POPULATION AGING, LABOR MOBILITY, AND ECONOMIC GROWTH: EVIDENCE FROM MENA AND THE DEVELOPED WORLD

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Abstract

This paper examines the economic effects of aging trends using a two-period, two-region OLG model and the population projections for the developed and MENA countries. Migrant workers change the political balance of young and elderly voters in both labor-receiving and labor-sending countries. Numerical simulations show that the MENA region benefits more from international capital mobility. Restricting migration or political participation of migrant workers in the developed region produces inferior growth results for the MENA region. The study reveals that the MENA countries would suffer significantly from lower return to education in terms of growth and consumption.

ملخص

تبحث هذه الورقة التأثيرات الإقتصادية للإتجاهات العمرية باستخدام نموذج OLG لفترتين ومنطقتين، بالإضافة إلى التوقعات السكانية للدول المتقدمة ودول الشرق الأوسط وشمال أفريقيا. إذ يقوم العمال المهاجرون بتغيير التركيب والتوازن السياسي بين الناخبين من صغار وكبار السن في الدول المستقبلة للعمالة وتلك المصدرة لها على حد سواء. وتبين المحاكاة الرقمية أن منطقة الشرق الأوسط وشمال أفريقيا تستفيد أكثر من حركة رأس المال البشري الدولية. ويؤدي تحديد الهجرة أو المشاركة السياسية للعمال المهاجرين في الدول المتقدمة إلى نتائج نمو أقل لمنطقة الشرق الأوسط وشمال أفريقيا. حيث توضح الدراسة أن دول الشرق الأوسط وشمال أفريقيا ستعاني بشدة من عوائد منخفضة للتعليم فيما يتعلق بالنمو والاستهلاك.

1. Introduction

Middle East and North Africa (MENA) region countries have unique demographic characteristics. Within the MENA region, Arab countries have higher fertility and population growth rates and a significantly younger age structure than other countries and regions. The 2002 Arab Human Development Report notes that this can present a "demographic gift or a demographic curse", depending on whether the high population growth and fertility can be transformed into human wealth through capital investments and technological progress. Similarly, in a recent study, Dhonte, Bhattacharya and Yousef (2000) argued that the expected "explosion" in working-age population in the Middle East present challenges as well as opportunities for these countries. These unique demographic characteristics show stark contrast to the developed world where countries are going through a serious population aging trend.[1] Table 1 shows the significant demographic differences between MENA, OECD as a group that represents the developed world, and a group of other Non-OECD countries. MENA countries stand out as the group that is clearly different from both country groups with the largest difference from the OECD group. Hence MENA and OECD make an excellent case for studying population aging in the OECD countries and its impact through labor flows from the MENA countries.

While there is an extensive literature on the link between population aging and international capital mobility[2], only few studies examined aging with labor migration (Tosun, 2005; Leers, Meijdam and Verbon, 2004; Storesletten, 2000). Galor (1992) argued that capital and labor have asymmetric characteristics. Labor mobility has a dual effect in the sense that it exhibits the characteristics of capital mobility as well. Young migrant workers contribute to the economy both as laborers, and as savers. What the aging literature has not addressed is that, when allowed to vote, migrant workers will change the political structure composed of young and elderly voters in both labor-receiving and labor-sending countries. In a majority voting mechanism for fiscal policy decisions, political shifts resulting from labor migration may have sizeable impacts on government programs such as education. Since education is a major input to human capital accumulation, aging is expected to have significant growth consequences. This paper uses a two-region, two-period overlapping generations model with international labor mobility and a politically responsive fiscal policy to examine the labor movements from the MENA countries to the aging developed countries (OECD). The goal is to examine the economic growth consequences of demographic differences and the labor movements. The paper brings out the political economy of aging through the aging – education - human capital link. This is particularly important in the context of international labor mobility with young migrant workers from the MENA region participating in the political system of developed countries. The paper examines the significance of factor mobility as a policy choice by comparing the labor mobility model to an alternative open economy model with international capital mobility. The paper also allows us to discuss policy implications through migration and education policies in both MENA countries and developed countries.

The paper is structured as follows. The next section gives a description of a two-region, two-period overlapping generations model with international labor mobility. This is followed by a transition analysis in section 3 that shows results from various numerical simulation exercises. The last section presents summary and concluding remarks.

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[1] See Heller (2003) and CSIS (2002) for recent discussions on the aging trend in developed countries.

[2] This literature generally argues that demographic differences can lead to capital flows from low population growth to high population growth regions. For examples, see Börsch-Supan (1996), Kenc and Sayan (2001), Tosun (2003, 2001) and Van Groezen and Leers (2000).

2. The Two-Region Model

The model builds on a two-period overlapping generations model first developed by Diamond (1965)[3]. To examine open economy issues, the standard framework is extended to a two-region model with international labor mobility similar to Galor (1986, 1992) and Crettez *et al.* (1996, 1998)[4]. Another major extension is the modeling of fiscal policy decision-making through a political process.

Recent discussions on population aging have noted the potential generational conflict created by the need to share society's resources between non-working elderly and the younger working population. It is argued that increasing number of elderly voters could render changes in public expenditure patterns in favor of the elderly. This, in turn, could trigger serious generational conflict regarding government programs that enhance the productivity of the working young. One good example on this, is government spending on public education. For simplicity, the productivity enhancing public program will be referred to as "education" throughout the text.[5] The goal is to highlight the strong link between this type of government spending and human capital accumulation, which is considered to be one of the most important avenues for economic growth.[6]

To make the political process of fiscal policy determination for public education rich, interesting, yet tractable, a median-voter framework with voter heterogeneity is used.[7] This framework suggests that public sector responds to voter preferences over the long period (thirty years) assumed in the two-period overlapping generations model. Voter heterogeneity is introduced by assuming a distribution of genetic ability levels for the working generation. The ability level of the individual will, in turn, determine the value she receives from public education. For clarity, the model is presented for one region only. This is followed by a description of the two-region world equilibrium.

2.1. Households

Individuals live for two periods and seek to maximize a utility function based on discretionary consumption in the first and second period of their lives,

$$U = \ln C_{jt} + \left(\frac{1}{1+\delta}\right)\ln C_{jt+1}, \qquad (1)$$

here j indexes individuals, C_{jt} is consumption when young, C_{jt+1} is consumption when old, and δ is the pure rate of time preference. The period-specific budget constraints in the first and the second periods are:

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[3] However, the earliest overlapping generations models are described by Allais (1947) and Samuelson (1958). Children are not modeled in a two-period model.

[4] A two-country model with international capital mobility is shown by Buiter (1981).

[5] It should be noted that any other government program that is directed towards increasing the labor productivity of young could easily be used.

[6] Tosun (2005) introduced a social security program in the model by having an exogenously fixed level of social security spending. An income tax that is earmarked for social security adjusts through the periods to balance the social security budget. Thus, there are separate taxes for education and social security spending with voters deciding only on the education tax rate. The results from that paper showed that modeling social security in this way only affected the magnitude of the effects, not the qualitative results.

[7] The political process is modeled through a median voter framework because the conditions for the median voter theorem are satisfied. The choice of voters is over a single dimension since the preferred education tax rate is the only choice variable, and the voter preferences are single peaked. The property of single-peakedness has been demonstrated to ensure existence of a voting equilibrium (Black 1948).

