ON THE AGGREGATE EFFECTS OF IMMIGRATION IN SPAIN

2007

Mario Izquierdo, Juan F. Jimeno
and Juan A. Rojas

Documentos de Trabajo
N.º 0714

BANCO DE ESPAÑA
Eurosistema

ON THE AGGREGATE EFFECTS OF IMMIGRATION IN SPAIN

ON THE AGGREGATE EFFECTS OF IMMIGRATION IN SPAIN

Mario Izquierdo

BANCO DE ESPAÑA

Juan F. Jimeno

BANCO DE ESPAÑA, CEPR AND IZA

Juan A. Rojas

BANCO DE ESPAÑA

Documentos de Trabajo. N.º 0714
2007

ISSN: 0213-2710 (print)
ISSN: 1579-8666 (on line)
Depósito legal: M.28993-2007
Unidad de Publicaciones, Banco de España

Abstract

This paper presents a dynamic general equilibrium model designed to compute the aggregate impact of immigration, accounting for relevant supply and demand effects. We calibrate the model to the Spanish economy, allowing for enough heterogeneity in the demographic characteristics of immigrant and native workers. We consider an initial steady state characterized by the age structure of the Spanish population in 1995 and study the effects of several immigration scenarios on several macroeconomic variables (GDP, employment, productivity, etc.).

Keywords: Immigration, general equilbrium models.

JEL Codes: E10, F22.

1 Introduction

Immigration flows into Western Europe accelerated since the early 1990s. There is a significant body of empirical literature regarding the impact of immigration on the host country, but most of it refer to Anglo-Saxon countries. Since there are reasons to believe that the effects of immigration may vary across countries, depending upon the demographic characteristics of the immigrants and of the native workers and the functioning of the labour market, the demand for economic analysis and empirical evidence on the economic effects of immigration in other recipient countries has significantly increased.

Broadly speaking, the quantitative studies of the impact of immigration on the host country can be grouped into two categories: i) microeconometric studies of the impact of immigrants on the labour market performance of the native workers, and ii) macroeconomic studies based on the calibration of some general equilibrium models that, typically, incorporate some parameters estimated by microeconometric studies.[1]

Among all Western European countries, Spain, traditionally an out-migration country, has been, by far, the largest recipient of immigrants: foreign population residing in Spain, 0.35 millions (1% of total population) in 1995, went up to 4,1 millions (around 10% of total population) in 2006. This immigration boom has expanded both aggregate supply and aggregate demand and plausibly altered the functioning of the Spanish labour market.[2] Hence, immigration has

[1] Examples of the first category are, for instance, Card (2001), Borjas (1999), and Ottaviano and Peri (2006). For the second category, see Storelestten (2000)

[2] Some previous studies on several economic effects of inward migration flows to Spain are

probably had significant aggregate effects.

First, there are the demographic effects of immigration. Western European countries are going through a demographic transition with significant population ageing. Although demographic ageing is not a new phenomenon, it has now assumed unprecedented proportions owing to the post-war baby boom, and the baby bust that followed. One extreme case is Spain, where the aging of the baby boom generation and the very low levels of the fertility rates, e.g. 1.17 and 1.2 in 1995 and 2000 respectively, are expected to increase the ratio of the elderly (65 and older) over the total population from 16.96% in 2004 to 35.6% by 2050.[3] As the age structure of immigrants is in general younger than that of the host population, there is a popular belief that a more generous immigration policy can increase the working-age population and help to reduce the pension burden of the elderly by 2030-2055 which is when the large cohorts born in the 60s and 70s in Spain will be retired.

Secondly, there are the effects of immigration on the labour market. These immigration flows, not only imply a huge labour supply shock, also alter the skill composition of the labour force and the functioning of the labour market. For instance, immigrant workers are typically regarded as a production factor that substitutes low skilled native workers, while it is complementary of both physical capital and high skilled native workers. Also, as their bargaining power at wage setting is plausibly lower, their wages, after controlling for observable

Aparicio and Tornos (2000), Collado et al. (2004), Oficina Económica del Presidente (2006) and Caixa Catalunya (2006).

[3] These figures come from *Eurostat Demographic Statistics 1996*

characteristics, are typically lower.

Thirdly, there are the effects of immigration on productivity and long-run growth. Since the mid-1990s, labor productivity growth has significantly fallen in some European countries and, most noticeably, in Spain.[4] Since immigrants are typically employed in labour intensive sectors with below average productivity, part of the decline of labour productivity growth is the result of a transitory negative composition effect. However, depending on assimilation patterns of immigrants, the size of future immigration flows and their skill composition, this effect on productivity growth could be more lasting.

The computation of these aggregate effects of immigration requires the use of a general equilibrium model capable of accounting for all the relevant supply and demand effects of immigration. In this paper we use a large overlapping generations model, calibrated to the Spanish economy, to perform such an exercise. Given the lack of microeconomic studies on the impact of immigration into Spain, we start from the basic specification of this type of models, trying to achieve sufficient flexibility to enrich the model as more empirical evidence becomes available. In this respect, our approach takes as given the age, fertility and skill characteristics of current immigrants in Spain. We consider an initial steady state characterized by the age structure of the Spanish population in 1995 and study the effects of several immigration scenarios on several macroeconomic variables (GDP, employment, productivity, etc.). The structure of the paper is standard. Sections 2 and 3 describe, respectively, the model and the

[4] See Jimeno, Moral and Saiz (2006).

calibration strategy; Section 4 presents the findings and Section 5 contains some concluding remarks and hints at several research lines that could contribute to enrich the model in the future.

2 The Model

2.1 Demographics

The economy is populated by agents that live a maximum of I periods. Each agent is indexed by age i, time t, type j and native status n. The index n represents the age of an individual when entering the country, consequently a native has $n = 1$ and an immigrant is indexed by $n \geq 2$. Depending on occupation j they can be more or less productive and we allow for different occupational distribution for natives and immigrants and hence, define $\omega_{j,n}$ as the probability of having productivity j conditional on being a native $n = 1$ or immigrant $n \geq 2$. Upon arrival at the age of $i \geq I_A$ an agent starts taking decisions. Each individual is endowed with 1 unit of time that can be allocated to work or leisure up to age I_{R-1}. After this age agents retire. Each agent faces an age dependent probability of surviving between age i and age $i+1$ at t denoted by $s_{i,t}$. Then the unconditional probability of reaching age i for an individual that has age v at t is $\pi^i_{v,t} = \prod_{k=v+1}^{i} s_{k-1,t+k-v-1}$ with $\pi^v_{v,t} = 1$.

