Demographic shock transmission from large to small countries
An overlapping generations CGE analysis

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Abstract

International commodity and capital flows provide channels for the transmission of the effects of demographic changes in large countries onto small open economies by altering the prices and interest rates facing them. This implies that even small countries with relatively young populations are potentially vulnerable to the effects of population aging in large industrial economies. To address this issue, which has largely been overlooked in previous literature, this paper considers the case of European Union and Turkey and shows, within an overlapping generations general equilibrium framework, that spillovers of the demographic shock in Europe would intensify the changes that Turkey would experience during its own demographic transition. © 2001 Society for Policy Modeling. Published by Elsevier Science Inc.

1. Introduction

Most industrial countries are currently experiencing considerable demographic changes with significant long-term consequences. The fraction of the population

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over age 65 in these countries is projected to increase sharply in the next few decades. While this is partly due to increasing life expectancy and declining fertility rates, a more important reason is the fertility shock of the postwar period. As the so-called baby boom generations (born during the late 1940s and the early 1950s) keep getting older, the growth in the population share of elderly is becoming increasingly visible in many countries, and will be evident shortly after the year 2000. Projections by the United Nations for the OECD area as a whole show that the share of the population over age 65 will rise from 15% today to 22% in 2040, outweighing the decline in the share of younger population projected for the same period. As a result, the ratio of population outside the working age (those under 20 and those 65 years and older) to the part of population between the ages of 20 and 64 is projected to increase. Measuring the overall dependency shares of population in the OECD area, this ratio is expected to exceed 0.7 in the 2040s, representing a more than 10 percentage points increase beyond its value in the 1980s.

A higher dependency ratio has a number of important implications for both the macro- and microeconomic spheres of the economy.[1] The macroeconomic implications follow from its direct and indirect effects of a higher dependency ratio on national savings and investment. First, by changing the term structure and the level of age-dependent expenditures by the governments (such as pension and health care payments), a higher dependency ratio affects the budget position of the government and the level of public (dis)savings. Secondly, as shown by various generational accounting studies (e.g., Gokhale, Kotlikoff, & Sabelhaus, 1996), it increases consumption relative to output, and lowers the national saving rate, thereby slowing down capital formation. Thirdly, the decline in the share of population in the working age implies a fall in labor supply. Unless sustained improvements are recorded in labor productivity growth and/or labor force participation behavior, this might lead to reductions in per capita outputs (Turner, Giorno, de Serres, Vourch, & Richardson, 1998). Naturally, such effects are not without microeconomic consequences. The decline in savings and the increasing share of consumption in GDP imply a change in the composition of demand and hence must be expected to affect the relative prices of consumer and investment goods. On the supply side, the expected decline in labor supply, coupled with the slow down in capital formation, would cause changes in capital–labor ratios.[2] The changing capital–labor ratios, in turn, would alter relative factor prices leading to second-round effects on resource allocation. Furthermore, the changes in the relative capital intensities across traded and nontraded sectors are likely to affect the real exchange and trade patterns,

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[1] For a nontechnical, yet very insightful, account of these implications, see Peterson (1999).

[2] While the resulting change in capital–labor ratios may be in either direction depending upon the relative magnitudes of the effects on capital formation and labor supply, Auerbach, Kotlikoff, Hagemann, and Nicoletti (1989) predict an increase in economy-wide capital–labor ratios in the developed economies.

creating effects on other countries as well. The effects on other countries could be particularly significant if the countries facing the changes in demographic structure are large in the international trade sense of the term. Under these circumstances, trade provides a channel for transmission of the effects of demographic shocks experienced by large countries onto small open economies through the terms of trade effects it creates. With their inability to affect world prices individually, most of the developing countries fall into the latter category. This implies that even small developing countries, which have not experienced similar baby boom shocks and hence have not yet faced a population aging problem themselves, are potentially vulnerable to the effects of population aging in the larger countries of the OECD area.

Given the universal trend of declining mortality rates, the small open economies in the developing world will also face the consequences of population aging and related demographic issues eventually. In the absence of demographic shock transmission, however, such issues must be expected to surface at a later stage during the course of these countries' own demographic transition.[3] So, the need for an investigation of the direction and the magnitude of spillover effects arises as developing countries become increasingly exposed to the consequences of demographic shocks in the developed world through trade and capital flows. This is an issue that has largely been overlooked in the literature on the economic effects of population aging,[4] as the overwhelming majority of the existing works focus on social security and related macroeconomic aspects of aging in developed countries. As noted by Peterson (1999), the investigation of the indirect effects of aging populations in the developed world on other countries is one of the critical areas where more research is severely needed. This paper aims to help fill this gap by addressing the demographic transmission issue for the case of European Union (EU) and Turkey. More precisely, we investigate the economic impact on Turkey of the demographic shock in Europe as well as the effects of Turkey's own demographic transition, using an overlapping generations (OGs) computable general equilibrium (CGE) model. We argue that in the context of the Customs Union agreement, which Turkey recently signed with the EU, such an analysis of the EU–Turkey interaction is especially appropriate.

In terms of the framework of investigation employed, the present study links up particularly well with the recent, empirical literature on the OGs analysis of aging within a general equilibrium setup. These empirical analyses have their theoretical roots in the lifecycle models of 1950s and 1960s, and have become increasingly popular since the mid-1980s. The growth of this literature within the last decade began with the appearance of the generational accounting studies that examine the first-round economic impacts of aging through simple projections

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[3] For a recent comparative analysis of the demographic transition across several countries in the developing world (including Turkey), see Yousef (1998).

[4] Notable exceptions were Kenc and Sayan (1997, 1998) and Turner et al. (1998).

(see, e.g., Gokhale et al., 1996; Hagemann & Nicoletti, 1989; Halter & Hemming, 1987; Heller, Hemming, & Kohnert, 1986). Introducing general equilibrium aspects, Auerbach and Kotlikoff (1987) examined population aging through a dynamic model (see also Auerbach et al., 1989). This model was later modified by others and extended in various directions. The model in this paper generalizes the setup in the 1987 and 1989 papers by Auerbach and his co-authors by allowing for variable terms of trade and an imperfectly elastic supply of world savings. It can also be viewed as a generalization of the model in Perraudin and Pujol (1991) as we incorporate nonstationary population dynamics and technological change.[5]

This study also relates to the recent literature on dynamic general equilibrium analysis of trade policy issues in developing countries (for a brief survey, see Devarajan & Go, 1998), and nicely complements them by introducing OG aspects. Three recent studies that provide especially relevant examples of this literature are Diao, Roe, and Yeldan (1998, 1999) and Mercenier and Yeldan (1997). The paper by Mercenier and Yeldan is particularly interesting as it addresses the resource allocation and welfare effects of the Customs Union Agreement between Turkey and the EU, using a dynamic general equilibrium model that overlooks the OG aspects. These aspects are introduced into our model through consumption, bequest, and labor supply decisions that OGs of households make over their lifecycle. We consider households that live for a total of 12 periods of 5 years each beyond the working age, and allow nonstationary population dynamics with the only restriction that the population growth is assumed to start and end on a balanced path on which each age cohort makes up a constant fraction of the population.