First period: $C_{jt}\left(a_j\right)+S_{jt}\left(a_j\right)=\left(1-\tau_t\right)w_t l_t\left(a_j\right)$

Second Period: $C_{jt+1}\left(a_j\right)=\left(1+\left(1-\tau_{t+1}\right)r_{t+1}\right)S_{jt}\left(a_j\right)$, (2)

where $S_{jt}\left(a_j\right)$ is first period saving, w_t is the wage rate individual *j* faces, $l_t\left(a_j\right)$ is effective labor,[8] where a_j is the ability level of individual *j*, r_{t+1} is the rate of return to capital, τ_t is the rate of income taxation that is applied to both capital and labor income. This tax is used entirely to finance education spending. An additional tax (μ_t) is also applied to capital and labor income to finance social security spending by the government.

It is assumed that there is a continuous distribution of abilities that is replicated in each new generation. The ability level of individual *j* is indexed by a_j, which ranges from 0 to 1. The density function of abilities is denoted by *f(a)* where by definition:

$$\int_0^1 f\left(a\right)da=1\,. \tag{3}$$

Human capital is accumulated from the interaction of ability level (a_j) of the individual and government spending per young (g_t^e) on education:

$$l_t\left(a_j\right)=\Phi\left[a_j g_t^e+1\right]^{\psi}, \tag{4}$$

where, Φ denotes an index on human capital efficiency and ψ is a parameter indicating the return to human capital from the inputs (a_j and g_t^e).[9] The form of the human capital function is chosen so that even individuals with the lowest ability ($a_j=0$) will contribute to the economy in terms of human capital (see Holtz-Eakin, Lovely, and Tosun 2004). From the maximization of (1) subject to (2) and (4); we get the familiar first order condition:

$$C_{jt}\left(a_j\right)=\frac{1+\delta}{\left(1+r_{t+1}\left(1-\tau_{t+1}\right)\right)}C_{jt+1}\left(a_j\right). \tag{5}$$

Using (5) and (2), we derive the optimal saving of an individual *j*:

$$S_{jt}\left(a_j\right)=\frac{1}{2+\delta}\left(1-\tau_t\right)w_t l_t\left(a_j\right). \tag{6}$$

Saving of an individual depends on net labor earnings but it is independent of the interest rate. This is due to the Cobb-Douglas form of the utility function. Given (5) and (6), it is straightforward to derive consumption functions in each period:

$$C_{jt}\left(a_j\right)=\frac{1+\delta}{2+\delta}\left(1-\tau_t\right)w_t l_t\left(a_j\right)$$

$$C_{jt+1}\left(a_j\right)=\frac{\left(1+r_{t+1}\left(1-\tau_{t+1}\right)\right)\left(\left(1-\tau_t\right)w_t l_t\left(a_j\right)\right)}{2+\delta}. \tag{7}$$

[8] Here, young supplies one unit of time to the economy. Note that, making the allocation of time between "schooling" and supplying labor endogenous does not change this analysis.

[9] ψ should be less than or equal to unity to prevent increasing returns from government spending.

2.2. Political Process of Fiscal Policy

Fiscal policy for education is determined through a political process for which a median-voter framework with voter heterogeneity is used. Voter heterogeneity is introduced by assuming a uniform distribution of genetic ability levels for the working generation.[10] The ability level of the individual will, in turn, determine the value she receives from the public good.

The consumption and saving decisions, as seen above, depend on human capital, which is, in turn, determined by government spending (see equation 4). By plugging these into (1), we get the indirect utility function, which each voter maximizes, in determining his or her preferred tax rate, subject to the government budget constraint for this type of government spending ($\tau_t y_t = g_t^e$).[11] The preferred tax rate of individual *j* when young is:

$$\tau_{jt}\left(a_j\right) = \frac{a_j \psi y_t - 1}{\left(1+\psi\right) a_j y_t} \ . \tag{8}$$

Equation (8) is the tax rate each individual prefers based on her ability level. This preferred tax rate is increasing in both ability level a_j and in income per young. In addition, because the old do not derive any benefit from publicly provided education and there are no bequests in the model, they incur a cost without enjoying any benefits. Therefore, their preferred education tax rate will always be zero, regardless of their ability.

Total population in each period is $N_{t-1} + N_t$ where N_t is composed of both newly born nationals and migrant workers. Given this, the median voter is defined by

$$N_{t-1} + N_t \int_0^{a_m} f\left(a\right) da = \frac{N_{t-1} + N_t}{2}, \tag{9}$$

here a_m is the ability level of the median voter.

In the absence of migration, the median voter becomes a person with lower ability when population ages. In turn, the preferred tax rate of the median voter is lower. In other words, with population aging, older people need fewer young voters to form a majority. Since these young voters are the ones at the lower end of the ability distribution, they prefer lower taxes than higher ability people because their return from public education is lower.

When labor migration is allowed, an aging country will experience an inflow of labor due to a higher wage rate than the rest of the world. This will change the age distribution of population in favor of the young generation. The identity of the median voter will be different from the case without migration (see Appendix I). Now, the ability of the median voter will be higher compared to median voter's ability in the case without migration. However, whether the ability of median voter with migration can be greater than the pre-aging level is uncertain[12].

2.3. Producers

Each country produces a single good using a Cobb-Douglas production technology.

$$Y_t = \Lambda K_t^{\alpha} H_t^{1-\alpha} \ , \tag{10}$$

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[10] While not very realistic, uniform distribution is used for its simplicity in deriving analytical results.

[11] It is assumed in each period that government uses the entire revenue from this tax to finance the public good for all young equally, regardless of their ability level (Bearse, Glomm, and Ravikumar 2000).

[12] In reality, there are barriers to labor migration that may rule out such a case.

here Λ is the productivity index, K is capital stock and H is aggregate supply of human capital. The aggregate supply of human capital is:

$$H_t = N_t \int_0^1 l(a)\, f(a)\, da. \tag{11}$$

Human capital per worker, using (4) and (11), is

$$h_t = \Phi \int_0^1 (ag_t + 1)^{\psi}\, f(a)\, da. \tag{12}$$

Competitive factor markets require that real wage and interest rates are equal to the marginal products of labor and capital respectively. Therefore, factor demand equations are:

$$w_t = (1-\alpha)\Lambda \left(\frac{k_t}{h_t}\right)^{\alpha} \tag{13}$$

$$r_t = \alpha\Lambda \left(\frac{k_t}{h_t}\right)^{\alpha-1}. \tag{14}$$

Here, $k_t = K_t / N_t$ and $h_t = H_t / N_t$ are capital stock per worker and human capital per worker, respectively.

Using (6) and (12), saving per worker can be expressed as

$$s_t = \left(\frac{1}{2+\delta}\right)(1-\tau_t)\, w_t \Phi \int_0^1 (ag_t + 1)^{\psi}\, f(a)\, da. \tag{15}$$

2.4. International Goods Market Equilibrium and Labor Flows

In the absence of international capital mobility, capital market equilibrium requires that saving in each period equals to accumulated capital in the following period. Capital market equilibrium conditions for each region can be depicted as

$$k^{A}_{t+1} = \frac{N^{A}_{t} s^{A}_{t}}{N^{A}_{t+1}} \tag{16}$$

$$k^{B}_{t+1} = \frac{N^{B}_{t} s^{B}_{t}}{N^{B}_{t+1}}, \tag{17}$$

where, superscripts *A* and *B* denote regions.

