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IMMIGRATION AND GROWTH UNDER IMPERFECT CAPITAL MOBILITY: THE CASE OF ISRAEL

by

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Working Paper No.12–93

June, 1993

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I. INTRODUCTION

An influx of immigrants from the Soviet Union began to arrive in Israel in 1989. By the end of 1992 450,000 had arrived, comprising 10% of the 1989 population, and more are expected in the next few years. This wave was triggered by Glasnost and therefore, from the point of view of the Israeli economy the *occurrence* of this immigration is clearly an exogenous event. However, its *magnitude* can be considered related to the domestic macroeconomic conditions.

Since the immigrants possess practically no physical or financial capital, the direct effect of the immigration is a decline in the capital/labor ratio. This implies lower real wages and higher unemployment during the first few years, which in turn diminish the potential immigrants' benefits from immigration. The degree of international capital mobility is an important factor in this context: less capital mobility implies slower capital accumulation, and hence a lower real wage and higher unemployment paths.

The aim of this paper is to analyze and quantify the implications of the degree of capital mobility for immigration and growth, in the face of an open window of emigration abroad (from the CIS) for a given period. The framework of the present analysis is a neoclassical small open economy growth model, where imperfect capital mobility is represented by an upward sloping supply curve of foreign funds. The shape of this curve is parametrized empirically and it is exogenously given. Therefore, the cost of borrowing is not derived from the model itself, as in Eaton and Gersovitz (1981). The basic notion here is that the supply schedule of foreign funds is subject to exogenous changes, which may follow from special loans granted by international organizations or other governments. A recent example is the $10 billion loan guarantees extended by the United States government to Israel in 1992.

The decision to immigrate in this framework depends on expected income flows. Although there is no aggregate uncertainty in the model presented here, the job search process involves individual uncertainty. Immigrants have a reservation level for the expected present value of income (which should reflect the alternative income flows abroad and the once–and–for–all migration costs). Hence, assuming identical individuals, the immigrant "supply curve" is perfectly elastic at the reservation income level. Given that the number of immigrants also affects the capital/labor ratio and hence—through unemployment and real wages—the expected present value of income, the "demand curve for immigrants" is downward sloping. The equilibrium immigration flows are then determined by the combination of these two factors. The tightening of foreign borrowing implies a lower path for the capital/labor ratio and hence it yields lower present values of future income. In other words, this change implies a leftward shift of the "demand curve", and consequently lower immigration flows.

The mechanism described above differs from the two–country neoclassical analysis of migration and capital mobility, which suggests that the opening of factor mobility between two economies with initially different capital/labor ratios causes factor migration until these ratios are eventually equalized (assuming the same constant–returns technology). Labor migrates to the capital–intensive country and/or capital flows to the labor–intensive country. Then, the lower the degree of capital mobility (for some exogenous reason), the larger should be the migration of labor. In other words, there should be a negative relationship between capital mobility and migration. By contrast, the present framework of a small open economy facing a given supply of funds schedule, displays the opposite characteristic: the lower the degree of capital mobility, the <u>smaller</u> the migration of labor. The difference stems from the assumption that the interest rate schedule faced by the small open economy is unaffected by the opening of new world migration possibilities.

The analysis is carried out by simulating the model, after calibrating it to Israeli data. A simulation consists of computing paths for the different variables starting in a base period, taken here as 1992. Then the main analysis consists of changing the degree of capital mobility by shifting the schedule of the supply of funds, and computing the resulting change in immigration and the other macroeconomic variables.

The remainder of the paper is organized as follows. Section II presents the model. Its empirical calibration to Israeli data is discussed in Section III, and Section IV addresses the simulation of the model and the results. Section V presents concluding remarks.

II. THE MODEL

The structure of the domestic economy is described in subsection IIa, where the number of immigrants is treated as exogenous. Subsection IIb incorporates the endogenous determination of immigration.

IIa. Exogenous Immigration

The population of a competitive open economy at time zero is N_0. All original residents at time zero are employed. Starting from period one an exogenous immigration wave of $\{A_t\}_{t=1}^{\tau}$ arrives for τ periods. The population N_t includes the employed E_t (N_0 plus the number of immigrants who found employment), and the unemployed, U_t, who are immigrants.

Production in the economy takes place according to the technology:

$$(1) \qquad Y_t = F(K_t, L_t) = [\alpha K_t^{\sigma} + (1-\alpha)L_t^{\sigma}]^{\frac{1}{\sigma}}, \; 0 < \alpha < 1, \; \sigma < 1,$$

where K_t is the net capital stock and $L_t = N_0\ell_t^o + (E_t - N_0)\ell_t^e$ is the total input of work hours, with ℓ_t^o and ℓ_t^e as the hours worked per member of the original population and employed immigrant respectively. The capital stock is thought of as combining private (including housing) and public capital. In Hercowitz and Meridor (1993) the private nonresidential, the private residential and the public capital stocks are determined separately in a simpler growth model with exogenous immigration and a constant interest rate.

The capital stock evolves according to

$$(2) \qquad K_{t+1} = K_t(1-\delta) + I_t, \quad 0 < \delta < 1$$

with I_t as gross investment. Changing the capital stock entails the adjustment costs

$$(3) \qquad J_t = \frac{\phi}{2}(K_{t+1} - K_t)^2.$$

Social welfare in this economy is given by:

$$(4) \qquad \sum_{t=1}^{\infty} \beta^{t-1}\{(1-\theta_t^e-\theta_t^u)u(c_t^o,\ell_t^o) + \theta_t^e u(c_t^e,\ell_t^e) + \theta_t^u u(c_t^u,0)\},$$

where $u(\cdot)$ is the momentary utility function, θ_t^e and θ_t^u are weights, and c_t^o, c_t^e, and c_t^u are the per–capita consumption levels of the original residents, employed immigrants and unemployed respectively. The function $u(\cdot)$ is parametrized as:

$$(4') \qquad u(c,\ell) = \ln\left[c_t - \frac{\mu}{1+\psi}\ell_t^{1+\psi}\right], \quad \mu, \psi > 0.$$

At time t the economy faces the real interest rate r_t. Defining $R_0 = 1$ and $R_t = 1/(1+r_t)$ for $t > 0$, the intertemporal resource constraint is:

$$(5) \quad \sum_{t=1}^{\infty} \prod_{i=1}^{t} R_{i-1}[C_t + K_{t+1} - (1-\delta)K_t + J_t + G_t - Y_t - V_t] + (1+r_0)D_0$$

where $C_t = N_0 c_t^o + (E_t - N_0)c_t^e + U_t c_t^u$, G_t is government expenditures, V_t is unilateral transfers from abroad and D_0 is the net foreign debt at the beginning of period one. The flows G_t and V_t are exogenous, and are included for empirical purposes only.

The number of immigrants is $A_t > 0$ for $t = 1,2,\ldots,\tau$ and zero for $t > \tau$. Hence, $N_t = N_{t-1} + A_t$ for $t \leq \tau$, and $N_t = N_\tau$ for $t > \tau$.

