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Demographics in MENA Countries: A Major Driver for Economic Growth

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Abstract

MENA region is undergoing rapid demographic transition, where 50% of the population is under the age 25 and high youth unemployment rates are argued to be one of the main sources of political instability. In this paper we evaluate the economic impact of the demographic transition for selected MENA countries, namely: Iran, Morocco and Egypt who experience different speeds of transition. We have developed a general equilibrium overlapping generations model with a cost of capital mobilisation as a proxy for financial markets' efficiency and simulated the demographic trends in each country. We find that the demographic shift will be an important driver for growth in the upcoming decades. Furthermore, our results show that a more efficient financial sector leads to better economic performance. Specifically, youth are the primary beneficiaries: an increase in the financial sector efficiency can reduce up to 8 percentage points of the the unemployment rate for the youngest age group.

Keywords Development · MENA region · Financial efficiency · OLG model · Demographic transition

JEL Classification J11 · E17 · O16

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1 Introduction

Middle East and North African (MENA) countries are facing political and economic challenges, requires an urgent implementation of structural reforms to enhance inclusive growth. In spite of relatively high educational attainments, youth in the region are excluded from many economic opportunities. In fact, youth unemployment rates in the MENA countries are among the highest in the world reaching 26.2% in 2018 (World Bank).

The demographic transition in the region started relatively late, compared to Latin America and Southeast Asia. However it is happening considerably faster and could be regarded as an opportunity. All the countries in the region are facing the same demographic transition and could benefit from the twin "demographic dividends". The first dividend arises from changes in the population's age structure that influence the share of the working age population (given fixed output per worker, participation and unemployment rates) this leads to an increase in output per capita. The second dividend comes from the increased capital due to the savings of a larger number of middle-aged workers approaching their retirement (see Mason 2005).

In this paper, we highlight the demographic opportunity in the region through the selection of three countries, Iran, Morocco and Egypt, which face different speeds of demographic change. Iranian fertility rate decline has been one of the fastest in the world, it took only a decade for the fertility rate to drop from more than 6 births per woman to fewer than 3, which is even faster than the Chinese transition. In Morocco, this transition took 22 years. In Egypt, even though, the fall in fertility rates started earlier and the number of births per woman dropped under 6 by 1970, it took 47 years to only reach a rate of 3.3 as of 2017 (United Nations, Department of Economic and Social Affairs, Population Division 2019). Hence, Iran, Morocco and Egypt have been chosen to represent fast, medium and slow demographic transition.

The labor market in MENA region is under high pressure with the unemployment rate at 10.6% in 2017: on the supply side, due to the demographic changes there is a massive entrance of youth into the labor market, while on the demand side, job creation happens at a very low rate. In MENA oil-importer countries, this is due to the large share of governmental jobs while MENA oil-exporting countries suffer from the dependence to the oil sector, which is not a labor-intensive sector. Moreover, technological improvements lead to less labor intensive jobs. This leads to critically high unemployment rates in the region which reached 12.3%, 9.2% and 11.8% for Iran, Morocco and Egypt respectively (2018, World Bank).

Another specificity of the region is that the labor force had the fastest annual growth rate in the world (2.7% in the past 10 years), at the same time this demographic shift comes more as a demographic challenge since the youth unemployment in the region is also among the highest: In 2015, youth unemployment reached 30% in Iran and Morocco and is higher than 40% in Egypt.[1]

[1] Unemployment rate for ages between 12 and 24, are given by national statistics.

Therefore, the demographic change not only matters for the stock of human capital but also for the stock of physical capital. Financial markets have a crucial role to allocate capital and channel the available funds to their most productive use. It is hence fundamental to take into account the role of the financial markets in the growth process associated with demographic change. Even though financial markets in the region are still underdeveloped and are subject to change, improving their efficiency could potentially enhance economic growth.

Our aim is to evaluate the effect of a demographic shift on economic growth, to identify factors that can promote youth employment and to estimate whether a gain in the efficiency of the financial sector can stimulate youth employment.

In the process of evaluating the effect of the demographic shift on growth, we develop a measure of financial market efficiency in the model, as a proxy for the cost of capital allocation. This cost represents the inefficiency of the financial sector and can reflect the systemic inefficiency such as corruption, poor management, non-performing loans or a lack of skilled professionals in the financial sector. Additionally, it can represent the cost associated with restrictive regulation and taxation of financial transactions.

Our focus is on selected MENA countries, namely, Iran, Morocco and Egypt. Similar to most countries in the region, all of these countries face persistent high youth unemployment rates and their demographic transition is imminent. Hence, we expect a massive entrance of young workers in the labor market followed by a fall in the upcoming decades. Although the fall is happening at different rates, it will severely impact the economy.

Our contribution to the literature is, firstly, to employ the cost of capital mobilization as a proxy for the financial sector efficiency in a general equilibrium Overlapping Generations Model. Which allows us to study the impact of demographic evolution and financial markets efficiency on growth in a single model. Secondly, we use real data of the demographic evolution per age group that assembles information regarding both fertility rates and mortality rates. However most researches, dealing with demography, focus on the evolution of the fertility or population growth rates, others such as Lagerlöf (2006) introduces endogenous fertility. All of which, does not include information on mortality rates among cohorts. Thirdly, the paper concentrates on Iran, Morocco and Egypt, three countries in MENA, a region of growing interest that is somehow neglected in the literature.

This paper is organized as follows: after the literature review in the second section, the model is introduced in the third section. The fourth section details our calibration strategy. Results are presented in the fifth section and the last section concludes.

2 Literature Review

This paper is relevant to three different strands in the economic literature, firstly, the research on the impact of demography on economic growth, secondly, studies on the influence of demographic structure and finance and thirdly, the literature on finance-growth nexus.