To close the dynamic model, international labor market equilibrium must be specified. For simplicity, I assume that there is perfect international labor mobility.[13] International labor market equilibrium requires

$$N^{A}_{t+1} + N^{B}_{t+1} = \left(1+\eta^{A}_{t+1}\right) N^{A}_{t} + \left(1+\eta^{B}_{t+1}\right) N^{B}_{t}. \tag{18}$$

where, η^{A}_{t+1} and η^{B}_{t+1} are the population growth rates in region A and region B, respectively. Labor income is taxed where income is earned. Thus, source based income taxation is used

[13] A recent study by National Research Council shows that total stock of migrants increased quite dramatically in late 1980s and early 1990s (see National Research Council, 2000, pp. 157–59). In addition, in my model one period corresponds to 30 years, which makes perfect labor mobility a viable assumption.

for both regions.[14] This implies that net-of-tax wage rates are equalized in equilibrium. Therefore, the international labor flow constraint is:

$$w_{t+1}^{A} h_{t+1}^{A} \left(1-\tau_{t+1}^{A}\right) = w_{t+1}^{B} h_{t+1}^{B} \left(1-\tau_{t+1}^{B}\right). \qquad (19)$$

It is assumed that only members of the young generation move between regions. Both regions are assumed to have "uniform" ability distributions, which mean that migration does not have any effect on the ability distribution in these regions.[15]

The model incorporates the interaction of household behavior, firm behavior, political process, and international labor flows. In the model explained above, a decrease in the population growth rate can affect labor flows and capital accumulation in two ways. First, it can affect "directly" by causing fewer workers in the economy, which leads to higher marginal product of labor, and thereby inducing labor inflows, *ceteris paribus*. Second, it can also affect "indirectly" through endogenous fiscal policy by changing the identity of the median voter. As a result of the aging trend, median voter becomes a lower ability person that votes for a lower tax rate.

3. Global Aging and Labor Migration

3.1. Population Projections and Simulation Description

Simulations in this section are based on the population projections for developed and MENA countries derived from the 2002 revision of the "World Population Prospects" published by the United Nations (United Nations, 2002a). The two world regions consist of 28 developed and 21 MENA region countries. Population growth rates implied by the projections are shown in Figure 1. The simulations will be shown for two 30-year periods, 2000–30 and 2030–60 and for the entire period 2000–60. The average population growth rates for the 1970–2000 period are used as a starting point. The population growth rate in developed countries decrease from an initial annual average rate of 0.8 percent to 0.67 percent for the 2000–2030 period and then to 0.38 percent for the 2030–60 period. In the MENA region countries, this rate goes down from an initial annual average rate of 3.98 percent to 2.29 percent for the 2000–30 period and then to 1.03 percent for the 2030–2060 period.

The elasticity of output with respect to capital input is set equal to one-third ($\alpha = 0.33$).[16] The annual rate of time preference is chosen to be 4 percent.[17] The two parameters, the rate of time preference in the utility specification and the population growth rate, are adjusted to the length of the model period (30 years). In the simulations, the ability level, *a*, is assumed to be distributed uniformly on the interval [0,1].

A critical parameter in the model is the elasticity of human capital with respect to government spending on education and ability level (ψ). Laitner (2000b) used a human capital function that is similar to (4) and set his human capital elasticity with respect to

[14] Under a source system, labor income is taxed where income is earned. The model tax treaties of the OECD and the United Nations both give source countries the first rights to tax income accrued within their borders.

[15] A more realistic case is allowing for migration of workers that have certain abilities (unskilled vs. skilled). However, this would conflict with the uniform ability distribution which assumes that ability levels in the distribution are chosen at random.

[16] This elasticity estimate is consistent with the data from the United States. See Laitner (2000a) for an argument.

[17] Caldwell, Favreault, Gantman, Gokhale, Johnson, and Kotlikoff (1999) argue that a premium of riskiness should be added to the widely used 2 percent rate. They use 3.5 percent as the discount rate which is the real safe return on indexed Treasury bonds. See Coronado, Fullerton and Glass (2000) for a recent argument on the variety of discount rates used in studies of social security. They assert that the selection of discount rates ranges between 2 to 5 percent.

education equal to 0.1967. Based on an initial value of the ability of the median voter, Laitner's estimate corresponds approximately to $\psi = 0.4$ in our model. However, series of studies (and updates) by Psacharopoulos (1985, 1994 and 2004) estimated a significantly higher rate of return to education for low income and developing countries compared to developed countries. Hence, $\psi = 0.5$ is chosen as a compromise given Laitner's estimate and the MENA countries used in population projections.

The numerical simulations are shown for the following economic variables: number of workers, capital per worker, government spending (on education) per worker, education tax rate, human capital per worker, income per worker, consumption of a young person, consumption of an old person, and total consumption. To address the research questions mentioned in the outline, various simulation scenarios will be considered. First, the full (or perfect) labor mobility model is compared to an alternative open economy model where capital is internationally mobile without international labor mobility. This shows the significance of the choice of factor mobility in growth results. To examine the impact of migration policies of developed countries, the full (or perfect) labor mobility model is compared to two variants of this model. The first is the case where labor mobility is only allowed after 2030. This scenario considers the possibility that doors remain closed in the developed region until aging becomes an even bigger problem in that region. The next scenario allows for free labor mobility but puts a constraint on the political participation of migrant labor in the developed region for the first period. This simulates an extended delay in the naturalization of foreign workers into the political system of a country. Finally, for the significance of education policies, a sensitivity analysis will be conducted to show growth results from a different rate of return on education in MENA and the developed countries.

3.2. Full Labor Mobility Simulation Results

The full labor mobility simulation has perfect international labor mobility with migrant labor participating in the political system. Based on the population projections mentioned above, labor migrates from the MENA region to the developed region. Figure 2 shows this in reference to the change in the number of workers in both regions. The developed region experiences a major boom in foreign workers, particularly between 2000 and 2030. On the other hand, the MENA countries send labor to the developed region and thus experience significantly lower domestic labor growth despite a high population growth.

Figure 3 shows that this labor movement leads to opposite changes in capital stock per worker in developed and MENA regions between 2000 and 2030. The influx of labor into the developed region does not translate into capital growth in that period since capital stock is determined by saving in the previous period (1970–2000), leading to a decrease in that period's capital stock per worker. MENA region experiences a significant rise in the capital stock per worker since the capital stock in the period 2000–2030 is utilized by fewer workers. The contribution of new labor to the growth in the developed region shows itself in the next period with a considerable 54 percent growth in capital stock per worker. While the MENA region still exhibits a strong growth in capital stock per worker between 2030 and 2060, this is significantly smaller than the growth recorded between 2000 and 2030. This is mainly due to considerable population growth decrease (from 3.98 percent to 2.29 percent) in the MENA countries coupled with labor emigration between 2000 and 2030 leading to significant saving per worker and capital per worker increases. While this population loss gave an initial boost to the MENA region in 2000–30, it eventually showed itself in lower capital growth in 2030–2060 period. The outlook for the sixty year period from 2000 to 2060 shows a small overall decline in capital stock per worker in the developed region but a strong increase in the MENA region.

The other important component of growth is the human capital accumulation. As shown in equations (4) and (12), human capital is a function of the government spending on education. Changes in human capital are shown first in Figure 4, which is followed by figures that show changes in the education tax rate and education spending. Figure 4 shows that both regions experience decreases in human capital worker between 2000 and 2030 and during the entire 2000-2060 period. Developed region record a slight increase between 2030 and 2060 mainly due to migrant labor offsetting the negative effect of a decrease in the median voter ability, which would mean lower support for education spending, caused by aging. On the other hand, the MENA suffers from losing labor to the developed world by having significant decreases in the human capital per worker in all periods, particularly between 2000 and 2030.

