts for Spain, we require population projections, taxes and transfers profiles in the base year, government expenditure and government debt in the base year. Our definition of government includes the central, the regional and the local governments. We have chosen 1998 as our base year, due to data availability.

2.3.1 Population

We construct population projections for the period 1998-2197, assuming that the population remains stationary thereafter.[5] To construct these projections, we need to make some assumptions on the behavior of the life expectancy and the fertility rate in future, as well as assumptions about the age structure of future immigrants. We do not make any distinction between immigrants and natives in terms of life expectancy and fertility rate. The reason is that there is no available data on the life expectancy and the fertility rate of immigrants in Spain.[6] According to our micro-data, the main difference between natives and immigrants is in their average labor income. The reason is two-fold. Firstly, because the percentage of employed people is larger among immigrants, and secondly, because in comparing immigrant workers to native workers, we observe that the average labor income of the former is lower.

We assume that life expectancy will rise within the period that we are studying. In Figure 1 we present the trend in life expectancy. In particular, we assume that life expectancy will rise from 74.7 years in 1998, to a limit expectancy of 78.5 for males, and from 81.9 in 1998 to 85 for females.[7] These numbers are quite similar to those of Fernández-Cordón (2000).

We also assume that the fertility rate will rise in the following years. In 1998, the fertility rate in Spain was 1.165,[8] the lowest in the European Union. We perform two distinct projections for the fertility rate. Under a low fertility scenario, we assume that the fertility rate will rise to 1.5 in the year 2015 and will stay at that level thereafter. This is our benchmark scenario and it corresponds, roughly, to the current average fertility rate in

[5]To calculate the accounts for current generations, we only need population projections up to 2098, because our maximum life-span is 100 years. However, we need population projections to infinity to calculate the present value of future government expenditures and the per capita accounts for future generations.

[6]To test for the robustness of our results, we have repeated our simulations using a value for the fertility rate of immigrants that is a 50% higher than the fertility rate of natives in the base year. The impact on the results is rather small. The reason is that immigrants are always a small fraction of the total population.

[7]In the Appendix we describe, in detail, the construction of the survival rates, by age and sex.

[8]According to data from INE, "Movimiento natural de la población" (http://www.ine.es).

the European Union. We also present a high fertility scenario, in which the fertility rate reaches 1.8 in the year 2020, and from that year onwards, it remains constant. We set this value because it corresponds approximately to the current average fertility rate in the Scandinavian countries. In Figure 2, we plot our fertility rate projections under both scenarios.

We first construct the age and sex profile for current immigrants in the base year. We consider immigrants to be *individuals from under-developed countries, who arrived in Spain when they were older than twelve.* We do not consider people from developed countries as immigrants,[9] because their tax and transfer profiles are similar to those of the natives. Secondly, we exclude individuals who arrived in Spain when they were younger than twelve, because we think that they have had the same education opportunities as the Spaniards and, therefore, will not differ much from the natives. The Spanish Statistics Office (INE) provides information on the number of immigrants by sex, age groups[10] and country of origin. In 1998, there were 389,333 legal immigrants from under-developed countries living in Spain. However, as far as we know, there are no official figures on the number of immigrants according to age when they first arrived in Spain. We obtained this information from the Spanish Labor Force Survey (Encuesta de Población Activa, EPA). The EPA is a large survey that is carried out each quarter, since the early seventies, and is representative of the Spanish population. The sample size is around 60,000 households (200,000 people) and one sixth of the households is renewed each quarter. We pool together all the data for 1999 (four quarters) and the available data for 2000 (the first three quarters). The total number of observations is 1.318,708. The number of immigrants from under-developed countries is 7,085, and of those, 5,407 came to Spain when they where older than twelve (0.41 percent of the total sample). We first calculate the proportion of immigrants within this sample by age-sex groups and then use these proportions to allocate the 389,333 immigrants that were living in Spain in 1998. Secondly, we calculate the proportion of immigrants in each age-sex group that arrived in Spain when they were older than twelve, and we use these proportions to estimate the number of immigrants by age-sex groups. Finally, we consider as natives all the children that the immigrants will have, after settling in Spain. That is, we assume that the characteristics of the second generation of immigrants are indistinguishable from those of the natives.[11] Under these assumptions, we construct population projections

[9] Most of the residents in Spain who were born in developed countries are from the EU.

[10] The age-groups are: younger than 16, from 16 to 24, from 25 to 44, from 45 to 64, and older than 64.

[11] This assumption rests on empirical evidence from the US (Chiswick (1977, 1978)), and Germany (Gang and Zimmermann (2000)).

for the period 1998-2197, both for natives and for those immigrants who were resident in Spain in 1998.

To complete our population projections, we need to make assumptions about the number of immigrants arriving in Spain. We consider three different scenarios regarding future immigration. The first scenario involves annual net immigration of 30,000 individuals. This is our benchmark scenario and it reflects the current quota of immigrants in Spain. In the second scenario, we consider the case of zero net immigration after the base year. Finally, the third scenario incorporates an annual net immigration of 100,000 individuals. Under the first and the last scenarios, we have to construct population projections for future immigrants. The reason why we have to distinguish between current and future immigrants is because the future immigrants did not belong to the "existing" generations in the base year. To construct population projections for future immigrants, we assume that new immigrants will be younger than 65 and their age-sex profiles will mimic the age-sex profiles of current immigrants in 1998.[12] Hence, we use the proportion of immigrants in each age-sex group derived from the EPA survey to allocate new immigrants to the different age-sex cohorts.

2.3.2 Fiscal Projections

Aggregate taxes and transfers are taken from several sources. Most of them come from the report "Actuación económica y financiera de las Administraciones Públicas", published by the Ministerio de Hacienda-Intervención General de la Administración del Estado (IGAE). Table 2 summarizes the public budget in the base year 1998.

We distinguish between four main categories of taxes: direct taxes, value added tax (VAT), excise taxes and social security contributions. Direct taxes include income tax, property tax and corporate tax. According to the "small-country" assumption, we assume that taxes on mobile corporate capital are borne by local, fixed factors. Transfer payments are categorized into direct monetary transfers (pensions, unemployment benefits, etc.), health and education. For each of these items, the aggregate amounts are distributed according to age, sex, and nativity profiles. The remainder of government expenditure, after subtracting all tax payments not allocated to particular individuals, is labelled as government consumption.

To construct the accounts, we also need the value of the outstanding public debt which, in 1998, amounted to 340,414 million euros, 64.7 percent of GDP, according to the Banco de España (2000). Finally, we assume an annual

[12] New immigrants who arrive when they are younger than twelve are considered natives.

productivity growth rate of 1.5 percent and a discount rate of 5 percent in the long run. We have chosen these figures as they are quite comparable to those used in most of the studies included in Auerbach, Kotlikoff and Leibfritz (1999). We test the robustness of our results by repeating the simulations under alternative discount and growth rate assumptions. The alternative assumptions are 1 and 2 percent for the productivity growth rate and 3 and 7 percent for the discount rate.

2.3.3 Construction of relative age-profiles

Relative age-profiles for taxes paid and transfers received are calculated through micro-data. Our two main sources of data were the European Community Household Panel Survey (ECHP) and the Spanish Consumer Expenditure Survey (Encuesta de Presupuestos Familiares, EPF). The ECHP survey presents comparable micro-level (persons/households) data on income, living conditions, housing, health and work in the EU. This survey covers all EU member states and it follows the same private households over consecutive years from 1994 onwards. For our study, we have used data on 6,522 Spanish households in the 1995 wave. The EPF is a large cross-sectional survey and provides very detailed information on family expenditures, household characteristics and personal income. This survey was carried out in 1990/91 on a sample of 21,155 households and is quite representative of the Spanish population.

The age-profiles are calculated as follows. First, we calculate initial profiles of average taxes paid or transfers received by sex and age for immigrants and natives, using the micro-data. We then derive the micro-based total taxes paid or transfers received by each group, by multiplying the averages by the number of people in the population on each age-sex-nativity cohort. Typically, when we add-up the micro-based figures for the entire population, we find that they do not coincide with the corresponding government budget figures represented in Table 2. We therefore construct our final profiles of taxes paid or transfers received by each group by allocating the exceeding amounts, proportionally, to the initial profiles. All these profiles are represented in Figures 3-18. In the horizontal axis we represent age and in the vertical axis, the average amount paid or received, in thousands of euros, by sex and nativity.

Direct Taxes

The age-profiles for direct taxes (Income Tax and Social Security Payments) are calculated from income data taken from the ECHP. The personal income data recorded in this survey are net of taxes and social security payments. As an approximation, we have calculated the age-profiles by sex and nativity for income tax, proportional to total personal net income, and for social security payments, proportional to labor income. In Figures 3 and 4, we present Income Tax and Social Contributions respectively.

The ECHP is not a very large survey and the number of immigrants is therefore rather small. As such, the figures for average income by sex and age for immigrants are not very reliable.[13] For this reason, we have used an alternative approach to calculate average income by sex and age for immigrants. We have calculated average labor income for employed immigrants and employed natives, and the ratio between the two is 0.8.[14] However, we are interested in estimating average labor income by age, sex and nativity for the entire population, and not merely for employed people. We should also check therefore, whether there are differences in employment rates between immigrants and natives. We have used the EPA survey to calculate employment rates by age, sex and nativity. We have found that the employment rates are higher for immigrants than for natives, for young cohorts and for those close to retirement age, and are very similar for middle age cohorts. Then, we have used the employment rates from the EPA survey and the labor income data from the ECHP to estimate average labor income, by sex and age, for both natives and immigrants. We first calculate the average labor income, by sex and age, for employed natives from 16 to 64 years of age. We then assume that average labor income, by sex and age, for employed immigrants, is 80 percent of the average for natives. Finally, we multiply these averages by the employment rate for each cohort to obtain their average labor income by age, sex and nativity, for the entire population.

We have also calculated average non-labor income, for immigrants and natives, and we find that there are no substantial differences between these two figures. Therefore, we have calculated average non-labor income, by age and sex, for the entire sample, and we have assigned these averages to both immigrants and natives. Average total income for each cohort, is then the sum of average labor and non-labor income.

Indirect Taxes

For indirect taxes we have used the EPF data. As already mentioned, the EPF data provides very detailed information on household expenditure (it covers 918 goods). Different goods are taxed at different rates and the ex-

[13]Once we divide the sample of immigrants by sex and age, the number of individuals in each cell is rather small.