The impact of demographic evolution on economic performance has long been debated in the literature. Bloom and Canning (2004) argue that since the early 1980s the dominant academic belief was that the population growth is rather neutral to economic growth. However, the emerging evidence indicates that since people's needs and contributions to the economy vary over their life cycle; population does indeed matter to growth, with age structure playing a central role. As noted by Bloom et al. (2003) and Lee and Mason (2007), an increase in the share of the working-age population can in particular produce a demographic dividend with respect to economic growth. Moreover, Chakraborty (2004), studies the impact of mortality rates on the economy, notably on savings and education decision. Favero et al. (2011) and Favero et al. (2015), provide empirical evidence based on US data, that underlies the importance of including population age structure in the macro-finance models. Liao (2011) highlights the importance of the demographic transition as a driver for growth and show that more than one third of Taiwanese output growth during the past 4 decades can be attributed to the demographic transition. Heijdra and Mierau (2011) show that ageing generally promotes economic growth due to a strong savings response. Boucekkine et al. (2002) evaluate the impact of an increase in life expectancy on growth and conclude that, although, higher survival probabilities lead to better schooling and later retirement, it does not necessarily lead to higher economic growth. D'Albis (2007), determines the impact of a demographic change on per capita capital and finds that this relationship is rather non-monotonic, in contrary to the classical OLG models that find a strictly decreasing relationship between capital accumulation and age structure. Bloom et al. (2017) put forward the high potential of the African countries to enjoy a demographic dividend. Martins et al. (2005) study the impact of ageing in OECD economies, and imply that the change in the population's age structure affects the supply side of the economy in capital markets, labor markets and also productivity; they conclude that demographic structure has a real impact on GDP growth rates. Moreover, they highlight the importance of financial markets structures in the process. Our results show a significant positive impact of the demographic transition on economic growth which is in line with this literature. Our paper contributes to this literature by performing a numerical exercise on an OLG setting and simulating future demographic trends by taking into account mortality rates forecasts of different age groups. Furthermore, we focus on countries that are least treated in the literature.

The literature dealing with financial markets and demography mainly investigates the effect of a demographic change on the demand side of financial assets by focusing on ageing. A common framework used in this literature is Overlapping Generations (OLG) with production and capital accumulation, the introduction of adjustment costs allows capital to be priced endogenously. Geanakoplos et al. (2004) show that demographic changes could impact asset prices. Abel (2003) shows that a baby boom will eventually lead to a meltdown in stock prices as the baby boom generation retires. The link between the change in demography and financial asset prices is the life cycle hypothesis, which suggests young people (aged 20–39) are likely to be net borrowers. While the middle-aged (aged 40–64) are involved heavily in accumulation of net assets because they are at the peak of their earnings potential, and likely to be saving for retirement. A relative increase in the size of this group would lead to a high demand for financial assets (e.g. stocks and bonds), resulting in an increase in financial asset prices. Similar to this literature, we also employ an OLG framework but we introduce a capital allocation cost as a proxy for financial efficiency and study its impact on employment rates notably for the youth.

The literature on Finance-Growth nexus has been largely studied in recent decades. However, there are few research dedicated to the development of financial markets in the MENA region. Ben Naceur and Ghazouani (2007) underline the relationship between financial development and economic growth for 11 MENA countries, using a dynamic panel model with GMM[2] estimators. Their empirical results reinforce the idea that there is no significant relationship between banking or stock market development and growth. They conclude that this lack of relationship must be linked to underdeveloped financial systems in the MENA region which hamper economic growth. These countries should improve the functioning of their financial system in order to protect their economies from the negative impact of a shaky financial market. Ben Naceur et al. (2008) also focus on the MENA region, specifically, the impact of the stock markets on growth. They find a negative impact of the stock markets in the short run that turns positive in the long run. Greenwood et al. (2013) use a costly state verification model and stress the importance of financial intermediation for economic development. They conclude that 29 percent of U.S. growth can be attributed to technological improvements in financial intermediation. Although the impact of financial market development on growth is well addressed in these studies, to our knowledge there is no literature on the impact of financial efficiency on economic growth that controls for demographic changes. Our goal is to fill this gap in the literature.

3 A Dynamic General Equilibrium Model with a Capital Mobilisation Cost

We develop a general equilibrium OLG model and introduce the financial sector efficiency to the real sector with search and matching structure in the labor market *à la* Diamond–Mortensen–Pissarides (DMP). Following Pagano (1993), we introduce an investment cost as a proxy for financial markets' efficiency. For the sake of simplicity, we do not introduce retirement in the model, although this will be a shortcoming in the case of studying an ageing population.[3]

Our focus is on the individual's behaviour when they are active in the labor market, more specifically, agents between ages 15 to 64. Average schooling years in 2016 equals 9.8 for Iran, 5.4 for Morocco and 7.2 in Egypt (UNDP data). Hence we assume people approximately enter the labor market when they are 15 years old. Each period of time in the model stands for 10 years, individuals are assumed to enter the labor market at age 15–24 ($a = 0$) and leave it at age 55–64 ($a = 4$).

2 Generalized method of moments.

3 The pension schemes are not very well developed in the region and many elderly stay in the labor market or depend on their children.