As mentioned above, the link between labor growth and human capital can be understood better with an examination of the changes in the education tax rate and education spending. These are shown in Figure 5 and Figure 6, respectively. As discussed in the political process of fiscal policy, aging causes median voter to become a lower ability person putting a downward pressure on the education tax rate. However, labor migration offsets this negative effect by increasing the number of young voters. The migrant workers do not only contribute to domestic production but they also participate in the political system by voting for fiscal policy decisions. Since they are young, they change the political scene in favor of the young generation. Thus, with labor migration the choice of the tax rate changes in favor of the young voters despite the aging trend. Figure 5 shows this for the developed region between 2000 and 2030. The education tax rate increases considerably in the developed region while it falls quite dramatically in the MENA region. However, the education tax rate decreases in the developed region in the following period as labor growth diminishes. The developed region experiences a slight decrease in the education tax rate between 2000 and 2060 while the MENA region records a significant decrease. This decrease in the MENA region is also partially due to significant decrease in the population growth rate in the region during the entire period as shown in Figure 1. Changes in education spending in Figure 6 closely match the tax rate changes in Figure 5 and the human capital changes in Figure 4. As in human capital and tax rate decreases in Figures 4 and 5, education spending in the MENA region decreases considerably in all periods between 2000 and 2060. This is mainly due to decreases in the number of productive workers through lower population growth rates and emigration.

Results in Figure 3 and 4 for capital per worker and human capital per worker provide a good background for examining changes in income per worker. Figure 7 shows that the MENA region exhibits income growth in all periods between 2000 and 2060. This is mainly due to strong growth in capital per worker which dominates decreases in human capital per worker. The developed region suffers from decrease in both capital per worker and human capital per worker between 2000 and 2030, which shows itself in significant decrease in income per worker in this period. This region exhibits an overall decrease in income per worker for the entire period. On the other hand, the MENA region benefits from strong growth in capital per worker, which leads to an income growth in all periods considered.

In addition to income per worker, consumption as a measure of welfare is examined in Figures 8 through 10. Figure 8 presents the change in the consumption by young people in developed and MENA regions. As shown in equation 7, consumption of a person when young depends on the net labor earnings. As also seen in equation 19, perfect labor mobility dictates that the net labor earning of a young worker gets equalized between the two regions. Since labor flows from the MENA region to the developed region, net labor earnings must have gone up in the MENA region and it must have gone down in the developed region. This would increase consumption by the young in the MENA region and decrease it in the developed region. This is seen clearly in Figure 8. Since labor migration to the developed

region occurs in both 2000-2030 and 2030-2060 periods, similar consumption pattern is observed in the MENA region in both periods and in the entire period from 2000 to 2060.

Old-age consumption, different from the young-age consumption, also depends on the net return on saving. The increase in the capital per worker in the MENA region shown in Figure 3 depresses the interest rate in this region, leading to a decrease in the net return on saving. Figure 9 shows that this leads to a decrease in the old-age consumption in this region between 2000 and 2030. The developed region experiences the opposite and has an increase in the old-age consumption in that period. In the following period, the old-age consumption in the MENA region (developed region) increases (decreases) due to an increase (decrease) in the net saving income. However, the old-age consumption decreases in the MENA region and increases in the developed region between 2000 and 2060.

Figure 10, brings the results shown in Figure 8 and 9 together and show changes in the sum of consumptions, in a given period, of representative persons from young and old generations. The figure shows that the MENA region experiences an increase in the sum of consumptions in all periods from 2000 to 2060. However, the developed region has an increase in the sum of consumptions only between 2000 and 2030. It has a slight overall decrease between 2000 and 2060.

3.3. Model Comparisons, Labor Mobility Scenarios, Sensitivity Analysis

In this section, full labor mobility model is compared to an alternative open economy model where capital is internationally mobile without international labor mobility. Further comparisons are also made using alternative assumptions about labor mobility and the political process of fiscal policy. The goal is to shed light on the choice of factor mobility in the presence of population aging. Table 2 presents simulation results for these comparisons. Results shown in Figure 2 through 10 are reproduced in columns 1 and 2 of Table 2.

Columns 3 and 4 in Table 2 show that the capital mobility model produces inferior outcomes for the developed region, in terms of the economic variables used in the analysis, compared to the full labor mobility model. It appears that labor flows to the developed region offset the adverse effect of population aging particularly on the human capital per worker. As explained earlier, migrant workers participate in the political process of fiscal policy by voting favorably for the education tax, leading to enhanced education spending and human capital in the developed region. The MENA region exhibits strong capital and income growth throughout the periods under both full labor mobility and capital mobility (without labor mobility) models. In the capital mobility model without labor mobility, the MENA region does not lose labor to the developed region and benefits from the inflow of capital from the developed region. In this model, capital inflows to the MENA region enable this region to increase investment, production and income while at the same time retaining its young productive workers, voters and human capital. Thus, the capital mobility model (without labor mobility) produces more favorable results for the MENA region compared to the full labor mobility model.

The next set of comparisons is between the full labor mobility model and variants of this model shown in columns (5) through (8) in Table 2. The first is the case where labor mobility is only allowed after 2030. This scenario considers the possibility that doors remain closed in the developed region until aging becomes an even bigger problem in the developed region.[18] The results for this scenario in column (5) show that the developed region may fare better if labor flow is delayed until 2030. With the relatively low labor growth, net return on labor does not decrease as much as in the full labor mobility model in column (1) leading to better

[18] For example, in the U.S., the effect of the baby boom generation retirement will not be fully seen for another decade.

capital, human capital, income and consumption results. The reverse is true for the MENA region results shown in column (6). Due to the constraint on labor migration until 2030, MENA region experiences significantly lower growth particularly in capital per worker.

The next scenario allows for free labor mobility but puts a constraint on the political participation of migrant labor in the developed region for the first period. This simulates an extended delay in the naturalization of foreign workers into the political system of a country. After a thirty-year delay, workers eventually become citizens with eligibility to vote. Column (7) shows that this scenario produces rather adverse outcomes for both regions. These are mostly driven by greater decreases in education tax rate, education spending and human capital per worker compared to the results in columns (1) and (2). With aging in the developed region, lack of young migrant votes for the education tax rate leads to a decrease in this tax rate such that net labor earning differential between the regions can only be closed by a greater flow of labor from the MENA to the developed region. This is the reason behind the interesting result of substantially high labor growth in the developed region.

The final scenario considers the effect of lower returns to education to the simulation results. This is done by choosing a lower value for the elasticity of human capital with respect to government spending on education and ability level (ψ). The results in column (10) of Table 2 show a substantially adverse outcome for the MENA region. Due to lower productivity of the MENA region workers, migration from the MENA to the developed region is significantly lower which in turn leads to lower capital growth. At the same time, lower return on education discourages human capital accumulation which explains the significant decrease in human capital per worker in the MENA region throughout the period from 2000 to 2060. These produce significant decreases in income per worker and sum of young and old consumption. This scenario highlights the importance of returns to education for the growth results in the MENA region.

4. Implications and Conclusions

This paper examines the economic effects of aging trends using the population projections for the developed countries and the MENA region. Unlike the majority of studies on aging, the paper addresses the political economy of aging and education spending through a median voter model. It is argued that labor mobility has a dual effect on the economy. Besides the contribution of young migrant workers to the economy as laborers, these workers also contribute to capital accumulation as savers. This paper highlights another effect through migrant workers' involvement in the political process of fiscal policy. When allowed to vote, migrant workers change the political structure composed of young and elderly voters in both labor-receiving and labor-sending countries. In a majority voting mechanism for fiscal policy decisions, political shifts resulting from labor migration may have sizeable impacts on government programs such as education, and in turn may have strong growth and welfare effects.

For the analysis, a two-region, two-period overlapping generations model with international labor mobility and a politically responsive fiscal policy is used. The numerical simulations based on United Nations population projections for the developed and MENA regions show significant labor movements from the developed to the MENA region throughout the 2000–60 period. While labor inflows seem to help the developed region recover from the aging trend, this region incurs an overall decrease in income per worker and consumption. On the other hand, the MENA region experiences significant increases in income per worker and consumption.