The evolution of employment is determined by:

$$(6) \qquad E_t = E_{t-1} + \gamma_t(N_t - E_{t-1}), \quad 0 < \gamma_t < 1.$$

where $\gamma_t = \gamma(\cdot)$ is the probability that a job–seeker (the unemployed in $t-1$ plus current immigrants) finds a job during period t. The probability γ_t depends on the degree of tightness in the labor market, but the individual takes γ_t as given. The form and arguments of the function $\gamma(\cdot)$ are specified in Section III.

Finally, the economy is assumed to start with a positive foreign debt. Hence, the interest rate in the economy is determined along the supply function of foreign funds:

$$(7) \qquad r_t = r(D_{t-1}/Y_{t-1}) \text{ with } r' \geq 0.$$

This function captures the imperfect nature of capital mobility, with $r' = 0$ for D/Y up to a critical value $(D/Y)_0$ and $r' > 0$ for higher values, up to a borrowing ceiling $(\overline{D/Y})$. The case of perfect capital mobility would correspond to $(D/Y)_0 \to \infty$. This foreign borrowing cost function is of the type derived by Eaton and Gersovitz (1981) in a framework with default risk. In the present context the specification of $r(\cdot)$ is admittedly ad hoc since default risk is not analyzed. [1]

The planning problem

The artificial planning problem solved here is constructed so that its solution matches the outcome of a competitive environment. The problem is to find $[c_t^o, c_t^e, c_t^u, \ell_t^o, \ell_t^e, K_{t+1}]_{t=1}^{\infty}$ so as to maximize the social welfare function in (4), subject to the technological constraints (1),(2), (3) and the resource constraint (5), taking as given $\left[r_t\right]_{t=0}^{\infty}$, D_0, K_0, $\left[G_t, V_t\right]_{t=1}^{\infty}$ and the probabilities $\left[\gamma_t\right]_{t=1}^{\infty}$ in the employment evolution equation (6). Hence, externalities through the functions $r(\cdot)$ and $\gamma(\cdot)$ are not taken into account. At each point in time, the state of the economy is given by the capital stock, K_t, the previous population and employment, N_{t-1} and E_{t-1}, and the foreign debt, D_{t-1}.

The first–order conditions for the planner's problem are:

$$(8) \qquad \beta^{t-1}(1-\theta_t^e-\theta_t^u)u_c(c_t^o,\ell_t^o) - \lambda\prod_{i=1}^{t} R_{i-1}N_0 = 0, \qquad (c_t^o)$$

[1] In the present framework, D_t is the net debt and hence there is no separate demand for reserves. Ben–Bassat and Gottlieb (1992) estimate a model in which the country risk diminishes with the amount of reserves held.

$$(9) \qquad \beta^{t-1}(1-\theta_t^e-\theta_t^u)u_\ell(c_t^o,\ell_t^o) - \lambda\prod_{i=1}^{t} R_{i-1}F_\ell(K_t,L_t)N_0 = 0, \qquad (\ell_t^o)$$

$$(10) \qquad \beta^{t-1}\theta_t^e u_c(c_t^e,\ell_t^e) - \lambda\prod_{i=1}^{t} R_{i-1}(E_t-N_0) = 0, \qquad (c_t^e)$$

$$(11) \qquad \beta^{t-1}\theta_t^e u_\ell(c_t^e,\ell_t^e) - \lambda\prod_{i=1}^{t} R_{i-1}F_\ell(K_t,L_t)(E_t-N_0) = 0, \qquad (\ell_t^e)$$

$$(12) \qquad \beta^{t-1}\theta_t^u u_c(c_t^u,0) - \lambda\prod_{i=1}^{t} R_{i-1}U_t = 0, \qquad (c_t^u)$$

$$(13) \prod_{i=1}^{t} R_{i-1}[1+\phi(K_{t+1}-K_t)] - \prod_{i=1}^{t+1} R_{i-1}[F_k(K_{t+1},L_{t+1}) + 1-\delta +$$

$$\phi(K_{t+2}-K_{t+1})]=0, \qquad (K_{t+1})$$

where λ is the Lagrangean multiplier associated with the constraint in (5).

Given the utility function in (4′) the hours of work of both original residents and employed immigrants are:

$$(14) \qquad \mu(\ell_t^o)^\psi = \mu(\ell_t^e)^\psi = \mu\ell_t^\psi = F_\ell(K_t,L_t).^2$$

Labor effort depends only on its marginal productivity, and, hence, there is no wealth effect

[2] This can be verified by substituting the marginal utilities from (4′) into (8)–(11) and dividing (9) by (8) and (11) by (10).

on this decision.

The individual consumption levels are:

(15a) $$c_t^0 = \left[\frac{1-\theta_t^e-\theta_t^u}{N_0}\right] \frac{\beta^{t-1}}{\lambda\Pi_{i=1}^t R_{i-1}} + \frac{\mu}{1+\psi}\ell_t^{1+\psi}.$$

(15b) $$c_t^e = \left[\frac{\theta_t^e}{E_t-N_0}\right] \frac{\beta^{t-1}}{\lambda\Pi_{i=1}^t R_{i-1}} + \frac{\mu}{1+\psi}\ell_t^{1+\psi}.$$

(15c) $$c_t^u = \left[\frac{\theta_t^u}{U_t}\right] \frac{\beta^{t-1}}{\lambda\Pi_{i=1}^t R_{i-1}}.$$

Total consumption is therefore:

(16) $$C_t = N_0 c_t^o + (E_t-N_0)c_t^e + U_t c_t^u = \frac{\beta^{t-1}}{\lambda\Pi_{i=1}^t R_{i-1}} + \frac{\mu}{1+\psi}\ell_t^{1+\psi} E_t .$$

The solution to the planning problem above has the following decentralized interpretation. Competition in the labor market implies that $F_\ell(K_t,L_t)$ equals the real wage, w_t, while the government grants unemployment benefits, b, to each unemployed. The government finances the unemployment benefits and expenditures, G_t, partly with its share in the transfers from abroad, V_t, and the rest with lump–sum taxes. The weights θ_t^e and θ_t^u, determining the consumption levels in (15), are assumed to be such that the solution for c_t^e and c_t^u match the decentralized consumption decisions of immigrants when they receive labor income when employed and unemployment benefits when unemployed. Note that under the present utility function, labor supply of both individual types (equation (14)) and total consumption (equation (16)) are independent of the weights in the social welfare function.

Regarding foreign borrowing, it is assumed that the government does not intervene in a monopsonistic manner.

II.b. Endogenous immigration

The planning problem above can be easily extended to a situation where the immigration flows, $\{A_t\}_{t=1}^{T}$, are endogenous. The competitive interpretation implies that the immigration flows are taken as given by all individual agents, and hence the form of the solution does not change when immigration is endogenous. The model is now closed by incorporating the immigration decision.

From the point of view of the potential identical immigrants, the main economic magnitude is the expected present value of total income—defined as $w_t\bar{l}$, where $\bar{l}$ is the endowment of time. The expected present value of income depends on w_t, b and the probability of being employed for each period after immigration. For an immigrant arriving in period t, the probabilities of being employed in t, t+1,...etc., are:

$${}_tP_t = \gamma_t,$$

$${}_tP_{t+1} = \gamma_t + (1-\gamma_t)\gamma_{t+1},$$

$$ {}_tP_{t+2} = \gamma_t + (1-\gamma_t)\gamma_{t+1} + (1-\gamma_t)(1-\gamma_{t+1})\gamma_{t+2}, $$

etc.