$Z_{a,t}$ represents the population of age a in period t. The size of the initial cohort (population at age $a = 0$) is known, i.e. $Z_{0,t}$ is known, let $\beta_{a,t}$ the conditional survival probability of reaching age a in period t, if the agent has survived until age $a - 1$ in period $t - 1$. The total population of age a in period t is given by:[4]

$$Z_{a,t} = \beta_{a,t} Z_{a-1,t-1} \qquad \forall t \geq 1 \tag{1}$$

We suppose that the participation rate is exogenous and normalized to 1. and since the individuals stay in the labor force until their last period, the working-age population is given by Z_t:

$$Z_t = \sum_{a=0}^{4} Z_{a,t}$$

Agents of working age are either employed ($N_{a,t}$) or unemployed ($U_{a,t}$) with $n_{a,t}$ and $u_{a,t}$ representing the employment and unemployment rates:

$$Z_{a,t} = N_{a,t} + U_{a,t} = (n_{a,t} + u_{a,t}) Z_{a,t} \tag{2}$$

The labor market has a Diamond–Mortensen–Pissarides (DMP) search and matching structure in which firms post vacancies at a cost and jobs are distributed through a basic search and matching model. Wages are determined in each period by a Nash bargaining solution.[5] We assume that there is a constant returns to scale matching function:

$$M_t = M(V_t, \Omega_t) = \bar{m} V_t^{1-\gamma} \Omega_t^{\gamma} \tag{3}$$

With M_t denoting the number of possible matches between job seekers and the vacancies, V_t the number of vacancies available and Ω_t the number of job seekers in period t. Let $\Omega_{a,t}$ represent the number of job seekers of age a in period t, then, the total number of job seekers in each period, Ω_t, is given by the sum of job seekers in all ages: $\Omega_t = \sum_{a=0}^{4} \Omega_{a,t}$ At age 0 every agent, entering the market is a job seeker, $\Omega_{0,t} = Z_{0,t}$ For ages above 0, the number of job seekers is given by the unemployed in the previous period, plus those who have lost their jobs in the past period (with χ being the job destruction rate):

$$\Omega_{a,t} = (u_{a-1,t-1} + \chi n_{a-1,t-1}) Z_{a,t} \tag{4}$$

$$= (1 + (\chi - 1) n_{a-1,t-1}) Z_{a,t} \quad \text{for} \quad a = \{1, 2, 3, 4\} \tag{5}$$

Hence,

[4] Considering migration is beyond the scope of this paper.

[5] The classical contributions are introduced in Diamond (1981), Pissarides (1985) and Mortensen and Pissarides (1994).

$$\Omega_t = \sum_{a=0}^{4} \Omega_{a,t} = Z_{0,t} + \sum_{a=1}^{4} (1 + (\chi - 1)n_{a-1,t-1})Z_{a,t} \tag{6}$$

The probability of finding a job denoted by p_t, and the probability for a vacancy to be filled, q_t are given by:

$$p_t = \frac{M_t}{\Omega_t} \quad \text{and} \quad q_t = \frac{M_t}{V_t} \tag{7}$$

The employment rate for workers in age group a is equal to non-destroyed jobs from the last period, plus new hires of this period:

$$n_{a,t} = (1 - \chi)n_{a-1,t-1} + p_t \frac{\Omega_{a,t}}{Z_{a,t}} \quad \text{for} \quad 1 \le a \le 4 \tag{8}$$

and

$$n_{0,t} = p_t \tag{9}$$

By replacing $\Omega_{a,t} = (1 - (1 - \chi)n_{a-1,t-1})Z_{a,t}$ we obtain the law of motion for employment:

$$n_{a,t} = (1 - \chi)n_{a-1,t-1}(1 - p_t) + p_t \quad \text{for} \quad 1 \le a \le 4 \tag{10}$$

We have a representative agent for each age category with perfect foresight, who does not leave intended bequest. All agents in the economy are price takers. The objective function of the households depends on their consumption and employment status, it is given by:

$$W_t^H = \max \sum_{a=0}^{4} \left(\frac{1}{1+\theta} \right)^a \beta_{a,t+a} \Big(u(c_{a,t+a}) - d_n n_{a,t+a} \Big) \tag{11}$$

Where $\theta > 0$ is the time preference and d_n is the constant disutility per unit of work and is supposed to be constant. We assume that there is no government in this model. This hypothesis is convenient, since the tax rates are relatively low in the countries of this study, and in general the government in these countries does not play an active role in providing citizens with good and widespread social security and pension schemes. Therefore, we assume that the government's debt policy cannot be used as a vehicle for redistributing of wealth among generations.

The household budget constraint at time $t + a$ is given by:

$$(w_{a,t+a} n_{a,t+a}) + \frac{\beta_{a-1,t+a-1}}{\beta_{a,t+a}} (1 + r_{t+a}) s_{a-1,t+a-1} = c_{a,t+a} + s_{a,t+a} \tag{12}$$

With $s_{a,t}$ be the financial wealth accumulation at time t in per capita terms or simply the savings rate. The financial wealth is either held in shares or physical capital. Following Yaari (1965), we suppose that there is perfect insurance against individual lifetime uncertainty. Therefore the total return to savings is equal to gross risk-free interest rate divided by the survival probability from period $t + a - 1$ to the next period.