[14]Remarkably, Schmidt (1997) finds exactly the same ratio for Germany.

haustive good classification of the EPF allows us to calculate the VAT paid by each family quite well.[15] Hence, we first calculate VAT paid by the household using appropriate rates for each good. We then allocate VAT to each adult in the family, proportional to his/her income. We also use the EPF data to calculate the excise taxes that are paid on certain goods such as beer, spirits, tobacco, electricity, vehicles, gasoline, and some types of insurance. Unfortunately, there is no information on nativity in this survey. As such, we could not directly derive any VAT profile for immigrants and natives. What we did was to calculate the average VAT paid, by sex and age, using the EPF, and considered these figures as the relative VAT profile for natives. We then used the ratio of average total income for immigrants and natives, by sex and age, that we had obtained from the ECHP, and multiplied the profile for natives by these ratios, to estimate the relative VAT profile for immigrants. We use the same approach to calculate the excise taxes profiles. In Figures 5 to 11 we present the age profiles for indirect taxes.

Transfers

Direct monetary transfers received by each group have been calculated using the ECHP data. This data set provides information on direct transfers received by each adult member of the family. Direct transfers are disaggregated into unemployment benefits, pensions, family allowances and other transfers. However, in this study we have considered total transfers received by each adult and we have calculated the age-profile for total transfers for immigrants and natives, using a similar approach to that used for direct taxes. We first calculated the average total transfers for immigrants and natives, the ratio between the two being 0.9. Secondly we computed the average total transfers, by sex and age, for natives. Finally, we multiplied the profile for natives by 0.9, to estimate average total transfers, by sex and age, for immigrants.

To construct the profile for education we need per capita expenditure by level of education, and enrolment rates by age, sex and nativity. We first calculate per capita expenditure by level of education, using data from the Spanish Ministry of Education. We then use the enrolment rates, by age and sex, provided by the OECD. Unfortunately, these enrolment rates do not distinguish between immigrants and natives. According to the EPA survey, the proportion of students differ sharply between immigrants and natives, and we have used the proportion of students by age, sex and nativity, derived from the EPA survey, and the enrolment rates provided by the OECD, to estimate the enrolment rates by age, sex and nativity. Finally, we combined

[15] The EPF data for food and alcohol that we have used has been corrected for the bulk purchases effect according to Peña and Ruiz-Castillo (1998).

per capita expenditure, by level of education, with enrolment rates by age, sex and nativity, to derive the education profile.

We could not find reliable data for Spain to construct the health profile. Instead, we have used the profile for Belgium.[16] This is because Belgium and Spain have similar age structures and, thus, the distribution of health expenditures by age and sex must be very similar in both countries. However, we have also used the data contained in Alonso and Herce (1998),[17] to check for consistency. We found that both profiles were roughly similar, except for the case of children below one year. In the data in Alonso and Herce, health expenditure per capita for children below one year was twice the expenditure using the data from Belgium. We believe that the reason for this discrepancy is that Alonso and Herce only took health expenditure within hospitals into account including, in particular, all the expenditure in premature babies, which inflates the corresponding amount. The health profile is assumed to be identical for immigrants and natives. In Figures 13 to 15, we present the profiles for transfers. Finally, we present the age profiles for all per capita taxes, transfers and net taxes in Figures 16 and 18.

2.4 Results

As we have two different fertility projections and three different quotas of immigrants, we have six different scenarios. Our benchmark scenario is that of low fertility and 30,000 immigrants per year. Moreover, we study two different approaches for the implementation of the necessary changes in fiscal policy.

Tables 3 to 6 show the results of the paper. The upper part of Table 3 shows the per capita Generational Accounts for existing generations by sex and nativity. They present the typical life-cycle pattern found for other countries. The accounts increase during childhood and youth, peaking at around the age of 25. Above that age, accounts start to decrease, because the remaining period within the labor force gets shorter and social security transfers are less discounted. Around the age of 50, accounts become negative (45 for women), and they reach a minimum at around 65. Above that age, they rise again, due to the short period of the remaining life-span.

The very large differences between men and women is worth mentioning. This is primarily due to the low participation of women in the labor mar-

[16] These data were kindly provided by Arnaud Dellis.

[17] Alonso and Herce (1998) report data on per capita health expenditure by age groups. However, they do not disaggregate by sex.

ket. However, it is also due to our tax incidence assumptions.[18] Differences between natives and immigrants are also significant. These differences arise mostly from taxes paid, not from benefits received. At each age, immigrants earn less than natives and, thus, pay lower taxes (see Figures 16 and 17).

The results in Table 3 correspond to the traditional approach of Generational Accounting, in which the whole existing imbalance is paid only by future generations and we consider a proportional increase in all taxes and a decrease in all transfers. In the bottom part, we present the burdens on future generations for alternative immigration policies and different fertility scenarios. In the benchmark case with low fertility and 30,000 immigrants per year, the account for a male born in 1999 is 93,624 euros, which is 82.7 percent higher than the account for a male born in 1998. Compared to the results for other countries in Auerbach, Kotlikoff and Leibfritz (1999), we see that this imbalance is comparable to the existing imbalance in Germany and Italy but higher than in the remaining countries covered in that study, except Japan.

We can compare the burden on future generations under different fertility-rate assumptions. The first thing to be considered is that an increase in the fertility rate has two opposite effects on the per capita burden of future generations. On the one hand, an increase in the population implies an increase in total government consumption, since we are assuming that government consumption per capita is constant. On the other hand, the larger the population is, the lower the per capita contribution will be for a given total burden. The total effect of higher fertility on future generations is, at best, quite modest. In the scenario with no immigration after the base year, it reduces the burden on future generations by 3.5 percent. Under a high immigration policy, the reduction in the burden of future generations is only a 0.5 percent. The reason is that, as shown in the table, the average amount that an immigrant pays is larger than the amount paid by a new-born native. Therefore, when the number of new immigrants is large, the first effect mentioned above almost offsets the second.

If we now compare the burden on future generations under different immigration policies, we can see that the larger the number of new immigrants, the lower the burden on future generations and this effect is quite large. For instance, under the scenario with 100,000 immigrants per year and low fertility, the per capita burden on future generation is reduced by 14.2 percent compared to our benchmark. This is because the average new immigrant arrives when he is 34, and, at that age, his remaining lifetime contribution

[18] As we explained above, we allocate VAT and excise taxes among adult members within a household, proportional to their income.

is very large. In 1998, we estimate that the present value of the average contribution of a male immigrant during his remaining life-time is 107,399 euros, while the corresponding figure for a female immigrant is 13,278 euros.

In Table 4 we present alternative methods of allocating the imbalance. In the first four columns of the table we follow the traditional approach in the literature of Generational Accounting. That is, we assume that all the imbalance is allocated to future generations alone. Therefore, the accounts for current generations are the same as in Table 3. In the benchmark scenario, all taxes would have to rise and all transfers would have to fall by 24.2 percent. Notice that this method of allocating the imbalance does not imply the same increase in the burden for men as for women, or for immigrants as for natives. In the last four columns of Table 4, we explore the alternative approach, by considering an immediate change in fiscal policy that affects both current and future generations. Now the accounts change also for currently living generations. The increase in taxes and the decrease in transfers needed to fill the gap is 4.1 percent.

In Table 5, we present the contribution of the generations born in 1998 and 1999, for different quotas on immigrants and alternative changes in fiscal policy. For simplicity, we present only the scenario with low fertility. The alternative fiscal tools that we consider are: A proportional increase in all taxes, a proportional decrease in all transfers, and the combination of both. The left-hand side of the table corresponds to the case in which all the burden falls on future generations while, on the right-hand side, we present the results for an immediate change in fiscal policy. The first thing to be considered is that a cut in all transfers increases the burden on females more than an increase in all taxes, and the opposite can be said for males. The reason is that there are huge differences in the tax profiles between women and men, while differences in the transfer profiles are quite small (see Figures 16 and 17). If we now compare the alternative immigration policies, we can see that immigration contributes to alleviating the burden on future generations under all the different fiscal policies that we have considered in our analysis. However, the contribution of one additional immigrant is higher when the number of new immigrants changes from zero to 30,000, than when it changes from 30,000 to 100,000. The contribution of immigrants has, therefore, decreasing returns.

Finally, we present in Table 6 the results of our simulations for alternative discount and productivity rates. We present the percentage change in all taxes and transfers under the three immigration scenarios (zero, 30,000 and 100,000 immigrants per year), and the two fiscal policy scenarios (all the burden is payed by future generations and an immediate change in fiscal policy) that we have analyzed along the paper. We want to stress that, for all the combinations that we have considered, generational accounts remain unbalanced. Furthermore, in all the cases, an increase in the number of immigrants will significantly lower the per-capita fiscal burden payed by current and future generations. Under the assumption that all the imbalance is paid by future generations, the size of the gain decreases when either the interest rate decreases or the growth rate increases. However, under the assumption of an immediate change in fiscal policy, the effect of an increase in the interest rate on the size of the gain is not monotone. The same can be said about an increase in the growth rate.

2.5 Conclusions

The main purpose of this study was to analyze the impact of immigration in the Spanish Welfare State. We have used the Generational Accounting methodology to address this issue. We have calculated the accounts for existing generations in 1998 (our base year) and the main conclusion is that the imbalance under current fiscal policy is rather large and is comparable to the imbalance in other European countries, like Germany and Italy. We have considered alternative immigration policies. The main conclusion is that, contrary to the results for the US in Auerbach and Oreopoulos (2000), a higher number of immigrants will substantially help to alleviate the fiscal burden on future generations in Spain. This evidence is in line with the results for Germany in Bonin, Raffelhüschen and Walliser (2000).

The main drawback of this paper is the lack of data on the characteristics of immigrants in Spain, mainly about their incomes. However, we think that we have estimated average income for immigrants in the best possible way, and hopefully, in the near future, the Spanish Statistics Office will carry-out an exhaustive survey on immigrants, which will allow us to verify our results.

Women's participation in the labor market in Spain has been increasing substantially for the last two decades. However, it is still quite low compared to other European countries. Most of the empirical research in the area points to a further increase in female labor force participation in the near future. Therefore, it will be particularly interesting to analyze the effect of an increase in female labor force participation on the Spanish Welfare State, within the Generational Accounting framework, and see whether the positive effect of immigration found in our paper is offset by an increase in female labor force participation. However, we think that this issue is out of the scope of this paper, and we leave it for future research.

To conclude, we have developed a flexible tool that allows us to perform different experiments concerning policy instruments. One experiment that we believe is particularly interesting is to study different types of immigration policies. For instance, should Spain try to attract immigrants of a particular type, of a particular educational level, age or sex? These questions can be properly addressed within our framework and are left to future research.