Then, the expected present value of income to a period–t immigrant is:

$$ (17)\, W_t = {}_tP_t\, w_t \ell + (1-{}_tP_t)b + \sum_{j=1}^{\infty} \prod_{i=0}^{j-1} R_{t+i}\left[{}_tP_{t+j}\, w_{t+j}\, \ell + (1-{}_tP_{t+j})b\right]. $$

The potential immigrant in period t has a reservation level, $\overline{W}_t$, for the expected present value of income, and thus immigrates only if $W_t \geq \overline{W}_t$. Given that all prospective immigrants are identical, the "supply curve" of immigrants at time $1 \leq t \leq \tau$ is infinitely elastic at $\overline{W}_t$. After τ, immigration is zero.

The model also generates a "demand curve" for immigrants, which reflects the diminishing marginal productivity of labor and the crowding of the labor market that reduces the probability of finding a job. Both effects imply that W_t falls with A_t, although each immigrant takes W_t as given. Hence, immigration in period t is such that it equates W_t to $\overline{W}_t$. Note that W_t depends not only on A_t, but also on the immigration flows in the other immigration years. Hence, all $\{A_t\}_{t=1}^{\tau}$ should be determined simultaneously.

It is assumed that the original residents do not emigrate. This is consistent with a situation where the present value of income at home is higher than the alternative present value abroad less emigration costs. In any event, in the Israeli case emigration since 1989 is negligible relative to immigration.

III. CALIBRATION OF THE MODEL

Quantitatively, the dynamic behavior of the model depends crucially on the values of the base–period state variables, and on the parametrization of two functions: the probability of finding a job $\gamma(\cdot)$ and the supply of foreign funds $r(\cdot)$.

The base–period of the simulation is taken as 1992, which should capture the implications of the massive immigration during the 1989/1992 period. The initial state variables are the population or labor force, N_{92}, the employment level, E_{92}, the foreign debt, D_{92}, and the capital stock, K_{93} (corresponding to the end of 1992). First, the normalization $N_{92}=1$ is adopted, and D_{92} is determined so as to match the foreign debt/GDP ratio of 0.24 in 1992. The remaining state variables are E_{92} and K_{93}. Assuming that in 1989, prior to the influx of immigrants, the economy was at a steady state, initial 1992 employment and 1993 capital stock are specified as follows.

The unemployment rate in 1992 is 11.2%, while in the pre–immigration year, 1989, it was 8.9%. Given that in the model only immigrants may be unemployed, the model's unemployment rate for the base year 1992 — $(N_{92} - E_{92})/N_{92}$ — is set equal to 0.112–0.089 = 0.023. Given that $N_{92}=1$, that equality implies that $E_{92} = 0.977$. According to this procedure the unemployment rate among 1989–1992 immigrants in 1992 should be 27.8%. The actual figure is fairly close: 28.9%.

The initial capital stock is determined along similar considerations. Starting from a steady–state capital stock in 1989, K_{93} is computed according to the change in the net stock per participant in the labor force. Specifically, the total net stock increased from 1989 to 1992 by 10.3 percent, while the labor force increased by 17.2 percent. Hence, the initial 1992 capital stock is assumed to be $(1+0.172)/(1+0.103) - 1 = 0.059$ lower than the steady state level corresponding to $N = N_{92}$.

The probability of finding a job is adopted from Flug, Hercowitz and Levi (1993). They estimated the specification:

$$(18) \qquad \gamma_t = \gamma(\hat{u}_t, z_t) = \gamma_0 - \gamma_1 \hat{u}_t + \gamma_2 z_t, \quad \gamma_0, \gamma_1, \gamma_2 > 0$$

where z_t represents the current innovation in labor demand and $\hat{u}_t$ is the unemployment rate net of the effects of current labor demand innovations. Equation (18) reflects externalities of immigration (which increase $\hat{u}_t$) and investment (affecting z_t) on the crowding of the labor market. They estimated $\hat{u}_t$ as a linear projection of the unemployment rate on various lagged variables. We implement (18) here by using

$$\hat{u}_t = u_{t-1} = (N_{t-1} - E_{t-1})/N_{t-1} + 0.089, \text{ and}$$

$$z_t = \log Y_t - \eta_{\ell t} \log L_t - (\log Y_{t-1} - \eta_{\ell t-1} \log L_{t-1})$$

where $\eta_{\ell t} = (1-\alpha)(L_t/Y_t)^{\sigma}$ is the elasticity of output with respect to hours of work. The variable z_t, therefore, approximates the shift in labor productivity. The measure of $\hat{u}_t$ includes 0.089, which was the unemployment rate in 1989 prior to the immigration influx, because $(N_t - E_t)/N_t$ measures the unemployment of immigrants only. The estimates of the parameters in (18) from Flug, Hercowitz and Levi are $\gamma_0 = 0.88$, $\gamma_1 = 4.7$ and $\gamma_2 = 1.58$. These values imply, for example, that if $\hat{u}_t = 0.1$ and $z_t = 0$ the probability that a job–seeker finds a job within one year is $0.88 - 0.47 = 0.41$. If, at the same time, the productivity of labor increases by 2%, the probability increases by $1.58 \times 0.02 = 0.0216$ to 0.4316.

The supply curve of foreign debt was parametrized using data on the external debt and interest rates in the last decade, during which the debt/output ratio varied from 0.24 to 0.8. It also takes into account the recent $10 billion loan guarantees from the United States, by shifting the r(·) schedule to the right. The simulations reported in Section IV address the effects of these loan guarantees. The empirical r(·) function is accordingly set flat at 5.5% for $D/Y < 0.51$ and then the slope increases gradually as shown in Figure 1.

A key set of exogenous variables is $\{\overline{W}_t\}_{t=1}^{\tau}$ — the reservation levels for the expected values of future income. The discussion of how these values are computed is left for the next section.

To complete the calibration of the model, values have to be assigned to the technology parameters, α, σ, δ and ϕ, and to the preference parameters, μ and ψ. Also, the exogenous sequences $\left[G_t, V_t\right]_{t=1}^{\infty}$ should be specified, along with the unemployment benefits, b. The considerations adopted and the resulting values for all parameters and exogenous variables appear in Appendix A.

IV. SIMULATION OF THE MODEL

The focus of the simulation analysis is on the implications of the degree of capital mobility for immigration and macroeconomic performance. The degree of capital mobility, or the availability of foreign funds, is represented by the horizontal location of the r(·) curve. Increasing capital mobility implies that the r(·) curve shifts to the right, and hence the interest–rate begins to rise at a higher debt/output ratio. The extreme case of perfect capital mobility corresponds to a flat interest rate curve at 5.5%. The technical aspects of the solution are described in Appendix B.

The simulation consists of two stages. The first is the computation of a basic scenario, resulting in benchmark paths for the endogenous variables from 1993 onwards. In the second step, the supply of foreign funds is reduced by shifting the $r(\cdot)$ curve to the left by an amount corresponding to the \$10 billion of U.S. loan guarantees. The purpose is to assess the implications of these guarantees for immigration and macroeconomic performance.