While lacking mechanisms for such population dynamics capable of capturing complicated patterns of baby boom and bust along the transition path, the latter group of studies cited above tends to use a more disaggregated classification of sectors. As compared to nine sectors explicitly modeled in Mercenier and Yeldan (1997), for example, we distinguish three sectors so as to keep the model structure manageable. Two of the sectors we model are domestic sectors — one producing a nontradable good, and the other an export good. The demand for the country's exports is incompletely elastic, as is the supply of savings from the rest of the world (ROW). Aside from domestically produced goods, households consume one imported good. They possess nested Constant Elasticity of Substitution (CES) utility functions over three consumption goods and leisure, and also derive a utility from the bequests they make. The production technology employed by domestic firms is characterized by CES production functions of

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[5] Other recent OGs, general equilibrium exercises typically address social security issues and can be found, for example, in Broer and Lassila (1996), Huang, Imrohoroglu, and Sargent (1997), and Imrohoroglu, Imrohoroglu, and Joines (1995), and, for Turkey, in Sayan and Kenc (1999). An OGs, general equilibrium analysis with a broader emphasis on macroeconomic effects of aging can be found in Thoenissen (1997).

capital and labor, with firms maximizing profits over time, and altering their capital stocks subject to convex costs of adjustment.

In modeling Turkey's international transactions, we treat the rest of the world as made up of two separate blocs: the EU and other countries. For the EU, we consider a scaled down version aggregating four countries (hereafter, EU4): Germany, France, Italy, and UK. These are the major trading partners of Turkey, with their respective shares typically ranking among the top five in Turkey's exports/imports. Based on trade figures, we take EU4 as accounting for 40% of Turkey's trade, with other countries accounting for 60%. Turkey is taken as a small country with respect to trade flows and it faces given world prices, weighted according to the trade shares of Turkey's trading partners within and outside the EU. So, any change in the prices of one of these blocs alters world prices facing Turkey, accordingly with the weights assigned to that bloc. Since we are primarily interested in the transmission of demographic shock in the EU onto the Turkish economy, however, we consider the effects of changes in EU4 prices alone.

Our simulation experiments are based on two scenarios concerning the effects of demographic changes facing Turkey. In the first scenario, only the changes observed during the course of this country's own demographic transition are considered without allowing for the transmission of EU4 demographic shocks onto the Turkish economy. In the second scenario, transmission is allowed, enabling one to compare the results with and without the effects of demographic shock in the EU4 transmitted onto Turkey. In both simulations, demographic changes are modeled by introducing population projections by the United Nations for the 1995–2050 period into the model-generated population profiles based on stable population growth assumption for the starting period (1990) and the periods after 2055. In modeling demographic transmission, a simulation is run for EU4 so as to generate prices resulting from the demographic shock in the EU4, which are then fed into the Turkish economy simulation.

The results of our simulation experiments suggest that the demographic developments leading to population aging and changes in age composition of the Turkish population will affect the time paths of major macroeconomic variables considerably. Furthermore, the demographic shock in Europe magnifies these effects visibly. The transmission of demographic shock from Europe has implications for such macroeconomic variables as consumption, savings, investment, output, and labor supply in Turkey, as well as on wages, exchange, and interest rates in the country. Given that the formation of the Customs Union between Turkey and the EU clearly facilitates the transmission of these effects, Turkish policy makers will have to watch closely the demographic developments in Europe as these appear to have a bearing on Turkey's long-term growth prospects.

The plan of the paper is as follows. Section 2 sets out the model, explicitly showing how the assumptions about household and firm behavior are modeled. Section 3 explains the parameterization of the model. Section 4 describes the simulation scenarios and reports the results, and Section 5 concludes the paper by discussing some of the policy implications of results.

2. The model

The model employed in this paper is a multiperiod OGs model. Auerbach and Kotlikoff (1987) first developed a numerical OGs model to study the US economy. Its realism in capturing heterogeneities among age groups encouraged researchers to extend the Auerbach–Kotlikoff model in various directions. Perraudin and Pujol (1991) generalized Auerbach–Kotlikoff framework by introducing a demand curve for exports, a supply curve for savings from the rest of the world, and domestic industries producing export goods and non-tradables. Several researchers added further realism into consumer behavior by introducing bequests and probability of dying.[6]

The model described here generalizes the Perraudin–Pujol framework by introducing bequests,[7] labor-endowment-augmenting technological change, and a growing population. Furthermore, the solution algorithms employed here are new to this study.

2.1. Household behavior

The modeling of household behavior follows the lifecycle approach. Aggregate consumption, saving, and labor supply are derived from the intertemporal optimizing behavior of forward-looking age cohorts under perfect foresight assumption. Each cohort is assumed to have an economic life of 60 years—becoming active at age 21 (16 in Turkey) and dying at 80 (75 in Turkey). To limit the computational burden, we assume that a time period equals 5 years. Hence, in any given period, 12 cohorts of different ages are economically active. We differentiate generations by birth date, t_0. Thus, at any given period t, households that belong to generation t_0 will be at the age of $t - t_0$. We suppose that during transition periods, the population varies over time, while in the steady state it increases at a constant rate.

Households derive utility from consumption, leisure, and bequest-giving. The lifetime utility $U(t,t_0)$ of generation t_0 as of period t takes the following additively separable form (Eq. (1)):

$$U(t, t_0) \equiv \frac{1}{\alpha} \left(\sum_{s=t}^{t_0+n-1} \frac{u(s, t_0)^{\alpha}}{(1+\delta)^{s-t}} + \alpha_B \frac{b(t_0 + n - 1, t_0)^{\alpha}}{(1+\delta)^{n-1}} \right), \tag{1}$$

where δ is the rate of time preference, $u(s,t_0)$ is an index showing the utility that the generation t_0 derives from leisure, l, and consumption, c, of goods 1, 2, and 3, and from the bequest, $b(t_0 + n - 1, t_0)$, made at the beginning of the last period of

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[6] See, for instance, Auerbach et al. (1989) for models with bequests, and Broer, Westerhaut, and Bovenberg (1994) for models with the probability of dying.

[7] Empirical studies by Gale and Scholz (1994) and Kotlikoff and Summers (1981) on savings behavior suggest that bequest motives are important determinants of savings behavior.

life, n. In the equation, α_B is a parameter showing the intensity of utility from bequests made, and $\alpha = 1 - 1/a$, where $a > 0$ is the elasticity of substitution between utilities in different periods. $u(s,t_0)$, that is, the household's utility at time s from leisure, l, and the consumption of nontradable, c_1, imported, c_2, and exportable, c_3, goods, is decomposed as follows (Eqs. (2), (3), and (4)):

$$u(s, t_0) \equiv [(1 - \alpha_L)c(s, t_0)^\rho + \alpha_L l(s, t_0)^\rho]^{1/\rho}, \tag{2}$$

$$c(s, t_0) \equiv [(1 - \alpha_T)c_1(s, t_0)^{\rho_1} + \alpha_T c_0(s, t_0)^{\rho_1}]^{1/\rho_1}, \tag{3}$$

$$c_0(s, t_0) \equiv [(1 - \alpha_X)c_2(s, t_0)^{\rho_2} + \alpha_X c_3(s, t_0)^{\rho_2}]^{1/\rho_2}, \tag{4}$$

where ρ, ρ_1, ρ_2 are parameters used to define the elasticity of substitution between consumption and leisure, nontradables and tradables, and imports and exportables, respectively. Likewise, α_L, α_T, α_X are parameters showing intensity of utility from leisure, consumption of tradables, and consumption of exportables, respectively.

