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# The impact of MENA-to-EU migration in the context of demographic change*

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**Abstract.** In this paper, we analyze the consequences of increasing MENA-to-EU migration flows on both sending and receiving regions. In the first part of the paper, we characterize the structure of MENA emigration as well as the demographic trends in the EU and MENA. We show that EU27 is a major destination for 9 MENA countries, including Algeria, Egypt, Morocco and Tunisia. Potential increased flows of MENA-to-EU migration in the future would in all probability particularly impact these countries. Moreover, replacement migration policies encouraging MENA-to-EU flows of working-age people would need to be temporary, as MENA countries themselves will be facing labor shortages in the future. In the second part of the paper, we analyze the economic effects of increased migration using a general equilibrium model. We find that increasing MENA-to-EU migration would generate significant changes in EU15 tax rates and GNI per capita, smoothing the fiscal and economic burdens of aging. Compared to a non-selective immigration shock, selecting immigrants has a moderate impact in reducing tax rates, but leads to a greater impact on GNI per capita in the EU15. On the other hand, increases in emigration, without some compensating policies on education, would have a strong detrimental impact on MENA tax rates, especially if emigrants are high-skilled. Regarding GNI per capita and inequality in MENA, increasing low-skilled emigration leads to strong improvements (mainly due to remittances) while increasing high-high-skilled emigration induces detrimental consequences. Finally, the negative effects of a more selective migration policy in MENA may be considerably mitigated if the brain drain leads to side-effects or is accompanied by increased education attainment at origin. In particular, our results suggest that a stronger partnership between EU15 and selected MENA countries, involving more high-skilled migration and a greater cooperation in human capital formation, could raise the welfare of all parties concerned.

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# 1 Introduction

The decrease in fertility and mortality rates induces a progressive and inescapable *greying* of European nations. The economic effects of an aging population are considerable. Changes in the demographic structure are likely to affect the amount of capital per worker (with induced effects on interest rates and wages), the demand for some types of goods or the rate of economic growth. However population aging also raises the average amount of public expenditures per capita. The largest areas of public expenditure in many countries are now health care and pension benefits. Both are expected to increase dramatically as the population ages. Governments then face hard choices between higher taxes (including a possible reweighting of taxes from earnings to consumption), increasing debt (which could jeopardize the welfare of future generations) and a reduced government role in providing health care and social security.

Another option is to find policies that increase the supply of labor and the tax basis. Over the last years, economists and policymakers have discussed the opportunity to define a new labor-market oriented policy of immigration. Immigration appears as a potential solution to reduce the burden of aging. This is especially the case in Europe where the European Commission has suggested to conduct a *blue card* policy facilitating the entry of foreign high-skilled workers. Following the examples of the German *green card* or UK points-based system, many countries are now considering the possibility to select immigrants. Clearly, we should not expect immigration to totally solve the problem. In their report on replacement migration, the United Nations (2000) demonstrate that keeping the dependency ratio constant over the period 2000-2050 requires multiplying European annual immigration flows by 50 (by 15 in the United States). In many countries, the immigration rates would then reach unrealistic values that are not politically, economically and demographically sustainable.

Nonetheless, a decent increase in immigration flows or a change in the schooling level of immigrants could attenuate the burden supported by future generations of European natives. Given its economic (low skill premia, high tax rates, generous welfare programs) and linguistic characteristics, it is very hard to believe that continental European nations are able to attract many (skilled) migrants from the rest of the world. However, given its colonial links and geographical proximity, European countries are the main destinations of African emigrants, especially those from the Maghreb and a couple of Middle East countries. In fact, migrants originating from the MENA represented the largest shares among migrants (33.1%) and also among *high-skilled* migrants (19.7%) originating from less advanced countries and living in the EU in 2000. In comparison, MENA citizens constituted only 5% of all migrants and only 7.7% of all high-skilled migrants from less advanced countries living in North America (United States and Canada), where Latin American citizens are proportionally the largest group among migrants from less advanced countries (53.6% of all migrants and 33.1% of all high-skilled migrants).[1] Given the large diasporas resulted from guest-worker bilateral

[1] In fact, MENA citizens living in the EU15 exceeded migrants originating from Eastern Europe (21.6%), South Asia (12.7%), sub-Saharan Africa (11.2%), East Asia (9.7%), Latin America and Caribbean (8.9%) and the former Soviet Union (2.9%), see Docquier, Lowell and Marfouk (2007).

programs of the post-World War II and given that diasporas attract further migrants (see Beine et al. 2010), European countries could probably increase the number of immigrants from the Middle East and Northern Africa (MENA) or even conduct more selective policies towards these immigrants. Would such policies be optimal for European countries? What would be their implications for MENA origin countries? These are the questions addressed in this paper.

Different approaches have been used in the economic literature to study the implications of replacement migration. Beyond numerous theoretical analyses[2], economists have also quantitatively assessed the fiscal effect of immigration. One strand of this literature relies on the generational accounting methodology and delivers mixed results concerning the impact of immigration on public finance.[3] Auerbach and Oreopoulos (1999) stress that the net benefit of immigration on the fiscal balance is small relative to the size of the overall imbalance itself, while Collado et al. (2004) find a significant positive impact of immigration on intertemporal public finance in Spain. Other generational accounting studies reveal that policies acting upon migrants' characteristics can lead to important fiscal gains. For instance, Bonin et al. (2000) suggest that the skill structure of future immigrants can have a considerable impact on public finance. A similar conclusion is drawn by Chojnicki (2006) for France. However, the generational accounting methodology relies on many restrictive assumptions. For instance, since it works in a partial equilibrium setting, it cannot account for the indirect effect of immigration on public finance via its impact on factor prices.

Some authors claim therefore that the use of a general equilibrium approach is more accurate to quantitatively measure the fiscal effect of immigration. Only few (dynamic) general equilibrium studies investigate if *future* immigration can contribute to reduce today's and tomorrow's fiscal burden.[4] The standard reference is Storesletten (2000), who sets up a closed-economy general equilibrium model with overlapping generations of the US economy. He finds that immigration does little to reduce the fiscal burden of aging in the United States, but a rise in the number of *high-skilled* immigrants may be beneficial. A similar conclusion is provided by Fehr, Jokisch and Kotlikoff (2004), who study the fiscal effects of immigration within a three-regional model (US, Europe and Japan) to account for the potential fiscal effects of induced capital movements.[5]

Studies on the fiscal effects of immigration focus exclusively on the implications for host countries. However, in an increasingly globalized world, advanced countries cannot anymore ignore the consequences of their political decisions on other countries. It would therefore be instructive to evaluate the impact of immigration policies in developed countries on migrants'

[2] See among others, Razin and Sadka (1999), Krieger (2004), Kemnitz (2003, 2008), Sinn (2002), Leers, Meijdam and Verbon (2004), Scholten and Thum (1996), Lagos and Lacomba (2010).

[3] The generational accounting approach consists in investigating the long-run sustainability of fiscal policies, accounting for the needs of present and future generations (Auerbach, Gokhale and Kotlikoff, 1994).

[4] Chojnicki, Docquier and Ragot (2009) assess the impact of immigration on the overall US economy over the 20th century, including the impact on public finance.

[5] Within a large-scale computable general equilibrium model for the Danish economy, Schou (2006) finds that immigration can alleviate the fiscal sustainability problem only when immigrants and their children have participation and productivity levels close to those of natives.

sending countries. Fehr, Jokisch and Kotlikoff (2004) stress that increasing the number of immigrants is not unproblematic. They conjecture that if high-skilled migrants' would come from developing regions, it may worsen the brain drain "that is already greatly depleting the human capital of developing regions". This claim is hazardous and requires an analysis able to deal with the impact of migration both on migrants' destination and origin countries.

In fact, the brain drain literature shows that the impact of skilled emigration on the level of human capital in sending countries and on their economy, in general, is not clear-cut. Early studies on skilled emigration emphasize the direct negative effect induced by the loss of a highly productive labor force, a scarce resource in developing countries (Baghwati and Hamada, 1974). However, a recent wave of papers highlights several positive side-effects of skilled emigration for migrants' source countries.[6] One benefit from high-skilled emigration is that it fosters human capital formation (Mountford 1997, Stark and Wang 2002; Beine, Docquier and Rapoport, 2001, 2008). Higher migration prospects for high-skilled migrants induce greater incentives for individuals to educate because of a higher expected skill premium. If the incentive effect (brain gain effect) compensates the loss of high-educated workers (brain drain effect), then human capital is enhanced compared to a situation without high-skilled emigration. Beine, Docquier and Rapoport (2008) show that regions with the largest high-skill emigration rates are those who do not benefit from brain gain but suffer brain drain. Moreover, besides the positive impact of remittances sent home by emigrants, one benefit of the brain drain is attributed to increased FDI inflows favored by migrant networks, which reduce informational barriers and thus enhance the attractiveness of the home country to foreign investors (Kugler and Rapoport, 2007). Also, several authors suggested that a high-skilled diaspora facilitates international technology diffusion raising total factor productivity in immigrants' home countries (e.g., Kerr, 2008).

To the best of our knowledge, our study is the first to evaluate the implications of high-skilled migration both on migrants' receiving countries and on migrants' sending countries in a unified framework. To perform this analysis, we employ a multi-region general equilibrium model of the world economy (both developed and developing regions) and calibrated to real data. The model is characterized by overlapping-generations (OLG) dynamics and features high- and low-skilled individuals. We study the consequences of increased South-North migration, i.e. from the MENA to the EU15. First, we compare the consequences of an immigration policy favoring the arrival of high-skilled migrants ("High-Skilled" scenario) with a policy allowing the entrance of low-skilled migrants ("Low-Skilled" scenario) into the EU15.

Another originality of our study is that it encompasses various ways in which high-skilled migrants may affect their host and sending countries. In a subsequent analysis, we consider therefore several scenarios of high-skilled migration. Along with the "High-Skilled" scenario, we investigate a "Brain Gain" scenario, which accounts for several externalities of high-skilled migration identified in the brain drain literature. To do so, we calibrate these various

[6] See Commander, Kangasniemi, Winter (2004) and Docquier (2007) for surveys of the literature.

side-effects using existing empirical estimates.[7] Moreover, we compare the results of the "High-Skilled" scenario, which assumes that migrants' human capital acquired in the MENA is perfectly transferrable to the EU15, with the ones of a "Brain Waste" scenario, which hypothesizes that high-skilled migrants are employed as low-skilled at destination. A last scenario, "Expansionary", allows for the possibility where MENA countries prepare for greater skilled migration to Europe by accelerating their human capital formation.

The main insights of our analysis can be summarized as follows:

- The MENA region sends about 15 million emigrants abroad, including 5.1 million to the 27 countries of the European Union. For 9 countries of the region, the EU27 (and foremost the EU15) is a particularly important destination. We refer to MENA9 as a group which includes Algeria, Djibouti, Egypt, Iran, Lebanon, Libya, Malta, Morocco and Tunisia. These 9 countries send 9.2 million emigrants abroad, and for more than half (50.5 percent of them), the EU27 is the migration destination. Within this group, there is a subset of countries we refer to as MENA4, including Algeria, Morocco, Tunisia, and Egypt, in which the flows to EU27 as a group are particularly high (either in numbers or proportions of their population). MENA4 sends 4.2 million migrants to Europe, representing 56 percent of their diaspora. In any discussions about increased migration flows from MENA to Europe, these are the countries which would be particularly affected.

- Previous macroeconometric studies suggest that the "brain drain" – the loss of high skilled labor to migration – begins to demonstrate harmful impacts on development if it exceeds a threshold of 10-15 percent (see Docquier, 2007). With the exceptions of Djibouti, Libya and Egypt, all of the MENA9 are already above that level (Lebanon, Malta, Morocco; Algeria, Egypt and Iran are at the border). As a result, for the sending countries of MENA, increasing the levels of high-skilled migration are likely to have damaging impacts on growth and development without accompanying policies to mitigate these harmful effects.

- Demographically, increasing migration flows from MENA4 or MENA9 to EU27 countries would clearly attenuate the deterioration of the European population structure. However, MENA countries themselves expect serious demographic strains after 2030 and will need pension reforms to minimize the risk of a financial crisis. The MENA4 aged-dependency ratio in 2050 will exceed the current ratio observed in the EU. Hence, "replacement or selective migration" policies encouraging MENA-to-EU flows of working-age people should ideally be structured to be temporary (not beyond 2050).