The basic scenario is characterized by three elements: (a) the base period captures the main features of 1992, as described in Section III, (b) a supply function of foreign funds as parametrized in Section III, and (c) a future flow of 80,000 immigrants per annum for five years, starting in 1993. These figures are a common forecast based on the ongoing 1993 flow and the macroeconomic conditions in 1992 and 1993. It is assumed, therefore, that the five years flow of 80,000 immigrants is consistent with the conditions in (a) and (b). This assumption is important because then the expected present values of future income W_t computed from the basic simulation (for each of the five immigration years) can be taken as the reservation levels, $\overline{W}_t$, of immigrants in the corresponding years.

The paths for the main macroeconomic variables in the basic scenario are presented in Figures 2 to 7. As shown in Figure 2, investment in the first years is high, given the initially low capital/labor ratio and the new immigration. Investment is financed by additional foreign borrowing of about \$16 billion, or 117% of the initial debt, over the first 9 years (Figure 3). The maximal debt/output ratio is 0.48, below the 0.51 level at which the interest rate begins to rise. Hence, in the basic scenario the imperfections of capital mobility are not at work.

Given the initial conditions, the starting (1992) real wage is lower than the steady state level by 1.3%. This figure is between the actual decline from 1989 to 1992 of 0.43%, when the real wage is computed with the output price deflator, and the 5% decline when the cost–of–living index is used. The real wage in the simulation (Figure 5) declines further in 1993, and then it has a general upward trend that becomes clear after immigration stops in 1997.

Figures 6 and 7 plot the unemployment rate above the initial 1992 level, u_t, and the probability of finding a job during one year of search, γ_t, respectively. The two variables interact strongly. During the first few years both γ_t and u_t increase. This behavior of γ_t is because capital accumulation increases labor demand, which outweighs the negative effect of the unemployment rate. Similarly, the upward movement in u_t implies that the number of job searchers increases by more than the decline in γ_t. Unemployment is stabilized after a couple of years. After 1997–1998, when immigration stops, both u_t declines and γ_t increase rapidly, until they converge to the long run levels.

In the second stage of the simulation the $r(\cdot)$ curve is shifted to the left by $10 billion, or 17% of the 1992 GDP. Given that $r(\cdot)$ depends on the current D/Y ratio, that shift may exaggerate somewhat the effects of the U.S. loan guarantees.

Reduced availability of foreign funds affects immigration by depressing the expected present value of immigrant income through three channels: (a) higher interest rates slow down capital accumulation and hence labor demand and real wages are reduced, (b) lower labor demand, and thus z_t values, also implies smaller probabilities, γ_t and ${}_tP_{t+i}$, $i =$ 0,1,.., of finding a job and being employed after immigration respectively, and (c) higher interest rates directly depress the present values W_t. This can be visualized as a leftward shift of the economy's demand curve for immigrants. Given the reservation levels $\overline{W}_{93},\dots,\overline{W}_{97}$ computed in the basic scenario, which represent flat supply curves of immigrants, the immigration flows $A_{93},\dots,A_{97}$ decline. To simplify the calculations, a uniform flow during the five–year period is computed by minimizing the absolute deviations of the five resulting W_t values from the corresponding $\overline{W}_t$ values. Given that each of the resulting present values is very close to the corresponding reservation levels, this procedure seems to give a reasonable approximation.

As a result of tightening the supply of funds by $10 billion immigration is reduced from 400,000 over the 1993–1997 period to 262,500 (or by 34%). Relative to the 1992 population, the impact is of 3%. It should be noted, however, that this is an average calculation. Not the entire $10 billion of loan guarantees are effective, while the first dollars have a strong effect.

The resulting paths appear in Figures 2–7 under "Case 1". As expected, the tighter supply of funds reduces investment and foreign borrowing (Figures 2 and 3) and increases interest rates (Figure 4). Note that tightening the supply of funds results in a *lower* unemployment path (Figure 6), and, for a number of years, both *higher* real wages and probabilities of employment (Figure 5 and 7). How are these developments consistent with a lower motivation to immigrate ? The explanation is that given that the expected present values $\overline{W}_t$ remain the same, higher γ_t and w_t values in the short run should imply lower values in the long run. Hence, slower capital accumulation generated by credit tightening reduces the *long run* prospects of immigrants. Thus, the diminished current immigration reduces the supply in the labor market, leading to the short run results above.

V. CONCLUDING REMARKS

This paper undertakes a small open economy analysis of immigration under increasing foreign borrowing costs. The model constructed here is an extension of a small open economy growth framework in two directions. One is the endogenous immigration aspect, which is coupled for empirical purposes with a job–search process that is relevant for the immigration decision. The other direction is an upward sloping supply function of foreign funds, which in the present context is taken as exogenous.

The main purpose of the paper is to analyze the quantitative effects of an exogenous change in the availability of foreign funds for immigration and macroeconomic behavior. The channel is the effect on capital accumulation, which affects the paths of real wages and probability of employment. Tightening the supply of funds generates lower real wages and probabilities of employment in the long–run. Hence, it reduces immigration during the immigration years, which in turn causes the opposite behavior of real wages and probabilities of employment in the shorter run: both increase.

The assumption of a given supply schedule of foreign borrowing makes it easier to concentrate on immigration and the macroeconomic variables. Given that the shape of this function should reflect default risk, that specification is a reasonable approximation if the current immigration shock does not alter systematically future borrowing needs—and hence the temptation to default.

APPENDIX A

Parameter Values

$\sigma = -1$	Parameter of the CES production function determining the elasticity of substitution between labor and capital. It is chosen from the range 0 (consistent with the Cobb–Douglas form) to the –1.5 derived from the estimates in Elkayam (1990).
$\alpha = 0.5$	Production function parameter determining the shares of labor and capital. See next.
$\delta = 0.07$	Depreciation rate of capital. The parameters α and δ are jointly determined using the steady state of the model so that the capital/output ratio is 2.0 and the labor share is 0.75.
$\phi = 1.4$	Capital adjustment cost parameter. Set so as to get a maximum ratio of adjustment costs to output of 0.1%. This criterion is adopted from Mendoza (1989).
$\beta = 1/1.055$	Rate of time preference.
$\psi = 2$	Set so that the elasticity of labor supply, ψ–1, equals 1.
$\mu = 2.4$	Constant in utility function that normalizes leisure.
$\gamma_0 = 0.88$, $\gamma_1 = 4.7$, $\gamma_2 = 1.6$	Parameters in the job search function. See Section III.

Values of Exogenous Variables and Initial State Variables

V_t	Unilateral transfers from abroad: constant at 11.2% of base year output (1989/1992 average).
G_t	Government expenditures: constant at 29.8% of base year output (1989/1992 average)
D_{92}	Initial foreign debt: 24.5% of base year output (1992).
b	Unemployment benefits: 34% of the average salary. This calculation is based on unemployment benefit of NIS700 and the average salary in 1989.
K_{93}	Initial capital stock: 5.9% lower than the model's steady state value. See section IV.
E_{92}	Initial employment: 2.3% lower than steady state value. See section IV.

APPENDIX B

Technical Aspects of the Solution

The infinite horizon problem is approximated by setting a finite horizon of T = 36 years. The final capital stock K_{T+1} is set at the per–capita steady state level times N_{T+1}, and $D_T = 0.24\ Y_T$—where 0.24 is the initial D/Y ratio.