Thus, the Euler equation for the households is:

$$u'(c_{a,t+a}) = \frac{u'(c_{a+1,t+a+1})}{1+\theta}(1 + r_{t+a+1}) \tag{13}$$

For later use, we need to calculate the value of an additional job for the household:

$$\frac{\partial W_t^H}{\partial N_{a,t}} = \frac{Z_{0,t}}{Z_{a,t}} \sum_{j=0}^{4-a} \left(\frac{1}{1+\theta}\right)^{a+j} (\beta_{a+j,t+j})(u'(c_{a+j,t+j})w_{a+j,t+j} - d_n)\frac{\partial n_{a+j,t+j}}{\partial n_{a,t}} \tag{14}$$

with:

$$\frac{\partial n_{a+j,t+j}}{\partial n_{a,t}} = (1-\chi)\left(1 - p_{t+1}\frac{\beta_{a,t}}{\beta_{a+1,t+1}}\right)\left(\frac{\partial n_{a+j-1,t+j-1}}{\partial n_{a,t}}\right) \tag{15}$$

In this model we have a single production sector, which is assumed to behave competitively. Production is constant returns to scale, with two factors of production, namely, capital and labor. Labor is measured in efficiency units, h_t, and efficiency can vary across ages due to experience and also across generations due to education difference. The total labor input is defined as:

$$H_t = \sum_{a=0}^{4} h_{a,t} N_{a,t} \tag{16}$$

Production function of the representative firm is assumed to be a constant returns to scale Cobb–Douglas.

$$Y_t = A_t F(K_t, H_t) \tag{17}$$

Where Y_t is the output produced in period t and A_t is the total factor productivity and K_t is the capital stock.

Firms rent capital at cost v_t, which is an increasing function of the interest rate, depreciation rate of capital and the financial cost of capital, which we will define in the following section. In our model, we focus on one of the main functions of the financial sector which is to mobilize savings.

With ζ being the cost of posting a vacancy. The firm will maximize the following Bellman equation:

$$W_t^F = \max_{K_t, V_t} \left\{ F(K_t, H_t) - v_t K_t - \sum_{a=0}^{4} w_{a,t} N_{a,t} - \zeta V_t + R_{t+1}^{-1} W_{t+1}^F \right\} \tag{18}$$

Subject to:

$$N_{a,t} = Z_{a,t} n_{a,t}$$

$$n_{a,t} = (1-\chi) n_{a-1,t-1} + p_t \frac{\Omega_{a,t}}{Z_{a,t}} \quad \text{with} \quad n_{0,t-a} = p_{t-a}$$

$$p_t = q_t \frac{V_t}{\Omega_t}$$

Hence, we obtain the first order conditions:

$$v_t = F_{K_t} \tag{19}$$

$$\zeta = q_t \sum_{a=0}^{4} \frac{\Omega_{a,t}}{\Omega_t} \frac{\partial W_t^F}{\partial N_{a,t}} \tag{20}$$

Note that ζ is the marginal cost of hiring and $\frac{\partial W_t^F}{\partial N_{a,t}}$ is the value at time t of an additional worker of age ζ and is given by:

$$\frac{\partial W_t^F}{\partial N_{a,t}} = \frac{1}{Z_{a,t}} \frac{\partial W_t^F}{\partial n_{a,t}} \tag{21}$$

$$= \sum_{j=0}^{4-a} \frac{\beta_{a+j,t+j}}{\beta_{a,t}} \frac{(1-\chi)^j}{1+r_{t+j}} (h_{a+j,t+j} F_{H_{t+j}} - w_{a+j,t+j}) \tag{22}$$

This condition shows that in the equilibrium the marginal cost of hiring should be equal to the marginal value of employment to the firm.

Wages are negotiated in every period and are determined by a standard Nash bargaining rule:

$$\max_{w_{a,t}} \left(\frac{\partial W_t^F}{\partial N_{a,t}} \right)^{1-\eta} \left(\frac{1}{u'_{c_{a,t}}} \frac{\partial W_t^H}{\partial N_{a,t}} \right)^{\eta}$$

The first order optimality condition is given by:

$$(1-\eta) \frac{1}{u'_{c_{a,t}}} \frac{\partial W_t^H}{\partial N_{a,t}} = \eta \frac{\partial W_t^F}{\partial N_{a,t}} \tag{23}$$

All agents in this economy are price takers, and all markets are competitive. There are 3 markets in our economy: market for capital, labor and a physical good which is either consumed or invested to build future capital. The equilibrium conditions are:

- Labor market equilibrium: the equilibrium is given by the wages and the Nash bargaining solution in Eq. (23).
- Good market equilibrium: we have the good market equilibrium as:

$$\sum_a c_{a,t} Z_{a,t} + I_t = Y_t \tag{24}$$

- Capital market equilibrium and the investment cost:

  The capital market equilibrium, in the absence of government and perfect financial markets calls for the aggregate gross saving, $S_t = \sum_a s_{a,t} Z_{a,t}$, to be equal to the gross investment, I_t. Here, following Pagano (1993) and as explained later, we assume that a proportion, $1 - \varphi$ of the savings is 'lost' in the process of financial intermediation, so the equilibrium condition writes:

$$\varphi S_t = I_t \tag{25}$$

  where φ indicates the presence of financial market friction and represents the amount of investment produced by one unit of savings. This can reflect the X-inefficiency of the intermediaries, that is a non-allocative inefficiency with unknown origins that makes the final outcome deviate from the optimal outcome (see the seminal work of Leibenstein 1966). This 'lost' share of savings may also represent what is absorbed by the financial intermediaries, for instance as the spread between lending and borrowing rates that goes to banks or fees charged by the financial intermediaries. It may also reflect the systemic inefficiency such as corruption, poor management, poor loans within the banking system who are majorly under reported or lack of skilled professionals in the financial sector. Additionally, it can represent the cost associated with restrictive regulation and taxation of financial transactions. According to this definition $0 < \varphi \leq 1$ with $\varphi = 1$ representing perfect financial markets.