- Our general equilibrium analysis reveals that an increased MENA-to-EU migration would generate considerable changes in EU tax rates and GNI per capita, significantly smoothing the fiscal and economic burdens of aging. Contrary to pure fiscal studies

[7] This procedure is employed in Marchiori, Shen and Docquier (2010) to assess the isolated effect of various externalities of skilled emigration as well as their global impact on sending countries' GDP per capita.

(such as generational accounting), selecting immigrants has only a moderate impact on tax rates. This can be explained by induced effects on wage rates, skill premia and interest rates. However, selection has a strong and positive impact on GNI per capita. In MENA, however, increases in emigration have a strong detrimental impact on tax rates, especially if emigrants are skilled. Moreover increasing low-skilled emigration in MENA leads to improvements in GNI per capita and inequality (mainly due to remittances) while increasing high-skilled emigration induces detrimental consequences.

- The analysis also accounts for different variants of the high-skilled migration scenario. A "Brain Waste" variant (in which high-skilled migrants are employed as low-skilled at destination) combines the worst effects of the selective and non selective shocks, since MENA looses its most productive workers, who are employed as low-skilled in Europe and thus contribute poorly to the EU's economy. In a second variant accounting for positive externalities of the brain drain ("Brain Gain" scenario), the negative impact of high-skilled migration on income per capita and inequality in MENA are mitigated. Still, MENA would suffer from an enlarged brain drain.

- Finally, we consider a possibility where MENA countries prepare for greater high-skilled migration to Europe by accelerating their human capital formation. In this case ("Expansionary" scenario), a high-skilled emigration shock could go along with a rise in education levels of the MENA population and income per capita. This suggests that a stronger partnership between EU15 and MENA countries, involving more high-skilled migration and a greater cooperation in human capital formation, can raise the welfare of all parties concerned. For instance, such an initiative could be designed in the framework of the *"Union pour la Méditerranée"* initiated in late July 2008 by French President Nicolas Sarkozy. The goal of this Union is explicitly to promote a development of the Euromediterranean Partnership.

The remainder of this paper is organized as following. Section 2 provides a detailed snapshot of the current MENA-to-EU labor mobility by education level and its demographic impact on both regions. In Section 3, we use a computable general equilibrium model of the world economy to simulate the impact of increased migration flows from MENA to the EU on tax rates (reflecting the burden of aging), productivity, GDP-GNI levels and demographic variables in both regions.

# 2 MENA-to-EU migration and demographic effects

In this section, we take advantage of two recent studies sponsored by the World Bank, to describe the MENA-to-EU labor mobility. These statistics provide a snapshot on the number of migrants by country of origin and destination (Section 2.1) and on their skill characteristics (Section 2.2). Moreover, based on these data, we evaluate the impact of the MENA-to-EU migration on the demographic structure of both regions (Section 2.3).

## 2.1 Global situation of the MENA-to-EU migration in 2000

To assess the magnitude of MENA-to-EU migration, we first rely on the data set described in Parsons et al. (2007).[8] From Table 2.1, we see that the 21 MENA countries sent 15 million emigrants abroad in 2000. Since the resident population amounted to 316 million, this gives an emigration "rate" of 4.5%. Countries of the Gulf Cooperation Council (GCC) sent 1 million emigrants abroad, representing 3.3% of the native population. Countries with the highest emigration rates were West Bank and Gaza (33.8 percent), Malta (28.9 percent), Kuwait (21.8 percent) and Bahrain (19.2 percent). As shown in Docquier, Lohest and Marfouk (2007), there is an obvious link between population size in country of origin and number of migrants abroad. In absolute numbers, the main emigration countries are the largest ones while the smallest number of emigrants comes from small countries. However, an increase in population generates a less than proportional increase in emigration. The emigration rate decreases with population size in the country of origin. Table 2.1 confirms this result. In absolute terms, the main exporters of migrants are large countries such as Morocco, Egypt and Algeria. In relative terms, these countries exhibit lower emigration rates. In the fourth column, we also report a concentration index of emigrants by country of destination (Herfindahl index). Emigrants from Algeria, Israel, Tunisia, Yemen and West Bank and Gaza are highly concentrated. On the contrary, emigrants from Lebanon, Libya, Syria, Iran and Morocco are more geographically dispersed.

Unsurprisingly, the main destination varies by country. France is the main destination of emigrants from Algeria, Djibouti, Morocco and Tunisia. Emigrants from Bahrain, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates are mostly residing in West Bank and Gaza. Saudi Arabia and the US appear twice in the list of main destinations. For Algeria, the main destination drains 64.4 percent of total emigration. On the contrary, the main destination represents less than one fourth of the total emigration stock originating from Lebanon and Libya.

Table 2.2 provides more details on the location of emigrants. We distinguish emigration to the members of the OECD (including the EU15, North America, Oceania), to the EU27 and to other MENA countries (including GCC members). Migration to the OECD (South-North migration) is dominant (i.e., larger than migration to other MENA countries) in 7 cases: Algeria, Djibouti, Iran, Lebanon, Malta, Morocco and Tunisia. In all these cases, the share of EU27 host countries is important. If we add Libya (sending one fourth of emigrants to the EU27) and Egypt (sending about 200,000 migrants to the EU27) to the above 7 countries, we

[8] Parsons et al. (2007) provide a 226x226 matrix of origin-destination stocks by country and territories. Four versions of the database are available, giving increasing levels of completeness, but decreasing levels of accuracy as more missing data are interpolated or constructed with each successive version. Our analysis is based on version 4 of this dataset, which provides a single comprehensive bilateral matrix of migrant stocks. As this version contains many estimated cells, the results listed in Table 2.1 and 2.2 should only be considered as approximations. In particular, the fact that West Bank and Gaza appears as the main destination of many Middle East countries should be taken with caution.

can define a MENA9 sub-group for which EU27 is an important destination, in absolute or relative terms. Within this group, we define the MENA4 sub-group including four important emigration countries (Morocco, Algeria, Tunisia and Egypt). In 2000, MENA4 sent 4.15 million emigrants to EU27, i.e. 90 percent of MENA9 and 81.5 percent of MENA emigrants to EU27.

**Table 2.1. Emigration from MENA countries in 2000**

| | Total migration | | | Main destination | | |
|---|---|---|---|---|---|---|
| | Stock | Rate | Herfin | Country | Stock | Share |
| **MENA4** | | | | | | |
| Algeria | 2070840 | 6.8% | 0.428 | France | 1333587 | 64.4% |
| Egypt | 2173711 | 3.2% | 0.232 | Saudi Arabia | 1015124 | 46.7% |
| Morocco | 2589108 | 8.9% | 0.131 | France | 759011 | 29.3% |
| Tunisia | 607491 | 6.4% | 0.373 | France | 364498 | 60.0% |
| **MENA9** | | | | | | |
| Djibouti | 16990 | 2.4% | 0.208 | France | 6093 | 35.9% |
| Iran | 926312 | 1.4% | 0.133 | USA | 291625 | 31.5% |
| Lebanon | 577123 | 17.0% | 0.084 | USA | 111142 | 19.3% |
| Libya | 78109 | 1.5% | 0.098 | Israel | 19200 | 24.6% |
| Malta | 113094 | 28.9% | 0.261 | Australia | 46998 | 41.6% |
| **Others** | | | | | | |
| Bahrain | 128719 | 19.2% | 0.262 | W.Bank Gaza | 54230 | 42.1% |
| Iraq | 1109957 | 4.4% | 0.163 | Iran | 413710 | 37.3% |
| Israel | 956959 | 15.7% | 0.374 | W.Bank Gaza | 567467 | 59.3% |
| Jordan | 667754 | 13.4% | 0.277 | W.Bank Gaza | 319367 | 47.8% |
| Kuwait | 486861 | 21.8% | 0.244 | W.Bank Gaza | 210594 | 43.3% |
| Oman | 17881 | 0.7% | 0.219 | W.Bank Gaza | 7841 | 43.9% |
| Qatar | 15958 | 2.6% | 0.224 | W.Bank Gaza | 7065 | 44.3% |
| Saudi Arabia | 243258 | 1.2% | 0.214 | W.Bank Gaza | 106230 | 43.7% |
| Syria | 423764 | 2.5% | 0.100 | Saudi Arabia | 109048 | 25.7% |
| United Arab Em | 123886 | 3.8% | 0.218 | W.Bank Gaza | 53883 | 43.5% |
| W.Bank Gaza | 1065224 | 33.8% | 0.368 | Syria | 630725 | 59.2% |
| Yemen | 603173 | 3.4% | 0.371 | Saudi Arabia | 360438 | 59.8% |

*Source: Parsons et alii (2007)*

If one had to increase the flows of MENA-to-EU migration in the future, these sub-groups countries would be seriously concerned. The other 12 countries mainly send migrants to other MENA nations. In particular, GCC countries attract the majority of emigrants from Yemen and, to a lower extent, Syria, Kuwait and Jordan.

**Table 2.2. Location of MENA emigrants in 2000**

| | OECD | *EU15* | *NAM* | *PAC* | EU27 | MENA | *GCC* |
|---|---|---|---|---|---|---|---|
| **MENA4** | | | | | | | |
| Algeria | 81.0% | *79.0%* | *1.8%* | *0.1%* | 79.1% | 9.2% | *0.9%* |
| Egypt | 17.8% | *8.7%* | *7.4%* | *1.6%* | 8.9% | 75.8% | *51.6%* |
| Morocco | 74.9% | *71.9%* | *2.8%* | *0.1%* | 71.9% | 16.5% | *1.7%* |
| Tunisia | 77.7% | *75.0%* | *2.3%* | *0.1%* | 75.1% | 12.8% | *2.6%* |
| **MENA9** | | | | | | | |
| Djibouti | 51.3% | *46.1%* | *4.7%* | *0.4%* | 46.1% | 11.2% | *0.9%* |
| Iran | 76.3% | *31.4%* | *39.6%* | *2.2%* | 31.5% | 45.9% | *1.5%* |
| Lebanon | 64.7% | *20.3%* | *31.2%* | *12.4%* | 20.9% | 38.9% | *9.0%* |
| Libya | 45.0% | *23.4%* | *14.7%* | *2.0%* | 24.6% | 53.2% | *2.3%* |
| Malta | 92.8% | *34.3%* | *16.5%* | *41.9%* | 34.4% | 9.5% | *0.7%* |
| **Others** | | | | | | | |
| Bahrain | 8.5% | *4.7%* | *3.1%* | *0.7%* | 4.8% | 57.7% | *3.0%* |
| Iraq | 34.9% | *19.3%* | *10.7%* | *2.7%* | 19.5% | 66.7% | *2.7%* |
| Israel | 21.5% | *5.5%* | *14.6%* | *0.7%* | 5.8% | 83.4% | *3.1%* |
| Jordan | 11.9% | *2.9%* | *8.2%* | *0.5%* | 3.0% | 88.3% | *24.7%* |
| Kuwait | 10.2% | *3.0%* | *6.5%* | *0.6%* | 3.1% | 86.6% | *25.1%* |
| Oman | 30.1% | *16.6%* | *10.7%* | *2.5%* | 16.7% | 72.1% | *5.7%* |
| Qatar | 32.4% | *11.5%* | *18.4%* | *1.9%* | 11.8% | 73.7% | *4.3%* |
| Saudi Arabia | 25.5% | *7.2%* | *15.5%* | *0.8%* | 7.2% | 74.5% | *5.4%* |
| Syria | 36.8% | *16.2%* | *17.0%* | *1.6%* | 18.0% | 62.1% | *28.1%* |
| United Arab Em | 20.6% | *7.3%* | *11.5%* | *1.5%* | 7.5% | 64.0% | *1.8%* |
| W.Bank Gaza | 2.6% | *1.7%* | *0.6%* | *0.3%* | 1.7% | 90.6% | *12.2%* |
| Yemen | 7.7% | *3.9%* | *3.6%* | *0.1%* | 4.0% | 88.7% | *63.3%* |

*Legend: NAM = US+Canada; PAC=Australia+New Zealand*
*Source: Parsons et alii (2007)*

## 2.2 Migration from MENA by educational attainment

To characterize the skill structure of migration, we build on Docquier, Lowell and Marfouk (2007) who use data on the immigration structure by educational attainment and country of birth from all OECD receiving countries.[9]

More precisely, Docquier, Lowell and Marfouk (henceforth DLM) collected gender-disaggregated data from the 30 members of the OECD, with the highest level of detail on birth countries and three levels of educational attainment: $s=m$ for immigrants with upper-seconday education, $s=h$ for those with post-secondary education and $s=l$ for those with less than upper-secondary education (including lower-secondary, primary and no schooling). Let

[9] The data set of Docquier, Lowell and Marfouk (2007) is based on the aggregation of harmonized immigration data collected in host countries, where information about the birth country, gender, age and educational attainment of immigrants is available. This information is found in national population censuses (or samples of them) and registers.