We assume that all households retire at the beginning of some given period, and that households' marginal labor productivities vary over the lifecycle. Within each group, productivity, and hence wages, are assumed to increase initially, peaking at Period 5 (ages 40 for Turkey and 45 for EU4) and declining slightly thereafter.

Taxation and transfers affect household behavior through their influence on income and prices. Lump sum transfers have a direct impact on income, VAT affects consumer prices, and direct taxation (including social security contributions) has an influence on interest rates and wages. Households maximize utility subject to an intertemporal wealth constraint. Letting $W(t,t_0)$ represent the lifetime wealth of generation t_0 at period t, r_t the interest rate at t, and τ_r the tax rate on household interest income, the lifetime wealth constraint is given by (Eq. (5)):

$$W(t, t_0) = b(t_0 + n - 1, t_0)d^H(n, t)$$

$$+ \sum_{s=t}^{t_0+n-1} (1 + \tau_\nu)p(s)c(s, t_0)d^H(s, t) \tag{5}$$

where τ_ν is the rate of VAT and $p(s)$ is a price index involving parameters of the utility function. The discounting factor for period s at current period t, $d^H(s,t)$, is defined as:

$$d^H(s, t) \equiv \begin{cases} \prod_{\nu=t}^{s-1}[1 + (1 - \tau_\nu)r_\nu]^{-1} & \forall \nu > t \\ 1 & \nu = t. \end{cases}$$

Total lifetime wealth, W, equals the sum of human wealth, W_h, pension wealth, W_p, and anticipated future bequests, W_b. Let τ_i for $i = $ x,w,r,d,g,v denote the rates of employee social security contributions, wage income tax, interest income tax, dividend income tax, capital gains tax, and value added tax, respectively. If $z(s,t_0)$ denotes the lump sum transfers received from the government, $w(s)$ the wage rate, and $e(t - t_0)$ the "effective labor input," human wealth inclusive of lump sum transfer payments can then be written as (Eq. (6)):

$$W_h(t, t_0) = \sum_{s=t}^{t_0+n-1} [(1 - \tau_x - \tau_w)w(s)e(t - t_0)(1 - l(s, t_0))$$

$$+ z(s, t_0)]d^H(s, t). \qquad (6)$$

Let us define the parameters of the pension system as follows. γ_{ac} is the accrual factor, n_r is the retirement age, $\bar{n}$ is the number of years worked to qualify for the maximum level of old age pension benefit, $\bar{w}(t_0)$ is the average wage rate calculated by taking into account wage income and working hours during the period specified for this purpose by the pension authorities, and λ is the factor used to index pension income to wages. Then, social security wealth may be written as (Eq. (7)):

$$W_p(t, t_0) = \begin{cases} \gamma_{ac} \sum_{s=t_0+n_r}^{t_0+n-1} [\bar{n}\bar{w}(t_0)^\gamma w(s)^{1-\lambda}]d^H(s, t) & \text{if} \quad t_0 + n_r \geq t \\ \gamma_{ac} \sum_{s=t}^{t_0+n-1} [\bar{n}\bar{w}(t_0)^\lambda w(s)^{1-\lambda}]d^H(s, t) & \text{if} \quad t_0 + n_r < t. \end{cases} \qquad (7)$$

Finally, if $b_r(t + n_b, t_0)$ is bequests received in period $t + n_b$ with n_b denoting the age bequest received, and τ_b the rate of taxes on bequests, anticipated bequest wealth may be written as (Eq. (8)):

$$W_b(t, t_0) = \begin{cases} b_r(t_0 + n_b - 1, t_0)(1 - \tau_b)d^H(s, t) & \text{if } t_0 + n_b - 1 \geq t \\ 0 & \text{if } t_0 + n_b - 1 < t. \end{cases} \qquad (8)$$

We assume in our simulations that bequests are made in the last period of life. Households have offspring in the first period of adult life (i.e., at the age of 20–25 years) and hence, children receive bequests at the age of 60, that is, $n_b = 60$ (55 for Turkey).

If there were no further constraints, solving the dynamic programming problem for a given household would be easy, enabling us to derive closed form consumption and leisure demands. However, we assume that the household is not allowed to supply labor after the retirement age, n_r. One may think of this as reducing the shadow wage just sufficiently that the household wishes to supply zero labor in its last few periods. Alternatively, one may consider the retirement

as a period when the productivity falls to zero. Since the shadow wage cannot be obtained in closed form, neither can the associated consumption and leisure demands. We must therefore solve the household's program numerically.

2.2. Firm behavior

We assume that the economy contains two domestic industries labeled 1 and 3, respectively, producing nontradable and tradable (exportable) goods under perfect competition. Each sector is made up of identical firms whose technologies are characterized by constant returns-to-scale CES production functions with capital,[8] $K(t)$, and labor, $L(t)$, as the arguments. Scaling up variables, the production function for the industry as a whole is (Eq. (9)):

$$F_i[K(t), L(t)] \equiv \epsilon_i \left[\epsilon_{i_0} K(t)^{-\theta_i} + (1 - \epsilon_{i_0})L(t)^{-\theta_i} \right]^{-1/\theta_i} \qquad i = 1, 3. \qquad (9)$$

In each period, producers decide on cost-minimizing intensities of labor given the current stock of capital. They alter the stock of capital through investment so as to maximize the value of firms' equity. Optimal investment involves balancing the costs of new capital (acquisition and installation costs) against the higher future revenues made possible by a larger capital stock. Adjustment costs are assumed to take the form:

$$CK(I_t/K_{t-1}) \equiv \begin{cases} \frac{\xi}{2} \frac{[I_t/K_{t-1} - \kappa]^2}{I_t/K_{t-1}} & \text{for } I/K > \kappa \\ 0 & \text{for } I/K \leq \kappa, \end{cases} \qquad (10)$$

where ξ, κ are adjustment cost parameters. If firms invest in this way and adjustment costs are convex, the capital stock will follow a smooth transition path. In equilibrium, it must be the case that dividends and capital gains equal the required return (Eq. (11)):

$$(1 - \tau_d)D(t) + (1 - \tau_g)[V(t+1) - VN(t) - V(t)]$$
$$= (1 - \tau_r)r(t)V(t), \qquad (11)$$

where V is the equity value of the firm at the beginning of the year, D is dividend payments at the end of the year, VN, the proceeds from share issues, and τ_d, τ_r, τ_g are the tax rates on dividend and interest income, and the accrual-

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[8] In fact, capital is a composite good made up of the domestic and imported goods, each with a fixed share.

equivalent capital gains tax rate, respectively. Ruling out bubbles, we can write this as (Eq. (12)):

$$V(t) = \sum_{s=t}^{\infty} \left[\frac{1 - \tau_d}{1 - \tau_g} D(s) - VN(s) \right] d^F(s, t) \tag{12}$$

where

$$d^F(s, t) \equiv \prod_{v=t}^{s} [1 + (1 - \tau_r) r_v / (1 - \tau_g)]^{-1}.$$

To solve the firms' programming problems, we must make assumptions concerning their financial behavior. We assume, in particular, that (i) firms pay dividends equal to a constant fraction of after-tax profits net of depreciation; (ii) they issue debt to maintain a constant debt–capital ratio; and (iii) they issue new shares as the marginal source of finance. This financial behavior is consistent with the assumptions behind the "old view" of capital taxation. The adjustment cost function is assumed to be convex in the ratio of investment (I) to the capital stock (K). We also assume that the installation costs of capital are internal to the firm. Such behavior gives rise to a q investment function.