Appendix: Construction of Projections for the Survival Rates

We take the latest survival rates published by the Instituto Nacional de Estadística (1997) as our starting point. We adopt these survival rates as the survival rates for the base year 1998. To compute the survival rates for all subsequent periods, we use the following procedure: We fix life expectancy at birth, in the limit, at 78.5 years for men and 85 for women. These are the same figures used by Fernández-Cordón (2000). For simplicity, we assume that from the base-year to the limit, all male (female) survival rates by age increase in the same proportion. That is, if $p^0_{x,i}$ is the base-year survival rate of an individual of age $x = 0, .., 100$ and sex $i = M, F$, the survival rate in the limit will be $p^{\infty}_{x,i} = \alpha_i p^0_{x,i}$. With the above values for life expectancy in the limit, we get $\alpha_M = 1.00124$ and $\alpha_F = 1.00088$. Then, for each age and sex, we have already fixed survival rates in both the base-year and the limit, which we will use as the last year. To compute all the survival rates between those two extremes, we assume that they improve through time at a decreasing rate. In particular, we use the following equation:

$$p^t_{x,i} = (1 - e^{-bt})p^{\infty}_{x,i} + e^{-bt}p^0_{x,i},$$

for $0 \leq t \leq \infty$, where $p^t_{x,i}$ is the survival rate of an individual aged x in year t. We simply need to give some value to the parameter b. We propose a very simple procedure. Suppose that we call $\widehat{t}$ the number of years that it will take to fill exactly half of the gap between $p^0_{x,i}$ and $p^{\infty}_{x,i}$ (notice that $p^t_{x,i} \leq p^{\infty}_{x,i}$ for all t). Then, it is easy to see that the value of b will be:

$$b = -\frac{1}{\widehat{t}} \ln(\frac{1}{2}).$$

For our calculations, we will fix $\widehat{t} = 20$, and therefore $b = 0.0346574$.

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Table 1: Age structure of immigrants and natives, Spain 1998

	Natives	Immigrants
Proportion of individuals aged 0-15	16.75	14.61
Proportion of individuals aged 16-64	66.99	82.85
Proportion of individuals aged 65 and over	16.27	2.54

Source: Spanish Statistics Office (INE).

Table 2: Public Revenue and Expenditure in Spain 1998

(millions of euros and percentage of GDP)[19]

Revenue		Expenditure	
Direct Taxes	55,690 (10.6)	Monetary Transfers	67,371 (12.8)
Social Contributions	68,755 (13.1)	Pensions	53,995 (10.3)
Indirect Taxes	58,640 (11.1)	Unemployment Benefit	8,261 (1.6)
VAT	27,624 (5.2)	Other Mon. Transfers	5,115 (0.9)
Excise	15,642 (3.0)	Health	29,508 (5.6)
Insurance	0,717 (0.1)	Education	23,476 (4.5)
Other Indirect	14,655 (2.8)	Government Consumption	70,973 (13.5)
Other Revenue[20]	5,229 (0.9)	Interest Payments	22,606 (4.3)
Other[21]	12,128 (2.3)		
Deficit	13,492 (2.6)		
Total	213,934 (40.7)	Total	213,934 (40.7)

Source: Authors' calculations from IGAE (Intervención General de la Administración del Estado) and Ministerio de Educación, Cultura y Deporte.

[19]According to IGAE, total revenue in 1998 was 219.703 millions of euros (41.8% of GDP). From that amount we have substracted some items that represent transfers among public institutions. These items amount to 5,766 millions (1% of GDP).

[20]It includes revenue from state lotteries, fines, etc.

[21]It includes government production and transfers from the European Union.

Table 3: Generational Accounts
Spain 1998 (Euros)

	Natives		Immigrants	
Age	Men	Women	Men	Women
0	51243	-15737	-	-
5	68171	-12207	-	-
10	96303	1331	-	-
15	130453	18030	110431	19231
20	165020	34117	136170	29153
25	185572	41341	147085	31694
30	184586	33423	143613	28545
35	165270	21429	127686	21330
40	131312	3497	101217	8047
45	84242	-15452	64249	-6400
50	32376	-32276	22458	-21209
55	-20609	-47772	-18896	-37403
60	-60477	-59620	-48401	-51567
65	-79838	-65880	-68481	-59485
70	-71617	-62581	-62108	-56822
75	-58295	-56781	-51049	-51851
80	-46615	-53240	-41611	-49280
85	-32731	-37017	-29237	-34143
90	-24217	-25891	-21577	-23796
95	-15763	-16144	-14386	-14984
100	-6671	-6663	-	-
Average Immigrant in 1998			107399	13278
	Low Fert., 30,000 Immig. per year			
Generation born in 1999	93624	10427	161999	43261
% difference	82.7		50.8	225.8
	High Fert., 30,000 Immig. per year			
Generation born in 1999	91453	9162	159093	41831
% difference	78.5		48.1	215.1
	Low Fert., No immig. (after 1998)			
Generation born in 1999	102277	15466		
% difference	99.6			
	High Fert., No immig. (after 1998)			
Generation born in 1999	98720	13394		
% difference	92.7			
	Low Fert., 100,000 Immig. per year			
Generation born in 1999	80343	2694	144214	34518
% difference	56.8		34.3	160.0
	High Fert., 100,000 Immig. per year			
Generation born in 1999	79951	2465	143689	34260
% difference	56.0		33.8	158.0

Table 4: Generational Accounts
Low Fertility, 30,000 Immigrants per year
Spain 1998 (Euros)

	All Burden on Future generations				Immediate Change			
	Natives		Immigrants		Natives		Immigrants	
Age	Men	Women	Men	Women	Men	Women	Men	Women
0	51243	-15737	-	-	58997	-11220	-	-
5	68171	-12207	-	-	77090	-7108	-	-
10	96303	1331	-	-	106187	6710	-	-
15	130453	18030	110431	19231	141448	23715	119780	24074
20	165020	34117	136170	29153	177312	40101	146558	34313
25	185572	41341	147085	31694	198957	47446	158378	37081
30	184586	33423	143613	28545	198441	39366	155290	34014
35	165270	21429	127686	21330	178987	27192	139309	26790
40	131312	3497	101217	8047	144451	8995	112497	13397
45	84242	-15452	64249	-6400	96431	-10215	74906	-1163
50	32376	-32276	22458	-21209	43494	-27192	32360	-16084
55	-20609	-47772	-18896	-37403	-10493	-42653	-9625	-32321
60	-60477	-59620	-48401	-51567	-51468	-54421	-39863	-46549
65	-79838	-65880	-68481	-59485	-72117	-60721	-61227	-54588
70	-71617	-62581	-62108	-56822	-65241	-57852	-56123	-52330
75	-58295	-56781	-51049	-51851	-53394	-52651	-46447	-47925
80	-46615	-53240	-41611	-49280	-42942	-49610	-38141	-45813
85	-32731	-37017	-29237	-34143	-30170	-34431	-26818	-31673
90	-24217	-25891	-21577	-23796	-22322	-24082	-19792	-22075
95	-15763	-16144	-14386	-14984	-14530	-15016	-13196	-13900
100	-6671	-6663	-	-	-6149	-6198	-	-
Generation born in 1998	51243	-15737	107399	13278	58997	-11220	118310	18563
Generation born in 1999	93624	10427	161999	43261	57097	-10843	113126	19218
% Change (Taxes & Transf.)		24.2				4.1		

Table 5: Burdens on Newborns and Future Generations

Low Fertility

Alternative Immigration Policies

Spain 1998 (Euros)

	All Burden on Future generations				Immediate Change			
	Natives		Immigrants		Natives		Immigrants	
	Men	Women	Men	Women	Men	Women	Men	Women
	30,000 Immigrants per year							
Generation born in 1998	51243	-15737	107399	13278	58997	-11220	118310	18563
Generation born in 1999	93624	10427	161999	43261	57097	-10843	113126	19218
% Change (Taxes & Transf.)	24.2				4.1			
Generation born in 1998	51243	-15737	107399	13278	59645	-12442	120461	18246
Generation born in 1999	98419	3929	176153	42547	57725	-12024	115255	18987
% Change (Taxes only)	42.1				7.0			
Generation born in 1998	51243	-15737	107399	13278	58076	-9484	115254	19015
Generation born in 1999	87172	19171	142951	44220	56205	-9163	110100	19546
% Change (Transfers Only)	56.7				10.0			
	No immigration after 1998							
Generation born in 1998	51243	-15737	107399	13278	59457	-10952	118958	18877
Generation born in 1999	102277	15466			57542	-10583		
% Change (Taxes & Transf.)	28.9				4.4			
Generation born in 1998	51243	-15737	107399	13278	60162	-12239	121264	18551
Generation born in 1999	109040	8093			58225	-11828		
% Change (Taxes only)	51.3				7.4			
Generation born in 1998	51243	-15737	107399	13278	58461	-9131	115696	19338
Generation born in 1999	93537	24995			56577	-8823		
% Change (Transfers Only)	66.3				10.5			
	100,000 Immigrants per year							
Generation born in 1998	51243	-15737	107399	13278	58001	-11800	116909	17885
Generation born in 1999	80343	2694	144214	34518	56134	-11404	111824	18583
% Change (Taxes & Transf.)	16.9				3.6			
Generation born in 1998	51243	-15737	107399	13278	58535	-12878	118734	17589
Generation born in 1999	82813	-2189	152782	33511	56650	-12445	113634	18364
% Change (Taxes only)	28.7				6.1			
Generation born in 1998	51243	-15737	107399	13278	57235	-10253	114288	18310
Generation born in 1999	76806	9687	131942	35961	55392	-9907	109226	18898
% Change (Transfers Only)	41.1				8.7			

Table 6: Sensitivity Analysis

Percentage change in taxes and transfers

Interest Rate	0.03	0.03	0.03	0.05	0.05	0.05	0.07	0.07	0.07
Growth Rate	0.010	0.015	0.020	0.010	0.015	0.020	0.010	0.015	0.020
	All Burden on Future Generations								
No immigration after 1998	19.4	16.4	12.8	33.2	28.9	25.3	59.5	50.7	43.5
30,000 Immigrants per year	16.4	14.0	11.1	27.7	24.2	21.2	49.0	41.9	36.0
100,000 Immigrants per year	12.0	10.5	8.7	19.2	16.6	15.0	33.4	28.6	24.7
	Immediate Change								
No immigration after 1998	5.0	5.3	5.3	4.3	4.4	4.5	4.4	4.3	4.2
30,000 Immigrants per year	4.8	5.0	5.1	4.0	4.1	4.3	4.2	4.1	4.0
100,000 Immigrants per year	4.2	4.5	4.8	3.5	3.6	3.8	3.7	3.6	3.5