$M_{t,s}^{i,j}$ denote the stock of adults 25+ born in *j*, of skill *s*, living in country *j* at time *t*. Aggregating these numbers over destination countries *j* gives the stock of emigrants from country *i*:

$$M_{t,s}^{i} = \sum_{j} M_{t,s}^{i,j} .$$

Obviously, the stock of high-skilled emigrants (absolute measure brain drain) is positively correlated with the size of the country and its level of development (reflecting the average educational level of natives). The pressure exerted on the sending country's labor market is better captured by comparing the emigration stocks to the total number of people born in the source country and belonging to the same gender and educational category. Hence, the DLM data set also provides a relative measure of the brain drain, defined as the ratio of the stock of high-skilled emigrants to the educated population born in the source country. Although their analysis is based on stocks (rather than flows), DLM refer to these proportions as emigration rates. Denoting $N_{t,g,s}^{i}$ as the stock of individuals aged 25+ at time *t*, of skill *s*, gender *g*, born in source country *i*, the emigration rate is defined as

$$m_{t,g,s}^{i} = \frac{M_{t,g,s}^{i}}{N_{t,g,s}^{i}}$$

where the native population $N_{t,g,s}^{i}$ is proxied by the sum of the resident population living in country *i* ($R_{t,g,s}^{i}$) and the stock of emigrants: $N_{t,g,s}^{i} \equiv R_{t,g,s}^{i} + M_{t,g,s}^{i}$. To compute $R_{t,g,s}^{i}$, DLM use population data by age provided by the United Nations and several sources on the average educational attainment of the resident population.[10]

In this paper, we have extended DLM work by adding immigration data and estimates for 14 non-OECD host countries:

- the OECD group includes 19 EU countries. We have added 8 non-OECD EU countries (Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Malta[11], Romania and Slovenia) to have a comprehensive view of the brain drain to the EU27;

- we have also added estimates of the immigration structure for the GCC. For Saudi Arabia, we have collected labor force survey data on the age and education level of guest workers in 1990 and 2000. In the remaining GCC countries (Bahrain, Kuwait, Oman, Qatar and United Arab Emirates), we start from Parsons et al. bilateral stocks and apply the age and educational structure observed in Saudi Arabia. This gives reasonable estimates of the brain drain to GCC nations.

[10] A more detailed description of the methodology can be found in Section A of the appendix available on the authors' webpage.

[11] Malta belongs to both EU27 and MENA groups. Obviously, we do not count Malta residents as migrants from MENA to EU27.

Table 2.3 presents the results on the brain drain from the MENA.[12] The first column gives the total brain drain rates to the 44 host countries (30 OECD + 14 non-OECD). High-skilled emigration rates are particularly high in Malta, Lebanon, Yemen or West Bank and Gaza. The brain drain is quite important in large countries such as, Iran, Morocco or Algeria. Given its size, Egypt is also suffering from a relatively high brain drain.

**Table 2.3. High-skilled emigration rates of MENA countries in 2000**

| | Total | to EU27 | to NA | to GCC | to OECD | EU27% |
|---|---|---|---|---|---|---|
| **MENA4** | | | | | | |
| Algeria | 9.6% | 7.1% | 2.1% | 0.2% | 9.4% | 73.7% |
| Egypt | 8.3% | 0.9% | 3.5% | 3.8% | 4.5% | 11.3% |
| Morocco | 18.5% | 13.3% | 4.3% | 0.6% | 17.9% | 72.0% |
| Tunisia | 12.9% | 9.6% | 2.3% | 0.6% | 12.3% | 74.6% |
| **MENA9** | | | | | | |
| Djibouti | 3.9% | 3.0% | 0.7% | 0.1% | 3.8% | 77.0% |
| Iran | 14.4% | 3.3% | 10.6% | 0.1% | 14.2% | 23.3% |
| Lebanon | 45.1% | 10.5% | 32.2% | 1.8% | 42.7% | 23.3% |
| Libya | 4.8% | 2.3% | 2.3% | 0.1% | 4.3% | 47.2% |
| Malta | 58.4% | 24.7% | 32.8% | 0.2% | 58.1% | 42.3% |
| **Others** | | | | | | |
| Bahrain | 6.0% | 1.8% | 3.3% | 0.9% | 5.1% | 30.0% |
| Iraq | 11.5% | 5.1% | 5.6% | 0.4% | 10.8% | 44.2% |
| Israel | 8.2% | 1.0% | 6.7% | 0.3% | 7.8% | 12.3% |
| Jordan | 11.3% | 1.5% | 5.8% | 4.0% | 7.1% | 12.8% |
| Kuwait | 12.6% | 0.8% | 5.9% | 5.9% | 6.7% | 6.1% |
| Oman | 0.5% | 0.2% | 0.2% | 0.1% | 0.4% | 34.1% |
| Qatar | 2.3% | 0.4% | 1.7% | 0.2% | 2.0% | 18.7% |
| Saudi Arabia | 1.1% | 0.1% | 0.8% | 0.1% | 0.9% | 12.0% |
| Syria | 7.8% | 2.3% | 3.8% | 1.5% | 6.0% | 29.7% |
| United Arab Em | 0.9% | 0.2% | 0.6% | 0.1% | 0.7% | 20.1% |
| W. Bank Gaza | 19.3% | 1.0% | 9.9% | 8.2% | 11.0% | 5.0% |
| Yemen | 31.3% | 1.9% | 2.5% | 26.8% | 4.4% | 6.0% |

*Source: Docquier, Lowell and Marfouk (2007)+Extension*

[12] To provide a detailed overview of the MENA brain drain in this section, we have extended the DLM work by adding immigration data and estimates for 14 non-OECD host countries. First, the OECD group includes 19 EU countries. We have added 8 non-OECD EU countries (Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Malta[12], Romania and Slovenia) to have a comprehensive view of the brain drain to the EU27. (It can be noted that Malta belongs to both EU27 and MENA groups. Obviously, we do not count Malta residents as migrants from MENA to EU27.) Second, we have also added estimates of the immigration structure for the GCC. For Saudi Arabia, we have collected labor force survey data on the age and education level of guest workers in 1990 and 2000. In the remaining GCC countries (Bahrain, Kuwait, Oman, Qatar and United Arab Emirates), we start from Parsons et al. (2007)'s bilateral stocks and apply the age and educational structure observed in Saudi Arabia. This gives reasonable estimates of the brain drain to GCC nations.

There is a hot debate in the literature on the global implications of the brain drain for developing countries. It is more than likely that high-skilled migration induces some positive effects on developing countries. The question is: Are these effects significant and sufficiently large to turn the brain drain into a brain gain? Recent empirical studies based on aggregate data suggest that these positive effects are of significant size. From the macroeconometric studies reviewed in Docquier (2007), the average threshold emigration rate above which the brain drain becomes harmful for development can be estimated to 10-15 percent in developing countries. The "optimal emigration rate" (which maximizes country gains) probably lies between 5 and 10 percent. Except Djibouti, Libya and Egypt, all MENA9 are above the potentially optimal level and many are above the maximal level (Lebanon, Malta, Morocco, Iran is at the border). Increasing the brain drain from these countries could have damaging effects on the economy.

## 2.3 Aging in European and MENA countries

The decrease in fertility and mortality rates induces a progressive and inescapable *greying* of European nations. On the contrary, all countries in the MENA share a relatively young population. However, a rapid increase in old-age dependency ratios will take place in 15 to 20 years, putting the pension systems under growing financial stress. In this section, we briefly analyze the demographic trends in the EU and in the MENA. Our analysis relies on the 2006 Revision, which is the twentieth round of official United Nations population estimates and projections prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.

The direct impact of demographic change occurs through the so-called dependency ratio. The total dependency ratio (*TDR*) is the ratio of the economically dependent part of the population to the productive part. The economically dependent part is recognized to be children who are too young to work, and individuals that are too old, that is, generally, individuals under the age of 15 and over the age of 65. The productive part makes up the gap in between (ages 15-64). The TDR is expressed as a percentage. This gives:

$$TDR = \frac{POP_{0-14} + POP_{65+}}{POP_{15-64}}$$

This ratio is important because as it increases, there is increased strain on the productive part of the population to support the upbringing and the pensions of the economically dependent. There are direct impacts on financial elements like social security.

The (total) dependency ratio can be partitioned into the child dependency ratio and the aged dependency ratio (*ADR*). The latter is defined by