2.3. The government

The model considers typical functions of the government as public expenditures on goods, maintenance of various transfer payments, the levying of taxes, and the issuance of debt. Total public expenditures on goods and services, and total transfer payments fall into four categories: public goods, education, health care and unemployment benefits, and other transfers.[9] The expenditures on public goods are determined exogenously, whereas expenditures on the remaining categories are determined endogenously as the age composition of population changes. It must be noted that pension balances are also age-dependent, but these are treated separately through the budgets of publicly managed social security authorities (as opposed to the central government budget described above). At any given period in time, discounted present value of total tax revenue, $T(t)$, and discounted present value of total government spending, $G(t)$, are related to each other through the following intertemporal budget constraint (Eq. (13)):

$$\sum_{t=1}^{\infty} T(t) d^G(t) = \sum_{t=1}^{\infty} G(t) d^G(t) + B^G(1), \tag{13}$$

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[9] On account of the fact that Turkish government provides no unemployment benefits, this spending item has been taken to be equal to zero for Turkey.

where

$$d^{G}(t) = \begin{cases} \prod_{s=1}^{t-1}[1 + (1 - \tau_{r})r(s)/(1 - \tau_{g})]^{-1} & \forall t > 1 \\ 1 & t = 1 \end{cases}$$

and B^{G} is government debt.

The changes in the level of public expenditures affect the distribution of wealth across different generations through their impact on government debt, B^{G}. Given the emphasis placed upon the transmitted effects of demographic shocks in the EU, and Turkey's own demographic transition, this treatment of the government's role in the economy is viewed as appropriate for the purposes of this paper.

2.4. Treatment of open economy features in the model

In modeling Turkey's international transactions, we take two separate blocs into account: the EU represented by EU4 and the rest of the world. While we consider Turkey as facing a weighted average of given world prices in its trade, the treatment of country size with respect to capital flows in the model departs from the commonly adopted small country assumption. Since the stylized facts of international capital markets suggest that the supply of world savings is imperfectly elastic for all but the smallest countries, the following three assumptions are adopted.

First, the demand for the export good (which is also consumed by domestic households and used as an input by firms) is assumed to be given by a constant elasticity function, $X_3 = X_0 P_3^{\omega}$ where X_0 is a positive constant, X_3 and P_3 are the quantity demanded of export good and the relevant foreign currency price, respectively, and ω is the elasticity parameter. Second, the net supply of savings from the rest of the world, W_{ROW}, is related to the difference between the domestic interest rate, $r(t)$, and the weighted average of EU4 and other country interest rates, $\bar{r}$, according to the equation:

$$W_{\text{ROW}} = \bar{K}\text{sign}[r(t) - \bar{r}](|r(t) - \bar{r}|)^{\omega^{*}}$$

where ω^* is the elasticity parameter, and $\bar{K}$ is a nonnegative constant. $\bar{K} = 0$ represents the case of no capital mobility, but for any positive value of $\bar{K}$, the degree of capital mobility would depend on the elasticity parameter. When $\omega^* = \infty$, the interest rate is given internationally, that is, the small country assumption holds for capital markets. (If $\omega = \infty$, the same is true of the goods market.) $\omega^* = 0$, on the other hand, implies that there is a constant flow of capital between the domestic economy and the rest of the world, which would be maintained through the adjustment of domestic interest rate. For relatively large industrial economies such as those in the EU4, it is safer to assume that the elasticity parameter would take values that are strictly between zero and infinity, implying a less than perfect mobility of capital. Even though it is

smaller in size, the same assumption can safely be made about Turkey as well, since the relatively less developed nature of capital markets in this country would not allow for perfect mobility of capital. This treatment may be defended in the light of the work of Feldstein and Horioka (1980) and others on the limited degree of international capital market diversification, for both the industrial economies of the EU and a middle income economy like Turkey. Finally, the third assumption fixes the foreign currency price of the imported good, which is consumed by households and used by firms in their constant coefficient production of capital, at P_2.

3. Parameterization

Some of the utility and production function parameters were selected by drawing upon a large number of empirical studies, and values of other parameters were found through calibration. This section summarizes how the information available in the literature was used while searching for values of various parameters, and reports the values picked for some of the key parameters.

For the utility function, the intertemporal elasticity of substitution is one of the key parameters. In the literature, estimated values for this parameter typically lie either within a low range of 0.2–0.4 (see Bayoumi, 1990; Hall, 1988 for estimates based on US and UK time series data), or within a high range of 1.0–1.3 (see Lawrance, 1991; Mankiw, Rotemberg, & Summers, 1985 for US estimates from quarterly panel data and time series, respectively). With somewhat more faith placed in microeconomic estimates, this elasticity is taken here as equal to 0.9 for EU4 and 0.75 for Turkey. Of the other utility function parameters, the consumption–leisure elasticity of substitution is set at 1.1. This yields an uncompensated wage elasticity of labor supply of 0.2 that appears to be sensible for the combined labor supply of a husband and wife couple. Empirical support for such a value may be found in various studies surveyed by Hum and Simpson (1994). The bequest preference parameter is taken as 0.50 for EU4 and 0.75 for Turkey, on account of the higher level of altruism one would expect to observe in this country. These values are generally consistent with the levels estimated by Kotlikoff and Summers (1981).

In accordance with the findings of Davies (1992), Gottschalk and Joyce (1992), and Kotlikoff and Gokhale (1992), the wage–age profile used is hump-shaped. Kotlikoff and Gokhale, in particular, argue that productivity peaks at around age 45 and declines thereafter. Both Davies and Gottschalk and Joyce find, using cross-country data, that the ratios of mean earnings for 40- to 49-year-old men to mean earnings for 25- to 29-year-old men are in the range of 1.08–1.30.

Consistently with the parameters in Perraudin and Pujol (1991), the elasticities of substitution between different goods that appear in the utility function are picked for EU4 as 1.2 for tradables and nontradables, and as 0.8 for two different tradables. For Turkey, the values available in the literature were for elasticity of

substitution between imports and domestic goods, and that between exports and domestic goods. The respective values of these parameters are taken to be 0.9 and 0.8 as in Celasun (1986) and Yeldan (1996).