There are three sets of policy implications from this paper. The first is about the comparison of internationally mobile factors of production. The policymakers in the MENA region

would benefit from knowing the consequences of the policy choice by the developed countries of making capital or labor mobile in the region. The developed region suffers from substantial income and consumption decreases under the capital mobility model without labor mobility, which is averted, to a large extent, in the labor mobility model. The MENA region, on the other hand, seems to benefit more in the capital mobility model. These comparisons show that the choice between labor and capital mobility indeed matters for the analysis of the effects of population aging.

The second is related to migration policies of developed countries. For this, further comparisons are made using alternative assumptions about labor mobility and the political process of fiscal policy. The full labor mobility model performed quite well compared to a scenario where labor migration from MENA to developed region is restricted until 2030 and another scenario where labor migrates to the developed region but does not participate in the political system for the first thirty-year period. The latter scenario gives inferior economic results for both the developed and the MENA regions. Constraining political participation of young migrant workers does not seem to help when these young workers can vote for greater education spending that sets a growth process through human capital enhancement.

The third is about education policies. The paper is unique as it incorporates a political economy model of education. Labor movements and growth results are expected to depend significantly on return to education. A sensitivity analysis on the parameter that shows the return to education spending reveals that the MENA countries would suffer significant decreases in income per worker and sum of young and old consumption from a lower return to education. This scenario highlights the importance of returns to education for the growth results in the MENA region.

This paper points to various possible extensions for future research. One important extension is to model brain drain more explicitly. This is could be an important factor that will weigh against the positive welfare impact of labor outflows for the MENA region. On the other hand, remittances of these workers may partially or fully offset this effect. Hence, modeling brain drain and including remittances in the same model would be an important extension of this paper. Finally, high unemployment in the MENA region and problems associated with integration of immigrant workers into the developed country societies are two other important issues that need to be addressed in future research.

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Figure 1: Population Growth Rates in Developed and MENA Regions