Figure 1: Life expectancy at birth

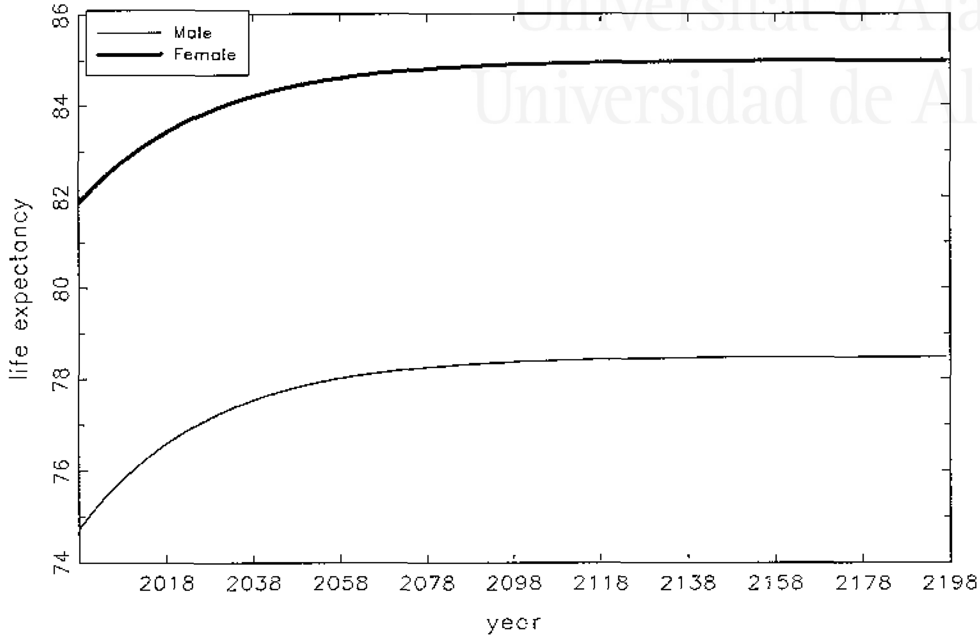


Figure 2: Fertility rate

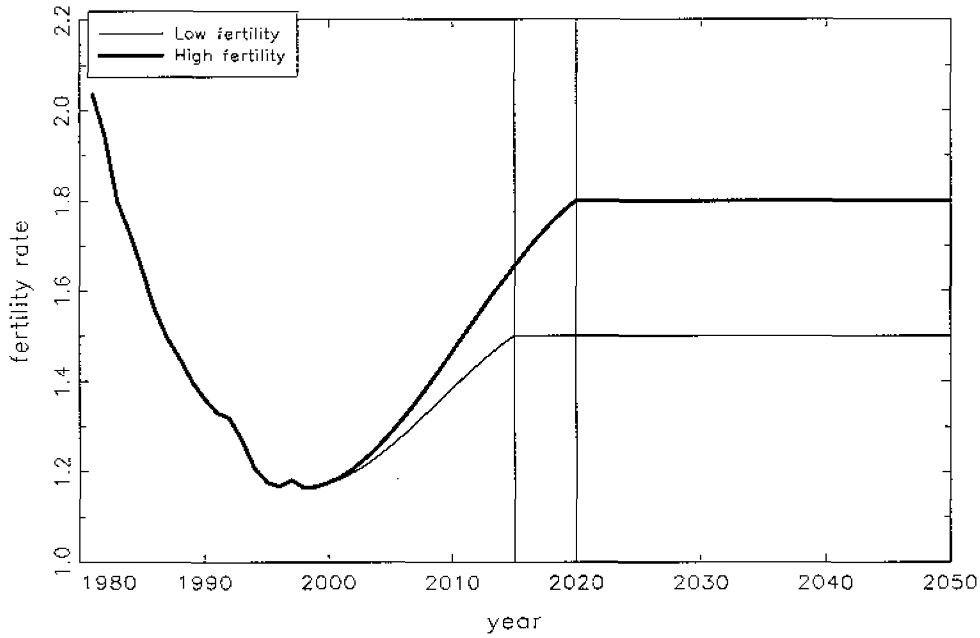


Figure 3: Income Taxes

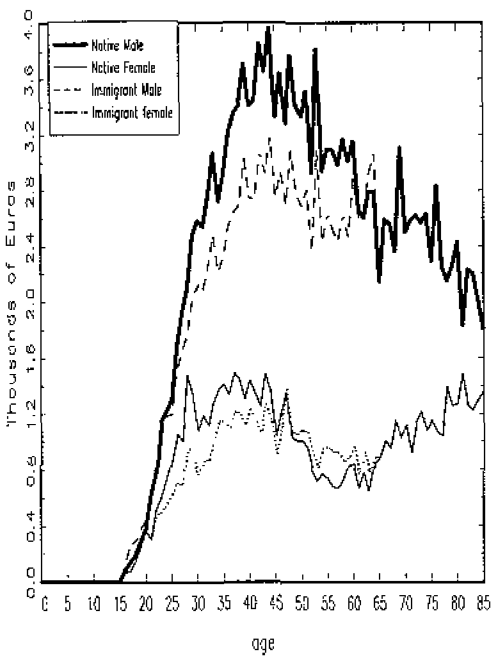


Figure 4: Social Contributions

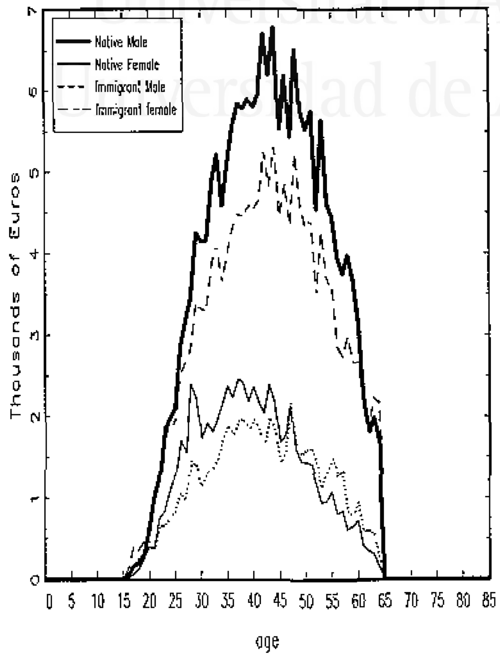


Figure 5: VAT

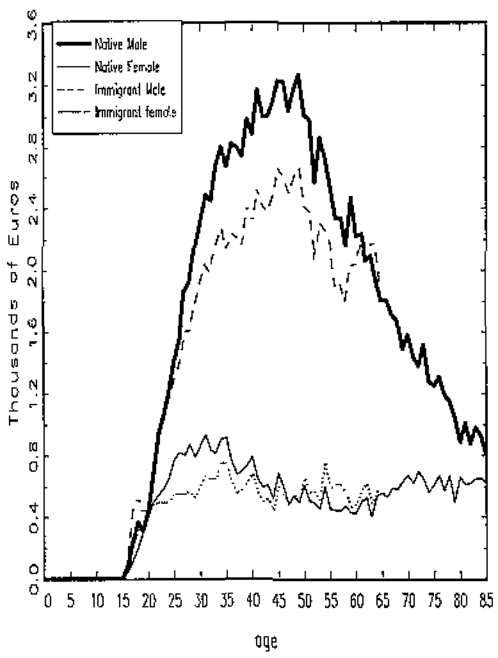


Figure 6: Spirits

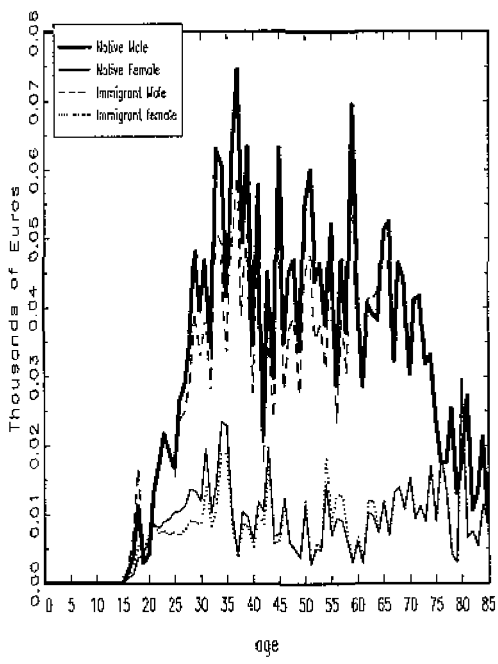


Figure 7: Beer

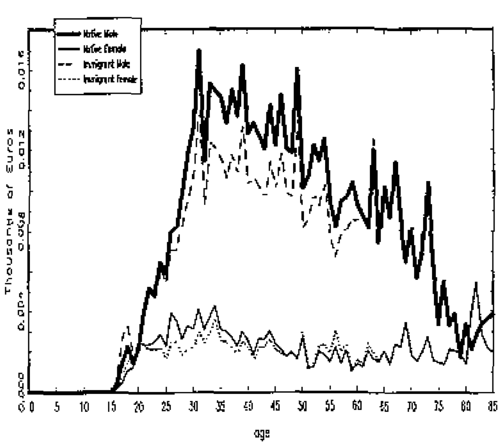


Figure 8: Tobacco

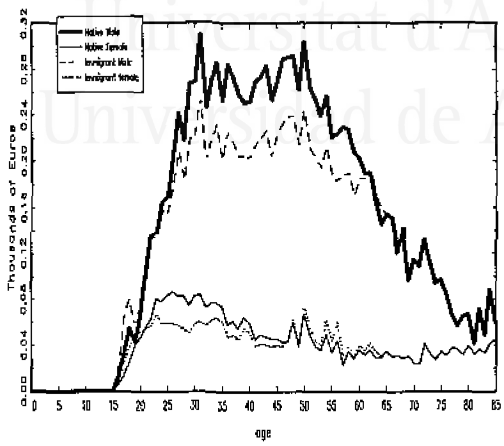


Figure 9: Electricity

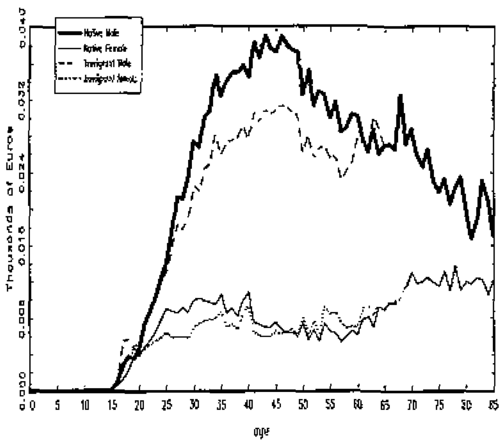


Figure 10: Gasoline

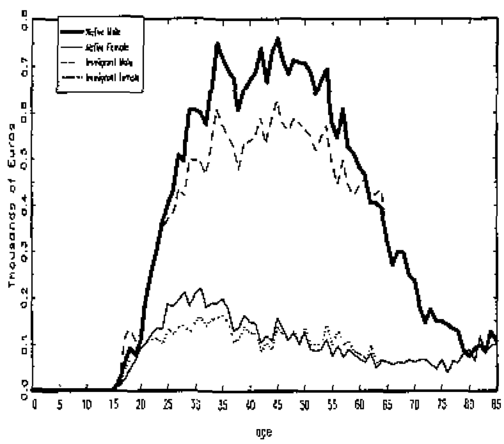


Figure 11: Vehicles

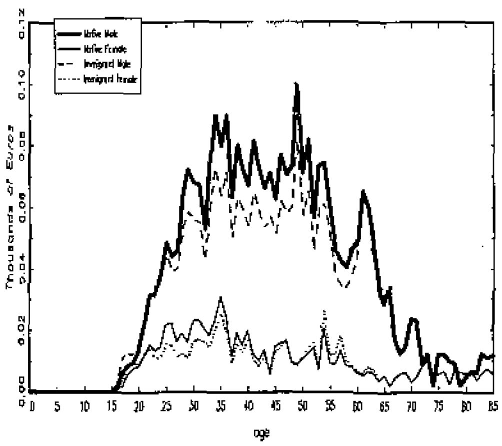


Figure 12: Insurances

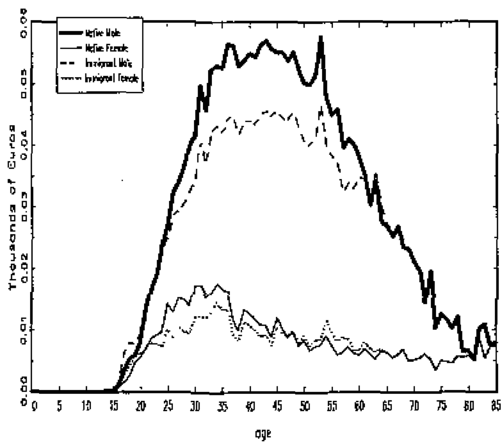


Figure 13: Direct Transfers

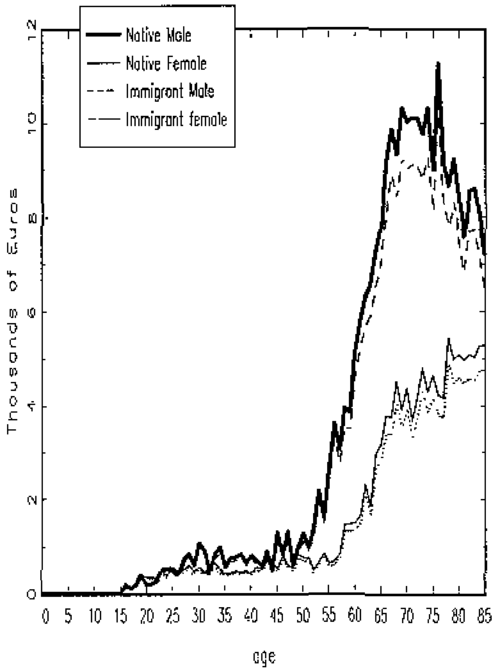


Figure 14: Health

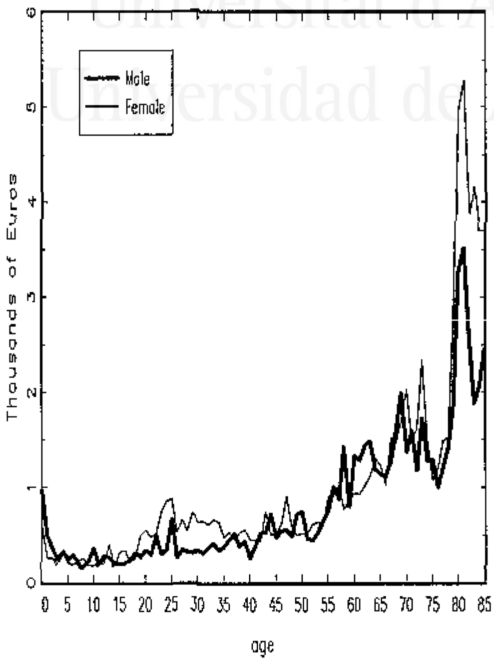


Figure 15: Education

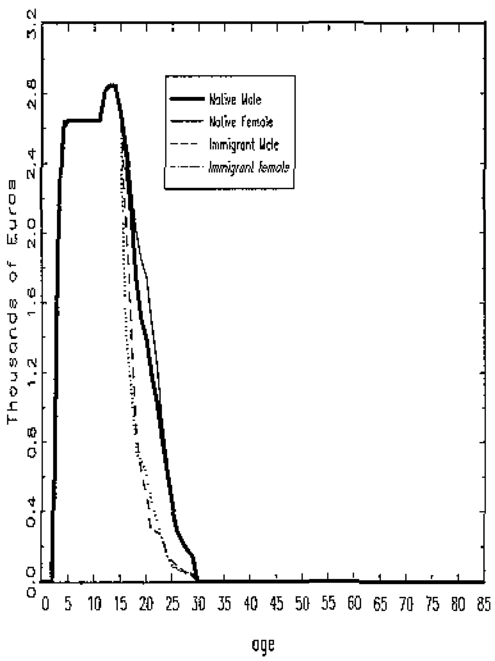


Figure 16: Per Capita Taxes

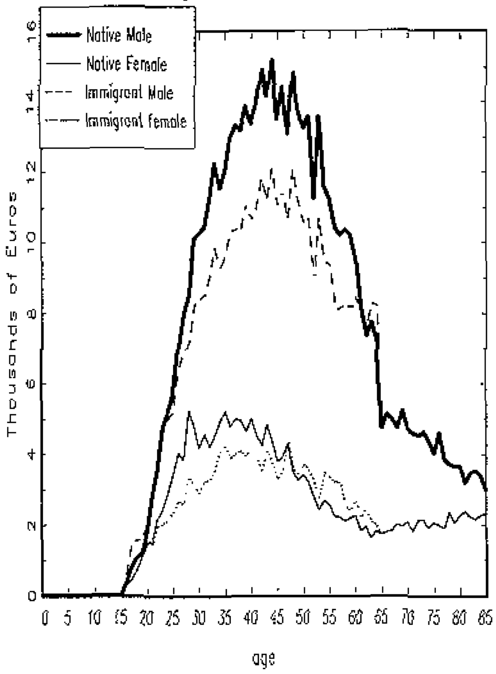


Figure 17: Per Capita Transfers

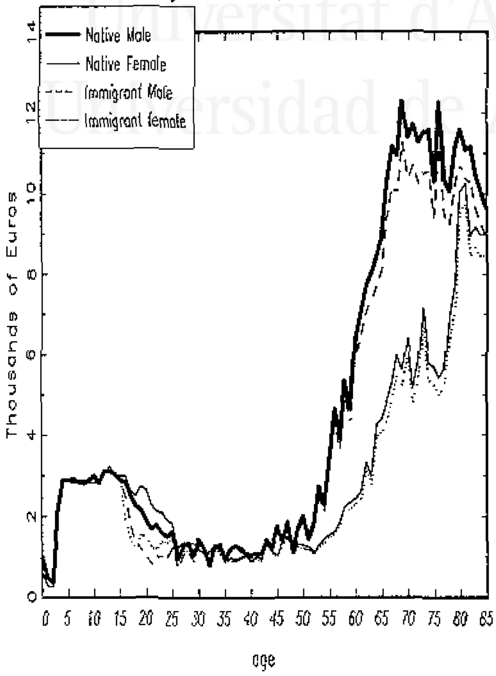
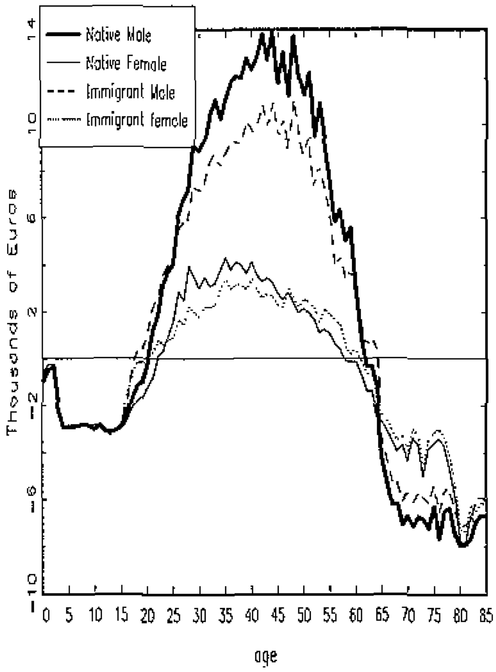


Figure 18: Per Capita Net Taxes



Chapter 3

Pension Systems and Immigration Policy

3.1 Introduction

The current demographic situation in many of the OECD countries, namely a rapidly aging population living longer, raises interesting and controversial questions about the future of some welfare state programs. As public pension systems are by far the largest component of total welfare outlays, considerable attention has been paid to them. Because most pension systems are financed on a pay-as-you-go basis, these demographic trends have placed a huge pressure on their future viability. In particular, the proportion of the population of working age will decline, particularly in the years after 2010, when the baby boom generation begins to retire. The tendency towards early retirement makes the situation even worse by further increasing the ratio of retired individuals to working people.

In this context, a number of proposals for reforming social security have been put forward (see Gruber and Wise (2001) for an overview of alternative reform proposals). In addition, immigration may also play an important role for dealing with aging and declining populations, since it may rejuvenate the native population due to their relatively young age structure. Indeed, the need for immigrant workers has been stressed and is present on the political agenda of most governments. In all these receiving developed countries, however, negative attitudes towards further immigration have risen among the native population.

One may believe that this resistance to immigration should be weaker and less widespread when immigrants are relatively skilled. In fact, in recent years, many developed countries have implemented immigration policies to attract more skilled immigrants.[1] Nevertheless, with a native population that is heterogeneous in terms of skills, it seems clear that the effects of the mix of immigrants entering the country are no even as they depend on the qualification structure of both the immigrants and the native population. All this has interesting policy implications. Policy-makers are typically concerned about re-election, and hence must be interested in the voters' opinion about immigration.