$$ADR = \frac{POP_{65+}}{POP_{15-64}}$$

**Figure 2.1. Total dependency ratio (TDR) by region (1950-2050)**

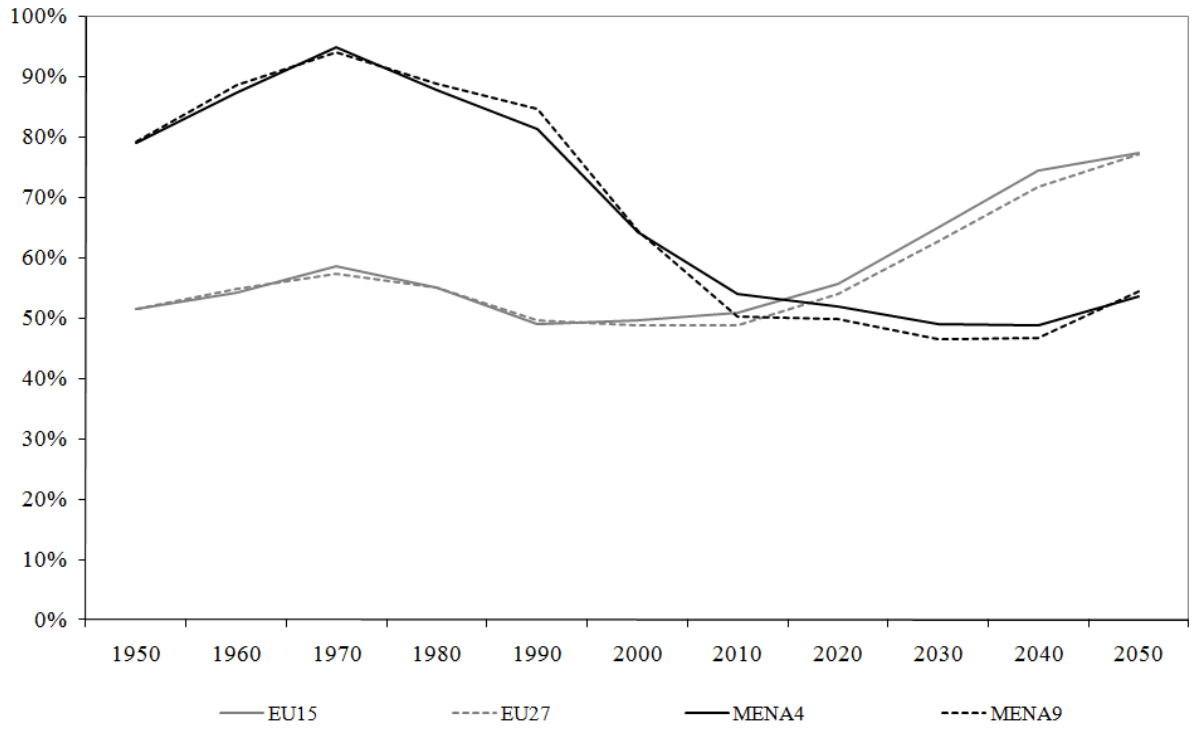



**Figure 2.2. Aged dependency ratio (ADR) by region (1950-2050)**

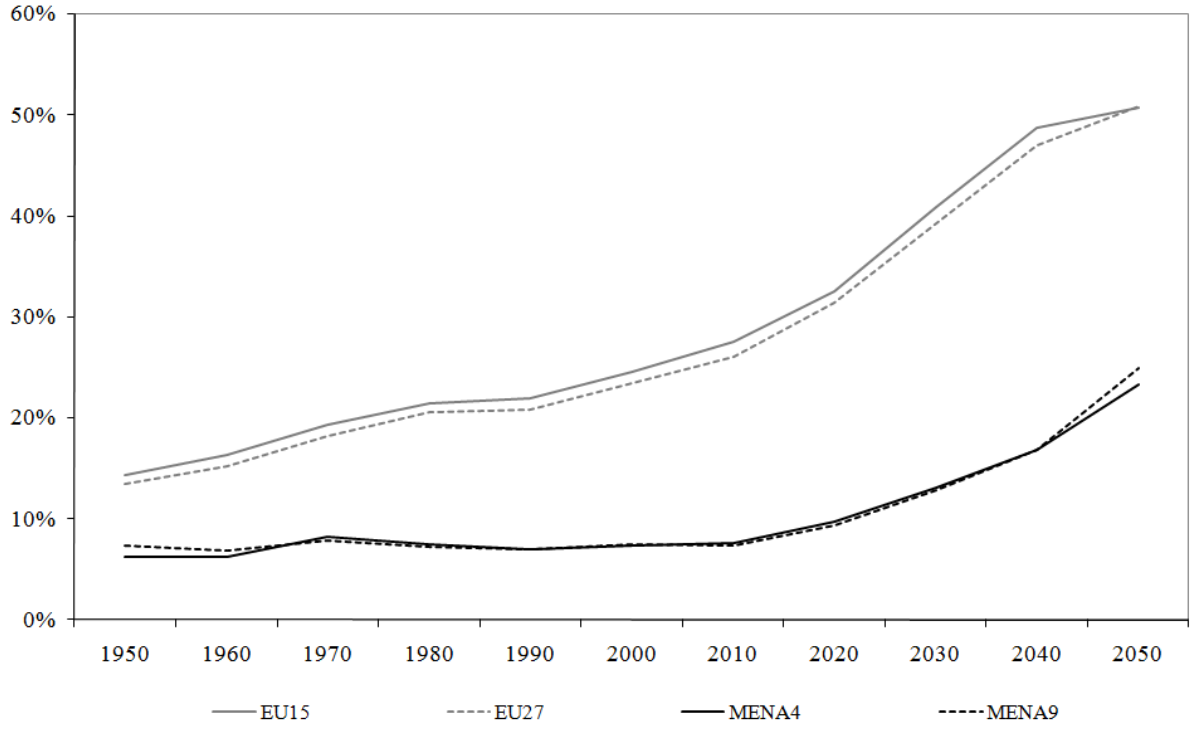


Figure 2.1 shows that the total dependency ratio has been higher in the MENA than in the EU since 1950 and is still expected to remain higher until 2020. After 2020, the rise in life expectancy will push the EU ratio upward while the drop in fertility rates will push the MENA ratio downwards. The conclusion obtained for the EU15 or EU27 are very similar. In the same vein, the evolutions observed in the MENA4 and MENA9 groups are almost identical.

In the EU, the deterioration of the dependency ratio is exclusively due to the *greying* of populations. Figure 2.2 shows that the EU aged-dependency ratio is expected to double between 2010 and 2050, after having doubled between 1950 and 2010. In the MENA, aging is hardly perceptible before 2030. But after 2030, the aged dependency ratio will be multiplied by 3 in the MENA4 and MENA9.

Figure 2.3 and 2.4 gives the evolution of total and aged dependency ratios for consolidated regions, i.e. aggregating EU and MENA4 or MENA9 countries. Clearly, this consolidation smoothes the trends and attenuates the rise in dependency. However, the change observed in the EU27+MENA4 hypothetical region remains important. This can be explained by the relative size of these regions. The population of the EU27 is around 500 million. Although the 21 countries of the MENA represent more than 300 million inhabitants, the population of the MENA4 group amounts to 136.5 million, i.e. about 27 percent of the EU27. The population of the MENA9 group (212.7 million) represents 42.5 percent of the EU27.

From these figures, we conclude that increasing migration flows from MENA4 or MENA9 to EU27 countries would clearly attenuate the deterioration of the European demographic structure. However, we should keep in mind that MENA countries also expect serious demographic problems after 2030 and need pension reforms to minimize a financial crisis (see Robalino, 2005).[13] In particular, the MENA aged-dependency ratio in 2050 will approximately be equal to the current aged-dependency ratio observed in the EU. Hence, "replacement or selective migration" policies encouraging MENA-to-EU flows of working-age people should not be permanent. It should be limited in size and in time.

The above analysis delivered some insights on the demographic implications of MENA-to-EU migration. But what are the economic consequences of increased migration? What would be the lessons of a general equilibrium analysis, with endogenous wages, pension benefits and interest rates? What would be the outcomes of a change in immigration policy for sending countries? These are the issues we address in the next section.

[13] It can be noticed that public pension expenditures (in percent of GDP) are lower in MENA (2.8%) than in the EU15 (9.2%), see OECD (2005) and Palacios (1996). Robalino et al. (2005) provides more detailed information on pension systems in various countries of the Middle East and North Africa, such as on coverage rates, gross replacement rates, normal retirement age, etc.

**Figure 2.3. Total dependency ratio (TDR) by consolidated region**

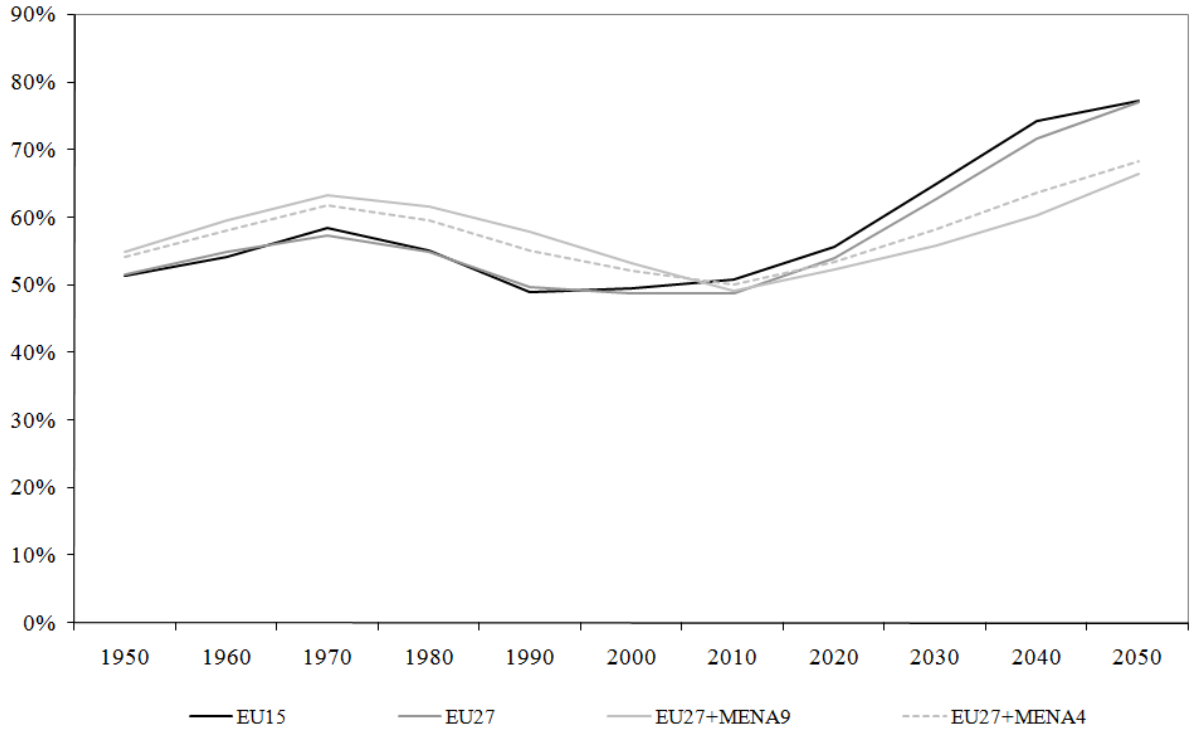
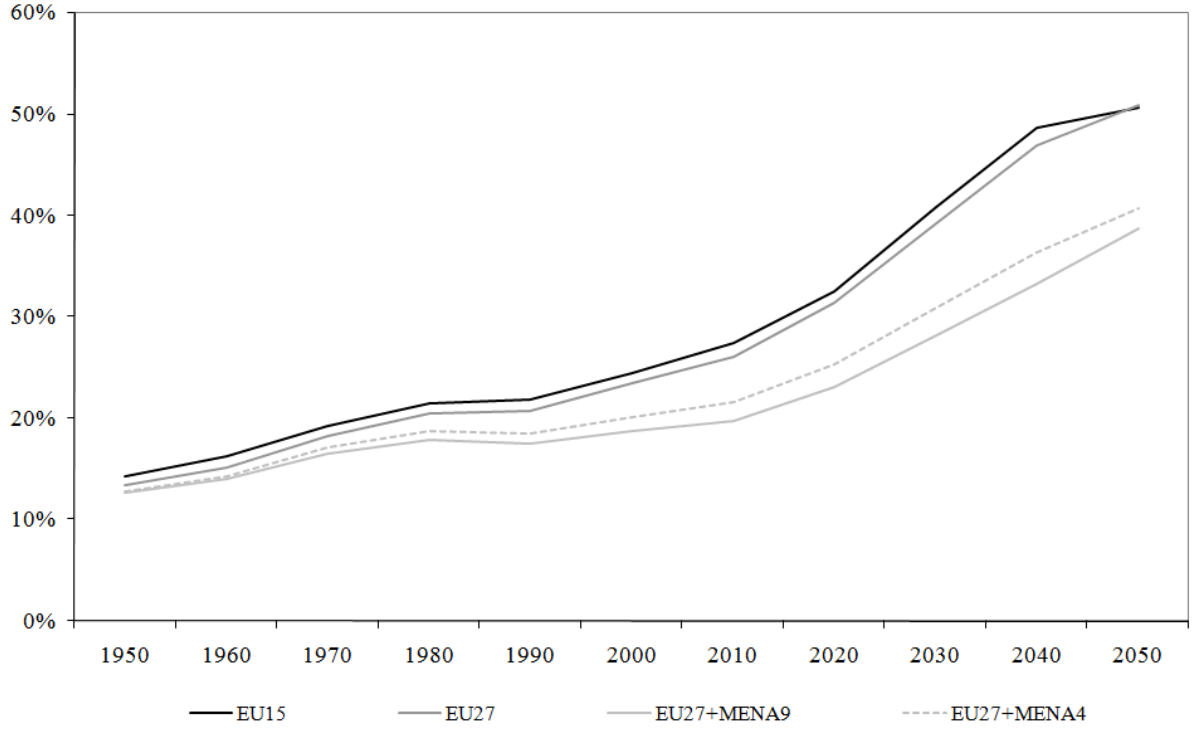



**Figure 2.4. Aged dependency ratio (ADR) by consolidated region**



# 3 General equilibrium analysis

Our purpose here is to analyze the impact of a doubling of migration flows from the MENA to the EU15 on demographic variables, on the tax rate, on GDP per capita, on GNI per capita and on the high-skilled to low-skilled income ratio in both regions.[14] The shock occurs between 2000 and 2050. We distinguish various scenarios regarding the education level of additional migrants, the way educated migrants are "economically assimilated" at destination, the ties between migrants and their origin country (affecting the feedback effects of international migration) and the progress in education attainment in the MENA region.

For this purpose, we use a computable general equilibrium (CGE) model with overlapping generations of individuals who are heterogeneous in skills, date and place of birth.[15] In the model, countries from the MENA and the EU15 are aggregated into two regions: we disregard the heterogeneity between countries and compute the impact on the aggregate MENA and EU15 regions.