As for the elasticities in production, a search of the existing literature revealed the following values. Estimates of the elasticity of substitution between labor and capital for the US range typically between 0.5 and 0.9 (see, e.g., Artus, 1984; Feldstein, 1983). Artus (1984) also obtained an estimate of 0.85 for Canada. As for European countries, Törmä, Rutherford, and Vaittinen (1995) made an attempt to estimate the Finnish production function parameters in traded and nontraded industries. At 0.915 and 0.703 for traded and nontraded industries, respectively, their estimates are in the range of US and Canadian ones. The values estimated from Finnish data were used for EU4 simulations as these values not only fit well to the commodity aggregation scheme employed here, but also are more likely to be relevant for EU4 countries. For Turkey, on the other hand, the values were chosen, following Yeldan (1996), as 0.85 for tradable and 0.65 for nontradable goods industries. Another important pair of parameters is adjustment cost parameters, ξ, κ, in Eq. (10). These were assigned values similar to those chosen by Summers (1981).

Table 1
Baseline parameterization

Parameters	Value for EU4	Value for Turkey
Elasticities		
Elasticity of intertemporal substitution	0.900	0.750
Consumption–leisure elasticity of substitution	1.100	1.100
Tradable–nontradable elasticity of substitution	1.200	
Elasticity of substitution between tradables	0.800	
Elasticity of substitution between imported and domestic goods		0.800
Elasticity of substitution between exports and domestic goods		0.900
Elasticity of demand for exports	−1.200	−2.000
Elasticity of savings supply by ROW	5.000	5.000
Production elasticity (nontraded)	0.703	0.850
Production elasticity (export good)	0.915	0.650
Assumptions about ages		
Life expectancy	80	75
The age when individuals begin to work	20	15
The age when individuals receive bequests	60	55
Other parameters		
Bequest preference parameter	0.500	0.750
Adjustment cost parameter, κ	0.050	0.050
Adjustment cost parameter, ξ	20	20
Capital–output ratio	3.000	4.000
Depreciation rate for tradable industries	0.100	0.075
Depreciation rate for nontradable industries	0.075	0.050

Concerning the demand elasticities, the rest of the world elasticity of export demand, ω, was set at -1.2 for EU4 as in Perraudin and Pujol (1991) and -2 for Turkey as in Yeldan (1996). The ROW elasticity of savings supply, ω^*, on the other hand, was taken as 5 as in Perraudin and Pujol. Finally, the constants in the savings supply function were chosen in such a way that a 1% deviation from world interest rates elicited a change in world savings supply equal to 10% of GDP.

Table 1 summarizes the values of key parameters used in simulation runs. As for taxes, the rates to be employed are chosen, wherever feasible, as average and marginal income tax rates for married couples with two children. Wage income tax rates come from three different publications of OECD (1991a, 1992, 1993). Average and marginal social security contribution rates come from OECD (1991a), while marginal rates are taken from OECD (1992) and (1993). The savings tax rates employed are for taxes on interest income as in OECD (1991b). Finally, VAT rates are taken from various issues of *OECD Economic Surveys* of individual member countries. Other relevant information on pension schemes needed in model implementation are taken from OECD sources, Foster (1994), and Van der Noord and Herd (1993). More information on Turkish pension system and pension parameters can be found in Sayan and Kiraci (2001) and Topal (1999).

4. Simulation results

We now consider the effects of the demographic shock transmitted from the EU4 onto Turkey. In order to gauge these transmission effects on key variables of Turkish economy, simulation results are compared across two experiments, each conducted by feeding a different set of exogenous values for world prices of tradables and the world interest rate to the Turkish economy model. The world prices and interest rate are essentially indexes weighted by respective shares of EU4 and other countries in Turkey's international transactions. The first simulation scenario is meant to capture the effects resulting from Turkey's own demographic transition when the country faces a given set of world prices and interest rate. In the second scenario, on the other hand, the world prices and interest rates facing Turkey change, along with the demographically induced changes in EU4 over the period under consideration. To conduct this experiment, we first simulate the model for EU4 and obtain relevant prices that prevail in the presence of the demographic shock in Europe. We then plug these prices into the Turkish economy simulation so as to simulate the change in world prices facing Turkey in accordance with the share of EU4. A comparison of the results across scenarios allows for an observation of differential effects resulting from the transmission of the effects of the demographic shock in EU4 onto Turkey, through the channels described above.

Both simulations consider the period from the year 1990 until the end of model horizon. Year 1990 is chosen to represent the current situation and the

periods we particularly want to consider, that is, 1990 onwards. We take the model horizon as extending into 71 periods of 5 years each after 1990. At the 71st period, various growth rates and the population share of each age cohort become equal to calibrated values. To solve the intertemporal equilibrium of the model over the model horizon, we follow the tradition of earlier CGE works such as the seminal work by Adelman and Robinson (1978) and employ a Fair–Taylor type of the Gauss–Seidel algorithm written in the programming language Gauss. The algorithm is quite robust and works well with a range of different starting values. Starting from a guessed vector of prices in each of the 5-year periods considered, we calculate an updated vector by sequentially solving for each period's prices so as to eliminate excess demands in the different markets with future prices held fixed at the currently guessed values.[10] Roughly 50 such iterations are required to find equilibrium state variables to a satisfactory degree of precision.

4.1. The nature of demographic transitions

We assume that at the beginning, the economy is on the balanced growth path characterized by a constant population growth of 0.75% (0.5% for the EU4) and a productivity growth of 3% (2% for the EU4) per annum. This implies that younger age cohorts are 1.0075 times greater in size than the previous age cohorts. Between 1995 and 2050, however, we change the age composition and growth rates of population by using demographic projections obtained from the UN sources. After 2050, we use the model-generated population profiles based on stable population growth assumption. This implies that the model starts, after 2050, to converge to an equilibrium where various growth rates and the population share of each age cohort become equal to calibrated values.

Changes in demographic profiles, as captured by exogenously fed demographic projections, affect dependency ratios. This, in turn, causes changes in consumption and savings patterns, as well as the composition of government spending by age groups, leading to changes in prices. To highlight the comparative magnitudes and directions of demographic changes taking place after the European baby boom of the 1950s, the fractions of population in different age groups in EU4 and Turkey are reported in Table 2. The corresponding changes in dependency ratios for EU4 and Turkey are shown in Fig. 1.

Both Fig. 1 and Table 2 show that not only the size but also the timing of demographic transitions differ considerably for Turkey and EU4. Turkey always has a relatively younger population as compared to the largest four European countries, as it has a higher population growth rate. It is particularly evident from Fig. 1 that the ratio of population in the young age up to 19 to the working age in EU4 drops markedly first, and then begins to rise as older baby boomers retire after 2010. The decline in this ("young age dependency") ratio is even more

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[10] We use NLSYS application of Gauss for this procedure.