The literature on the political economy of immigration policy studies the attitudes of voters towards immigration (see for example Benhabib, 1996). Natives' opinions about the welfare state and labor markets are likely to shape attitudes towards immigration related questions, and eventually influence economic policies.[2] Epstein and Hillman (2001), for example, develop a model in which the source of anti-immigration attitudes is the feeling by native workers that they have lost their jobs to immigrants. On the other hand,Razin and Sadka (1999b) show in a dynamic framework, with a pension system, that immigration never causes inter and intragenerational conflicts, that is, immigration is beneficial to all age and income groups. This implies that "the political economy equilibrium will be overwhelmingly pro-migration."

In this paper we extend the model by Razin and Sadka (1999b) in two directions. First, we do not restrict immigrants to be of low skill. That is, we consider heterogeneity across natives and immigrants. Virtually all of the existing literature on the relationship between immigration and pension systems has studied inflows of unskilled immigration. This emphasis on the composition of immigrants entering the country leads to different preferences over the mix of immigrant flow that the native population wants to enter their country.

Second, we construct a richer pension system. This allows us to see the influence that the particular scheme of the pension system has on the composition of the immigrant inflows that the countries may wish to attract. These two features distinguish our analysis from the rest of the related literature, and in particular from Casarico and Devillanova (2001), the model closest to

[1] For a review of recent trends in international migration, see Coppel, Dumont and Visco (2001).

[2] For an empirical evidence on the relationship between welfare and labor market concerns and attitudes towards immigration, see Dustmann and Preston (2000).

ours.[3]

Our analysis allows us to identify some of the sources of negative reactions towards further immigration. This seems crucial for implementing the appropriate economic policies to reduce social tensions. Our model captures conflicting effects of immigration through the social security system. In particular, immigration flows add new contributors and also new beneficiaries to the public pension system.

In this context, an interesting question is whether different reforms of the social security systems may help to reduce social conflicts caused by immigration policy. We then implement a reform proposal that leads to a Pareto improvement.

The results of this paper may shed light on the current debate over immigration in the industrial countries. Furthermore, we hope to draw attention to the important role that effective economic policy intervention can play in reducing social tensions.

The rest of the paper is organized as follows. Section 2 describes the analytical framework. In Section 3 examines the preferred immigration policies. Section 4 studies the effects of reforming the system. Section 5 discusses the case of variable wages. Finally, Section 6 concludes.

3.2 The Model

We consider a small open economy, the host economy,[4] populated by young and old individuals. The size of the young population in period 0 is normalized to one. Individuals live for two periods. In the first period, young individuals work and consume. In the second period, old individuals live in retirement and consume. We assume that individuals are not altruistic, that is, they only care about their own lifetime utility. There is no uncertainty.

Individuals are heterogeneous in their skill level. For simplicity, we assume that there are two types of workers: skilled and unskilled. This is an individual feature that does not change throughout her life. The proportion of skilled workers at time 0 is p, where $0 < p < 1$. Furthermore, we assume

[3] In a model of skill upgrading they also study the interaction between the pension system and immigration to analyze joint redistributive effects. However, only unskilled immigrants are considered. Furthermore, the individual pension benefit does not change with the individuals' skill level.

[4] We do not model the source economies; they only provide the origins for exogenous immigration flows to the host economy.

that without immigration the proportion of skilled workers remains constant over time.

In period 0, every young individual is endowed with one unit of labor time which is supplied inelastically to the labor market. In turn, she gets a pre-tax wage determined by her skill level and is equal to ϖ_0^s for skilled workers, and to ϖ_0^u for unskilled workers. The wage of skilled individuals is supposed to be higher that the wage of unskilled individuals, that is, $\varpi_0^s > \varpi_0^u$.

We consider that the immigration policy in the host country specifies that at the beginning of period 0, m immigrants are allowed in.[5]All immigrants are assumed to be young and they can be either skilled and unskilled. We call m^s the number of skilled immigrants entering the host country. Similarly, $m^u = (m - m^s)$ refers to the number of unskilled immigrants. To simplify matters we will consider that all immigrants are either skilled or unskilled.

Once immigrants are admitted, we assume that they will blend instantaneously with natives. In particular, *they will have the same natural growth* rate as the native population.[6]Each individual has n children that are born in period 0.

All individuals have preferences over consumption represented by a utility function $u^i(c_0^i, c_1^i)$, where c_0^i and c_1^i are the consumption levels of individual i in period 0 and 1, respectively. Note that we allow preferences to vary among individuals with different skill levels.

Now, we introduce the social security system. We consider an unfunded pay-as-you-go (PAYGO) scheme financed with a pay-roll tax, which is a fixed proportion of the wage. As individuals differ in their skill level, and therefore in the wages they earn, they will also differ in their contributions to the system. The contribution of a given individual i in period 0 is $T_0^i = \lambda \varpi_0^i$. In particular, a skilled individual contributes $\lambda \varpi_0^s$ and an unskilled individual contributes $\lambda \varpi_0^u$.

After obtaining employment, the immigrant worker participates in the host country's public pension system on a non-discriminatory basis (immigrants are legal). This means, in particular, that the immigrant worker begins paying contributions to the host country's program according to the same rules as a native resident and, therefore, she will receive the same pension benefit in period 1. In period 0, total revenue to the social security system

[5]Most countries impose quotas to immigration. Specially in developed countries, governments restrain immigration from poor countries, often with explicit rules attempting to improve the skill mix of immigrants (Jasso and Rosenzweig, 1990).

[6]The literature on immigrants' fertility has stressed the fact that immigrants assimilate the local fertility pattern quite quickly (Blau, 1992; Ford, 1990).

is:

$$T_0(m^j) = \lambda\left[(p+m^s)\varpi_0^s + (1-p+m^u)\varpi_0^u\right]. \tag{1}$$

where m^j, $j = s$, u, denotes the kind of immigration entering the country.

In this case, the social security system pays all contributions out as pensions to the currently retired in period 0. Therefore, the average pension in period 0 will be:

$$b_0(m^j) = (1+n)\,T_0(m^j). \tag{2}$$

Recall that at period 0 there are $\frac{1}{1+n}$ old individuals.

We also consider the possibility that the PAYGO benefit be partly related to past contributions. In particular, we set the redistributive factor under the PAYGO scheme as a number $D^i(\alpha)$ that follows the expression:

$$D^i_{-1}(\alpha) = \alpha + (1-\alpha)\frac{T^i_{-1}}{\overline{T}_{-1}}, \tag{3}$$

where $\alpha \in [0,1]$ measures the degree of redistribution within the system, and $\overline{T}_{-1}$ is the average contribution in period -1. Then, in the absence of immigration in period -1, the pension benefit of individual i in period 0 will be:

$$b^i_0(m^j) = b_0(m^j)D^i_{-1}(\alpha) = [\alpha b_0(m^j) + (1-\alpha)\,b_0(m^j)\frac{\varpi^i_{-1}}{p\varpi^s_{-1} + (1-p)\varpi^u_{-1}}], \tag{4}$$

for $i = s, u$.

Note that the pension benefit has two tiers. First, a universal pension benefit, $\alpha b_0(m^j)$, which is completely unrelated to past contributions. Second, a pension benefit proportional to past contributions $(1-\alpha)\frac{T_0(m^j)}{\overline{T}_{-1}}\,T^i_{-1}$. This implies that pension benefit depends on the agent's skill level.[7]

To sum up, the host country operates a PAYGO pension system which is only partially redistributive. This is the case for most pension systems across countries. Note that when $\alpha = 1$, all individuals will receive the same pension which takes the form of a demogrant. This particular case corresponds to the pension system considered by Razin and Sadka (1999b).

If $\alpha = 0$, there will be no redistribution at all, and each individual will receive a pension benefit which will depend not only on her own contribution

[7] This design of the pension system differs from Razin and Sadka (1999a, 1999b) who, in all the versions of their model, consider that the individual's pension benefit is independent of the agents' skill level.

to the system, but also on the growth rate of total contributions to the system $\left(\frac{T_0}{T_{-1}}\right)$.

3.3 Choosing an Immigration Policy

In this section we examine the preferred immigration policy of the natives. Put differently, we examine the natives' preferences over the composition of immigration inflows. This, in turn, reflects their attitudes towards further immigration. As such, we have to study how the immigration of skilled and unskilled workers affects the utility of the different groups of native population (unskilled old, skilled old, unskilled young and skilled young).[8]

We first analyze the impact of immigration on the pension benefits of the old generation in period 0. At time 0, immigration changes the proportion of skilled (unskilled) young population. Within this section, we assume that wages are fixed. In the final section we will study what happens when in period 0 wages change after the inflow of immigrants. It is clear that for all members of the old generation the best composition of immigrants is $(m^s = m, m^u = 0)$.

We can rewrite the pension benefit of an old individual as:

$$b_0^i(m^j) = D_{-1}^i(\alpha)(1+n)\,T_0(m^j), \tag{5}$$

where $T_0(m^j)$ is defined by expression (1).

We first observe that the pension benefit of an old individual is strictly proportional to period 0 total contributions, T_0. Immigration, by increasing the number of contributors to the pension system in that period, rises the pension benefit received by an old individual, i.e. $\frac{\partial b_0^i(m^j)}{\partial m^j} > 0$.

Secondly, as migration affects the skill composition of the contributors to the pension system in period 0, the pension benefit changes not only in response to size, but also to composition. It is easy to see that, the more skilled contributors are, the higher that increase will be. The old will be in favor of attracting skilled immigrants. Furthermore, their preferred immigration policy is that only skilled immigrants enter the country.

This result is independent of the degree of redistribution within the system. This is not surprising. The redistribution within the system depends on past contributions, $\left(\frac{T_{-1}^i}{T_{-1}}\right)$, and the old cannot change the contributions

[8]Recall that these attitudes are determined before migration takes place, but upon expectation of it.

they made when young. Thus, there is no impact of period 0 immigration policy on redistribution within the system in that period.

We will now analyze the impact of immigration on the utility of the young. To see which is the composition of immigrants preferred by the young, we have to consider the impact of the inflow of migrants at time 0, on their lifetime income. To do this, however, we need to make some assumptions about the skill level that immigrants' offspring will have in period 1. In the following, we will first analyze the case where immigrants' offspring is considered as natives and then allow for a different assimilation process.