We provide a brief introduction of the model structure in Section 3.1. Section 3.2 describes our five alternative scenarios. The demographic effect of our shock is constant across scenarios; it is discussed in Section 3.3. Then, in Section 3.4, we first analyze the economic impact at origin and destination comparing two simple scenarios: one considers that additional migrants are high-skilled and one assumes that they are low-skilled. Our comparison disregards two types of feedback effects of international migration that have been stressed in the literature (i.e. diaspora externalities and brain gain mechanisms) and assumes that human capital acquired in the MENA is perfectly transferrable to the EU15 labor market. In Section 3.5, we focus on the case of high-skilled migration and relax the above hypotheses in three alternative scenarios, (i) one in which additional migrants are high-skilled but employed as low-skilled laborers in the EU, (ii) one is based on the recent literature on the beneficial effects of the brain drain, and (iii) one assumes that the MENA region experiences a stronger rise in the education levels of its native population.

[14] A policy aiming at increasing immigration may obviously create political tensions. Explaining how such a doubling of immigration flows arises or whether it is politically feasible is however beyond the scope of our analysis. For a political economy approach of immigration one can refer to Scholten and Thum (1996), who use a model where migrants have a negative effect on wages. Natives (i.e. the median voter) can choose the immigration policy, the outcome of which will depend upon the age of the natives. Krieger (2003) as well as Lagos and Lacomba (2010) also study the preferences towards immigration of various age groups of the population.

[15] The economic model is based on previous work by Marchiori (2010), who analyzes the impact of demographic trends on current accounts but disregards labor mobility. Moreover, the present work also integrates various side-effects that high-skilled emigration has on developing regions (see scenario "Brain Gain"). The calibration of these effects is detailed in Marchiori, Shen and Docquier (2010). Section 3.1 provides only the essential elements of the model's structure, but a more complete description of the model and the calibration of the side-effects of the brain drain can be found in sections B.2 and B.3 of the appendix available on the authors' webpage.

### 3.1 The model

Each region has three types of agents: households, firms and the public sector. The adult population is divided into 8 overlapping generations, from age 15-24 to age 85-94. Individuals have uncertain lifetime and can die at the end of every period. In each generation, we have time-varying proportions of low-skilled and high-skilled individuals. Due to data availability constraints, the high-skilled are those with post-secondary education completed. Migration occurs at the first period of life and is permanent.[16] Moreover migrants have the same fertility rate as natives and their children the same educational achievement as natives' offspring.[17]

Migrants remit a fraction of their consumption. This proportion is calibrated in order to match the amounts remitted by the migrants from MENA living in developed countries to their origin country. While high-skilled migrants remit a larger amount than low-skilled migrants (as suggested by Bollard, McKenzie, Morten, and Rapoport, 2009), it is assumed, based on Faini (2007) or Nimii et al. (2008), that their propensity to remit is lower (only 70%) than the one of low-skilled migrants.[18] The production process of the firms in each region is characterized by a constant elasticity of substitution (CES) transformation function for efficient labor, which defines the mix of high-skilled and low-skilled labor forces to produce a homogenous good. The parameters of the production process are dynamically calibrated in order to match the income disparities between and within regions (i.e. distance to the frontier and skill premium).

The government levies taxes on labor earnings and consumption expenditures to finance general public consumption, pension benefits and other welfare transfers. Moreover, the government issues bonds and pays interests on public debt. The government's budget constraint is satisfied each period by adjusting the tax rate on labor income.

Finally, capital is perfectly mobile in the model and the arbitrage condition on capital markets requires the equality of the expected returns to capital given region-specific risk premia.

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[16] Allowing for return migration would considerably complicate the computation of the transitional dynamics and steady states, because migrants returning to their region of origin have accumulated a different wealth than similar aged, similar skilled nationals that never left their region of origin. Thus, introducing return migration in our multi-regional framework implies that we need to deal with another dimension of agent heterogeneity, along with the ones that are already present in the model (i.e., skills, age and place of birth). Return migration poses therefore fewer problems in a single country model, like Storesletten (2000). Moreover, our analysis focuses on the impact of high-skilled migrants, which are less prone to return to their region of origin than low-skilled migrants (see, for instance, Faini 2007). Return migration is however an important issue in the study of international migration, see Krieger (2008) for a theoretical analysis and Winters, Walmsley, Wang, and Grynberg (2003) for a quantitative assessment of the impact of temporary migration.

[17] In some EU countries, migrants' children are assumed to be natives by the national legislation, as e.g. the "right of the soil" in France (see Krieger 2008). It can be observed that under these two assumptions (migrants have the same fertility rate as natives and their children the same educational attainment as natives' offspring), immigration will have an impact on the tax rate as long as the additional migrants increase the work force. Relaxing these assumptions would imply that immigration has a longer lasting effect on the tax rate (see Krieger, 2004) and on other indicators. These assumptions also allow keeping the smaller degree of agent heretorgeneity in the model (see footnote 14). Furthermore, our focus is on the impact of *high-skilled* migrants, who have quite similar characteristics than natives.

[18] Our results are robust to that the alternative assumption that the propensity to remit of high-skilled that is equal to the one of low-skilled.

### 3.2 Scenarios

In the baseline, the model is calibrated in such a way that it matches the world disparities between and within regions over the period 1950-2000. Our period of interest is 2010-2050, or the period corresponding to the first wave of additional migrants in the developed regions to the period when the last wave is arrives. Our baseline predictions are based on official demographic forecasts and extrapolates the trends observed in the last decades (in terms of educational attainment, productivity growth, public consumptions and generosity of welfare programs, etc.). More precisely, the evolution of the size and structure of the population is based on the United Nations' "World Population Prospects, the 2006 Revision" (United Nations 2007), which cover the period 1950 to 2050. The *size* of the population at each period of time, according to the data and forecasts of the United Nations, is calibrated through the growth rate of the youngest cohort of individuals. To match the predictions of U.N. Population Prospects in terms of the population *structure* of each region, we use the probabilities of being alive for each age class of individuals at each period. After 2050 the growth rate of the youngest cohort is held constant over time. Given this hypothesis, the population structure reaches a steady state in 2130, because individuals live for 8 periods of 10 years.

In the baseline scenario, the technical progress of each region (expressed as a percentage to North-America) is assumed to be constant after 2000. In addition, we hold the proportion of high-skilled individuals among each new generation constant from 2000 onwards. As young cohorts are more educated than older cohorts, it implies that the proportion of educated workers in the MENA will progressively increase from 11.5 percent in 2000 to 15 percent in 2050. In comparison, the rise in educational attainment observed in the MENA between 1975 and 2000 corresponds to +3.5 points of percentage.

Our immigration shock consists in a 100 percent increase (i.e. doubling) in the emigration flows from the MENA to EU compared to the baseline over the period 2000-2050. In the baseline, the estimated migration *flow* from the MENA to EU15 corresponds to 1.67 million in 2010, 1.73 million in 2020 and 1.79 million from 2030 onwards.[19] Thus, doubling these flows over the period 2000-2050 implies that an additional number of 8.77 million migrants from MENA would arrive to the EU by 2050. These newcomers emigrate in the first period of their life and acquire higher education in the EU. Hence, in case of high-skilled migration, we underestimate the actual fiscal cost of the MENA brain drain.

Along with the magnitude of this migration shock, the skill structure of the additional migrants might also play a role. Four immigration shocks are considered; they mainly differ with respect to the skill composition of the additional migrants and their assimilation in EU host countries:

[19] U.N. Population Projections provide the estimated number of migrant flows to the EU15 for the first half of the 21st century. We can retrieve the number of migrants coming from the MENA by applying the shares of migrants by origin of Docquier, Lowell and Marfouk (2007). From these datasets we can also compute the total number of migrants (stock) from MENA living in the EU15 in the baseline: 8.14 million in 2000, 9.56 million in 2010, 10.98 million in 2030 and increases up to 16.08 million after 2100.

- The ***"High-Skilled" scenario*** assumes that the 8.77 million additional migrants arriving from the MENA to the EU from 2010 until 2050 are high-skilled and employed as high-skilled workers in the EU (i.e. perfect assimilation).

- The ***"Low-Skilled" scenario*** considers that all additional migrants are low-skilled and employed as low-skilled workers in the EU.

- The ***"Brain Waste" scenario*** assumes that all additional migrants are high-skilled and employed as low-skilled workers in the EU.

- The ***"Brain Gain" scenario*** is equivalent to the "High-Skilled" scenario but accounts for the ex-ante effect of high-skilled migration prospects on human capital formation at origin and various diaspora externalities.

- The ***"Expansionary" scenario*** is similar to the "High-Skilled" scenario but assumes that the population in MENA regions becomes more and more educated during the first half of the 21st century. In the baseline, the proportion of high-skilled among youngest cohort is constant at 15% from 2000 onwards. This means that the proportion of high-skilled in the workforce and in the population reaches 15% in the long run. In this scenario, a brain drain occurs while the share of high-skilled among the youngest cohort continues to rise after 2000 to reach 20% in 2030, with the consequence that 20% of the population will be educated in the long run.

The latter three scenarios will be explained in more details in Section 3.5.[20] In the Figures 3.1 to 3.4 as well as in the Tables 3.1 and 3.4, we distinguish between the impact on the EU15 and the MENA regions. As mentioned above, we first focus on the demographic (section 3.3) and economic (section 3.4) impacts of the "High-Skilled" and "Low-Skilled" scenarios and then turn to the consequences of different variants of the high-skilled scenario (section 3.5).

## 3.3 Demographic impact

Before turning to the implications on economic indicators, let us comment the demographic situation in EU and MENA forecasted for 21st century and the implications of our migration shock on the demographics of both regions. Indeed, the skill composition of future migration flows has a negligible impact on demographic indicators.[21] In this section, we disregard differences in skill composition and compare demographic trends obtained in the baseline and after doubling immigration flows.

The migration flows in our baseline result from the United Nations' "Trends in Total Migrant Stock" (United Nations 2005), which predict that the share of foreigners in the EU population evolves from 3.5 percent in 2000 to 8.3 percent in 2050 and to 9.6 percent in 2100 (Figure

[20] A more technical description of the "Brain Gain" scenario can be found in Section B.3 of the Appendix available on the authors' webpage.

[21] The only variable to be slightly affected is the support ratio. This is due to the fact that, in the first period of life, high-skilled immigrants supply less labor than low-skilled ones as they spend more time in education. Nevertheless, the difference between the "High-Skilled" and "Low-Skilled" scenarios is hardly perceptible.