A "big" iteration starts with a given $\{A_t\}_{t=1}^{T}$ and a corresponding $\{N_t\}_{t=1}^{T}$.

A "small" iteration of the solution starts with a given $\{r_t,\gamma_t\}_{t=1}^{T}$, which, along with $\{N_t\}_{t=1}^{T}$, generates $\{E_t,U_t\}_{t=1}^{T}$. Then the variables solved for are:

$$\{\ell_t,C_t\}_{t=1}^{T},\ \{K_{t+1}\}_{t=1}^{T-1} \text{ and } \lambda,$$

a total of 3T–1 variables. The system of nonlinear equations in these variables consists of the labor supply condition (14), the total consumption equation (16), both for t=1...T, the optimal investment condition (13) for t=1...T–1, and the intertemporal resource constraint (5). A total of 3T–1 equations.

The solution of the previous iteration implies a new $\{D_t,Y_t,u_t,z_t\}_{t=1}^{T}$, from which a new $\{r_t,\gamma_t\}_{t=1}^{T}$ is computed and so on until convergence. Each "small" iteration produces a $\{W_t\}_{t=1}^{\mathcal{T}}$.

Then, a new "big" iteration is computed by adjusting $\{A_t\}_{t=1}^{\mathcal{T}}$ (downwards if the W_t values are lower than the reservation levels $\overline{W}_t$) and so on until convergence.

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FIGURE 1
BORROWING COST FUNCTION