3.3.1 Immigrants' children as natives children

The question of how fast or how well immigrants and their children are being integrated into native society is subject to debate, in part because it is still too early to draw conclusions about their educational and occupational attainment. The early studies conclude that most immigrants and their children are doing comparatively well (for a survey on this issue, see Smith and Edmonston (1997)). One possible explanation for this empirical finding is that immigrants' children have the same schooling opportunities as natives' children. Given these opinions about immigrants' assimilation process, it seems natural to start with the assumption that the children of immigrants follow the same distribution of skills as natives' children, irrespective of the characteristics of the immigrants.

This setting provides an interesting reference point to illustrate the possible conflicts of interest that may arise due to immigration inflows. In this case, in period 1 the immigrants' offspring cannot be distinguished from natives' descendants. Thus the skills of second-generation immigrants are assumed to be independent of the skill composition of their parents.

We also assume that wages are independent of population size. Then, in period 1 the young will get the same wages as those they would have received under *no immigration in period* 0. Then, in period 1 total contributions to the pension system will be:

$$T_1(m^j) = \lambda \left[p\varpi_1^s + (1-p)\varpi_1^u\right](1+n)(1+m), \tag{6}$$

as $(1+m)$ is the post-migration young population in period 0. In period 1 a given individual i will receive a pension benefit:

$$b_1^i(m^j) = b_1 D_0^i(\alpha), \tag{7}$$

where b_1, the average pension benefit in period 1, is not affected by period 0 immigration.[9] The redistributive factor, $D_0^i(\alpha)$, is now:

$$D_0^i(\alpha) = [\alpha + (1-\alpha)\frac{\varpi_0^i(1+m)}{(p+m^s)\varpi_0^s + (1-p+m-m^s)\varpi_0^u}]. \quad (8)$$

Every young individual solves the following maximization problem:

$$\max_{\{c_0^i, c_1^i\}} \quad u^i(c_0^i, c_1^i) \qquad (9)$$
$$s.t. \quad c_0^i + \tfrac{c_1^i}{1+r} = W_0^i(\varpi_0^i, b_1^i),$$

where $W_0^i(\varpi_0^i, b_1^i) = (1-\lambda)\varpi_0^i + \frac{b_1^i}{1+r}$ is her lifetime income and, b_1^i is given by:

$$b_1^i(m^j) = \alpha b_1 + (1-\alpha)T_1(m^j)\frac{T_0^i}{T_0(m^j)}. \quad (10)$$

Solving this problem we get the indirect utility functions $V_0^i(\varpi_0^i, b_1^i, r)$, whose maximization determines the preferred composition of immigrants for the young individuals. Given that r is fixed,[10] the indirect utility function of an individual born at time 0 only depends on her lifetime income, $W_0^i(\varpi_0^i, b_1^i)$.

For young individuals, b_1^i is the only variable relevant for that choice, because they are affected by immigration only via pension benefits and not via wage changes. Also, note that W_0^i is strictly increasing in b_1^i. Then, a young individual will choose the composition of immigrants that maximizes her pension benefit b_1^i.

Moreover, as immigration only affects her pension through the contribution-related component, maximizing b_1^i is the same as maximizing the ratio between her own contribution and total contributions to the system in period 0, $\frac{T_0^i}{T_0}$. This ratio can be understood as her claim on future total pension benefits T_1. This is done by choosing $(m^s = 0, m^u = m)$. That is, her ideal immigration policy is to favor that only unskilled immigrants enter at period 0.[11]

[9] Immigration does not affect average pension benefit b_1. As $b_1 = \frac{B_1}{1+m}$ and $B_1 = T_1$, we have that $b_1 = \frac{T_1}{1+m} = \lambda[p\varpi_1^s + (1-p)\varpi_1^u](1+n)$. Given that ϖ_1^i do not change, b_1 does not change with immigration.

[10] Due to the assumption of a small open economy, capital is perfectly mobile and the interest rate is given at the world rate.

[11] A necessary condition to get this result is that $\alpha < 1$. When the pension system is completely redistributive, young skilled individuals are indifferent to the skill composition of the immigration flows, since their pension benefit do not depend on immigration at all.

The rationale for this surprising result is quite simple. Immigration in period 0 raises total contributions in period 1, T_1. The reason is that immigration increases the size of young population in period 1 by $(1+n)m$ raising, therefore, T_1. At the same time, however, immigration decreases the ratio $\left(\frac{T_0^i}{T_0}\right)$ by increasing T_0. This implies that the contribution to the system of any young individual, with respect to total contributions, is lower and her claim on future total pension benefit will be smaller.

Immigration, therefore, has two countervailing effects on the pension benefit of the young: on the one hand, it increases the amount to be paid out as pension benefit T_1. On the other hand, it reduces the amount of the pension benefit based on their past contribution.

Since the skills of immigrants' offspring do not depend on the skills of their parents, the increase in T_1 only depends upon the size of the inflow of immigrants. The decrease in $\left(\frac{T_0^i}{T_0}\right)$, however, also depends on the composition of immigrants. In particular, it is larger when immigrants are skilled than when they are unskilled because in the first case, the increase in total contributions T_0 is larger. As the immigration quota is fixed, and $\lambda\varpi_0^s > \lambda\varpi_0^u$, it is clear that the amount of contributions paid by skilled immigrants will be larger.

Therefore, young individuals are better off having unskilled immigration and, thus, they will like to admit only unskilled immigrants.[12]

Summing up, we find that, even when we assume that wages are not affected by immigration, young individuals are affected by immigration via changes in their pension benefits. We show that a selective immigration policy admitting only skilled immigrants can reduce the pension benefit of some groups. Interestingly, we find that not only skilled immigration hurts native skilled workers, it is also unskilled native workers who are penalized by this kind of immigration policy.

3.3.2 Immigrants' children different from natives' children

We now turn to a completely different assumption about the assimilation process of the second-generation immigrants. In particular, we will assume

[12] Namely, they are better off having only unskilled immigrants rather than having no immigration at all because they get higher pensions. On the contrary, they are worse off having only skilled immigrants since in this case their pensions would be lower than those received under no migration.

that if all immigrants are skilled, then all their children will also be skilled, whereas if all immigrants are unskilled, their children will have the same composition than the children of natives.

First, we consider that all immigrants entering the country are skilled, that is, $(m^s = m, m^u = 0)$. Once again, all the contributions paid by immigrants to the pension system are used to pay pensions in period 0. Then, $T_0(m^j)$ is defined by expression (1). Period 1 total contributions will be:

$$T_1(m^s) = \lambda\, [p + m)\varpi_1^s + (1-p)\varpi_1^u]\,(1+n)\,. \tag{11}$$

Second, if all immigrants are unskilled, that is, $(m^s = 0, m^u = m)$, period 1 total contributions will be:

$$T_1(m^u) = \lambda\, [p\varpi_1^s + (1-p)\varpi_1^u]\,(1+n)\,(1+m)\,. \tag{12}$$

As such, the pension benefit that a given individual will get in period 1, will be:

$$b_1^i(m^s) = b_1(m^s)[\alpha + (1-\alpha)\,\frac{\varpi_0^i\,(1+m)}{(p+m)\varpi_0^s + (1-p)\varpi_0^u}], \tag{13}$$

and

$$b_1^i(m^u) = b_1(m^u)[\alpha + (1-\alpha)\,\frac{\varpi_0^i\,(1+m)}{p\varpi_0^s + (1-p+m)\varpi_0^u}], \tag{14}$$

respectively. In particular, we get that in the case of skilled immigration, the average pension benefit $b_1\,(m^j)$ is:

$$b_1(m^s) = \frac{(1+n)}{(1+m)} T_0(m^s). \tag{15}$$

And, in the case of unskilled immigration,

$$b_1(m^u) = (1+n)\,T_0, \tag{16}$$

Notice that now, in contrast to the previous subsection, the average pension benefit for the case of skilled immigration, $b_1(m^s)$, depends on the number of immigrants.

If the pension system is completely redistributive, that is, $\alpha = 1$ we have that $b_1^i(m^s) > b_1^i(m^u)$. On the other hand, if $\alpha = 0$, that is, the system is not redistributive at all, we get that $b_1^i(m^u) > b_1^i(m^s)$. It is easy to prove the existence of some value $\widehat{\alpha}$, such that for $\alpha < \widehat{\alpha}$, $b_1^i(m^u)$ is always greater than $b_1^i(m^s)$. In particular, one has:

$$\widehat{\alpha} = \frac{p\,(1+m)\,\varpi_0^i}{p\,(1+m)\,\varpi_0^i + (1-p)\,[p\varpi_0^s + (1-p+m)\varpi_0^u]}.$$

We can easily see that $\hat{\alpha}$ rises with both p and m. Those countries with more redistributive pension system will prefer unanimously skilled migrants, while in countries with less redistribution there will be a conflict between the old and the young.

3.4 Avoiding the Conflict

As we mentioned before, the ongoing immigration policy of most labor-importing countries consists of quotas emphasizing skill levels.[13] In this section, we henceforth focus our attention on the case where the host economy receives positive immigration flows of skilled individuals in period 0. Again we assume that wages are fixed. In this case, the social tension arises because all young individual get lower pensions. One possibility to avoid this conflict between the young and the old is to check whether there is a transfer from the old to the young that would make the young to change their minds.

Suppose, for instance, that the government decides to implement the following pension system reform: At time 0, some fraction γ of the extra contributions paid by the immigrants to the pension system $T_0^m(m^s)$, is saved to build a fund. This fund, together with its returns will serve to increase pension benefits in period 1. Specifically, the total contributions in period 0 are split into two parts:

$$T_0(m^s) = T_0^n + T_0^m(m^s), \tag{17}$$

where T_0^n refers to the contributions paid by natives and T_0^m are the contributions paid by immigrants. In particular, we know that

$$T_0^n = \lambda \left[p\varpi_0^s + (1-p)\varpi_0^u\right], \tag{18}$$

and

$$T_0^m(m^s) = \lambda m \varpi_0^s. \tag{19}$$

A value of $\gamma > 0$ means that the contributions paid by immigrants will not be used completely to pay pension benefits in period 0. This policy seems to be easy to defend, even in the strongest case where $\gamma = 1$, in which all those contributions are saved. According to Stiglitz, most individuals

[13] Borjas (1994) studies the economic impact on immigration in the US economy. He concludes that the US should try to attract migrants with higher skills in order to increase the economic gains from immigration (see also Borjas 1999). It is also interesing the work by Storesletten (2000).

consider the pension system "as a government-run retirement program, to which they make contributions (pay premiums), with benefits commensurate with the contributions" (Stiglitz (2000)). Most individuals believe that they are getting a pension in turn of past contributions. Any sudden increase in period 0 contributions, T_0, due to the inflow of migrants would not drive the old to demand a higher pension benefit.