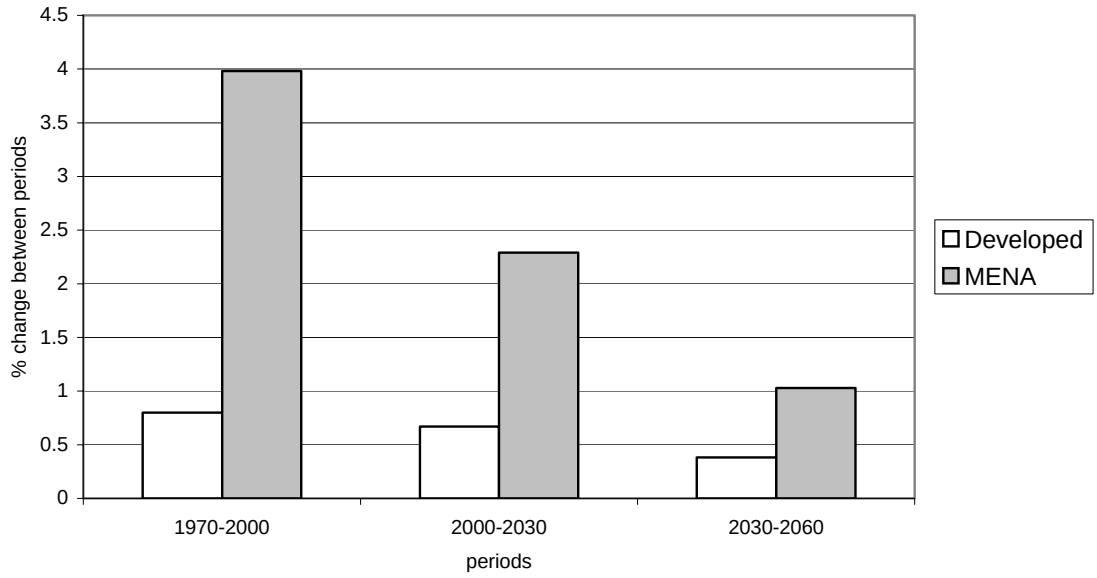

Figure 2: Change in Number of Workers

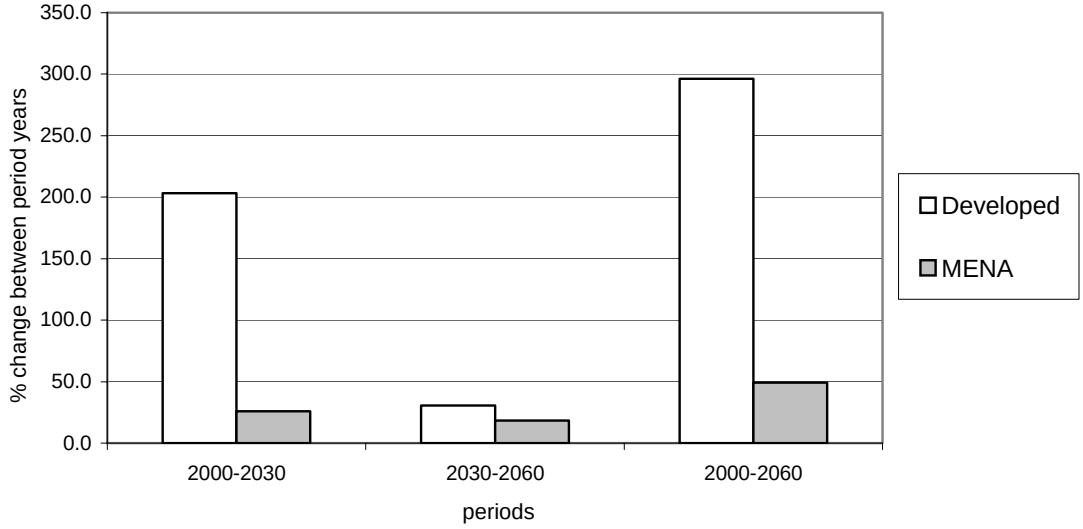

Figure 3: Change in Capital Stock Per Worker

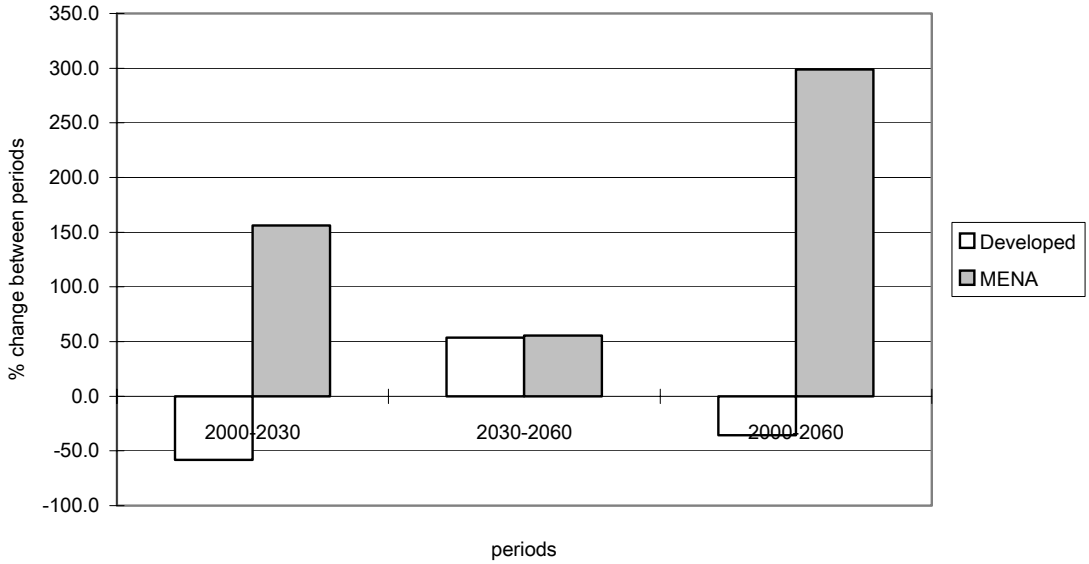

Figure 4: Change in Human Capital Per Worker

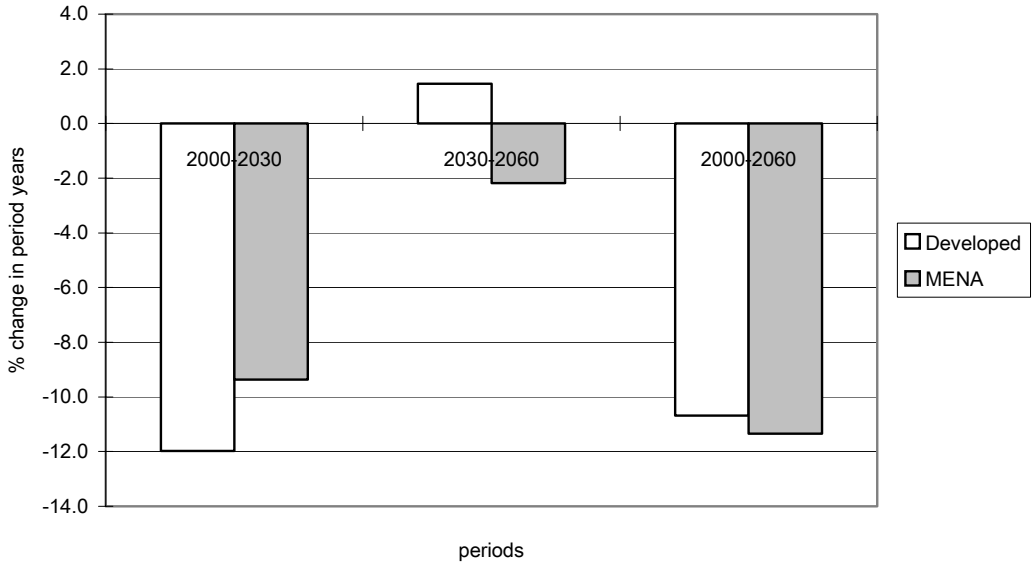

Figure 5: Change in Education Tax Rate

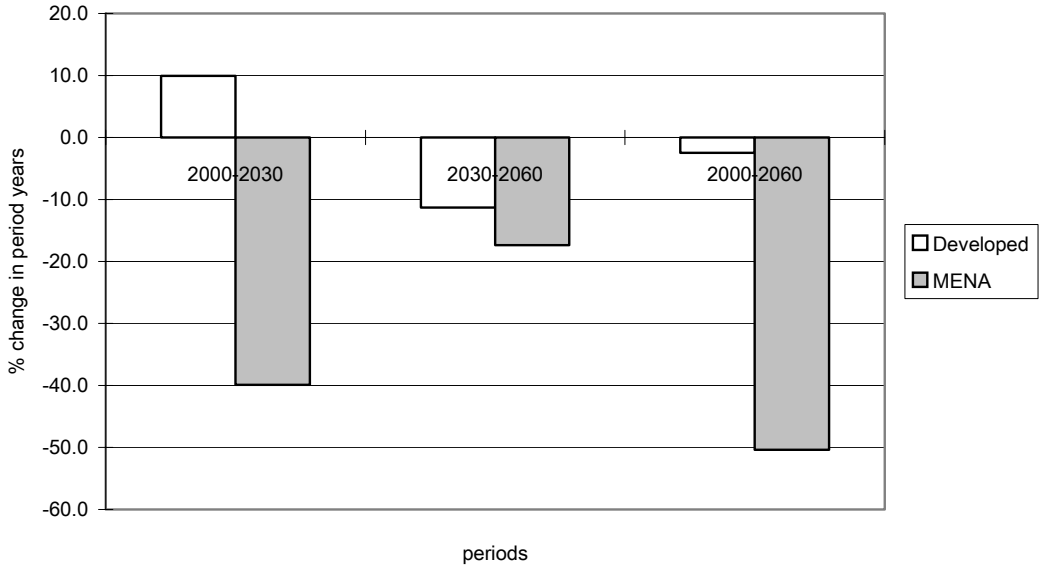

Figure 6: Change in Education Spending Per Worker