The population age groups of new immigrants moves according to the following law of motion

$$N_{i+1,t+1,j,n} = \omega_{j,n} IN_{i+1,t+1} \text{ if } i+1=n$$

where $IN_{i+1,t+1}$ denotes the number of new immigrants at time $t+1$ with age $i+1$, and the number of individuals that were already in the country evolve according to

$$N_{i+1,t+1,j,n} = s_{i,t} N_{i,t,j,n} \text{ if } i+1>n.$$

Individuals in the first age group are the children of all individuals in the economy plus the immigrants that enter the country with age 1, then

$$N_{1,t+1,j,1} = \omega_{j,1} \left(\sum_i \sum_j \sum_n N_{i,t,j,n} b_{i,t} + IN_{1,t+1} \right).$$

Finally $\mu_{i,t,j,n}$ is the share of age-i and type-j-n individuals over the total population at time t

$$\mu_{i,t,j,n} = \frac{N_{i,t,j,n}}{\sum_i \sum_j \sum_n N_{i,t,j,n}}.$$

2.2 Preferences

At each point in time agents are assumed to maximize lifetime utility. Hence the problem of the typical agent that at t has age $i = v$ ($v \geq I_A$) is to choose consumption and leisure $l_{i,t,j,n} = 1 - h_{i,t,j,n}$ to solve the problem

$$Max \sum_{i=v}^{I} \beta^{i-v} \pi^{i}_{v,t} U(c_{i,t+i-v,j,n}, h_{i,t+i-v,j,n}) \quad (1)$$

subject to the following period-by-period constraint

$$a_{i+1,t+1,j,n} = (1 + r_t(1 - \tau_k))(a_{i,t,j,n} + B_t) + y_{i,t,j,n} - c_{i,t,j,n}$$

with $a_{1,t,j,n} = 0$, $a_{I+1,t,j,n} = 0$. The discount parameter is β, and is assumed to be the same for all agents. Borrowing is possible and agents accumulate asset holdings to smooth consumption over time. r_t is the interest rate net of depreciation, $a_{i+1,t+1,j,n}$ denotes next period asset holdings, $y_{i,t,j,n}$ is labor income net of taxes plus transfers and τ_k is a proportional capital income tax. Let $e_{i,j,n}$ be the efficiency index, $\tau_{ss,t}$ the social security proportional tax, $\tau_{l,t}$ a proportional labor income tax and $d_{i,t,j,n}$ the social security benefits. Finally w_t denotes real wages per efficiency unit, $\phi_{i,t,j,n}$ the age specific employment rate and B_t is the accidental bequest received at t. These considerations allow us to define the labor income net of taxes plus transfers as

$$y_{i,t,j,n} = w_t \phi_{i,t,j,n} e_{i,j,n} h_{i,t,j,n} (1 - \tau_{l,t} - \tau_{ss}) + d_{i,t,j,n}$$

2.3 Production Technology

Production in period t is given by a standard constant returns to scale production function that converts capital K_t and labor N_t into output. Competitive firms rent labor and make investment decisions so as to maximize the present value of current and future profit flows, where at t are given by

$$\Pi_t = F(K_t, Z_t N_t) - \frac{\chi}{2}(\frac{I_t^2}{K_t}) - w_t N_t - I_t$$

subject to

$$I_t = K_{t+1} - (1-\delta)K_t$$

The FOC are

$$q_t = 1 + \chi \frac{I_t}{K_t}$$

$$r_{t+1} = \frac{F_K(K_{t+1}, N_{t+1}) + \frac{\chi}{2}(\frac{I_{t+1}}{K_{t+1}})^2 + q_{t+1}(1-\delta) - q_t}{q_t}$$

$$w_t = F_L(K_t, N_t)$$

The technology Z_t improves over time at a constant rate because of labor augmenting technological change, $Z_{t+1} = (1+\lambda)Z_t$.

2.4 Government

The government levies a proportional social security tax on labor income $\tau_{ss,t}$ to finance a benefit $d_{i,t,j,n}$ per retiree

$$d_{I_R,t,j} = max(P_{min}, min(P_{max}, \frac{rep}{1+\lambda} w_{av}))$$

where λ, rep, w_{av} and P_{max} are the productivity growth, the legal replacement rate, some average of past earnings and the maximum pension benefit respectively. From age $I_R + 1$ to I, the pension benefit is normalized by productivity growth $(1 + \lambda)$, since new pensions are greater than old ones, i.e. $d_{i,t,j,n} = \frac{d_{i-1,t,j,n}}{1+\lambda}$

The government also levies a τ_k and $\tau_{l,t}$ to finance per capita government consumption G_t such that

$$\sum_{n=1}^{N}\sum_{j=1}^{J}\sum_{i=I_A}^{I_R-1} \mu_{i,t,j,n} w_{j,t} \phi_{i,t,j,n} h_{i,t,j,n} e_{i,j,n} \tau_{ss,t} +$$

$$+ \sum_{n=1}^{N}\sum_{j=1}^{J}\sum_{i=I_A}^{I} \mu_{i,t,j,n} (r_t a_{i,t,j,n} \tau_k + w_t \phi_{i,t,j,n} h_{i,t,j,n} e_{i,j,n} \tau_{l,t}) =$$

$$= \sum_{n=1}^{N}\sum_{j=1}^{J}\sum_{i=I_R}^{I} \mu_{i,t,j,n} d_{i,t,j,n} + G_t.$$

2.4.1 The Equilibrium

A *Competitive Equilibrium* is a list of sequences of quantities $c_{i,t,j,n}$, $h_{i,t,j,n}$, $a_{i,t,j,n}$, $\mu_{i,t,j,n}$, $d_{i,t,j,n}$, N_t, K_t, prices w_t, q_t, r_t, social security tax rates $\tau_{ss,t}$ and income tax rates such that, at each point in time t:

1) firms maximize profits

2) agents maximize lifetime utility subject to the period budget constraints taking as given wages, the interest rate, taxes, social security benefits, survival probabilities, the age structure of the population and accidental bequests,

3) the age structure of the population $\{\mu_{i,t,j,n}\}$ follows the aggregate law of motion,

4) accidental bequests are given by

$$B_t = \frac{\sum_n \sum_j \sum_i \mu_{i-1,t-1,j,n} a_{i,t,j,n}(1 - s_{i-1,t-1,j})}{(1 + n_{t-1}) \sum_n \sum_j \sum_{i=I_A}^{I} \mu_{i,t,j,n}}$$

5) Market clearing conditions for labor holds

$$N_t = \sum_{j=1}^{J} \sum_{i=I_A}^{I_R-1} \sum_{n=1}^{N} \mu_{i,t,j,n} \phi_{i,t,j,n} e_{i,j,n} h_{i,t,j,n}$$

6) Let aggregate wealth be

$$A_t = \sum_{n=1}^{N} \sum_{j=1}^{J} \sum_{i=I_A}^{I} \mu_{i,t,j,n} a_{i,t,j,n}$$

and FA_t be the net foreign asset position, then the following holds

$$FA_t = A_t - q_{t-1} K_t$$

7) the budget constraint of the government is satisfied period by period

8) and the good market clearing condition is satisfied

$$F(K_t, Z_t N_t) = C_t + I_t + CADJ_t + G_t + FA_{t+1} - (1 + r_t)FA_t.$$

where $CADJ = \frac{\chi}{2}(\frac{I_t^2}{K_t})$, the current account is the variation of net foreign assets ($CA_t = FA_{t+1} - FA_t$), and the trade balance is the variation of net foreign minus income from these assets ($TB_t = CA_t - r_t FA_t$).

3 Calibration

3.1 Demographics

Each model period corresponds to 1 year. Agents reach adulthood at 16 and live up to age 100, after which death is certain. We take the age structure of the population of 1995 as the initial condition in order to propagate the population to the future. In that year, the stock of immigrants represented 1% of the total population. This number and the fact that there is no data set available in order to know when existing immigrants entered the country, lead us to make no distinction between immigrants and natives in the initial steady state. In order to obtain the initial asset distribution we are implicitly assuming that individuals living in the initial steady state think that the population will not change.