**Figure 3.1. Share of foreigners in EU15 (in percent)**

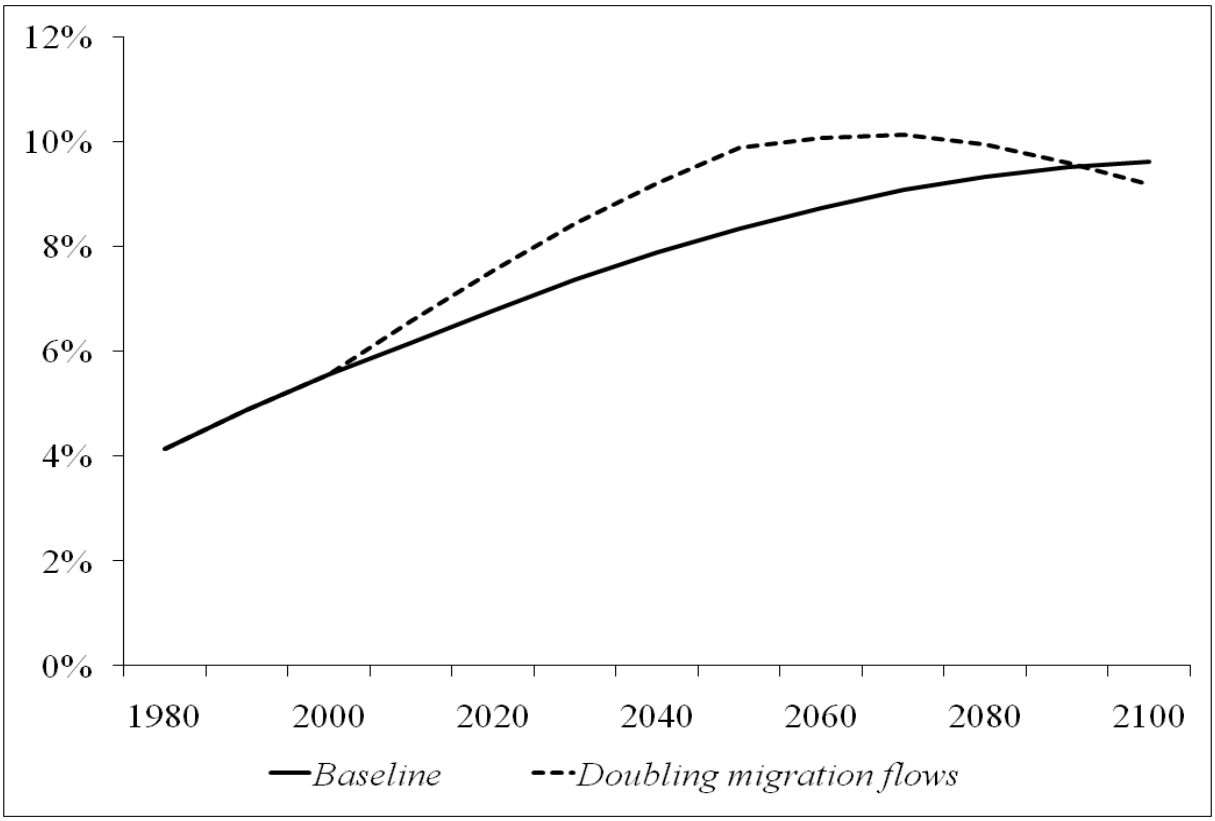



**Figure 3.2. Emigration rate in MENA (in percent)**

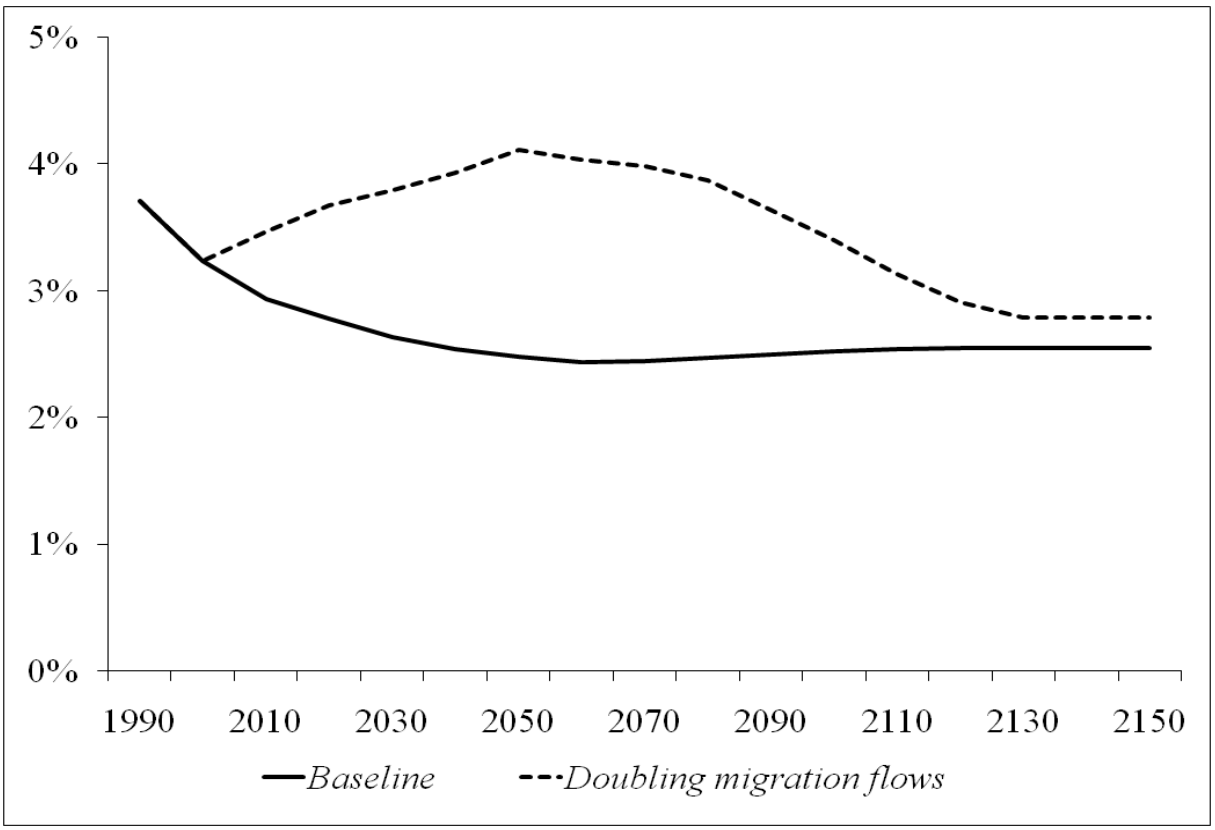


**Figure 3.3. Support ratio in EU15 (Population aged 15-64 / Total population)**

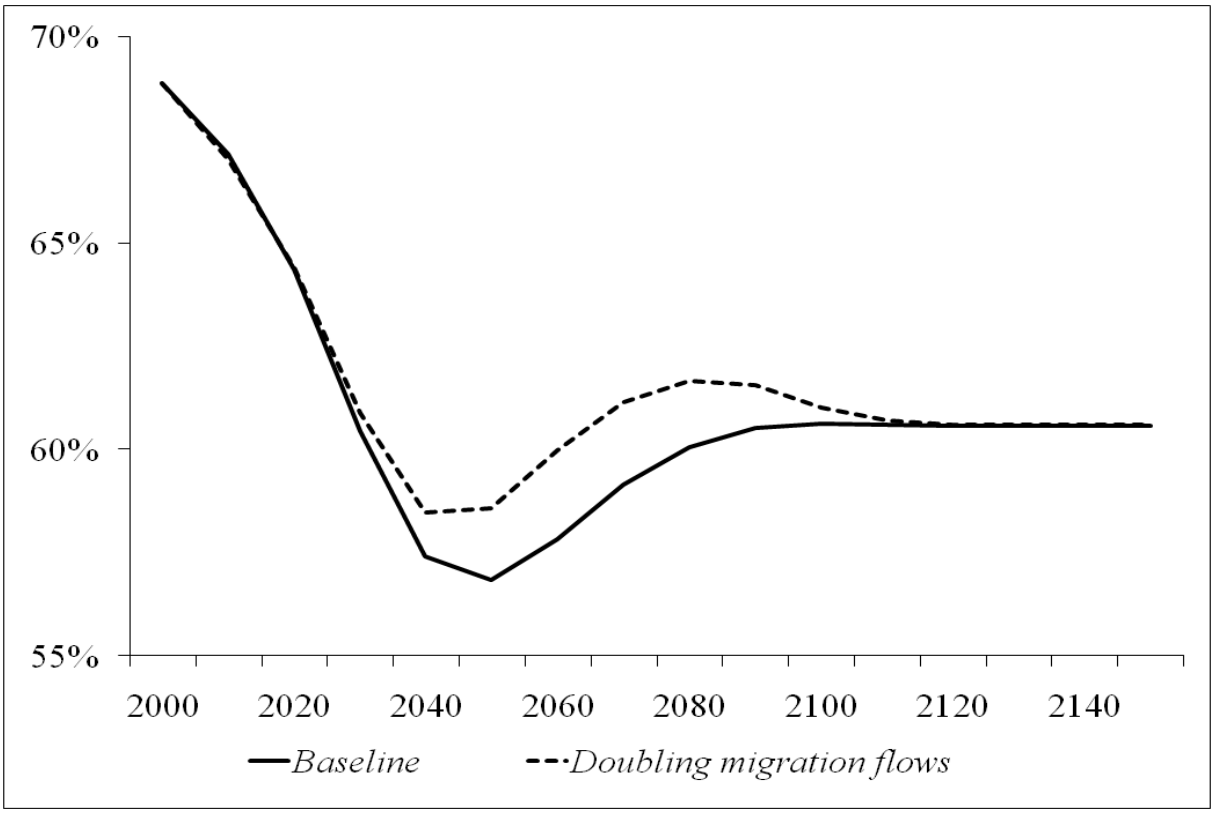
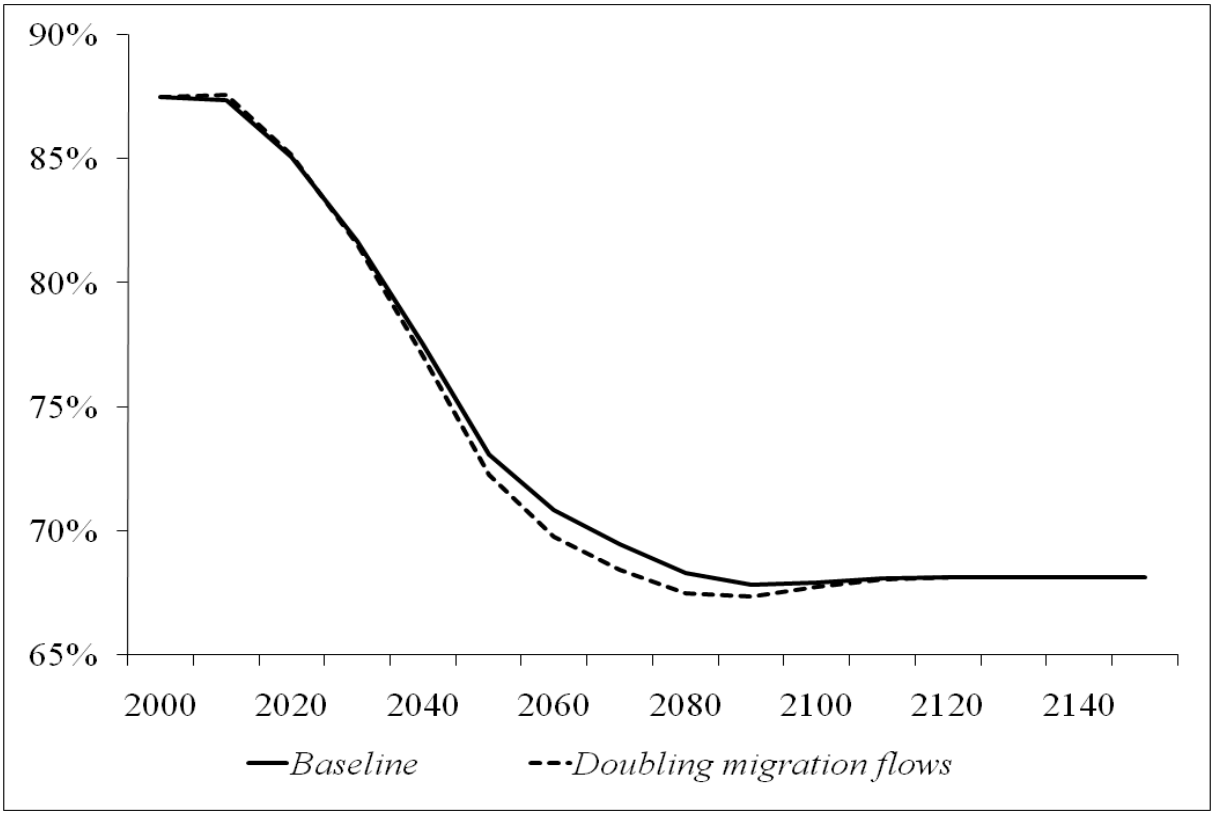



**Figure 3.4. Support ratio in MENA (Population aged 15-64 / Total population)**



3.1). If migration flows from MENA to EU are doubled from 2010 to 2050, this ratio reaches 10.1 percent in 2050 instead of 8.3 percent in the baseline. From 2050 onwards, the migration shock is ended and the stock of immigrants progressively converges to its baseline value. The migration shock progressively increases the EU population size, while the proportion of foreigners in the EU15 falls slightly below the baseline value in 2100. This is because when the shock ends, no more additional migrants, but, at the same time, children of the additional migrants arrived from 2010 to 2050 are considered as EU natives.

In the MENA, the global emigration rate (the ratio of emigrants to the residents plus emigrants) to the North (which comprises all OECD countries) is around 2.5 percent during the 21st century (Figure 3.2). Doubling migration flows to EU would bring the emigration rate to more than 4 percent in 2050.

The support ratios (i.e. the share of working aged-to-total population) are depicted in Figures 3.3 and 3.4. The baseline is calibrated to match the UN Population Projections until 2050. After this date, the population size in both regions slowly stabilizes as the youngest cohort is held constant from 2050 onwards. The forecasts reveal that both regions will face an aging of their population during the 21st century.[22] Since migrants are young individuals, increasing MENA-to-EU migration will obviously improve the support ratio in the EU15 and deteriorate it in the MENA. In the EU15, the effect of immigration is rather small compared to general impact of aging in the first half of the century, but becomes significant after 2040. In the MENA, the effect of emigration is not very significant. Our shock is compatible with our recommendations to limit emigration from the MENA in size and in time as explained in Section 2.