  Thus, we model the efficiency of the financial sector as a change in financial transaction costs. Households save the amount S_t and receive in the next period $(1 + r_{t+1})S_t$. Firms, on the other hand, only receive a fraction of these savings due to the presence of transaction costs, $\varphi_t S_t$, with $0 < \varphi \leq 1$, and $(1 - \varphi)$ What will remain from the initial savings after the production process, is the depreciated investment which would be equal to $(1 - \delta)\varphi_t S_t$, hence, the total cost of capital for the firm in the period $t + 1$, writes:

$$v_{t+1} \varphi S_t = (1 + r_{t+1}) S_t - (1 - \delta) \varphi S_t \tag{26}$$

$$v_{t+1} = \frac{1 + r_{t+1}}{\varphi} - (1 - \delta) \tag{27}$$

$$r_t = \varphi(1 - \delta + v_t) - 1 \tag{28}$$

  Equation (28) shows that an increase in the financial sector efficiency, translated to an increase in φ, which will lead to, ceteris paribus, an increase in the interest rates. We need to distinguish this definition for the cost of capital from the literature on adjustment costs for investment, since the nature of these two are completely different. In fact the cost of capital that we have defined is due to financial markets transaction costs, which does not depend on the production process or the nature of the investment.

We can define $R_t(\varphi, r_t) \equiv \frac{1+r_t-\varphi}{\varphi}$ to finally obtain the cost of capital, similar to the canonical model:

$$v_t = R_t(\varphi, r_t) + \delta \tag{29}$$

We can interpret $R_t(\varphi, r_t)$ as the interest firms pay for their capital which is not the same interest that households receive r_t due to financial market fees $(R_t(\varphi, r_t) > r_t)$.

The stock of the capital in the next period is equal to the investment in the current period plus the depreciated capital of the previous period, hence the capital accumulation equation writes:

$$K_{t+1} = I_t + (1 - \delta)K_t \tag{30}$$

4 Calibration

The focus of this paper is on selected MENA countries, namely, Iran, Morocco and Egypt. This selection is due to different demographic characteristics, notably the speed of decline in the fertility rate. The parameters of the model are set to reflect the economic situation, labor market tensions and the demographic shifts in these countries.

4.1 Parameters

The main parameters remain the same across the selected countries, the major difference is in demographics which is detailed in the following section. There are four different categories of parameters in the model:

General technological and preference parameters are mostly uncontroversial and are set to values consistent with previous contributions or microeconomic evidence. A constant returns to scale Cobb–Douglas production function, with elasticity of output with respect to capital set at $\alpha = 0.33$. Total factor productivity is set to produce the same gap in GDP per capita among the countries as we observe in the data.[6] Other technological and preference parameters are reported in Table 1.

The second category of parameters consists of age-dependent productivity of agents. Skirbekk (2004) gives a survey of the literature regarding the productivity of the labor force for different age groups. Most studies show a considerable decline in productivity after age 50, as a result of the decline in cognitive and mental abilities, which is considered a universal phenomenon.[7] According to Sibai et al. (2014)

[6] TFP is set to 21, 18.9 and 19.5 in Iran, Morocco and Egypt respectively.

[7] Age-productivity profile is estimated almost always by wage differentials, which is quite debatable as the rewards to the seniors maybe due to loyalty or past achievements rather than current productivity, on the other hand older workers importance to the companies is difficult to measure since it can be due to wider networks, knowing better how to deal with problems with lower frequencies etc. Hence, although wage differentials are not the ideal measures for productivity, they are considered one of the best so far.

Table 1 Calibration details. *Source*: Various and authors

Symbol	Definition	Value	Source
General technological and preference parameters			
α	Elasticity of output with respect to capital	0.33	Börsch-Supan et al. (2006)
θ	Time preference (quarterly)	0.01	Hagedorn and Manovskii (2008)
δ	Depreciation rate of capital	5% annually	Börsch-Supan et al. (2006)
d^n	Disutility of working	0.25	de la Croix et al. (2013)
Age specific human capital			
h_0	Human capital for agents of ages within 15–24	1.3647	Authors' calculation
h_1	Human capital for agents of ages within 25–34	2.3647	Authors' calculation
h_2	Human capital for agents of ages within 35–44	4.3647	Authors' calculation
h_3	Human capital for agents of ages within 45–54	6.8647	Authors' calculation
h_4	Human capital for agents of ages within 55–64	6.3647	Authors' calculation
Frictional labor market parameters			
γ	Elasticity of matches with respect to vacancies	0.5	de la Croix et al. (2013)
$\bar{m}$	Matching efficiency parameter	0.9	Targeting p and $q = 0.9$
η	Bargaining power of workers	0.5	de la Croix et al. (2013)
χ	Job destruction rate (quarterly)	0.004	ILO, KILM 9 dataset
ζ	Cost of posting a vacancy	43.5	Targeting p and $q = 0.9$

older people in the region suffer from chronic diseases which contribute to lowering their productivity. Our main assumption here is that the age-productivity profile remains the same for different countries and as suggested by empirical findings, increases until the age of 50, and then decreases very slowly. This is similar to Heijdra and Reijnders (2016), which take into account both human and physical capital accumulation in their model. They assume that the labor market participation leads to a higher human capital stock as valuable experience is gained; this human capital stock diminishes with ageing and finally prompt the individuals to exit the labor force. Hence the age specific human capital is calculated to form an inverse U-shaped curve and to reflect the wage differentials among age groups, their values are reported in Table 1.[8]

The third category gathers labor market parameters. These parameters are associated with a frictional labor market. The matching process is a constant returns to scale Cobb–Douglas function, the elasticity of matches with respect to vacancies, γ, and the workers' bargaining power, η, are set at 0.5 The matching efficiency

[8] In order to verify that our results are not simply a response to the calibration of the human capital we perform a robustness check (see in "Appendix 3") where we set the human capital constant among different age groups.

parameter, $\bar{m}$, and vacancy cost, ζ, are set to target the final steady state of finding a job and posting a vacancy at 90%, since according to national statistics the unemployment rate is around 10% in the countries in our sample.[9] The job destruction rate is calculated based on the KILM data set by ILO. It is estimated by quarterly unemployment inflows and is around 0.004 for the countries in MENA region. Table 1, brings together all these parameters.