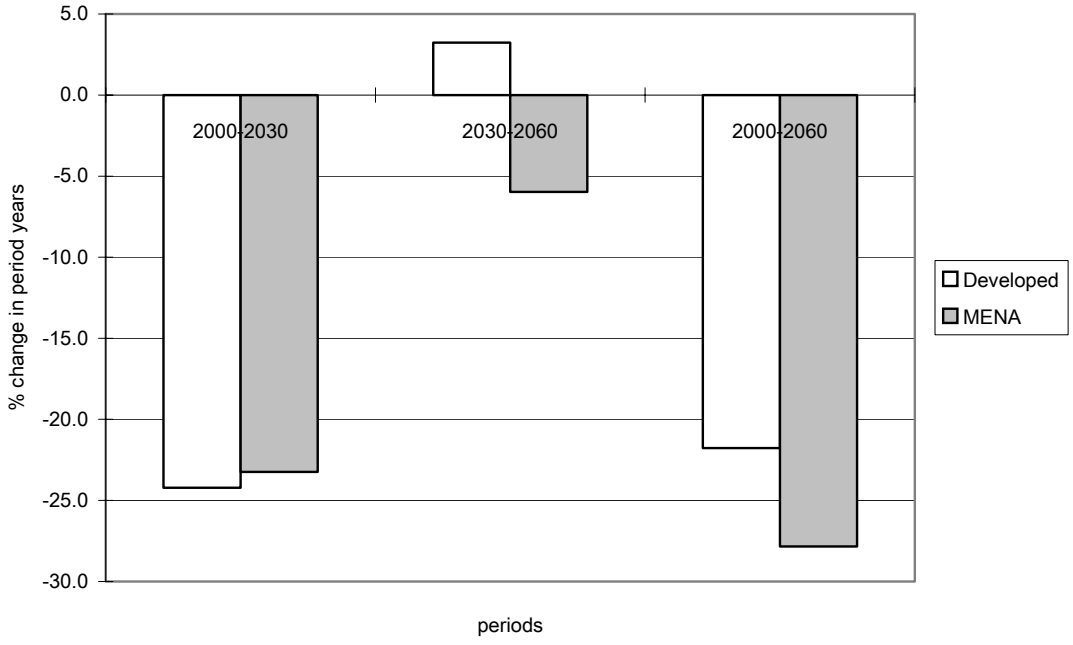

Figure 7: Change in Income Per Worker

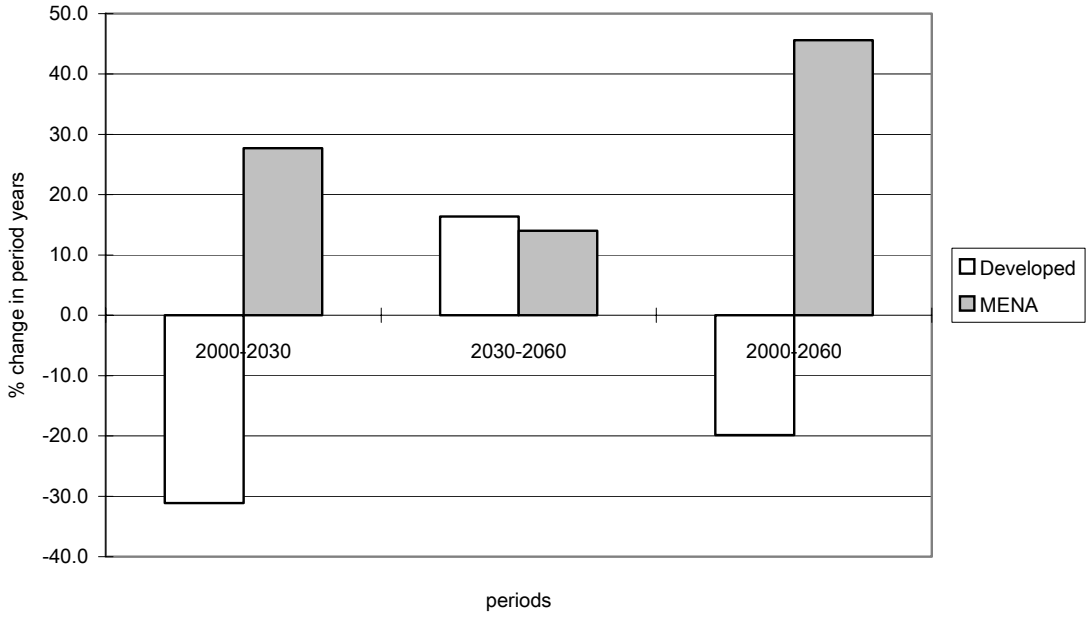

Figure 8: Change in Consumption of Young

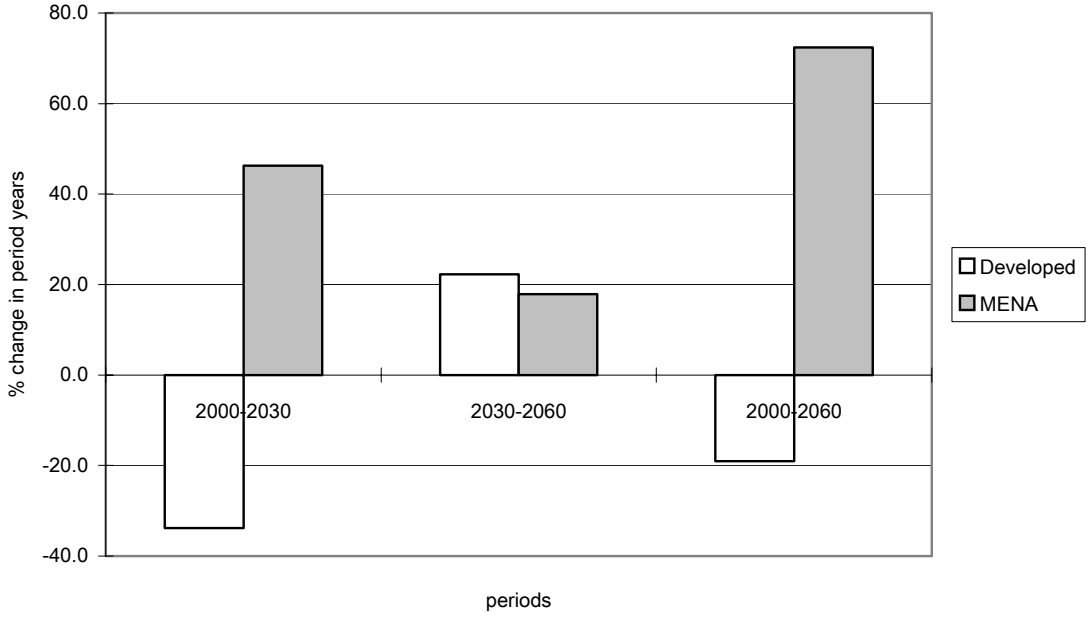

Figure 9: Change in Consumption of Old

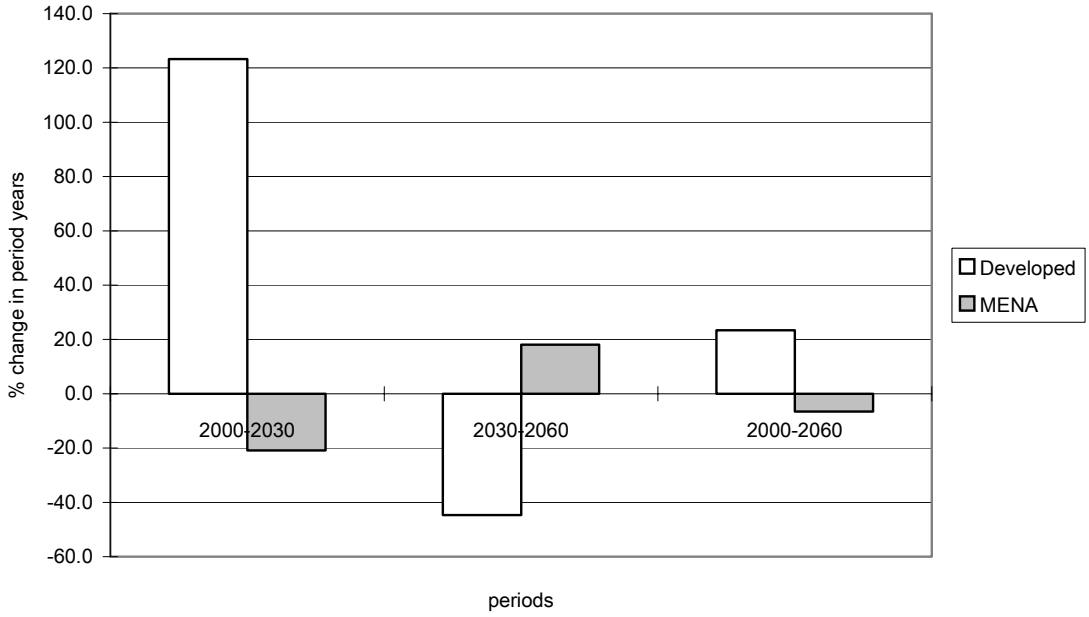

Figure 10: Change in Sum of Young and Old Consumption

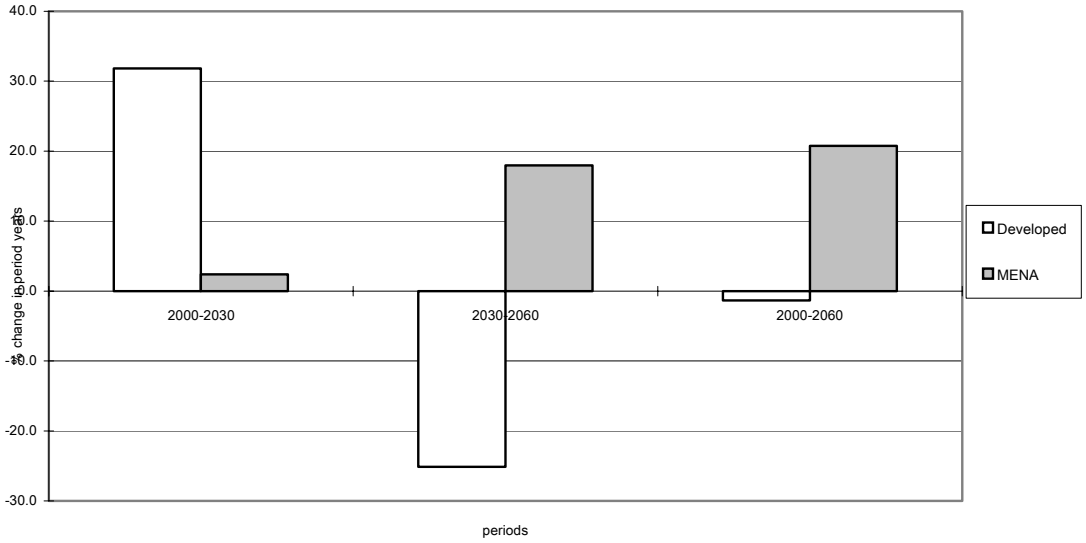

Table 1: Demographic Changes in MENA and other Countries (1982-97)