After 1995, given the dynamics of fertility and the mortality, we propagate the age structure of the population until it becomes stationary (in the sense that the share of each age group over the total population does not change through time) under several scenarios about the immigration flows.[5]

3.1.1 Immigration Flows

Our baseline scenario takes the reported number of new immigrants in the Labour Force Survey (*Encuesta de Poblacion Activa)* which increases from 33,060 in 1996 to 507,500 in 2005, and from 2006 to 2050 the number of inflows decreases until it settles around 270,000 immigrants per year.[6] The age distribution of these migration flows are taken to be constant and are computed as follows. The available data refers only to age groups of 10 years, and almost 80 per cent of the new immigrants enter the country with less than 40 years of age. Since in our model a period is 1 year, for computational reasons, we have assumed that there are 40 possible ages at which immigrants can enter the country. Furthermore, the proportion of new immigrants to each age group has been obtained by fitting a second order polynomial to the current age distribution of new immigrants in Spain (see first panel of Figure 1). Finally, these immigrants are assumed to have the same mortality and fertility rate as natives.

3.2 Preferences and Heterogeneity

The period utility function per-member of the household is

$$u(c,h) = \frac{c_{i,t,k,n}^{1-\sigma}}{1-\sigma} - \phi_{i,t,k,n} B \frac{h_{i,t,k,n}^{1+\mu}}{1+\mu}$$

[5] Fertility and mortality rates are obtained from the demographic projections (scenario 1) of the *Instituto Nacional de Estadística.*

[6] These figures are contemplated in the high-immigration scenario of the most recent demographis forecast of the Spanish National Statistics Office .

Notice that we are implicitly assuming that at each point in time only a proportion $\phi_{i,t,k,n}$ of household members are employed, but its members choose consumption and labor (of those who are employed) so as to maximize joint utility under the assumption that employed and non-employed members enjoy the same consumption allocation. The inverse of the elasticity of substitution σ is 2. The parameters μ and B has been set such that the average time spent working is around 1/3 and the Frisch elasticity of labor $(1/\mu)$ is 0.4. Hence we use $B = 600$ and $\mu = 2.5$. The discount rate parameter is set equal to $\beta = 0.999$.

3.2.1 Heterogeneity

In order to properly account for the potential differences in productivity between natives and immigrants and make alternative experiments concerning the skills content of immigration flows, we have partitioned individuals of the same generation into four possible occupations (qualified non-manual, non-qualified non-manual, qualified manual and non-qualified manual). The distribution of natives and immigrants workers by these occupational levels comes from the Structural Earnings Survey (SES) in 2002, since information about the nationality of the worker was not available in the 1995 wave of this survey. However, according to the information available in the Spanish Labour Force Survey (LFS), the distribution by occupation of immigrant workers has remained roughly constant over this period . As can be seen in Figure 1, it is important to take into account differences in the occupational distribution of workers by nationality given that immigrants are more concentrated than natives in low-skilled occupations.

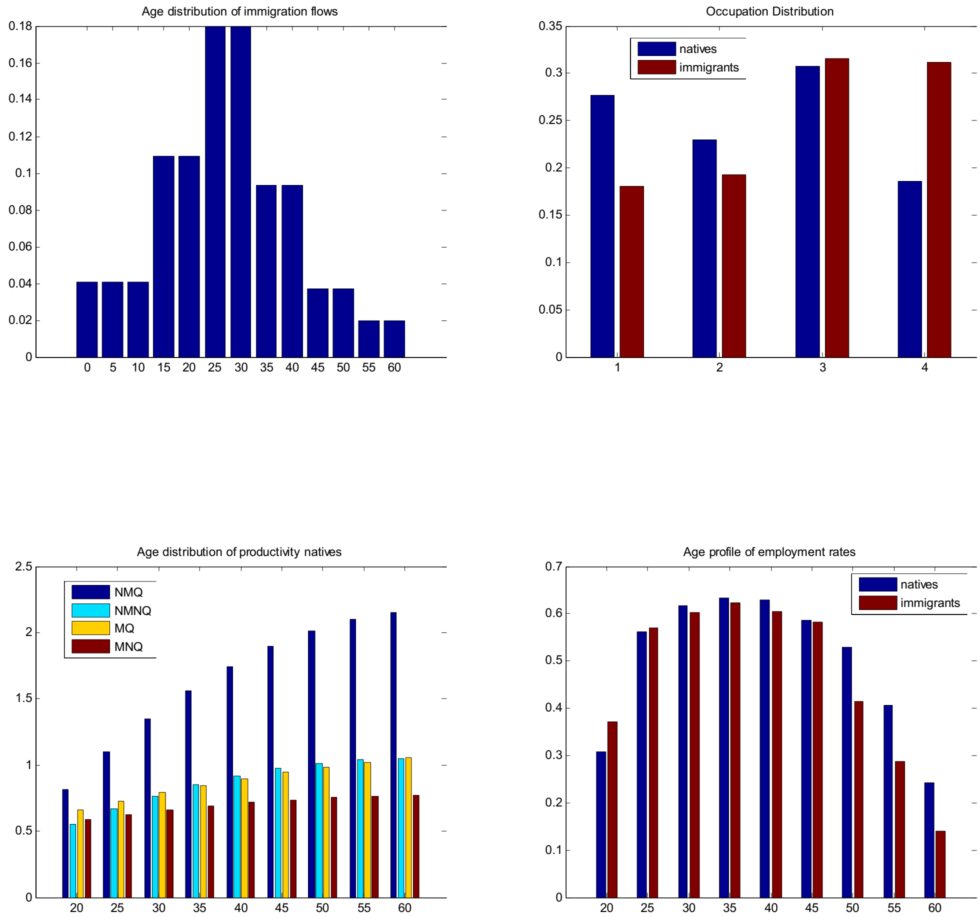
We assume that new immigrants entering the country until 2050 maintain this occupational distribution.

Regarding productivity, we allow productivity differentials across age, nationality and occupational level. As the information about productivity at the individual level is not available, we proxy productivity differentials by wage differentials using, as previously, information from SES in 2002. We compute hourly wages by age groups, nationality and occupational level (see Figure 1). It should be noticed that in the highest occupational level we assume that the wage differential is zero between natives and immigrants.[7]

Finally, individuals, natives and immigrants, are assumed to get employed with a probability equal to the employment rate of their age group. On average, immigrants present a higher employment rate than natives but this gap is mainly due to they are younger, so it is important to take into account age differences. Indeed, as can be seen in figure 1, immigrants show slightly lower employment rate for each age group except those less than 25 years. Employment rates are computed using Labour Force Survey data for 2005. We use more recent information for employment rates in order to take into account that new immigrants entering Spain since 1995 have showed higher employment rates than the few immigrants who where already here at that date. We think this is more adequate in order to extrapolate employment rates for new immigrants until 2050.

[7] Since there are the very few observations of immigrants in this occupational level, available data give implausible estimates of wage differentials.

Figure 1


Age distribution of immigration flows
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0 5 10 15 20 25 30 35 40 45 50 55 60
Occupation Distribution
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4
natives
immigrants
Age distribution of productivity natives
2.5
2
1.5
1
0.5
0
20 25 30 35 40 45 50 55 60
NMQ
NMNQ
MQ
MNQ
Age profile of employment rates
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
20 25 30 35 40 45 50 55 60
natives
immigrants

3.3 Government

Pension benefits are as follows. Upon retirement an individual's pension is computed applying a replacement rate over the average of earnings of the last 15 years before retirement. This replacement rate is, 0% if an individual has been contributing for less than 15 years, 100% if he has contributed for at least 35 years, and 60+2(m-15) in percent terms if the individual has contributed at least 15 years but less than 35, where m is the number of contributed years. The pension system in Spain also includes a maximum and a minimum pension level equal to 1.85 and 0.44 times the per-capita output in the Spanish economy in 1995. However in the model economy these limits were not binding, due to the fact that we have considered broad qualification's categories. The social security contribution rate is set to 15% which the ratio of social security contributions over labor income. Notice that we are not imposing (as many papers do) the social security system to be balanced.