Table 2
Population age distributions for EU4 and Turkey (in percent)

| Age group | 1950 | | 1975 | | 1990 | | 2000 | |
	EU4	Turkey	EU4	Turkey	EU4	Turkey	EU4	Turkey
0–14	23.669	38.330	23.238	40.105	17.725	35.505	17.072	29.849
15–39	43.474	44.822	41.273	42.923	44.244	46.450	42.271	49.647
40–64	22.914	13.557	22.021	12.455	23.014	13.265	24.332	14.475
65+	9.943	3.292	13.468	4.517	15.017	4.779	16.324	6.029

| Age group | 2010 | | 2025 | | 2050 | | Steady state | |
	EU4	Turkey	EU4	Turkey	EU4	Turkey	EU4	Turkey
0–14	15.907	25.831	15.860	21.742	18.797	18.302	20.946	21.909
15–39	38.572	48.838	34.325	43.851	34.764	34.999	38.713	39.194
40–64	27.428	18.035	29.764	23.744	25.089	26.722	23.647	23.054
65+	18.093	7.297	20.051	10.663	21.350	19.997	16.694	15.843

drastic for Turkey because of the birth rates that have slumped somewhat drastically since the 1970s in this country.[11] Also shown in Fig. 1 is the ratio of people over 65 to those in the working age (the "old age dependency ratio"), which rises steadily for a few decades after 2010 in both the EU4 and Turkey, and stabilizes just above 25% after 2060 in the EU4, and just above 35% after 2090 in Turkey. Thus, the population gradually becomes older in the EU4 starting from the 1990s, whereas Turkey begins to experience population aging following the period after 2020.

In simulating the model, we adopt the simplifying assumption that net immigration is zero, since treating immigration explicitly would complicate our projections considerably. In reality, immigration has affected the age profile of the Turkish population at various points in time. In the 1960s and in the second half of the 1970s, in particular, there was significant emigration to other European countries, and especially to Germany. Yet, with the restrictions imposed upon the inflow of Turkish labor into the EU in the last two decades, the assumption of zero emigration has become increasingly more realistic. Given the likelihood that these restrictions will be maintained into the foreseeable future, the assumption may be viewed as sufficiently realistic.

4.2. Transmitted effects of the demographic shock in the EU4

Simulating the model for changes in demographic size and composition is likely to exert price effects (general equilibrium effects) on the economy as well as first-round effects on factor supplies. The first-round effects are the effects that

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[11] To assure comparability of plots in Fig. 1, the working ages are defined as 20–64 for both EU4 and Turkey even though the model takes the beginning of working age in Turkey as 15.
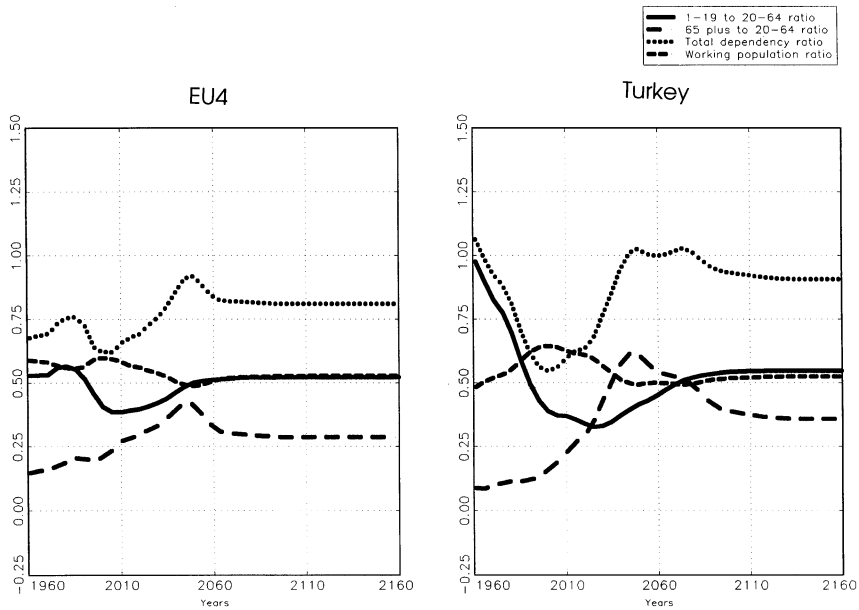
Fig. 1. Dependency ratios.

would have been observed on factor supplies if factor prices and incomes could be held constant in the course of the country's own demographic transition (i.e., in the absence of the effects transmitted from Europe). In other words, these are the effects that arise due to the changes in the age composition of the population over time as the age composition has a direct bearing on the supply of labor and capital (savings) to the economy. Additional changes are introduced to the time paths of factor supplies and other variables, as factor prices and incomes are allowed to vary along with the changes in the age composition of the country (second-round price effects or general equilibrium effects). Since the transmission of the effects of the demographic shock in Europe through price and interest rate channels is also expected to alter the time paths of economic variables in Turkey, we may compare the time paths with and without the demographic developments in Europe taken into account.

To distinguish the general equilibrium effects transmitted onto Turkish economy from the effects of Turkey's own demographic transition, we simulate the Turkish economy model with and without feeding the tradable prices and interest rates obtained from the EU4 simulation. These results indicate that substantial fluctuations must be expected in real and nominal macroeconomic variables as the profile of Turkish population with respect to the age composition changes during the country's own demographic transition even without the transmission effects. These effects might be observed through the time paths that various variables would follow as shown in Figs. 2–4. The figures showing
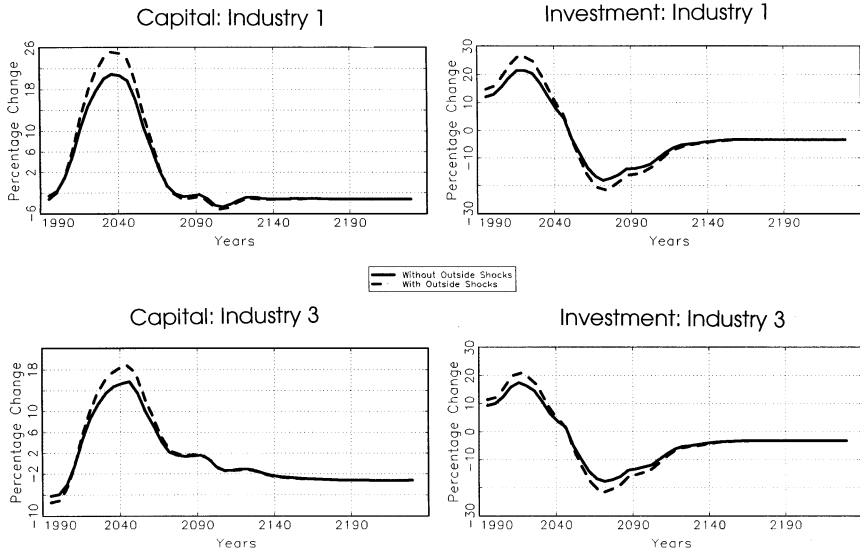
Fig. 2. Capital accumulation effects.