MENA	**1982-84**	**1988-90**	**1995-97**	**1982-89**	**1990-97**
Annual population growth rate (%)	3.43	2.46	2.84	3.31	2.67
Share of age 15-64 in total population (%)	55.14	56.23	57.63	55.76	57.39
Share of age 0-14 in total population (%)	41.36	40.97	38.86	41.17	40.03
Other Non-OECD	**1982-84**	**1988-90**	**1995-97**	**1982-89**	**1990-97**
Annual population growth rate (%)	2.09	2.24	1.87	2.15	1.97
Share of age 15-64 in total population (%)	56.91	58.56	60.05	57.62	59.44
Share of age 0-14 in total population (%)	38.27	36.69	34.43	37.66	35.30
OECD	**1982-84**	**1988-90**	**1995-97**	**1982-89**	**1990-97**
Annual population growth rate (%)	0.50	0.71	0.58	0.56	0.64
Share of age 15-64 in total population (%)	65.30	66.49	66.51	65.93	66.48
Share of age 0-14 in total population (%)	22.20	20.46	19.40	21.44	19.73

Source: World Development Indicators, World Bank CD-ROM (2003).

Table 2: Comparisons with Alternative Factor Mobility Models 1/

		Labor Mobility Model (No Capital Mobility)		**Capital Mobility Model (No Labor Mobility)**	
	Time Periods	**Developed Region (1)**	**MENA Region (2)**	**Developed Region (3)**	**MENA Region (4)**
Number of workers	2000–2030	203.2	25.9	22.2	97.2
	2030–2060	30.6	18.4	12.0	36.0
	2000–2060	296.1	49.1	36.9	168.2
Capital stock per worker	2000–2030	-58.1	156.2	-48.8	194.9
	2030–2060	53.7	55.6	32.9	40.5
	2000–2060	-35.6	298.7	-31.9	314.4
Human capital per worker	2000–2030	-12.0	-9.4	-21.1	24.4
	2030–2060	1.5	-2.2	-10.5	-2.1
	2000–2060	-10.7	-11.3	-29.3	21.7
Income per worker	2000–2030	-31.1	27.7	-31.5	65.3
	2030–2060	16.4	14.0	2.0	10.3
	2000–2060	-19.8	45.6	-30.2	82.4
Education tax rate	2000–2030	10.0	-39.9	-13.2	3.7
	2030–2060	-11.3	-17.4	-23.8	-14.0
	2000–2060	-2.5	-50.4	-33.8	-10.8
Education spending per worker	2000–2030	-24.2	-23.2	-40.5	71.6
	2030–2060	3.2	-6.0	-22.3	-4.9
	2000–2060	-21.8	-27.8	-53.8	63.1
Consumption of young	2000–2030	-33.8	46.3	-28.0	63.1
	2030–2060	22.2	17.9	9.9	16.2
	2000–2060	-19.1	72.4	-20.9	89.4
Consumption of old	2000–2030	123.2	-20.9	21.7	-38.9
	2030–2060	-44.7	18.1	-37.9	40.8
	2000–2060	23.4	-6.5	-24.4	-14.0
Sum of young and old consumption	2000–2030	31.8	2.4	-0.9	-8.8
	2030–2060	-25.2	18.0	-22.1	27.8
	2000–2060	-1.3	20.8	-22.8	16.6

Table 2: Comparisons with Alternative Factor Mobility Models 1/ (concluded)

		Labor Mobility Model with Mobility After 2030 (No Capital Mobility)		Labor Mobility Model with Migrants Voting After 2030 (No Capital Mobility)		Labor Mobility Model with Lower Returns to Education (No Capital Mobility)	
	Time Periods	Developed Region (5)	MENA Region (6)	Developed Region (7)	MENA Region (8)	Developed Region (9)	MENA Region (10)
Number of workers	2000–2030	22.2	97.2	217.1	20.5	116.5	60.1
	2030–2060	78.6	19.7	29.0	18.5	16.6	33.5
	2000–2060	118.3	136.2	308.9	42.7	152.4	113.8
Capital stock per worker	2000–2030	3.9	63.6	-59.9	167.7	-41.3	101.4
	2030–2060	-30.5	105.2	56.8	41.4	44.2	34.9
	2000–2060	-27.7	235.6	-37.2	278.6	-15.4	171.7
Human capital per worker	2000–2030	-1.2	7.0	-27.5	-26.3	-5.6	-36.3
	2030–2060	-0.5	-20.7	21.5	16.5	-7.1	-15.3
	2000–2060	-1.7	-15.2	-11.9	-14.2	-12.3	-46.0
Income per worker	2000–2030	0.4	23.1	-40.4	12.7	-19.3	-6.9
	2030–2060	-11.6	8.5	32.1	24.2	7.4	-1.2
	2000–2060	-11.2	33.6	-21.2	40.1	-13.3	-8.0
Education tax rate	2000–2030	-2.8	-3.4	-17.8	-63.8	9.6	-57.1
	2030–2060	11.7	-51.0	17.3	29.9	-20.8	-64.3
	2000–2060	8.5	-52.6	-3.6	-53.0	-13.2	-84.7
Education spending per worker	2000–2030	-2.6	18.9	-51.0	-59.3	-11.7	-59.9
	2030–2060	-1.1	-46.5	54.8	61.4	-14.9	-64.7
	2000–2060	-3.7	-36.4	-24.2	-34.2	-24.8	-85.8
Consumption of young	2000–2030	1.7	24.6	-36.2	39.1	-22.3	12.5
	2030–2060	-15.6	27.7	25.3	20.2	17.3	7.0
	2000–2060	-14.2	59.1	-20.1	67.2	-8.8	20.4
Consumption of old	2000–2030	54.5	0.1	124.5	-26.6	94.0	-25.9
	2030–2060	17.4	-14.8	-46.6	22.9	-33.6	-5.9
	2000–2060	81.4	-14.7	19.9	-9.8	28.9	-30.2
Sum of young and old Consumption	2000–2030	23.7	8.6	30.9	-3.9	26.3	-13.0
	2030–2060	1.6	2.1	-26.2	21.6	-15.3	-0.3
	2000–2060	25.8	10.8	-3.4	16.9	6.9	-13.3

Notes: 1/ All numbers refer to percentage changes between the years indicated in the time period.
Source: Computed by author.

Appendix:
The Effect of Increasing Dependency Ratio on the Ability Level of the Median Voter

Recall that median voter is defined by $N_{t-1} + N_t \int_0^{a_m} f(a)\,da = \frac{N_{t-1} + N_t}{2}$. Rewriting this:

$N_{t-1} + N_t F(a_m) - N_t F(0) = \frac{N_{t-1} + N_t}{2}$, which can be rearranged as**:**

$F(a_m) - F(0) = \frac{N_t - N_{t-1}}{2N_t}$**.** Differentiating both sides we get, $F'(a_m)\,da_m = \frac{\hat{N}_t - \hat{N}_{t-1}}{2(1+\eta^*)}$, where

$\hat{N}_t = \frac{dN_t}{N_t}$, $\hat{N}_{t-1} = \frac{dN_{t-1}}{N_{t-1}}$, and $1+\eta^* = \frac{N_t}{N_{t-1}}$ evaluated at the initial steady state. Finally this

can be rearranged as $da_m = \frac{\hat{N}_t - \hat{N}_{t-1}}{\underset{(+)}{F'(a_m)}\,2(1+\eta)}$ which is negative when $\hat{N}_t < \hat{N}_{t-1}$.