We use a value of the capital income tax $\tau_k = 0.186$ as reported by Bosca et al. (1999) and set a government to output ratio of $G/Y = 18\%$ which is the ratio of government consumption to GDP in 1995 in Spain. The labor tax rate $\tau_{l,t}$ is set endogenously to balance the overall (including the social security system) government budget. In the initial steady state the value that satisfies this condition is 23.3%. It should be noted that the labor tax will be changing over time as a result of (among other things) possible imbalances between social security contributions and expenditures.

3.4 Production Technology and the World Interest rate

The production technology is Cobb-Douglas

$$Y_t = F(K_t, Z_t N_t) = K_t^{\alpha}(Z_t N_t)^{1-\alpha}$$

and the capital share parameter is $\alpha = 0.375$ following the estimates of Domenech and Taguas (1995) for the Spanish economy. The productivity growth has been set to $\lambda = 1\%$ in annual terms which is the average growth of per-capita consumption over the period 1960-1995. The depreciation rate of capital δ is set to match the average ratio of gross investment over output I/Y=21.7% which is the value of this ratio in 1995. This yields a value of $\delta = 7\%$ in annual terms. The adjustment cost parameter is consistent with the estimates for the Spanish economy of Barcelo (2006) and Alonso-Borrego and Bentolila (1994) and is equal to χ=30. Finally the international real interest rate is set so as to reproduce in the initial steady state a ratio of foreign assets over GDP of around -19%. This target generates in the model a current account deficit over GDP ratio which is slightly more negative that the one observed in the data, due to the fact that the model is assumed to be in a steady state, while this is not necessarily the case in the data.

Table 1: Current Account in the Model versus Spain

	Data 1995	Model 1995
Current Account/GDP	-0.3%	-0.47%
Net Foreign Assets/GDP	-20%	-19%

3.5 Computation Method

The computational procedure used to solve for the transitional dynamics of the model is standard and follows Auerbach and Kotlikoff (1987).

4 Findings

To accounting for the aggregate effects of immigration, we compute the evolution of macroeconomic variables under several scenarios that vary in respect to the size and composition of the immigration flows. We start computing a baseline scenario characterized by two main features: i) the population ages according to the demographic projections specified in the calibration, including the current immigration flows, and ii) there is a fall in the international interest rate. In particular we assume that between 1995 and 2005 real interest rate falls by 1.5 percentage points, as observed in the Spanish economy during this period, and then increases until reaching a level consistent with a long term decline of 1 percentage point. This expected long-term decline in the real interest rate is consistent with results from recent papers that have addressed the impact of demographics on the evolution of international real interest rate.[8] Since the model is calibrated for 1995 and, in the baseline scenario we use factual immigrant flows for the 2005, from comparison with observed data we can evaluate to what extent the model is able to predict the impact of immigration over the short-run.

[8] See, for instance, Kara and von Thadden (2006) and Krueger and Ludwig (2006).

To disentangle the aggregate effects of immigration from the effects of the change in the interest rate, we consider four alternative scenarios combining different paths for immigration flows an the real interest rate. In particular, we have computed five alternative cases:

- Scenario 1 (baseline): Observed immigration flows and a fall in the international interest rate
- Scenario 2: No immigration and a fall in the interest rate
- Scenario 3: No immigration and a constant interest rate
- Scenario 4: An increase in immigration of unskilled workers and a fall in the interest rate
- Scenario 5: Immigration flows as in the baseline scenario, more skilled immigrants and a fall in the interest rate.

4.1 The aggregate effects of observed immigration flows

In order to gauge the aggregate effects of immigration flows into the Spanish economy, we present the results of the baseline scenario in comparison to the case of no migration flows (Scenarios 1 and 2). To present the results we use several graphs, plotting the evolution of some labor market variables (wages, employment, and labor supply), some macroeconomic variables (the capital labor-ratio, GDP per capita, investment and saving rates, and the current account balance -bcc-), and some variables reflecting the situation of the pension system (the dependency ratio -the ratio of retirees to the labor force-, pensions expenditures, and the Social Security deficit).[9] For some years, values reflecting the most relevant macroeconomic effects of immigration are also reported in Table 2. For this case the results are in Figure 2.

From the comparison between the first two scenarios, we draw the following conclusions. Immigration contributed both to the rise in employment per capita and to the decline of labor productivity (measured as GDP over employment). Both effects tend to cancel out and, as a result, GDP per capita turns out to be very similar in both scenarios over the initial periods of the transition, although it increases with immigration afterwards. There is not much difference between both scenarios in terms of the behavior of the saving rate, but the investment rate is substantially higher in the experiment with immigration flows. The reason is that, with immigration, the lower capital labor ratio increases the marginal productivity of capital and increases the profitability of investment decisions. As a by product of these trends, immigration flows deliver a more pronounced current account deficit as percentage of GDP. In Scenario 2 (No immigration), the aging of the baby boom generation increases the number of the retirees over the total population inducing an increase in the social security tax rate in order to balance the government budget. In addition, there is some reduction in the percentage of GDP spent on pensions and the social security deficit in the scenario with immigration flows, which, nevertheless, does not impede that both pension expenditures and the Social Security deficit surges

[9] Wages, GDP per employee, and GDP per capita are detrended.

to much higher levels that the current ones. Consequently, the inflow of immigrants alleviates, to a minor extent, the effects of the aging of the baby-boom generation.