Note that for all $\gamma < 1$, period 0 old always prefer only skilled immigrants. If $\gamma = 1$, they are indifferent with respect to the skill mix composition of immigrants. In period 1, total expenditure in pensions is:

$$T_1'(m^s) = T_1(m^s) + (1+r)\gamma T_0^m(m^s), \tag{20}$$

where $T_1(m^s)$ is given by expression (5). The pension benefit of an individual i will be:

$$b_1^{i\prime}(m^s) = b_1'(m^s)[\alpha + (1-\alpha)\frac{T_0^i}{T_0(m^s)}]. \tag{21}$$

where $b_1'(m^s) = \frac{T_1'(m^s)}{(1+m)}$ is the average pension benefit after the reform. Equation (21) can be rewritten as:

$$b_1^{i\prime}(m^s) = b_1^i(m^s) + (1+r)\gamma\frac{T_0^m(m^s)}{(1+m)}[\alpha + (1-\alpha)\frac{T_0^i}{T_0(m^s)}], \tag{21'}$$

and $b_1^i(m^s)$ is given by expression (10).

To guarantee that the young will be better off when immigrants are skilled, we need to prove that there exists some value of $\gamma \in (0,1]$, such that $b_1^{i\prime}(m^s) > b_1^i$, for any α. First, we can prove that if $\alpha = 0$, which is the strongest case against admitting only skilled immigrants, $b_1^{i\prime}(m^s) \geq b_1^i$ provided that:

$$\gamma > \frac{(1+n)}{(1+r)}(1-p)\frac{\varpi_0^s - \varpi_0^u}{\varpi_0^s}.$$

which is positive and less than 1, provided that $r > n$.[14] For values of α above 0, the condition is weaker since γ must be above

$$\underline{\gamma} = \frac{(1-\alpha)T_0^i}{\frac{\alpha}{(1+m)}T_0^m(m^s) + (1-\alpha)T_0^i}\frac{(1+n)}{(1+r)}(1-p)\frac{\varpi_0^s - \varpi_0^u}{\varpi_0^s}$$

This lower bound is lower the higher is α, that is, $\frac{\partial\underline{\gamma}}{\partial\alpha} < 0$. As the above result illustrates, in order to convince the young, the amount devoted to

[14] If $r < n$, the economy is in a dynamically inefficient state. As such, we consider the case $r > n$ which is dynamically efficient. Still, if a large share of young population is unskilled, the condition will be satisfied.

create the fund is lower, the higher is r, the lower is the wage gap between skilled and unskilled workers, and the less redistributive is the system.

3.5 An extension: Variable Wages

We now allow for the possibility that immigration affects wages. In principle, we should expect a fall in the wage of those workers for whom immigrants are competitors, and a rise in the wage of those workers for whom immigrants are complementary, as production adjusts to the new factor intensities.[15] Indeed, most studies provide estimates that the low-skilled immigration inflows lowered the unskilled natives' wages and increased the wage of high-skilled natives during the 1980s. However, most evidence also suggests that the effects of immigration on wages have been very small.

In our model we will assume that, due to the arrival of a large number of skilled (unskilled) immigrants, one has:[16]

$$\begin{aligned} \varpi_0^s(m^s) &\leq \varpi_0^s \leq \varpi_0^s(m^u), \text{ and} \\ \varpi_0^u(m^u) &\leq \varpi_0^u \leq \varpi_0^u(m^s). \end{aligned}$$

Moreover,

$$\varpi_0^u(m^s) < \varpi_0^s(m^u).$$

Once again, we proceed by studying the preferred immigration policy of each population group. As in the previous case, immigration increases contributions to the pension system at the time that it takes place.[17] Furthermore, we assume that

$$T_0(m^s) > T_0(m^u) > T_0.^{18}$$

[15] However, the empirical research does not support this conclusion completely. In particular, Friedberg (2001) finds that less-skilled native workers benefit from complementarities with skilled immigrants. Further, and contrary to the widespread belief that immigration of skilled workers hurts local skilled workers' wages, she does not find significant evidence that immigration of high-skilled workers lowers the wages of high-skilled natives.

[16] For the sake of simplicity, we assume that changes in wages are of the same magnitude.

[17] Provided that general equilibrium effects are small.

[18] Sufficient conditions for this result are $m > (1-p)\frac{\varpi_0^u - \varpi_0^u(m^u)}{\varpi_0^u(m^u)}$, $\varpi_0^s - \varpi_0^u > 2\varpi_0^u(m^u)$ and $(1-p) > p$. We will henceforth assume that these conditions hold.

Using (10), we see that for old individuals the immigration effect goes in the same direction than in the previous case. That is, the old prefer to admit only skilled immigrants. Our next step is to analyze the effect of immigration policy on the young generation's pension benefits. To avoid repetitions, we shall concentrate on pointing out the differences in the responses to immigration between the two wage scenarios.

In contrast to the case of fixed wages, for young individuals immigration affects their wages as well as their pension benefits. It is now the case that the change in the individual's contribution to the pension system matters (in particular, the relationship between the change in T_0^i and in T_0), and hence we have to consider two separate cases. Regarding T_1 the analysis of Subsection 3.1 applies.[19]

Note that immigration no longer affects skilled and unskilled young population in the same way. We therefore calculate the effect of immigration on the lifetime income of any young individual in order to find which composition of immigrants she will prefer.

Define $W_0^i(m^j)$ as the lifetime income of a young individual of type i as a function of migration of type j. Formally, this is given by:

$$W_0^i(m^j) = (1-\lambda)\,\varpi^i(m^j) + \alpha b_1 + (1-\alpha)\,T_1(m)\frac{T_0^i(m^j)}{T_0(m^j)}, \qquad (22)$$

where $T_0(m^j)$ and $T_1(m^j)$ are given by (1) and (5) respectively.

Not surprisingly one has:

$$\frac{T_1(m^s)}{T_0(m^s)}T_0^s(m^s) < \frac{T_1(m^u)}{T_0(m^u)}T_0^s(m^u). \qquad (23)$$

In words, as the increase in $T_1(m^j)$ is not affected by the type of immigration, the link between contributions and benefits represented by $\frac{T_1(m^j)}{T_0(m^j)}$, is higher with unskilled immigration. Furthermore, the contribution of any skilled young to the system is also higher with unskilled immigration. In addition, skilled young are penalized by a lower period 0 consumption, since $\frac{\partial \varpi^s}{\partial m^s} < 0$. Thus, there is no reason for skilled young to choose an immigration policy that admits skilled immigrants. Their ideal immigration inflow is that only unskilled immigrants will be admitted in the country, that is, $(m^s = 0, m^u = m)$.

On the other hand, for those unskilled individuals it is also verified that $\frac{T_1(m^s)}{T_0(m^s)} < \frac{T_1(m^u)}{T_0(m^u)}$. However, the contribution effect now goes in the opposite

[19] Given that wages are independent of population size, regarding T_1 the previous results hold.

direction. Unlike skilled workers, unskilled workers' contributions are lower with unskilled immigration, that is, $T_0^u(m^u) < T_0^u(m^s)$. Recall that $\frac{\partial \varpi^u}{\partial m^s}$ $\left(\frac{\partial \varpi^u}{\partial m^u}\right)$is positive (negative) since it captures the positive (negative) impact of skilled immigration on unskilled workers' wages. This, in turn, increases (decreases) their contributions to the social security system, T_0^u.

Two cases have to be distinguished according to the values of $\frac{T_1(m^s)}{T_0(m^s)}$ and $\frac{T_1(m^u)}{T_0(m^u)}$. First, when the value of $\frac{T_1(m^s)}{T_0(m^s)}$ is "sufficiently close" to $\frac{T_1(m^u)}{T_0(m^u)}$, it is easily verified that the preferred immigration policy of this group is to attract only skilled immigrants, that is, $(m^s = m, m^u = 0)$. The increase in the individual's contribution is more than sufficient to compensate the rise in total contributions and, thus, they can get higher pensions. There is no reason for unskilled young to choose an immigration policy that admits unskilled immigrants.

Clearly, conflicting interests may arise within the young population, regarding the composition of the immigration flows. The effects of the composition of immigration flows on the natives differ according to their skill levels: skilled young are always worse off with an immigration policy admitting only skilled immigrants, meanwhile unskilled young are in favor of this kind of immigration policy. The results obtained so far show that immigration may give rise not only to intergenerational conflicts but also to intragenerational ones.

Second, when $\frac{T_1(m^u)}{T_0(m^u)}$ is "much larger" than $\frac{T_1(m^s)}{T_0(m^s)}$, they may prefer an immigration policy attracting unskilled immigrants. This is because skilled immigration makes their pension benefits lower, and the increase in their present consumption, is not high enough to compensate the decrease in their pension benefit. In this case, we get the same results as in Section 3.

3.6 Conclusions

The question of how attitudes in the society towards immigration are determined is of great importance for implementing appropriate policies to moderate social tensions regarding further immigration. In this paper, we put the emphasis on the interaction between immigration and the pension system, with a focus on the host country. In a model where both unskilled and skilled migration are allowed, and where we model the pension system in a richer way than in the related literature, we have shown how the presence of immigrants can be beneficial for both native old and young —although old and young will not agree about what kind of immigration should be admitted.

Further, and contrary to what seems to be conventional wisdom, we find that immigration of skilled workers can hurt both native skilled and unskilled workers via pension benefits. This, in turn, rises inter and intragenerational conflicts. Moreover, our analysis shows how the government can obtain a Pareto improving by implementing the accurate pension reform. We think that by focusing on this issue in a dynamic context, our analysis may provide additional insights to the current debate on immigration policy in the developed economies. This is of particular interest for Europe, in view of the increasing pressure from Eastern Europe and of future European Union enlargements.

There are, however, several issues that would be interesting to look at in subsequent work. First, our analysis concentrates on the demand for immigrants. A possible extension would be to include the supply side to take into account the decisions of individuals in the source country. We have also assumed that only economic reasons determine voter attitudes towards immigration. The hostility towards further immigration, however, may also arise from racial factors. This is the case, for instance, if groups of the native population are concerned about cultural diversity and loss of national identity (for an empirical research of these issues, see Dustman and Preston (2000)).

Finally, we have not considered illegal immigration. This is so because, in principle, it is possible for the government to deny them access to the pension system since due to its status they do not contribute to the pension system. Nevertheless, we are aware that the fiscal status of illegal immigrants is more complex than that.

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