percentage deviations from trend values generally indicate that transmission of demographic shocks generate significant output, consumption, and savings effects. For example, between 1990 and 2060, the real output is expected to fluctuate between levels that are about 5% below and 18% above its trend value
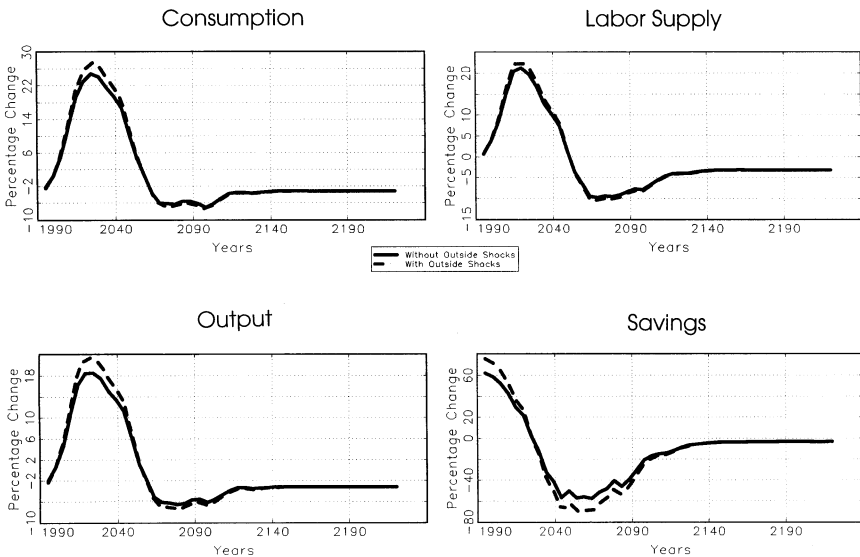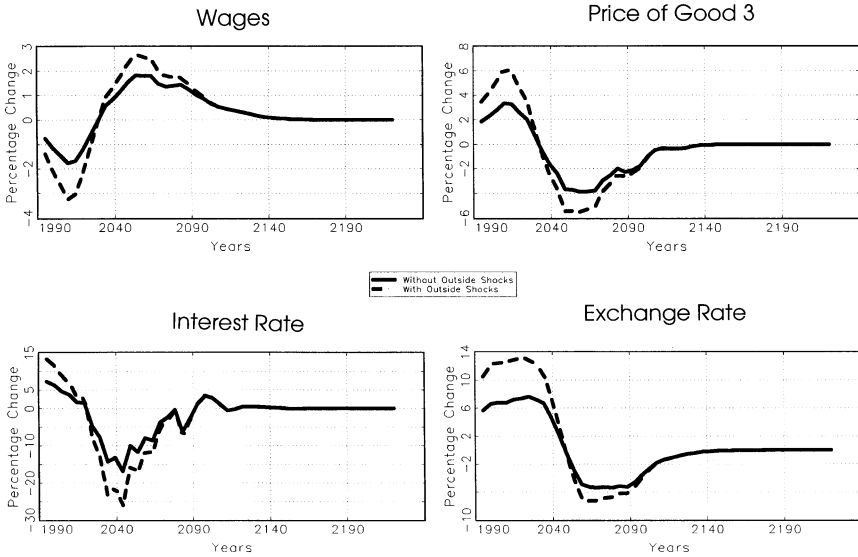

Fig. 3. Macroeconomic effects.

Fig. 4. Price effects.

(Fig. 3), and the fluctuations for such variables as consumption, household savings, and investment are larger (Figs. 3 and 4). When its effects are transmitted through price and interest rate channels, the demographic shock in Europe is expected to magnify these effects. The transmission effects are visible on the values over time of all variables including investment, household savings, consumption, and labor supply, as well as the exchange rate, interest rate, and wages.

The results can be interpreted as follows: As age composition of the population changes during the demographic transition, differences in labor supply and saving behaviors across age cohorts exert an immediate impact on overall labor supply and savings. For instance, as the ratio of working population in Turkey increases between 1990 and 2020 (Fig. 1), overall labor supply increases during the same period. As indicated by Fig. 3, this rise in the overall labor supply would be approximately 20% higher than its baseline value when we consider the case without transmission effects. In other words, the increase in labor supply is solely due to the changes in age composition of Turkish population during transition. Such increases in labor supply put downward pressures on the wage rate. In the year 2000, for example, the wage rate falls about 1.5% below the baseline rate. The decline in the wage rate induces firms to increase the use of labor input. This, in turn, results in a rise in total output. These movements can be followed in Figs. 3 and 4. As for movements in household savings during this period, the results reveal that savings are not purely driven by the demographic transition: While one would expect these savings to increase as the working population ratio (total dependency ratio) increases (declines), this

does not happen. This apparently counterintuitive result is due to the forward-looking nature of saving behavior in a dynamic setting. Since the rise in the working population ratio will be followed by a decline after 2020, and the agents know this with perfect foresight, firms and households in different age cohorts predict contractionary effects of savings on the economy and do not respectively invest and save more than they would otherwise have. Fig. 3 displays that savings decrease from the beginning of the simulation period until the year 2040. Increases in investment, financed mostly through internal funding generated by firms, are immediate and short-lived as seen in Fig. 2. Changes in savings and investment are reflected in the interest rate (Fig. 4). The exchange rate (expressed as the domestic price of a unit of foreign currency) varies positively with domestic output. In other words, when the output is high, the domestic currency depreciates to induce foreigners to purchase more Turkish exports. So, whenever the shock waves hitting Turkey add to the output effects to be observed during its own demographic transition, the real exchange rate would increase (i.e., Turkish Lira would depreciate) more than it would have in the absence of demographic spillover. In the early 2000s, for example, the real exchange rate increases by approximately 9% when transmission is allowed, and by about 7% when it is not (Fig. 3). The difference between these magnitudes is about 29%, implying that the additional depreciation of domestic currency caused by the demographic developments in Europe may be considerable at times.

In general, when the EU4 demographic shock is transmitted through price and interest rate channels, the effects that are expected to arise due solely to the demographic changes in Turkey are magnified. The transmission effects on the values over time of such variables as wages, exchange rate, and interest rate are more visible relative to such real variables as investment, consumption, labor supply, and output. Around the year 2020, for example, the real variables including investment and output are 2–4 percentage points above their corresponding values without transmission effects. The demographic shock in EU4 also generates positive effects on capital accumulation and output, and leads to reductions in prices of goods imported by Turkey and to rises in the demand for Turkish exports. This clearly results in a positive terms-of-trade effect for Turkey. Since the shock also reduces the interest rate in EU4, capital inflows to Turkey increase, magnifying the positive effects on production and investment. This implies that other small economies with a comparable income level and a similar age composition of population to Turkey could also take advantage of the lag between the pace of their own demographic transition and that in the larger economies of OECD/EU area. Due to this lag, the faster aging of population in the latter group of countries would cause their domestic interest rates to begin falling earlier than small countries'. Thus, small economies with younger populations could turn the positive interest rate differentials (to arise between their domestic interest rates and those prevailing in the large countries) into an opportunity for increased capital inflows over a certain period of their demographic transition. As attracting a higher share of foreign capital from large

economies with aged populations would be a competitive process for small countries, however, many of these countries would need to take additional policy measures to (further) liberalize their investment and banking regulations so as to facilitate movement of capital across borders and transfer of funds and to introduce any structural reforms that may be needed to make their good and labor markets more accommodating for foreign investors.[12]

As for the implications of the European demographic shock for the labor market in Turkey, the results suggest that the increase in the wage rate between 2010 and 2190 would be magnified by the transmission of the demographic shock in Europe, increasing beyond the case where the profile of the Turkish population followed its own course of transition. This result is rather intuitive as prices and interest rates that act as channels through which the demographic shock in Europe is transmitted onto Turkey should also be expected to push up the wages in Turkey towards those prevailing in the EU4. This, in turn, would cause labor supply to increase more than it would otherwise have. It should be noted here that while the direction of the effects to be observed in Turkish labor market is not likely to be reversed, their timing and magnitude could vary somewhat if Turkey fails to catch up with the recent efforts to raise the retirement ages in the EU, introduced as a policy response to increasing dependency ratios. However, there already is a move to increase the retirement age in Turkey as Turkish pension system is already facing financial trouble due mostly to retirement ages that are lower than what would be expected in a country at Turkey's stage of demographic transition (Sayan & Kenc, 1999; Sayan & Kiraci, 2001). Such a policy move can be anticipated to align the retirement age differentials between Turkey and the EU4 (or other OECD partners of Turkey) at a level that is compatible with the differences in the age composition of respective populations, at least until a further wave of retirement age increases in Turkey's faster aging partners is introduced. One can expect therefore that despite the lag between the rates at which their populations age, same type of policy responses introduced at comparable stages demographic transition in the EU and Turkey would leave our labor market results largely unaltered. Similar comments apply to other variables of key interest establishing that spillovers of the demographic shock in EU4 would intensify the changes that Turkey would experience during its own demographic transition.