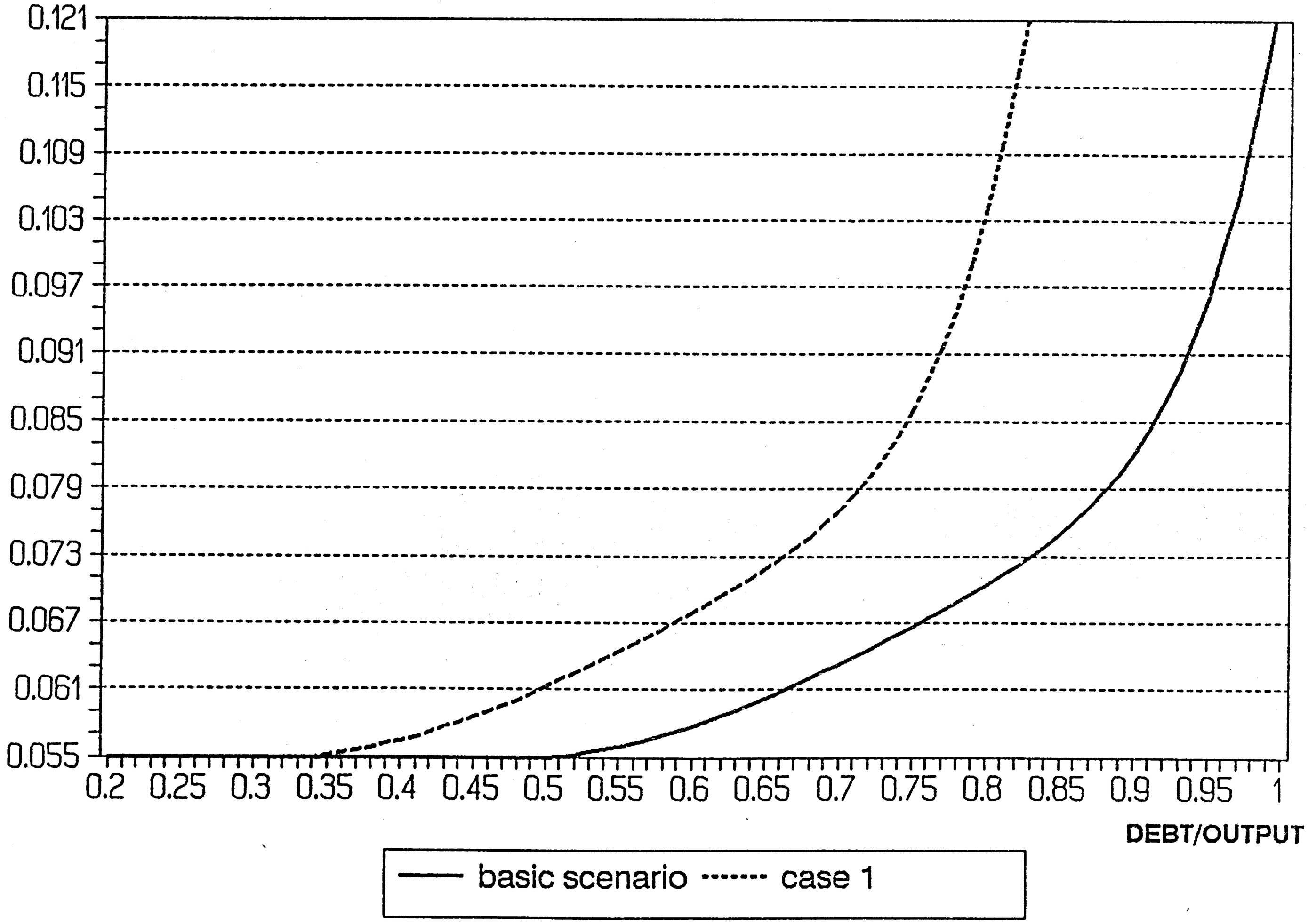


FIGURE 2

INVESTMENT

billions of 1992$

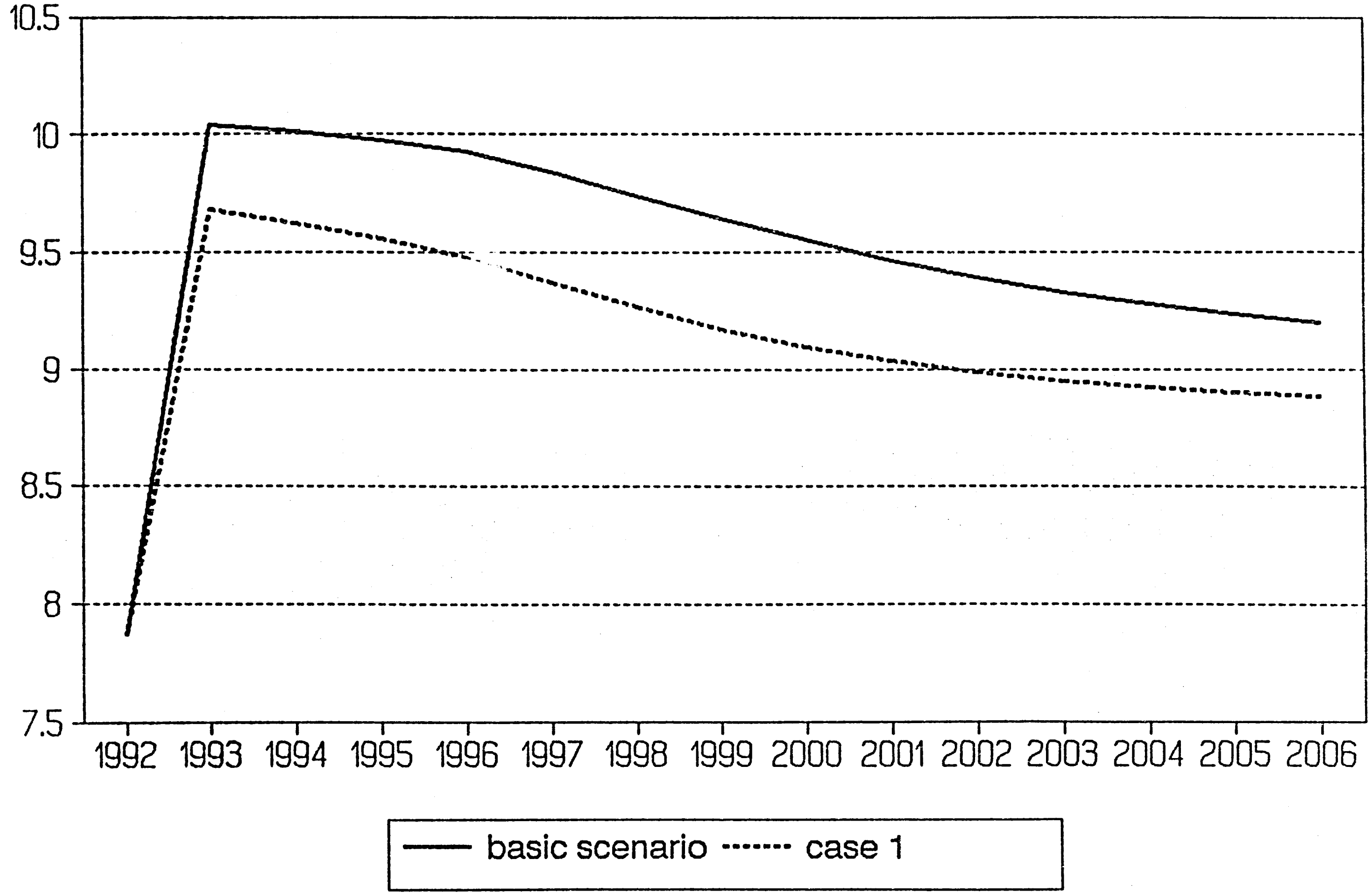


FIGURE 3
ADDITIONAL EXTERNAL DEBT
billions of 1992$