### 3.4 Economic impact – high-skilled versus low-skilled migration

In this section we analyze the impact of the first two scenarios ("High-Skilled" versus "Low-Skilled"). Table 3.1 presents their implications for the EU15 and the MENA in terms of key economic indicators (Tax rate, GDP per capita, GNI per capita and high- to low-skilled income inequality). It turns out that the skill composition of immigration flows does not appear to be so important when dealing with the *fiscal* consequences of migration.

*Tax rate.* As mentioned before, the labor income tax rate balances the government budget. The main driving force of the model over the 21st century is the evolution of the population structure. In particular, aging will put a strong the pressure on pension systems which will be reflected by rising tax rates. The fiscal effects of migration are presented in panel "Tax Rate" of Table 3.1. In the EU, the income tax rate needs to increase by around 12.5 percentage points from 2010 to 2050 to maintain the public budget balanced in the baseline (row "EU15 Baseline"). In the long-run, the fiscal impact is mainly explained by the progressive rise in life expectancy due to the *greying* of the baby boom generations.

[22] The support ratio in EU increases again after 2050 because of our assumption that the population is constant after 2050 while population growth is negative before 2050.

Since the population is younger in the MENA, increasing migration flows from the MENA to the EU15 could help to mitigate the consequences of aging on European pension systems. However, the aging process of the population will be also a critical issue for the MENA countries. In fact, as shown in Table 3.1 (row "MENA Baseline"), the tax rate also augments in the MENA.

Increasing MENA-to-EU migration raises (resp. reduces) the size of youngest cohorts at destination (resp. origin). Table 3.1 represents the resulting changes in tax rates in terms of *deviations* in percentage points from the baseline (while changes in the other indicators are depicted in terms of relative changes compared to the baseline). We see that both immigration shocks reduce the tax rate in the EU15 and raise it in the MENA. At destination, the "High-Skilled" scenario is unsurprisingly the most effective one in relieving the pressure on the pension systems since high-skilled individuals contribute more to and benefit less from welfare programs. In 2050, increasing high-skilled immigration induces a reduction in the EU15 tax rate that is 0.97 percentage points higher than the one induced by the "Low-Skilled" immigration shock (a 6.07 percentage point decrease compared to the baseline under a "High-Skilled" versus 5.10 percentage point under the "Low-Skilled" scenario). Obviously the immigration policies undergone in Europe have reversed consequences in migrants' origin countries. In fact, the MENA will have to cope with a higher tax rate if it looses part of its labor force and the "High-Skilled" scenario will have the worst fiscal implications.

However, the difference between these two scenarios appears to relatively small. This contrasts with earlier findings of generational accounting (GA) studies, which predict that selective immigration policies have a significant fiscal effect while non-selective policies have a rather negligible impact on public finance. What explains our result? Compared to a GA analysis, our analysis also includes general equilibrium effects. In fact, when the additional immigrants are high-skilled, the skill premium decreases (-6.27 percentage change compared to the baseline in 2050) and this reduces the average contribution of a high-skilled worker in financing pension systems (while the one of a low-skilled worker is augmented). Conversely, when the additional migrants are low-skilled, a high-skilled employee will pay more taxes since the skill premium is enhanced (+3.86 percent in 2050).

Another feature of the model is that the debt is defined as a fraction of GDP assuming a constant debt/GDP ratio. When additional migrants come to Europe (or leave the MENA), it leads to an increase (decrease) in the GDP and thus in the debt. Since GDP rises more rapidly under the "High-Skilled" scenario (11.20 percent in 2050) than under the "Low-Skilled" scenario (8.37 percent), the public deficit to be financed will be larger when additional migrants are high-skilled. To assess the magnitude of this mechanism, we simulated our model assuming that the public debt is held constant at the baseline level. It comes out that this effect is less important than the general equilibrium effect on wages and on the skill premium.[23] Still, a high-skilled emigration policy would reduce taxes by an additional 1.74

[23] With the "High-Skilled" scenario the variations in the tax rate represent -5.97 percentage points in 2050 when the debt is constant and -6.07 percentage points when the debt varies with the GDP; with low-skilled migration these changes are -4.94 and -5.10 percentage points, respectively.

percentage points compared to a low-skilled immigration policy in 2050 when the debt is hold constant at the baseline level (with a varying debt, the additional tax cut is ``only'' 0.97).

To be complete, another general equilibrium effect is that the inflow of workers will raise the interest rate which contributes to increase the public deficit. However, the impact on the interest rate is negligible, because it is determined at the international level. This general equilibrium effect plays therefore also a minor role in the small fiscal difference between the "High-Skilled" and "Low-Skilled" scenarios.

**Table 3.1. Impact of the "High-Skilled" and "Low-Skilled" scenarios**

| ***Tax Rate*** | | | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| EU15 | Baseline | | 46.88% | 49.34% | 53.75% | 58.22% | 59.36% |
| | High-Skilled | (% deviation) | -0.43% | -1.15% | -2.41% | -4.24% | -6.07% |
| | Low-Skilled | (% deviation) | -0.35% | -0.94% | -1.99% | -3.53% | -5.10% |
| MENA | Baseline | | 19.03% | 20.08% | 21.52% | 23.24% | 25.18% |
| | High-Skilled | (% deviation) | 1.16% | 2.92% | 4.85% | 7.10% | 9.22% |
| | Low-Skilled | (% deviation) | 0.76% | 1.83% | 3.35% | 5.31% | 7.36% |
| ***GDP per capita*** | | | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | Baseline | | 0.159 | 0.159 | 0.157 | 0.156 | 0.155 |
| | High-Skilled | (% change) | 0.02% | 0.63% | 1.60% | 3.06% | 4.55% |
| | Low-Skilled | (% change) | -0.07% | -0.07% | 0.29% | 1.05% | 1.89% |
| MENA | Baseline | | 0.035 | 0.035 | 0.034 | 0.033 | 0.031 |
| | High-Skilled | (% change) | -0.14% | -0.98% | -1.76% | -2.78% | -3.60% |
| | Low-Skilled | (% change) | 0.04% | 0.03% | -0.15% | -0.56% | -1.07% |
| ***GNI per capita*** | | | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | Baseline | | 0.140 | 0.138 | 0.133 | 0.130 | 0.127 |
| | High-Skilled | (% change) | -0.39% | -0.16% | 0.49% | 1.77% | 3.40% |
| | Low-Skilled | (% change) | -0.27% | -0.51% | -0.41% | 0.18% | 1.04% |
| MENA | Baseline | | 0.036 | 0.036 | 0.035 | 0.033 | 0.032 |
| | High-Skilled | (% change) | 0.14% | -0.33% | -0.86% | -1.62% | -2.36% |
| | Low-Skilled | (% change) | 0.17% | 0.32% | 0.33% | 0.15% | -0.18% |
| ***Inequality*** | | | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | Baseline | | 2.91 | 2.85 | 2.69 | 2.50 | 2.36 |
| | High-Skilled | (% change) | -1.55% | -2.82% | -3.93% | -5.04% | -6.61% |
| | Low-Skilled | (% change) | 0.18% | 0.45% | 0.79% | 1.30% | 2.36% |
| MENA | Baseline | | 2.45 | 2.54 | 2.56 | 2.54 | 2.52 |
| | High-Skilled | (% change) | 3.27% | 4.82% | 5.69% | 6.25% | 7.14% |
| | Low-Skilled | (% change) | -0.35% | -0.54% | -0.66% | -0.81% | -1.05% |

*GDP per capita.* GDP per capita is defined as total domestic production divided by total population. The reallocation of labor from the MENA to the EU15 leads to higher returns to capital in Europe. Since Europe is technologically more advanced, labor outflows from the MENA induce a more than proportional reallocation of physical capital to Europe. Thus, increased migration to the EU15 acts to enhance GDP per capita and to reduce it in the

MENA (Table 3.1, panel “GDP per capita”). This effect is particularly strong if the additional migrants are high-skilled and employed as such at destination (“High-Skilled” scenario). This is obviously due to the fact that high-skilled workers are more productive. In addition, the agglomeration of high-skilled labor in EU does increase the marginal productivity of capital in this region even more than the “Low-Skilled” scenario.

It can be observed that, in the first periods of the intensification in migration flows, the impact on GDP per capita in the EU is quite small (lower than 1 percent) and even slightly negative in the “Low-Skilled” scenario until 2020 (-0.07 percent). One obvious reason is that the number of additional migrants is relatively low in the beginning of the concerned period. Another explanation is that when they are young, migrants spend part of their time educating and do not add fully to the labor force in the EU15, while contributing to increase the population (and thus the denominator in GDP per capita).

The impact of additional migrants on GDP per capita turns to be positive and considerable when they become fully ``operational'' and reach a critical mass. In the MENA, similar reasons explain the relatively small initial effects on GDP per capita and the slight increase in it when additional migrants are low-skilled.

*GNI per capita.* GNI is composed of GDP minus consumption taxes plus foreign aid, remittances and net inflows of capital income, divided by total population. The channels at work are the same as for GDP per capita, except that remittances also come into play.

Then GNI per capita will follow a similar pattern than GDP per capita, but compared to the change in GDP per capita, the change in GNI per capita shifts down for the EU15 and shifts up for the MENA.

The reason is that an enlarged diaspora induces an increase in the amount of remittances from the EU to the MENA. Therefore the increase in GNI per capita will be lower than the one in GDP per capita for the EU15, while for the MENA, the reduction in GNI per capita is lower than in GDP per capita. In the first periods, GDP per capita experiences small changes in bith regions. Then the additional migration remittances contribute to depress GNI per capita in the EU15 and to increase it in the MENA. Besides, we may observe that under “Low-Skilled” scenario in MENA, changes in GNI per capita remain below a 1 percent change in the first periods of the shock as well as in the later periods.

*High-/Low-Skilled inequality.* Finally, high-/low-skilled inequality is defined as the ratio of high- to low-skilled GNI per capita. Table 3.1, panel “Inequality”, shows that immigration has different effects on the high- to low-skilled income inequality. The impact is mainly driven by the change in the skill premium since the immigration policies affect the skill composition of the labor force. For instance, under the “High-Skilled” scenario, high-skilled labor becomes scarcer in the MENA: the skill premium goes up and high- to low-skilled income inequality worsens. In contrast, in the EU, high-skilled labor becomes more abundant leading to less inequality since the skill premium declines. The “Low-Skilled” policy has reverse consequences compared to the “High-Skilled” policy and will deteriorate inequality in the EU15 and improve it in the MENA.

*Preliminary conclusion:* The conclusion of the previous analysis is that increasing immigration leads to a considerable beneficial impact in terms of fiscal pressure and of GDP/GNI per capita in Europe. However, a selective immigration policy does not involve a significantly greater tax relieving effect than a non-selective one: an inflow of high-skilled migrants leads to less than 1 percentage point higher tax-cut than an inflow of low-skilled ones. However, the rise in GDP per capita and GNI per capita would more be than twice as high with a brain drain as with a non-selective policy.

In the MENA, the loss of workers renders the financing of the fiscal systems more complicated and the situation would be even more dramatic when selecting immigrants. Moreover, differences in the skill composition of migration flows yield considerable differences in income. GNI per capita is strongly reduced by increased high-skilled emigration but only slightly by a low-skilled immigration policy. Besides, it would even be enhanced by the non-selective immigration policy at the beginning of the increased migration period.

### 3.5 Variants of the "High-Skilled" scenario

The previous section shows that selecting migrants generates much more positive (resp. negative) effects on GDP/GNI per capita at destination (resp. at origin) than increasing low-skilled migration. Concerning such a brain drain, several factors could affect the magnitude of the responses in both sending and receiving regions. First, it is widely documented that high-skilled migrants are not necessarily employed as high-skilled workers at destination. Second, the recent "brain drain literature" claims that the movement of high-skilled people goes along with diverse positive side-effects incurred by the countries of origin. Third, an increased movement of high-skilled workers from the MENA to the EU15 could be accompanied by a more generous assistance or a greater cooperation in education policies. In other words, we might also take into account the fact the population in the MENA could become more and more educated. How do these aspects alter the consequences of increased high-skilled emigration from the MENA?