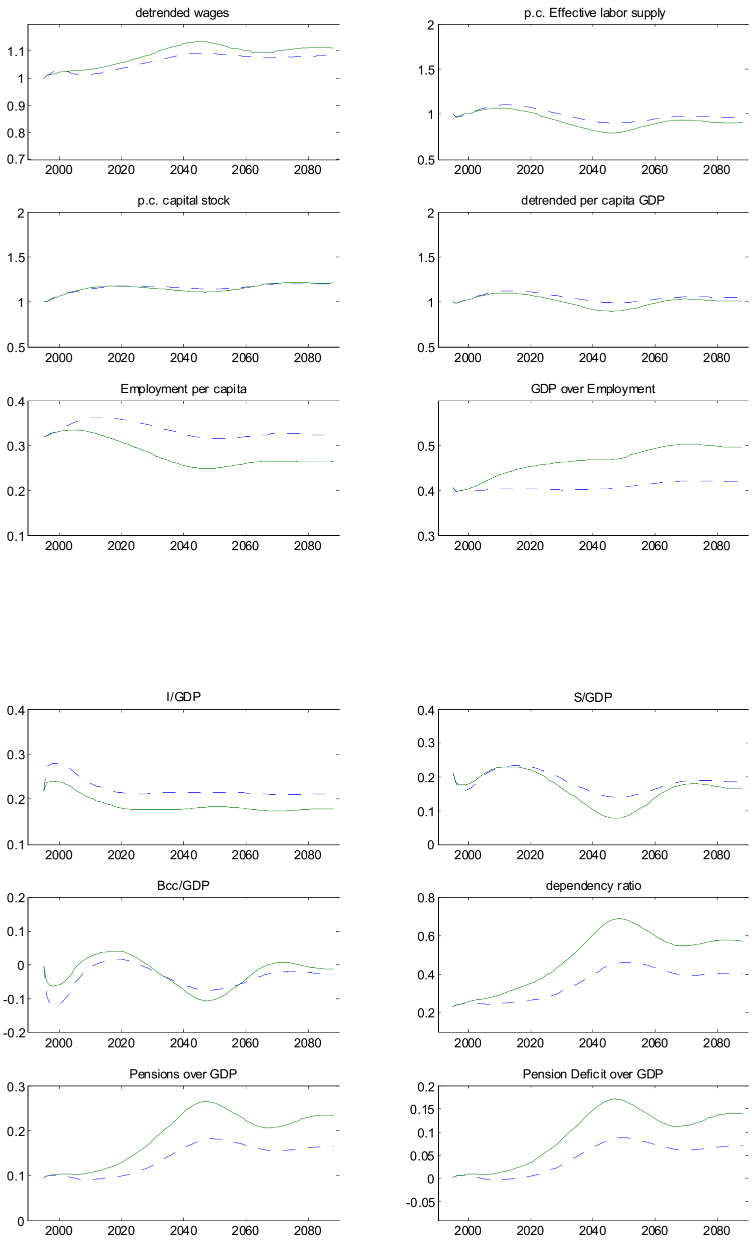
As for the quantitative effects (see columns [1] and [2] of Table 2), these are specially noticeable in the case of employment per capita (about 2, 5 and 8 pp higher at 2005, 2020 and 2050 in Scenario 1). This is due to two effects: i) the continuous immigrant flows of the order of those considered in Scenario 1 imply significantly less population ageing than under no migration, and ii) the weight of immigrants, who have higher employment rates, in the labor force increases. For a similar composition effect, GDP per employee is significantly lower due to immigration, and also the impact accumulates over time. As for GDP per capita, the effect of immigration, as already commented, is minor but increases over time (0.9%, 3,6%, and 9% higher in Scenario 1 in 2005, 2020 and 2050, respectively). Finally, the impact of immigration on the investment rate is significant: about 3 pp higher at the three horizons presented in Table 2 (diminishing over time due to the existence of investment adjustment costs).

We can evaluate the short-run performance of the model by comparing the results for 2005 with the observed data. Overall, the model replicates quite well the evolution of GDP per capita, whose average annual rate of growth over the 2000-2005 been 2.11% (2.02% in the model under the baseline [1]). Admittedly, over this period the model produces a lower rate of growth of employment per capita (1,03% annual) and a higher rate of growth of labour productivity (0,98% annual) than observed (1,70% and 0,40%, respectively). Another front where the model comes very close to replicate the observed data over this period is regarding the evolution of investment: the investment rate averaged 27.42% of GDP over the 2000-2005, while the model yields 27.23%.

Table 2. Results

	Scenario 1 [1]	Scenario 2 [2]	Scenario 3 [3]	Scenario 4 [4]	Scenario 5 [5]
Employment per capita (%)					
1995	31.99	31.99	31.99	31.99	31.99
2005	35.22	33.39	33.39	35.25	35.22
2020	35.83	30.79	30.79	37.69	35.83
2050	31.64	24.99	24.99	35.59	31.64
GDP per employee (detrended)					
1995	40.63	40.63	40.63	40.63	40.63
2005	40.06	41.90	41.33	40.34	41.08
2020	40.35	45.35	42.50	38.81	43.92
2050	40.77	47.39	44.17	37.98	46.90
GDP per capita (detrended)					
1995	13.00	13.00	13.00	13.00	13.00
2005	14.11	13.99	13.00	14.22	14.47
2020	14.46	13.96	13.09	14.63	15.74
2050	12.90	11.84	11.04	13.52	14.84
Investment/GDP (%)					
1995	21.75	21.75	21.75	21.75	21.75
2005	25.93	22.19	18.49	27.90	27.22
2020	21.42	18.11	16.16	24.00	22.45
2050	21.54	18.42	16.25	23.43	21.58

Figure 2 (Dashed lines: Scenario 1, Solid lines: Scenario 2)

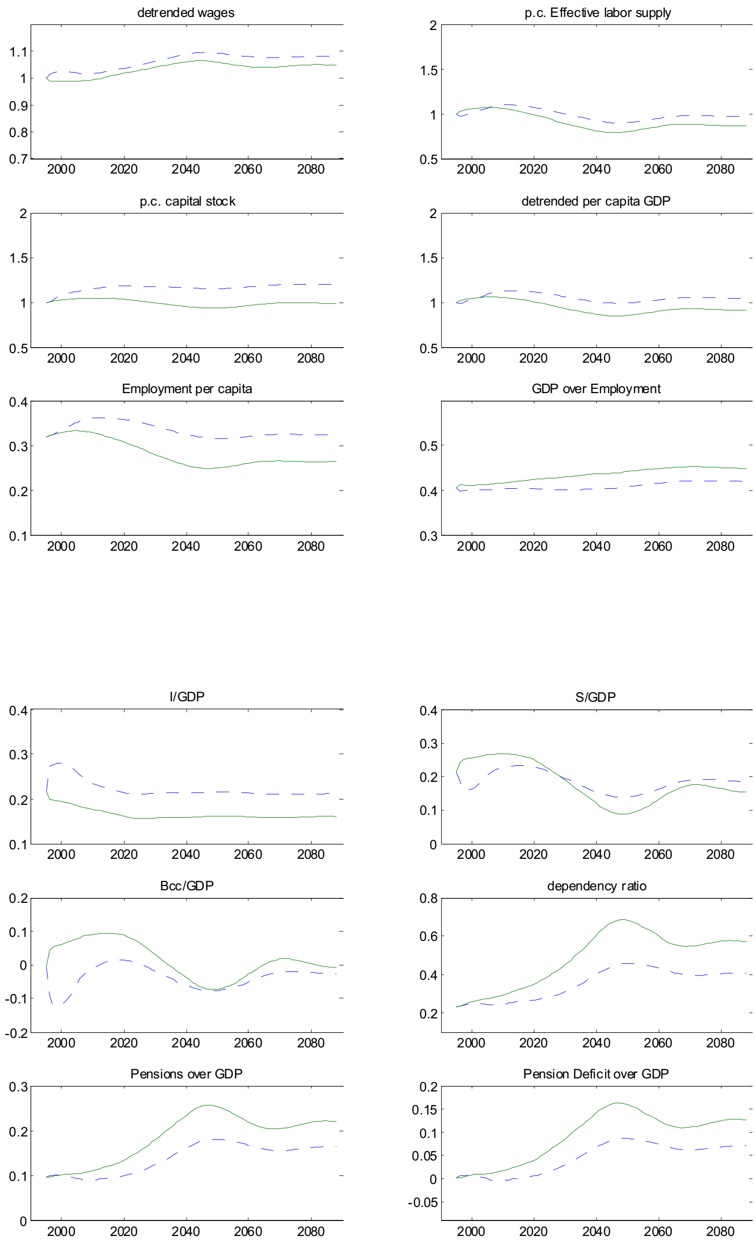


4.2 The combined effects of immigration and of the fall in the interest rate

Now we compare Scenario 1 to Scenario 3 (no immigration and a constant interest rate). This comparison, together with the results in the previous section, allows us to draw some conclusions about the interaction between the effects of immigration and the fall of the interest rate. The main qualitative difference is , that, under a constant interest rate there is a smaller increase in the stock of capital, due to the higher cost associated with investment. Hence, there is a lower increase in GDP per capita. The increase in the investment rate and the fall in the saving rate over the initial periods of the transition, associated to the fall in the interest rate disappear (Figure 3), and, consequently, the current account balance displays a surplus in the initial periods of the transition. In terms of the evolution of social security finances, there fall of the interest rate is not very relevant, as the most important factor determining pension expenditures and the Social Security deficit is the dependency ratio, which do not change in the three Scenarios considered so far.