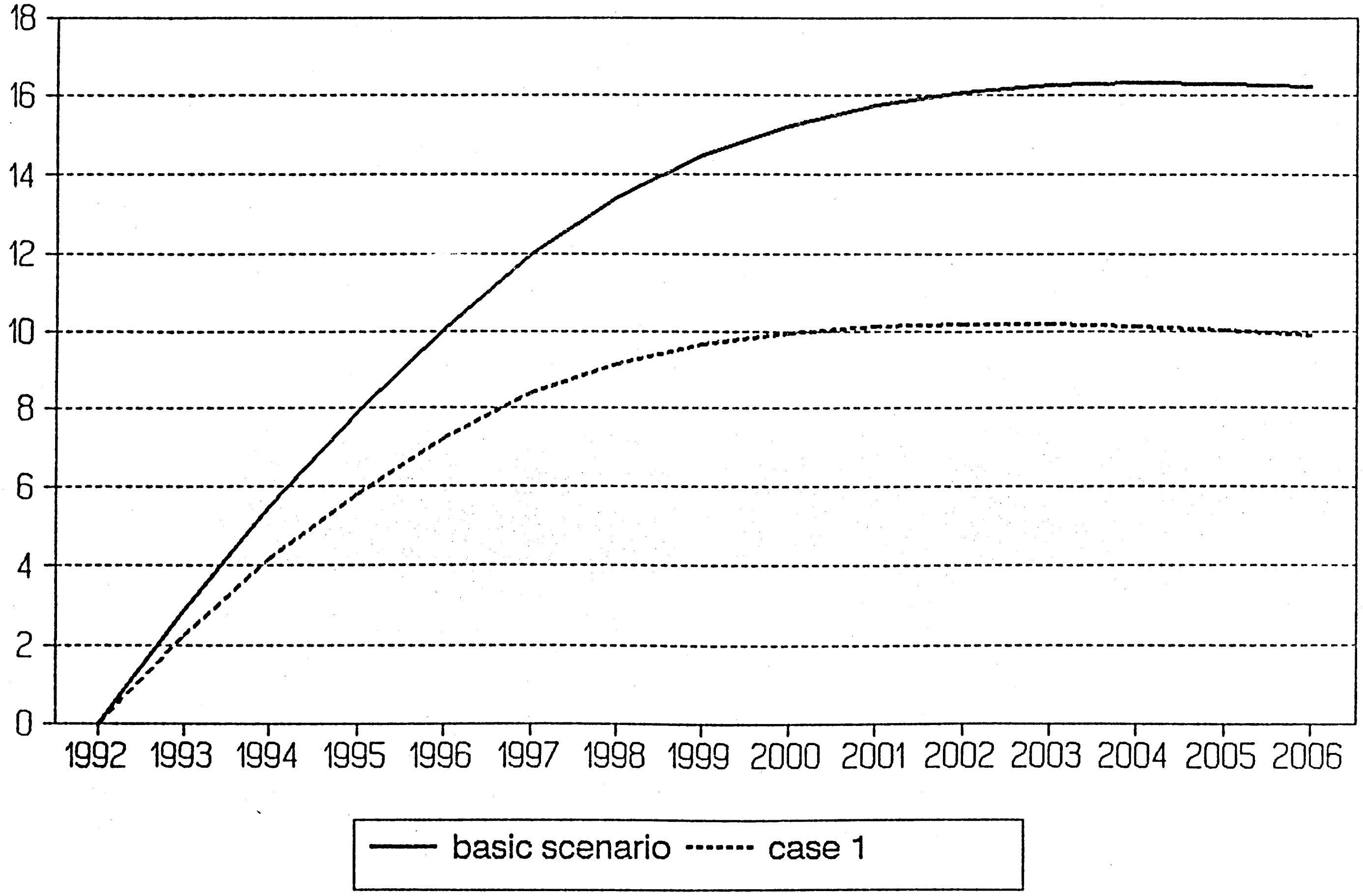


FIGURE 4
THE INTEREST RATE

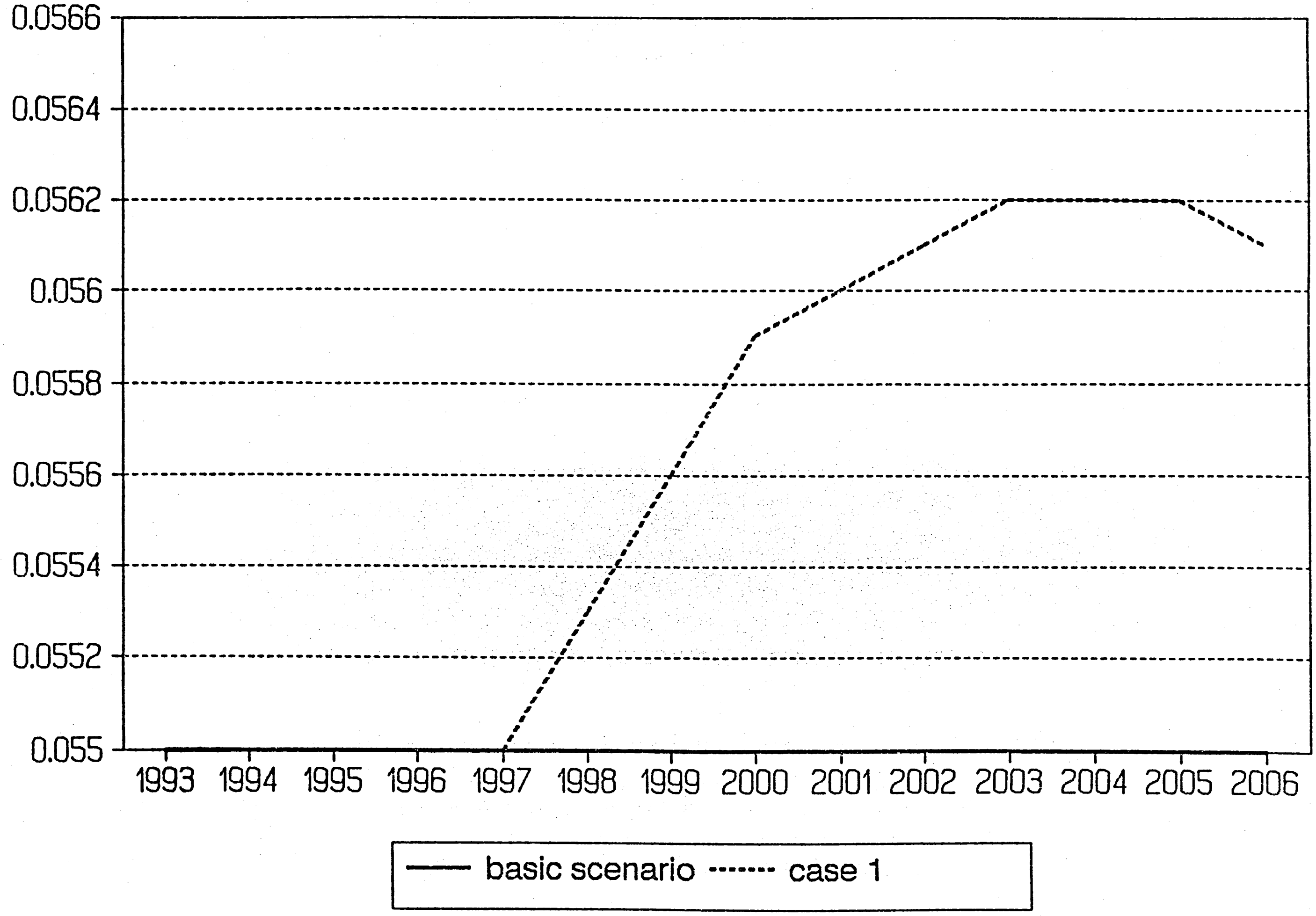


FIGURE 5
REAL WAGE

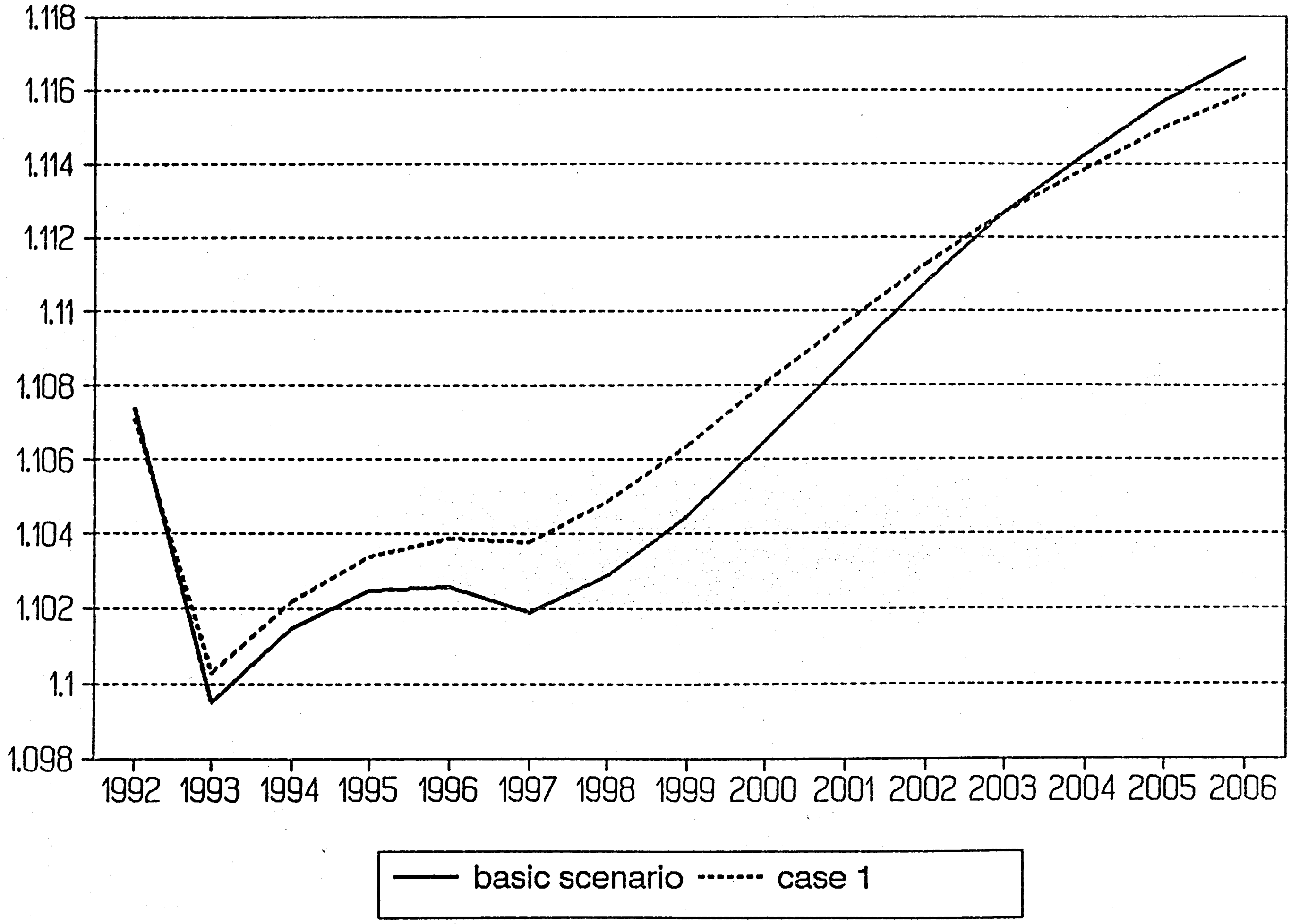


FIGURE 6
UNEMPLOYMENT RATE