The fourth category of parameters are specific to the financial sector development. According to Lesmond et al. (1999), estimated transaction costs vary from 10% for small firms to 1% for large firms in developed economies. Naturally, this figure is much higher in MENA region which has a less developed financial sector. We assume that the cost of allocating capital is 20%, when the financial markets are relatively inefficient. This cost can be reduced in the case of financial market efficiency improvement, meaning that the variable $\varphi = 0.8$ when financial markets are inefficient, and it can reach $\varphi = 1$ where financial markets are perfect and very efficient so that the cost of capital allocation falls close to 0. We also perform a robustness check with the transaction cost of 10%, and end up with similar results that are reported in "Appendix 2".

4.2 The Demographic Shift

According to Eq. (1) the parameters that define the population dynamics in the model are $Z_{0,t}$ and $\beta_{a,t}$, which are the size of the initial cohort and the probability of reaching age a in period t if the agent has already survived to age $a - 1$ in period $t - 1$, respectively. These parameters are set to replicate the World Population Prospects data set by UN.[10] The use of real data on population allows us to incorporate information about mortality rates by age in our analysis, which is one of the distinctive features of this paper since most of the literature simulate demographic shocks solely by considering the evolution of the fertility rates. The values of $Z_{0,t}$ and $\beta_{a,t}$ in each period are reported in "Appendix 1" along side of the dynamics of population evolution per age group as well as the total population and its growth rate for each country.

We consider the period where the share of the youngest age group surpasses the share of the oldest age group in the working age population as a turning point in the demographic shift of each country. Thus, according to Fig. 1, the turning points for Iran, Morocco and Egypt are 2040, 2070 and 2100 respectively. This also reflects the speed of the demographic shift and the ageing process in the labor force which is the fastest for Iran and the slowest for Egypt.

[9] 10.2% for Morocco, 13% for Egypt and 12.8% for Iran in 2014.

[10] United Nations, Department of Economic and Social Affairs, Population Division (2015), custom data acquired via website.

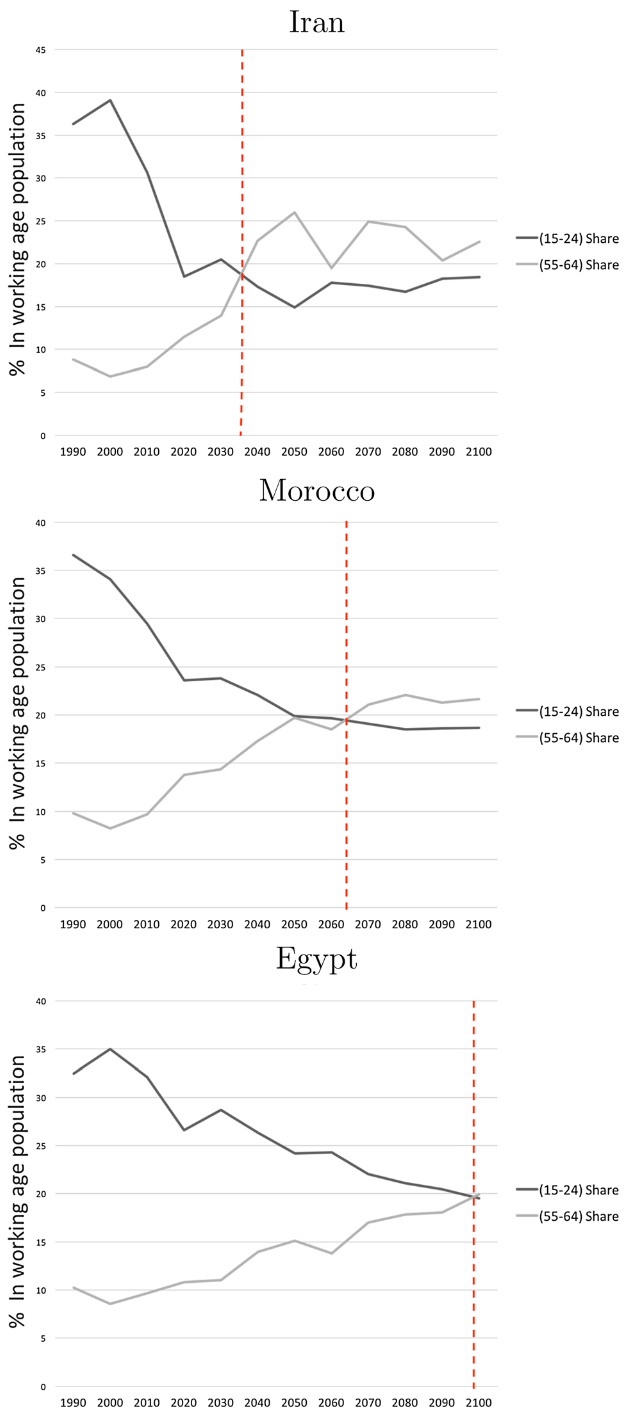


Fig. 1 The evolution of the share of the youngest and oldest age group in the labor force. *Source*: Authors

Table 2 The value of $(1-\varphi)$ or the cost of capital accumulation under different scenarios. *Source*: Authors

Period	1	2	3	4	5	6	7	8	9	10
Baseline	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
High	0.2	0.1	0.05	0.025	0.0125	0.0062	0.0031	0.00156	0.00078	0.00039
Low	0.2	0.19	0.18	0.17	0.16	0.15	0.147	0.139	0.132	0.126

4.3 Financial Efficiency Shock

In order to study the impact of financial efficiency improvement on the economy,[11] we consider different scenarios for the improvement of the financial sector efficiency. In the "Baseline scenario" the cost for allocating capital remains unchanged and the evolution of variables is solely a response to the change in the demographic structure. The "High scenario", in addition to the demographic change, consists of a 50% decline in the cost of capital allocation in every period or every decade; and the "Low scenario", is a very gradual improvement in the sector corresponding to 5% decline in the cost for mobilizing capital. In both of these scenarios the decrease in the capital's cost start in 2010, Table 2 represents the value of $(1-\varphi)$ in each period under each scenario.