Looking at columns [2] and [3] of Table 2, we can gauge how quantitatively important the effect of the postulated variations of the interest rate could be. The reduction of 1.5 pp of the real interest rate over the 1995-2005 embedded in Scenario 2 does not affect very much to either employment, productivity or GDP per capita over the short-run. However, as accumulation of capital is larger than under Scenario 3, at longer horizons labor productivity and, consequently, GDP per capita rise.

Figure 3 (Dashed lines: Scenario 1, Solid lines: Scenario 3)

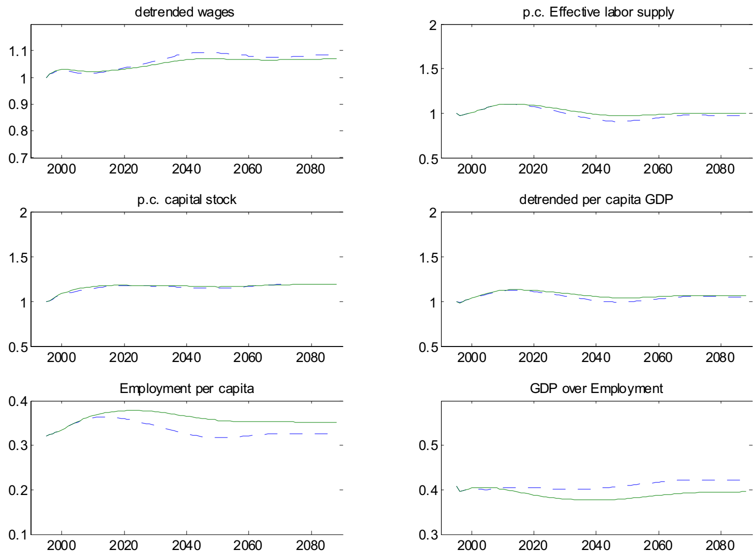


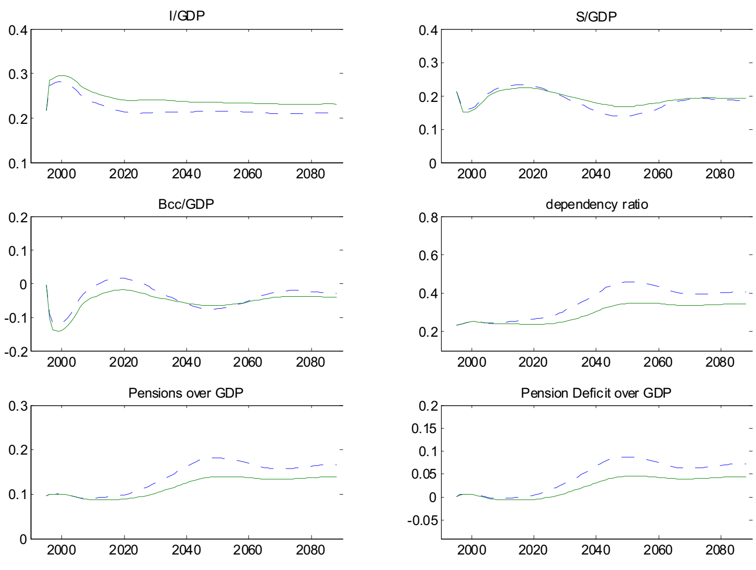
4.3 The effects of more unskilled immigration

In this case, we compare the baseline scenario, which is constructed on the observed and predicted flows by the Spanish National Statistics Office, with an alternative scenario in which immigration flows are permanently higher, at the level of 600,000 immigrants per year. Regarding the skill distribution of these flows we keep that observed under the baseline scenario, i.e. the one observed in the Spanish economy in the recent period. While it is very unlikely that immigration flows of this order of magnitude can be sustained over such a long period of time, this comparison can give us some intuition on how the returns of immigration depend on the size of the flows.

Under Scenario [4] the number of immigrants arriving at Spain over the 2000-2050 period is twice the number of immigrants than under Scenario [1]. As a result, employment per capita would be higher (only slightly over the short and medium run and more noticeably at the 2050 horizon) but at the cost of a substantial deterioration of labor productivity (see Figure 4). Still, larger immigration flows would result in an increase of GDP per capita of a small magnitude. With more immigration, the supply of labor increases, and for the reasons explained before, the investment rate would be also higher, without observing any significant change in the saving rate. Consequently, the current account deficit would suffer an additional deterioration. On the benefit side, the dependency ratio increases less importantly since the population ages less quickly, and the expected increase in the percentage of GDP spent on pensions would be less pronounced.

Figure 4 (Dashed lines: Scenario 1, Solid lines: Scenario 4)





4.4 The effects of an upgrade in the skill content of immigration

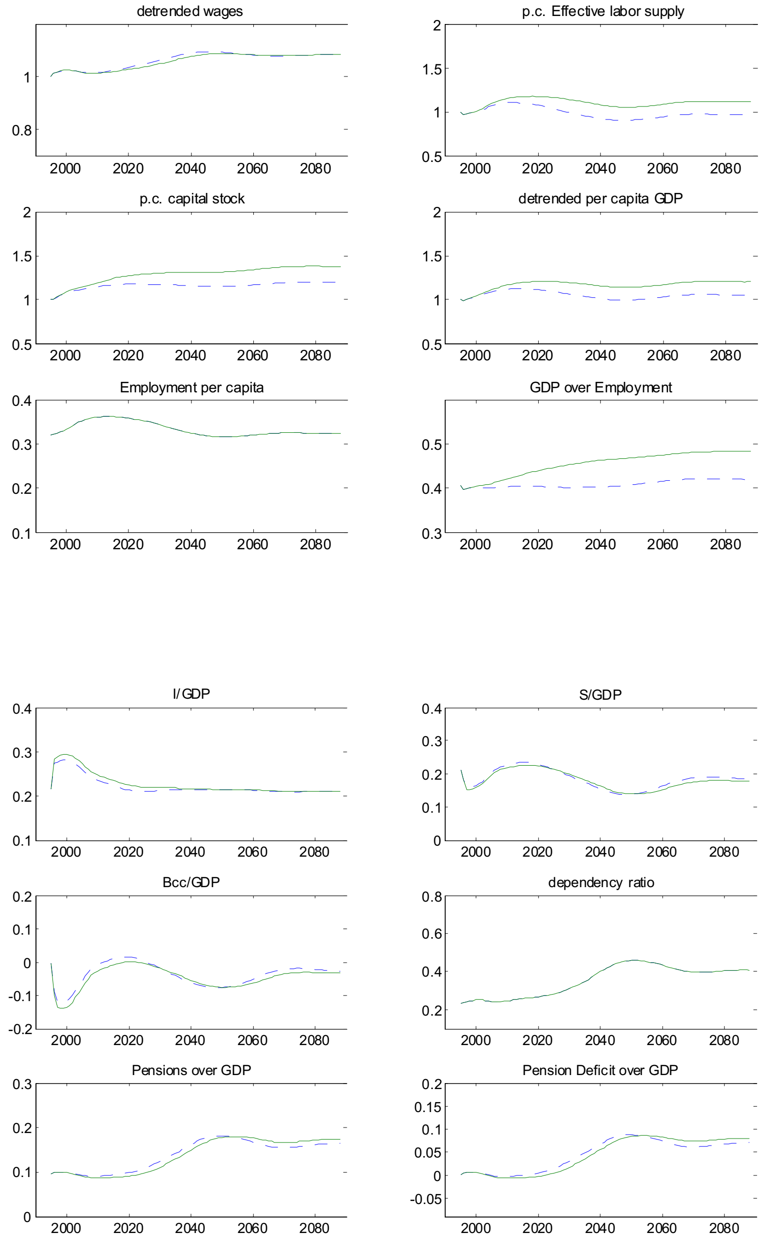
We now keep the immigration flows of the baseline scenario but consider a skill distribution of these flows more biased towards high skill occupations as shown in Table 3.