OVER THE 1989 LEVEL

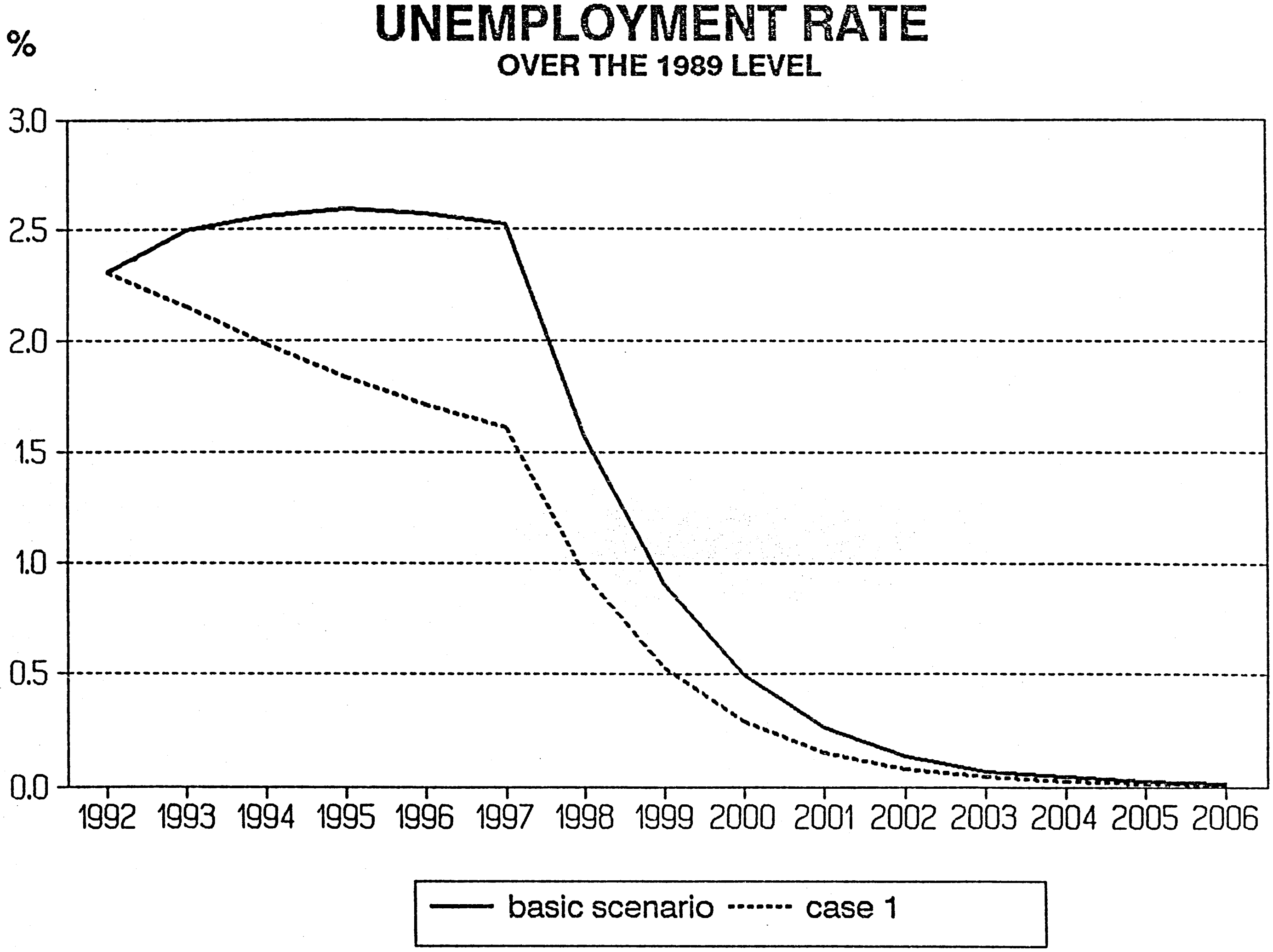
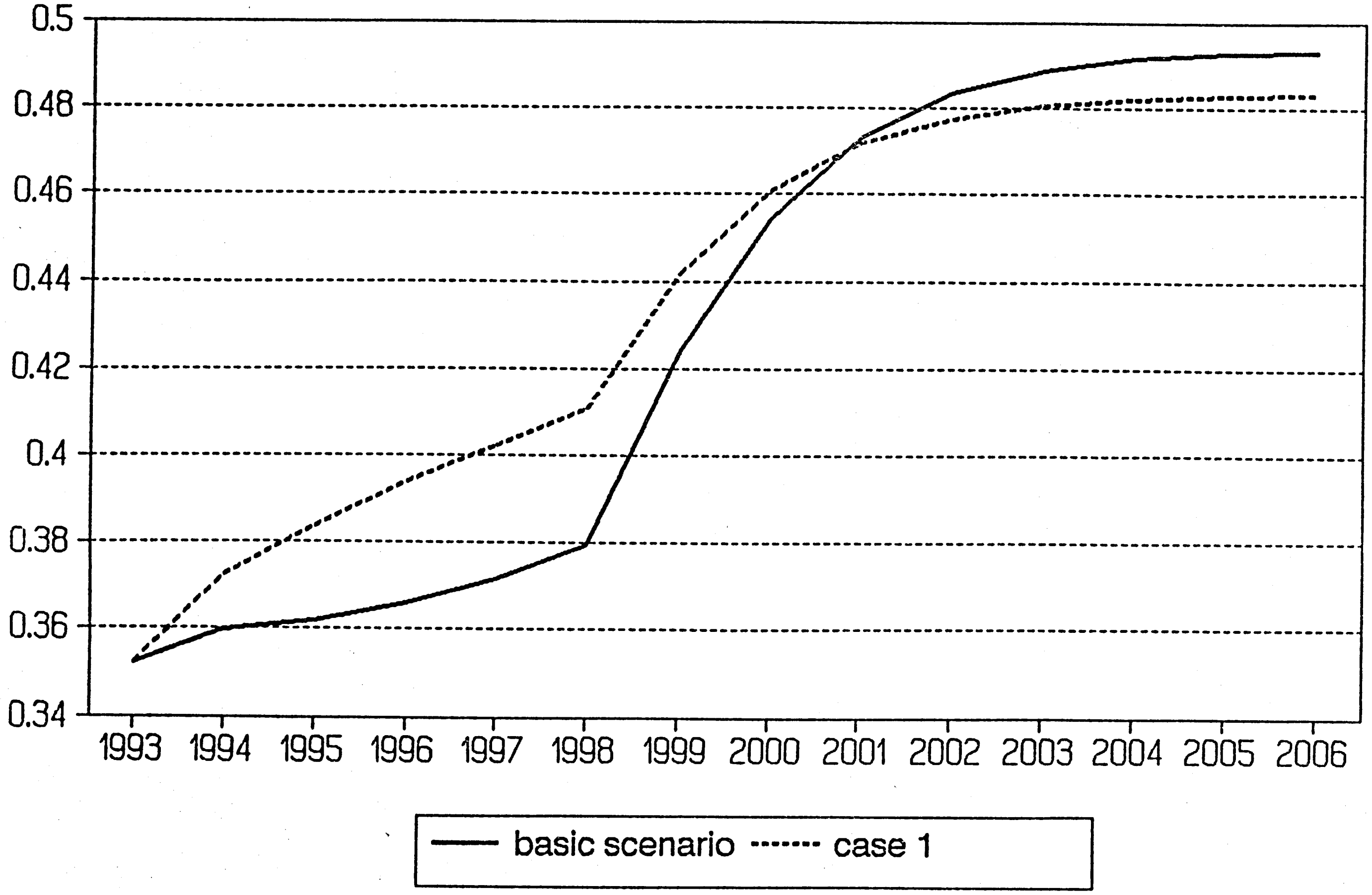


FIGURE 7

PROBABILITY OF FINDING EMPLOYMENT



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