In other words, our "Baseline scenario" takes into account only the demographic changes, while "High scenario" studies the impact of a continuous huge and significant reform in the financial sector on these demographic changes and "Low scenario" focuses on small but continuous reforms in the financial sector.

5 Results

We start by presenting the results of the impact of a demographic shift on GDP growth, employment rate, savings, wages and interest rate. Then, we compare the dynamics of each indicator under different scenarios for financial efficiency improvement.

5.1 Growth

In order to quantify the effect of the labor force ageing on growth and to exclude the effect of the population size, it is useful to look at the variations of GDP per capita (see Fig. 2). GDP per capita rises as the population ages, it tends to stabilise at the turning point of the demographic shift, i.e. for Iran in 2040 and for Morocco in 2070, meanwhile for Egypt it continues to rise until the last period, i.e. 2100. Our findings are in line with D'Albis (2007) and Boucekkine et al. (2002), that find

[11] The main focus of this paper is on the efficiency of the financial sector and not its size.The literature on the impact of the financial sector on economic growth is very well developed (see Arcand et al. 2015).

Table 3 GDP per capita in 2100. *Source*: Authors

	Baseline	High scenario	Low scenario	P.P. difference between High and the baseline	P.P. difference between Low and the baseline
Iran	69.63	92.65	76.93	23.02	7.3
Morocco	61.84	88.21	72.66	26.37	10.82
Egypt	43.78	68.73	53.38	24.95	9.6

The numbers are represented as the percentage difference from the initial value of GDP per capita in 2000. For instance, under the baseline scenario, the GDP per capita in Iran in 2100 is 69.63% higher than its value in 2000

a non-monotonic impact of the demographic evolution on the economy. The main difference of our work is that unlike D'Albis (2007) that only takes into account the evolution of the physical capital and Boucekkine et al. (2002) that focus only on the human capital, we consider the evolution of both physical and human capital. Secondly, those papers study the impact of an increase in population's growth rate (as a response to fertility shocks), while our paper uses real data on population structure, which also includes information about mortality rates that may have a different effect on GDP per capita.

One can also note that the rise in GDP per capita is higher under the High scenario, showing the positive impact of the financial sector efficiency improvement on GDP per capita. Table 3 reports the percentage rise in GDP per capita in the last period of the simulations, compared to its initial level in 2000. Morocco benefits the most from a gain in the efficiency of the financial sector and ends up with 26.37 percentage point higher GDP per capita under the High scenario. We expect this gain in GDP per capita to lead to a significant fall in unemployment rates.

5.2 Employment

The OLG framework makes it possible to distinguish between different age groups, the unemployment rates vary significantly among ages, with the youth having the highest unemployment rate of around 40% while the unemployment rate for the oldest agents is a quarter of it. These figures are in line with the data from the labor market in the region and highlights the fact that most of the tension in the labor market is on youth.

The demographic evolution can affect unemployment via two direct channels. Firstly, through an increase in the population size and the labor force that may lead to higher unemployment through the supply-demand mechanism. Secondly, through the change in the age structure of the population; as ageing in the population progress, the unemployment rate falls. The main reason is that the unemployment rate is higher among the youth, because individuals are more experienced at older ages, hence more productive and subject to higher human capital; besides, they were present in the labor market over a longer period of time, hence they have a higher probability to be employed. Furthermore, there is an indirect channel at play, which is through physical capital accumulation. With an ageing population, the aggregate

Fig. 2 GDP per capita (percentage deviation from the initial steady state). *Source*: Authors' calculations