Table 3: Occupation Distribution of Immigrants

	Non-manual		Manual	
	Skilled	Unskilled	Skilled	Unskilled
Scenario 1	18%	19.3%	31.5%	31.2%
Scenario 5	70%	10%	10%	10%

As can be seen in Figure 5 and columns [1] and [5] of Table 2, the most significant effects are to be found in the evolution of GDP per employee. Since in the two scenarios immigration flows are of the same order of magnitude and in our model employment rates of immigrant only vary by age (and not by occupation), the skill upgrade immigration has no effects on employment per capita. However, GDP per capita increases noticeably (by 2.6%, 8.9% and 15.0%, respectively, at 2005, 2020 and 2050) as a result of a more favorable evolution of labor productivity, which is also impulsed by a larger accumulation of capital.

Figure 5 (Dashed lines: Scenario 1, Solid lines: Scenario 5)



5 Concluding remarks

We have performed several accounting exercises to gauge the aggregate effects of immigration under different conditions, regarding the evolution of interest rates and the skill composition of immigration flows. For that, we have used a dynamic, general equilibrium, overlapping generations model calibrated to the Spanish economy, using as a baseline scenario the demographic projections currently envisaged by the Spanish National Statistics Office. This is a rather stylized model that does not account for several facts, well-documented in microeconometric studies on the effects of immigration in other countries but not yet in Spain, such as different preferences between immigrants and natives regarding the consumption-leisure choice, the imperfect substitution in production between immigrants and natives, the impact of immigrants on the employment rate and productivity of native workers, and the assimilation and return patterns of immigrants. Despite these drawbacks, to be amended as more microeconomic empirical evidence on the Spanish economy becomes available, the results provide some interesting insights on the magnitude of the effects of immigration on employment, productivity, GDP per capita, investment and saving rates, and the financial position of the pension system.

The main conclusions from these exercises are the following. Immigration increases employment through a positive impact on the age structure of the population and a composition effect (coming from higher observed employment rates of the immigrants), but it has a significant negative effect on productivity, so that, overall, its impact on GDP per capita, although positive, is not large.

This negative effect on productivity could be avoided with a skill upgrade of the composition of immigrant flows. There are also important effects of immigration on the investment rate, while the impact on the saving rate is less significant. Finally, none of the immigration scenarios contemplated in this exercise, whatever is size or composition, avoid a significant rise in pension expenditures and a noticeable worsening in the financial situation of the Social Security system.

References

[1] ALONSO-BORREGO, C., and S. BENTOLILA (1994). "Investment and Q in Spanish manufacturing firms", *Oxford Bulletin of Economics and Statistics,* vol. 56, pp. 49-65.

[2] APARICIO, R., and A. TORNOS (2000). *La inmigración y la economía española,* Madrid, IMSERSO.

[3] AUERBACH, A. J., and L. J. KOTLIKOFF (1987). *Dynamic Fiscal Policy.*

[4] BARCELÓ, C. (2006). "A Q-model of Labour Demand", *Investigaciones Económicas,* forthcoming.

[5] BORJAS, G. (1999). “The Economic Analysis of Immigration”, in O. Ashenfelter and D. Card (eds.), *Handbook of Labour Economics,* vol. 3A, North Holland.

[6] BOSCA, J. E., M. FERNANDEZ and D. TAGUAS (1999). *Estructura Impositiva en los Países de la OCDE,* Ministerio de Economía.

[7] CAIXA CATALUNYA (2006). *Informe Semestral I/2006. Economía española y contexto internacional.*

[8] CARD, D. (2001). "Immigrants Inflows, Native Outflows, and the Local Labour Market Impacts of Higher Immigration", *Journal of Labour Economics,* 19 (2), pp. 22-64.

[9] COLLADO, M. D., I. ITURBE-ORMAETXE and G. VALERA (2004). "Quantifying the Impact of Immigration on the Spanish Welfare State", *International Tax and Public Finance*, vol. 11, No. 3, May, pp. 335-353.

[10] DOLADO, J. J. (2002). "Los nuevos fenómenos migratorios: Retos y políticas", chapter 2, in T. García-Milá (ed.), *Nuevas Fronteras de la Política Económica,* (2001), CREI (UPR) and Generalitat de Cataluña.

[11] DOMENECH, R., and D. TAGUAS (1995). *Potential Output Estimations in the Spanish Economy,* Conference on Medium Term Economic Assessment, Helsinki, 7-9 June, mimeo.

[12] HUGGETT, M., and G. VENTURA (1999). "On the Distributional Effects of Social Security Reform", *Review of Economic Dynamics,* vol. 2 (3) pp. 498-531.

[13] JIMENO, J. F., E. MORAL and L. SAIZ (2006). "Structural breaks in labor productivity growth: the United States vs. the European Union", Working Paper No. 0625, Banco de España.

[14] KARA, E., and L. VON THADDEN (2006). *Monetary Policy and Demographic Changes,* European Central Bank, mimeo.

[15] KRUEGER, D., and A. LUDWIG (2006). "On the consequences of demographic chenge for rates of returns to capital, and the distribution of wealth and welfare", *Journal of Monetary Economics,* forthcoming.

[16] OFICINA ECONÓMICA DEL PRESIDENTE (2006). *Inmigración y Economía Española.*

[17] OTTAVIANO, G., and G. PERI (2006). *Rethinking the gains from immigration: Theory and evidence from the US,* NBER Working Paper 11672.

[18] PUCH, L., and O. LICANDRO (1997). "Are there any special features in the Spanish Business Cycle?", *Investigaciones Economicas,* vol. XXI (2) pp. 361-394.

[19] RAZIN, A., and E. SADKA (1999a). "Migration and Pension with international capital mobility", *Journal of Public Economics,* 74, pp. 141-150.

[20] — (1999b). *Unskilled Migration: A Burden or a Boom for the Welfare State,* NBER Working Paper 7013.

[21] STORESLETTEN, K. (2000). "Sustaining Fiscal Policy Through Immigration", *Journal of Political Economy,* vol. 108 (2), pp. 300-323.

BANCO DE ESPAÑA PUBLICATIONS

WORKING PAPERS[1]

0601 ARTURO GALINDO, ALEJANDRO IZQUIERDO AND JOSÉ MANUEL MONTERO: Real exchange rates, dollarization and industrial employment in Latin America.

0602 JUAN A. ROJAS AND CARLOS URRUTIA: Social security reform with uninsurable income risk and endogenous borrowing constraints.

0603 CRISTINA BARCELÓ: Housing tenure and labour mobility: a comparison across European countries.

0604 FRANCISCO DE CASTRO AND PABLO HERNÁNDEZ DE COS: The economic effects of exogenous fiscal shocks in Spain: a SVAR approach.