This section examines different variants of increased high-skilled emigration. We only consider the case of high-skilled migration and compare the different variants described in Section 5.2, i.e. the traditional "High-Skilled", the "Brain Waste", "Brain Gain" and "Expansionary" scenarios. Let us describe the differences between these scenarios in more detail.

The ***"Brain waste"*** scenario is simple. It assumes that high-skilled migrants are employed as low-skilled at destination.

The ***"Brain Gain"*** scenario deserves more explanations. It is basically identical to the "High-Skilled" scenario in terms of numbers of high-skilled people who migrate. However, it differs from the "High-Skilled" scenario in that it follows the recent literature and accounts for three externalities associated with high-skilled emigration:

- A first externality of the brain drain is the role of high-skilled diasporas in reducing transaction costs, informational costs and risk inducing a lower risk premium in the MENA countries. In the model, the risk premium is represented by a governmental tax on investment and a lower risk premium then leads to higher capital inflows. This effect is calibrated by using the findings of Docquier and Lodigiani (2008).

- Second, total productivity may be affected in two ways by high-skilled emigrants living in rich countries: (i) directly, because they induce improvements in the capacity of their origin country to adopt modern technologies (via a diaspora externality) and, (ii) indirectly, by affecting the level of human capital, which is essential for productivity. The calibration of the effect of high-skilled migration on productivity estimates of a reduced form equation by Lodigiani (2008), who follows the methodology in Vandenbussche, Aghion and Meghir (2006).

- Finally, selective immigration policies at destination raise the probability for educated people to leave their home country and induce therefore a higher expected return to education. As a consequence, a brain drain may enhance the formation of human capital at origin (incentive mechanism). This ex-ante additional skill acquisition may alleviate the ex-post loss of high-skilled individuals. Calibration of this effect is based on estimates by Beine et al. (2008).

The effect of high-skilled emigration on human capital formation, risk premium and technology is computed outside the core of the micro-founded model, using elasticities estimated in the empirical literature. The resulting paths of these three variables (risk premium, productivity, human capital) are then introduced into the model along with the migration shock.

**Table 3.2. High-skilled migration externality on technology (A) and network effects (π)**

| | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| $A$ | -0.04% | -0.09% | -0.12% | -0.13% | -0.15% |
| $\pi$ | -4.16% | -7.21% | -9.61% | -11.71% | -13.78% |

The table displays percentage point differences to the baseline.
Source: Docquier and Lodigiani (2008), Lodigiani (2007) and own computations.

**Table 3.3. Human capital in the "High-Skilled" (HS), "Brain Waste" (BW) "Brain Gain" (BG) and "Expansionary" (EXP) scenarios**

| | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| HS=BW | -0.48% | -0.81% | -1.06% | -1.30% | -1.58% |
| BG | -0.41% | -0.63% | -0.72% | -0.76% | -0.79% |
| EXP | 0.05% | 0.50% | 1.29% | 1.94% | 2.57% |

The table displays percentage point differences to the baseline.
Source: Beine, Docquier and Rapoport (2008) and own computations.

Table 3.2 presents the change in technology adoption and in network effects under the "Brain Gain" scenario. While technology is deteriorated (variable $A$) due to increased high-skilled emigration, information costs are reduced (variable $\pi$) and FDI to MENA are favored by high-skilled emigration. Table 3.3 depicts the effect of high-skilled emigration on the third affected variable: human capital. It can be observed that the ratio of high-skilled to total labor force (human capital) drops under the "Brain Gain" but less than under the "High-Skilled" scenario (because of the incentive effect).

Finally, the "Expansionary" scenario is the last variant of the "High-Skilled" scenario. It is similar to the latter scenario but assumes that the population in the MENA becomes more and more educated during the first half of the 21st century. In the baseline, the proportion of high-skilled among youngest cohort is constant at 15 percent from 2000 onwards, which means that the proportion of high-skilled in the workforce and in the population reaches 15 percent in the long run. In the "Expansionary" scenario, a brain drain occurs while the share of high-skilled among the youngest cohort continues to rise after 2000. It is assumed that 16.7 percent of the youngest individuals become educated in 2010, 18.4 percent in 2020 and finally 20 percent from 2030 onwards. Consequently, 20 percent of the labor force will be high-skilled in the long run. As stated above, the rationale of this human capital expansion is that an increased movement of high-skilled workers from the MENA to the EU15 could be accompanied by a more generous assistance or a greater cooperation in education policies. Under the "Expansionary" scenario, even with the increased departure of high-skilled individuals, human capital is improved compared to the baseline (see the last line of Table 3.3).

In the EU15, the "Brain Gain" and the "Expansionary" scenarios have an identical impact to the "High-Skilled" scenario, while a "Brain Waste" would lead to less optimistic results and has actually the same impact as the "Low-Skilled" scenario.[24] If high-skilled migrants arrive in the EU15 under the "Brain Waste" scenario, they will be employed as low-skilled and will have a similar contribution as the latter ones in financing the public budget and in improving the GNI per capita.

In the MENA, a "Brain Waste" scenario has a similar impact as the "High-Skilled" scenario, because the same people leave this region but are employed differently at destination. The "Brain Gain" scenario has a less damaging impact in the MENA than the "High-Skilled" scenario. The improvement in the risk premium and in human capital partly compensates the negative side-effect of high-skilled emigration on technology adoption, labor and capital productivity. We see that, when considering the side-effects of high-skilled emigration, i.e. under the "Brain Gain" scenario, the tax rate increases less and GNI is less reduced than under the "High-Skilled" scenario. Finally, since more individuals acquire higher education, inequality increases less under the "Brain Gain" scenario.

[24] In theory, general equilibrium effects could induce differences between these scenarios; in practice, these differences are negligible.

**Table 3.4. Results under the "High-Skilled", "Brain Waste", "Brain Gain" and "Expansionary" scenarios**

| *Tax Rate* | *(% deviation)* | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|
| EU15 | High-Skilled | -0.43% | -1.15% | -2.41% | -4.24% | -6.07% |
| | Brain Waste | -0.36% | -0.94% | -1.99% | -3.53% | -5.10% |
| | Brain Gain | -0.43% | -1.15% | -2.40% | -4.23% | -6.07% |
| | Expansionary | -0.43% | -1.14% | -2.40% | -4.23% | -6.08% |
| MENA | High-Skilled | 0.22% | 0.59% | 1.04% | 1.65% | 2.32% |
| | Brain Waste | 0.21% | 0.57% | 1.03% | 1.64% | 2.33% |
| | Brain Gain | 0.18% | 0.53% | 0.94% | 1.48% | 2.07% |
| | Expansionary | 0.13% | 0.34% | 0.59% | 0.93% | 1.42% |
| ***GDP per capita*** | *(% change)* | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | High-Skilled | 0.02% | 0.63% | 1.60% | 3.06% | 4.55% |
| | Brain Waste | -0.07% | -0.06% | 0.30% | 1.06% | 1.90% |
| | Brain Gain | 0.02% | 0.62% | 1.59% | 3.04% | 4.53% |
| | Expansionary | 0.02% | 0.62% | 1.58% | 3.02% | 4.52% |
| MENA | High-Skilled | -0.14% | -0.98% | -1.76% | -2.78% | -3.60% |
| | Brain Waste | -0.12% | -0.91% | -1.68% | -2.69% | -3.53% |
| | Brain Gain | 0.00% | -0.76% | -1.31% | -1.94% | -2.30% |
| | Expansionary | 0.02% | 0.01% | 0.43% | 1.07% | 1.52% |
| ***GNI per capita*** | *(% change)* | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | High-Skilled | -0.39% | -0.16% | 0.49% | 1.77% | 3.40% |
| | Brain Waste | -0.28% | -0.51% | -0.41% | 0.19% | 1.05% |
| | Brain Gain | -0.38% | -0.16% | 0.49% | 1.77% | 3.39% |
| | Expansionary | -0.37% | -0.15% | 0.49% | 1.76% | 3.38% |
| MENA | High-Skilled | 0.14% | -0.33% | -0.86% | -1.62% | -2.36% |
| | Brain Waste | 0.13% | -0.34% | -0.87% | -1.63% | -2.37% |
| | Brain Gain | 0.14% | -0.32% | -0.70% | -1.17% | -1.52% |
| | Expansionary | 0.11% | 0.24% | 0.69% | 1.33% | 1.83% |
| ***Inequality*** | *(% change)* | 2010 | 2020 | 2030 | 2040 | 2050 |
| EU15 | High-Skilled | -1.55% | -2.82% | -3.93% | -5.04% | -6.61% |
| | Brain Waste | 0.18% | 0.46% | 0.80% | 1.30% | 2.35% |
| | Brain Gain | -1.56% | -2.83% | -3.94% | -5.05% | -6.62% |
| | Expansionary | -1.56% | -2.83% | -3.95% | -5.05% | -6.62% |
| MENA | High-Skilled | 3.27% | 4.82% | 5.69% | 6.25% | 7.14% |
| | Brain Waste | 3.28% | 4.85% | 5.72% | 6.28% | 7.16% |
| | Brain Gain | 2.87% | 3.78% | 3.87% | 3.60% | 3.50% |
| | Expansionary | 0.08% | -2.50% | -6.02% | -7.80% | -8.95% |

The "Expansionary" scenario generates a much lower rise in the tax rate than the "High-Skilled" scenario since the level of human capital is enhanced even compared to the baseline (see Table 5.3). Obviously, in such a context, as per worker productivity increases, income per capita improves (contrary to the drop in GNI per capita obtained under the "High-Skilled" scenario). This scenario also results in a reduction in inter-household inequality as more people belong to the better-off group. The "Expansionary" scenario involves a win-win

situation, since besides improving the situation in the MENA it also leads to similar beneficial effects in the EU as under the "High-Skilled" scenario. Clearly, this suggests that a stronger partnership between the EU15 and the MENA countries, involving more high-skilled migration and a greater cooperation in human capital formation, can raise the welfare of all parties concerned. For instance, such an initiative could be designed in the framework of the *"Union pour la Méditerranée"* initiated in late July 2008 by French President Nicolas Sarkozy. Indeed, the goal of this Union is to promote a development of the Euromediterranean Partnership.

# 4 Conclusion

This paper examines the consequences of increasing MENA-to-EU migration flows in the coming decades on both sending and receiving regions. Different approaches are adopted to address this issue. First, from a pure demographic point of view, replacement migration policies encouraging MENA-to-EU flows of working-age people should not be permanent and be limited in size and in time. The reason is that, as Europe, MENA will also have to cope with the aging of its population.

Second, the paper also bases its conclusions on a general equilibrium analysis, which reveals some important insights. While selecting immigrants has a small additional impact in reducing tax rates (compared to a non selective policy), it leads to significant additional increments in income in aging Europe. In the MENA, emigration increases the economic burdens of aging, and even more if emigrants are high-skilled. Thus while high-skilled emigration would contribute to alleviate the aging problem in Europe, it would have negative consequences in terms of tax rates and income in the MENA.

Finally, we consider different variants of a selective policy within our analysis. The reasons are (i) that high-skilled migrants might not necessarily be employed as high-skilled workers at destination, (ii) that high-skilled emigration entails different side-effects on origin countries, and, (iii) that education in the MENA countries could be boosted by an increased cooperation with Europe. The first variant of the "High-Skilled" scenario, the "Brain Waste" scenario, combines the worst effects of the selective and non-selective policies explained before, since, under such a brain waste, high-skilled migrants leave the MENA and contribute as low-skilled workers to the European economy. The two other variants affect Europe in the same manner than a selective immigration policy, but considerably mitigate its effects in the MENA. The side-effects of high-skilled emigration contribute to moderate the increase in the tax rate, the drop in income per capita and the rise in inequality.

In a scenario in which high-skilled emigration is accompanied by an increase in education levels of the MENA labor force, income per capita would be even positively affected and inequality reduced. Such a situation results in a win-win situation, since besides improving the situation in the MENA, it also leads to similar beneficial effects in the EU as high-skilled migration alone. However, it leaves the question open on how such education improvements can be achieved. An increasing cooperation in education policies and managed migration

flows could be designed in the framework of the *"Union pour la Méditerranée"*, whose explicit goal is to promote a development of the Euromediterranean Partnership.

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