When combined with results on the direction of exchange rate movements, the labor market results reveal an important policy challenge for Turkey over the periods when the timing of declines in the real exchange rate (i.e., domestic

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[12] A closely related point is made by Turner et al. (1998), who argue that income to be earned from OECD investments flowing into non-OECD countries with higher returns may help offset the adverse effects of aging populations on living standards in OECD. The authors immediately add, however, that for the OECD to reap such benefits, non-OECD countries to receive these investments may have to undertake structural reforms in capital as well as product and labor markets so as to be able to accommodate incoming capital.

currency appreciation) matches that of the increases in wages resulting from reductions in labor supply (see Fig. 4). Clearly, Turkey's competitive position in international markets would be affected negatively by the parallel movement of these effects, and the country should be prepared to experience a deterioration in its current account during these periods. While such a development would be a direct result of the country's own demographic transition, transmission of shocks once again appears to amplify it dimensions. Once again, policies that affect the pattern of labor supply (such as those affecting the retirement age or workforce participation rates) may change the timing of wage rate increases (Sayan & Kenc, 1999)[13] to minimize their effects on the competitive position of the country.

5. Conclusions

Demographic projections for industrial countries including most of the EU area indicate that the fraction of the population over 65 will increase considerably in the next few decades, primarily as a result of the fertility shock of the late 1940s and the 1950s. The growth in the population share of elderly is becoming increasingly evident in many countries as the generations born during these decades (i.e., baby boomers) keep getting older. The already visible increase in dependency ratios resulting from the baby boom shock points to potential changes in such macroeconomic variables as national savings and investment, and requires alterations in the levels and/or the composition of government expenditures. Such macroeconomic changes are also likely to generate micro-economic consequences as they will affect relative prices of consumption and investment goods, as well as tradables and nontradables. Since small countries outside the EU or North America trade intensively with the industrial countries that currently experience population aging, trade must be expected to act as a channel for transmission of the effects of demographic shocks onto small countries through these relative prices. Similarly, the changes in interest rates in major suppliers of foreign capital to the rest of the world are likely to serve to the transmission of demographic effects to other countries. While the implications for countries, which experienced the demographic shocks themselves, have been investigated somewhat thoroughly in the literature, the potential for the trans-mission of these effects onto other countries has largely been overlooked so far.

In order to contribute to the filling of this gap in the literature, this paper addressed the issue by considering the effects likely to be transmitted from four major nations of the EU (EU4) onto Turkey — a small, middle income country that heavily trades with them. The magnitude and the direction of these effects upon Turkish economy were investigated within a dynamic, OGs, general

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[13] See also Turner et al. (1998) for a discussion on policies to affect participation rates and their consequences.

equilibrium framework. Despite its complexity, flexibility of the modeling framework enabled us to capture the differing nature of demographic transitions in the EU4 and Turkey, and to separately analyze the effects of Turkey's own, shock-free demographic transition with and without the transmission effects. The model employed here was noted to extend past work in various directions. Salient features of the model included the use of an open economy setup with variable terms of trade and an imperfectly elastic supply of foreign savings where both the EU4 and Turkey were assumed to face a finite supply of savings from the rest of the world. This treatment was argued to be particularly suitable for industrial economies of the EU as well as a middle income economy like Turkey, despite the small size of the Turkish economy with respect to international flows.

Simulation results reported in the paper suggest that the demographic developments leading to population aging and changes in age composition of the population are likely to affect the time paths of major macroeconomic variables significantly. Furthermore, the demographic shock in Europe is expected to magnify these effects visibly and will therefore have implications for such variables as consumption, savings, investment, output, and labor supply in Turkey, as well as the wage, exchange, and interest rates in the country.

While the discussion in the paper has so far tried to shed some light on the possible effects of demographic developments in Europe on Turkey, the results have implications also for other countries such as Mexico and other Latin American countries that have a large volume of international transactions with the US and Canada, where gradual aging of population is well under way. The transmission issue should also be a matter of concern for Asian countries that heavily trade with Japan and other industrial countries, as well as attract sizable amounts of foreign capital from these countries. The increasing degree of openness of small countries, the process of globalization, and the associated increases in the volumes of international commodity and factor flows should be expected to facilitate the transmission of demographic shock effects even further and make small countries increasingly susceptible to changes in the terms of trade, interest, and exchange rates in large countries. Coupled with the results presented here, this observation clearly points to a need on the part of all small developing or middle income countries to carefully watch the demographic developments in large industrial nations with which they have strong economic ties, while taking the implications of the aging of their own population into account.

If supported by appropriate policy measures taken in a timely fashion, such developments in large countries with aging populations may present opportunities for small countries with young populations. As discussed in Section 4, one possible area for differing rates of aging in two groups of countries to present itself as an opportunity for younger nations is the interest rate differentials expected to arise as domestic interest rates in the OECD/EU area begin to fall as a result of the changing saving behavior of older populations. As a development that is likely to hit the faster aging nations of the world earlier than others, this would make it possible for younger nations to attract sizable amounts of foreign

capital. The countries that would benefit the most out of this movement of capital across the borders would naturally be the ones that are best prepared to accommodate these inflows of capital. So, the countries with younger populations wishing to attract a higher share of capital from aged-population economies will need to transform their capital, as well as labor and product markets, into a form that is compatible with the needs of large country investors seeking higher returns. As for the timing of policy reforms, small countries should remember that such positive interest rate differentials would not be permanent as inflows of capital they receive would, after a while, bring their domestic interest rates down to the levels of large country interest rates, equalizing returns and hence causing incentives for capital inflows to disappear. Furthermore, it should be remembered that there would also be times when demographic developments experienced by small countries themselves would lead to adverse effects such as a reduction in their competitive position, causing, in turn, a deterioration in their external balances. Since demographic spillovers from large countries tend to magnify these effects, the problems facing small open economies could be worsened by the transmission mechanisms. As discussed in Section 4, various policies could be used to avoid these adverse effects, such as the ones designed to increase retirement ages or workforce participation rates. It should be kept in mind, however, that the timing of such policy responses would especially be important as delayed policy measures, as well as the steps taken too early, may significantly affect expected outcomes.

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