0605 RICARDO GIMENO AND CARMEN MARTÍNEZ-CARRASCAL: The interaction between house prices and loans for house purchase. The Spanish case.

0606 JAVIER DELGADO, VICENTE SALAS AND JESÚS SAURINA: The joint size and ownership specialization in banks' lending.

0607 ÓSCAR J. ARCE: Speculative hyperinflations: When can we rule them out?

0608 PALOMA LÓPEZ-GARCÍA AND SERGIO PUENTE: Business demography in Spain: determinants of firm survival.

0609 JUAN AYUSO AND FERNANDO RESTOY: House prices and rents in Spain: Does the discount factor matter?

0610 ÓSCAR J. ARCE AND J. DAVID LÓPEZ-SALIDO: House prices, rents, and interest rates under collateral constraints.

0611 ENRIQUE ALBEROLA AND JOSÉ MANUEL MONTERO: Debt sustainability and procyclical fiscal policies in Latin America.

0612 GABRIEL JIMÉNEZ, VICENTE SALAS AND JESÚS SAURINA: Credit market competition, collateral and firms' finance.

0613 ÁNGEL GAVILÁN: Wage inequality, segregation by skill and the price of capital in an assignment model.

0614 DANIEL PÉREZ, VICENTE SALAS AND JESÚS SAURINA: Earnings and capital management in alternative loan loss provision regulatory regimes.

0615 MARIO IZQUIERDO AND AITOR LACUESTA: Wage inequality in Spain: Recent developments.

0616 K. C. FUNG, ALICIA GARCÍA-HERRERO, HITOMI IIZAKA AND ALAN SUI: Hard or soft? Institutional reforms and infraestructure spending as determinants of foreign direct investment in China.

0617 JAVIER DÍAZ-CASSOU, ALICIA GARCÍA-HERRERO AND LUIS MOLINA: What kind of capital flows does the IMF catalyze and when?

0618 SERGIO PUENTE: Dynamic stability in repeated games.

0619 FEDERICO RAVENNA: Vector autoregressions and reduced form representations of DSGE models.

0620 AITOR LACUESTA: Emigration and human capital: Who leaves, who comes back and what difference does it make?

0621 ENRIQUE ALBEROLA AND RODRIGO CÉSAR SALVADO: Banks, remittances and financial deepening in receiving countries. A model.

0622 SONIA RUANO-PARDO AND VICENTE SALAS-FUMÁS: Morosidad de la deuda empresarial bancaria en España, 1992-2003. Modelos de la probabilidad de entrar en mora, del volumen de deuda en mora y del total de deuda bancaria, a partir de datos individuales de empresa.

0623 JUAN AYUSO AND JORGE MARTÍNEZ: Assessing banking competition: an application to the Spanish market for (quality-changing) deposits.

0624 IGNACIO HERNANDO AND MARÍA J. NIETO: Is the Internet delivery channel changing banks' performance? The case of Spanish banks.

0625 JUAN F. JIMENO, ESTHER MORAL AND LORENA SAIZ: Structural breaks in labor productivity growth: The United States vs. the European Union.

0626 CRISTINA BARCELÓ: A Q-model of labour demand.

0627 JOSEP M. VILARRUBIA: Neighborhood effects in economic growth.

0628 NUNO MARTINS AND ERNESTO VILLANUEVA: Does limited access to mortgage debt explain why young adults live with their parents?

0629 LUIS J. ÁLVAREZ AND IGNACIO HERNANDO: Competition and price adjustment in the euro area.

0630 FRANCISCO ALONSO, ROBERTO BLANCO AND GONZALO RUBIO: Option-implied preferences adjustments, density forecasts, and the equity risk premium.

1. Previously published Working Papers are listed in the Banco de España publications catalogue.

0631 JAVIER ANDRÉS, PABLO BURRIEL AND ÁNGEL ESTRADA: BEMOD: A dsge model for the Spanish economy and the rest of the Euro area.

0632 JAMES COSTAIN AND MARCEL JANSEN: Employment fluctuations with downward wage rigidity: The role of moral hazard.

0633 RUBÉN SEGURA-CAYUELA: Inefficient policies, inefficient institutions and trade.

0634 RICARDO GIMENO AND JUAN M. NAVE: Genetic algorithm estimation of interest rate term structure.

0635 JOSÉ MANUEL CAMPA, JOSÉ M. GONZÁLEZ-MÍNGUEZ AND MARÍA SEBASTIÁ-BARRIEL: Non-linear adjustment of import prices in the European Union.

0636 AITOR ERCE-DOMÍNGUEZ: Using standstills to manage sovereign debt crises.

0637 ANTON NAKOV: Optimal and simple monetary policy rules with zero floor on the nominal interest rate.

0638 JOSÉ MANUEL CAMPA AND ÁNGEL GAVILÁN: Current accounts in the euro area: An intertemporal approach.

0639 FRANCISCO ALONSO, SANTIAGO FORTE AND JOSÉ MANUEL MARQUÉS: Implied default barrier in credit default swap premia. (The Spanish original of this publication has the same number.)

0701 PRAVEEN KUJAL AND JUAN RUIZ: Cost effectiveness of R&D and strategic trade policy.

0702 MARÍA J. NIETO AND LARRY D. WALL: Preconditions for a successful implementation of supervisors' prompt corrective action: Is there a case for a banking standard in the EU?

0703 PHILIP VERMEULEN, DANIEL DIAS, MAARTEN DOSSCHE, ERWAN GAUTIER, IGNACIO HERNANDO, ROBERTO SABBATINI AND HARALD STAHL: Price setting in the euro area: Some stylised facts from individual producer price data.

0704 ROBERTO BLANCO AND FERNANDO RESTOY: Have real interest rates really fallen that much in Spain?

0705 OLYMPIA BOVER AND JUAN F. JIMENO: House prices and employment reallocation: International evidence.

0706 ENRIQUE ALBEROLA AND JOSÉ M.ª SERENA: Global financial integration, monetary policy and reserve accumulation. Assessing the limits in emerging economies.

0707 ÁNGEL LEÓN, JAVIER MENCÍA AND ENRIQUE SENTANA: Parametric properties of semi-nonparametric distributions, with applications to option valuation.

0708 DANIEL NAVIA AND ENRIQUE ALBEROLA: Equilibrium exchange rates in new EU members: external imbalances vs. real convergence.

0709 GABRIEL JIMÉNEZ AND JAVIER MENCÍA: Modelling the distribution of credit losses with observable and latent factors.

0710 JAVIER ANDRÉS, RAFAEL DOMÉNECH AND ANTONIO FATÁS: The stabilizing role of government size.

0711 ALFREDO MARTÍN-OLIVER, VICENTE SALAS-FUMÁS AND JESÚS SAURINA: Measurement of capital stock and input services of Spanish banks.

0712 JESÚS SAURINA AND CARLOS TRUCHARTE: An assessment of Basel II procyclicality in mortgage portfolios.

0713 JOSÉ MANUEL CAMPA AND IGNACIO HERNANDO: The reaction by industry insiders to M&As in the European financial industry.

0714 MARIO IZQUIERDO, JUAN F. JIMENO AND JUAN A. ROJAS: On the aggregate effects of immigration in Spain.

BANCO DE ESPAÑA
Eurosistema

Unidad de Publicaciones
Alcalá, 522; 28027 Madrid
Telephone +34 91 338 6363. Fax +34 91 338 6488
e-mail: publicaciones@bde.es
www.bde.es