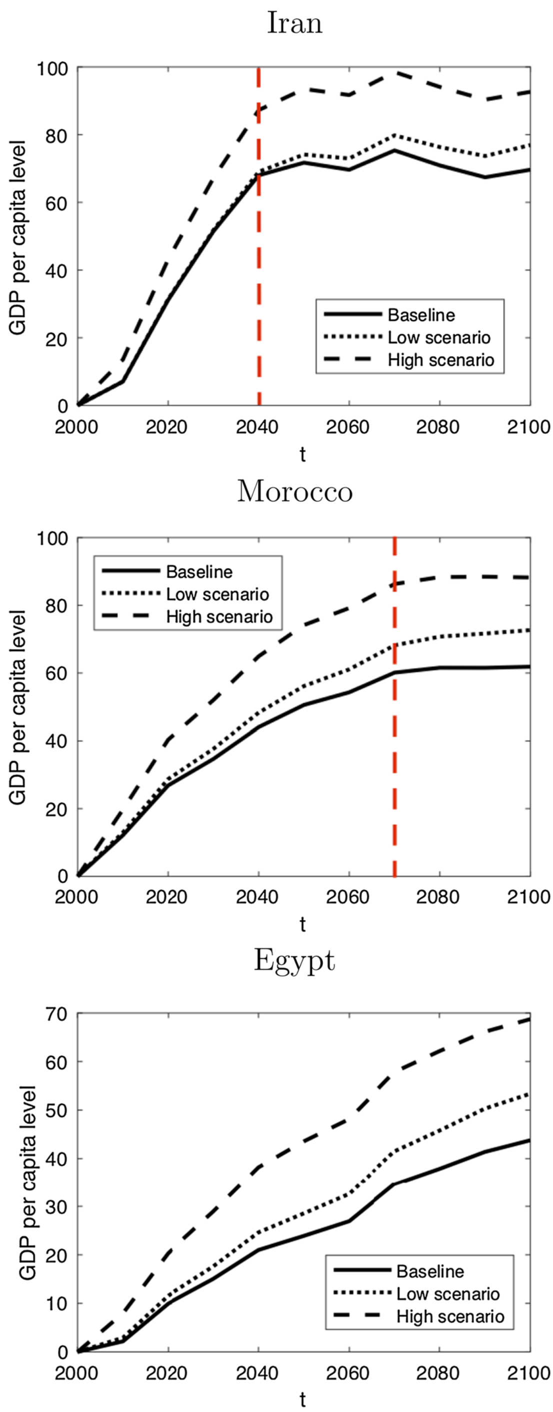


Table 4 Unemployment rates in 2100. *Source*: Authors

	Baseline (2000)	Baseline (2100)	High (2100)	Difference baseline-high (2100)	Difference base-line (2100–2000)
Iran					
15–24	40.5	22.3	15.7	6.6	18.2
25–34	19.3	8	4.7	3.3	11.3
35–44	12.6	5.2	3.2	2	7.4
45–54	10.5	4.8	3.1	1.7	5.7
55–64	9.9	4.7	3	1.7	5.2
Total	24.7	8.7	5.7	3	16
Morocco					
15–24	46.3	33.6	28.2	5.4	12.7
25–34	25.7	14.7	11	3.7	11
35–44	17.5	9.6	7.2	2.4	7.9
45–54	14	8.3	6.3	2	5.7
55–64	12.9	7.9	6.2	1.7	5
Total	28.6	14.4	11.4	3	14.2
Egypt					
15–24	42.7	34.6	26.3	8.3	8.1
25–34	21.8	15.2	10.1	5.1	6.6
35–44	14.7	10	6.7	3.3	4.7
45–54	12.1	8.6	5.9	2.7	3.5
55–64	11.2	8.2	5.7	2.5	3
Total	25.5	15.2	10.9	4.3	10.3

Unemployment rates in percentage in the Baseline and High scenario and their difference in percentage point. The last column represents the gain in employment rates as a response to demographic transition solely

savings increase because older age groups tend to save more, which leads to a higher investment and job creation, hence, lower unemployment rates.

Table 4 reports the unemployment rates in the first and the last period of the simulation under the Baseline and High scenario for all age groups, as well as, the total unemployment rate. It shows that the demographic evolution has a powerful negative impact on unemployment rates. The demographic transition alone is responsible for 16, 14.2 and 10.3 percentage point decrease in the total unemployment rate in Iran, Morocco and Egypt, respectively. One can note that as the size of the youngest cohort is shrinking, the fall in the unemployment rate is the greatest for the younger cohorts.

Financial market efficiency improvement leads to greater stock of capital and consequently higher productivity of capital, thus, lower unemployment rates; and since the impact of the shock is clearly stronger under the high scenario, the unemployment rates are the lowest in this scenario. Younger age groups benefit more from the efficiency gain in the financial sector; while the gain can be as high as 8.3 p.p. for the youngest cohort, it does not surpass 2.5 p.p. for the oldest one.

One can also note that the drop in the unemployment rate is sharper for Iran, who faces a more abrupt fall in its fertility rates (higher demographic dividend), than Morocco, where the fertility rates decline at a smoother pace. The fall in unemployment rates is the lowest for Egypt, where fertility rates are rather stable and the demographic dividend is the lowest.

5.3 Savings

Savings is one of the most studied macroeconomic aggregates which has important implications on growth and consumption levels and its evolution is a determining factor for the dynamics of the OLG models. In fact, the importance of the household's decision on savings in the model is twofold, it is an essential factor for wealth determination in the budget constraint, it also shapes the dynamics of the capital accumulation in the economy.

The dynamics of the unemployment and saving level are closely interrelated, higher levels of aggregate savings lead to abundance of physical capital, which in every neoclassical setting causes a fall in the unemployment rate.

Figure 3 demonstrates the savings evolution per capita for different age groups.[12] The savings is increasing during the agents lifecycle, here, since we do not have retirement in the model, we do not obtain a fall in the savings at the end of the lifecycle. Hence our results are consistent with the existing literature regarding the lifecycle model of savings. The demographic transition to an older labor force, globally makes the saving per capita increase for the youngest age group and decrease for the older ones who hold much higher savings, hence the saving per capita on average declines. This result is in line with the existing literature, as studied in detail by Heijdra and Ligthart (2006) who show that the per capita savings mostly decrease as a response to a fertility shock, although in theory it may increase if the effect of generational turnover is sufficiently strong to dominate the aggregate labor supply effect, this case is not empirically relevant.[13]

6 Discussion

This study is focused on Iran, Morocco and Egypt. Although the demographic trend by age groups is at the center of our analysis and is taken into account in the model, one cannot neglect the uniqueness of the labor market structure of each country. Some key differences derive from the educational systems, with an over-extended education in Iran and Egypt where average years of total schooling among the population of age over 25 in 2010 is 8.17 and 6.55 while the same figure for Morocco is 4.25 (Barro and Lee 2013). In Iran 15.8 percent of the population of age 25 and above complete a tertiary education cycle, while in

[12] In this model, like any other overlapping generation settings with perfect foresight the savings is 0 for the oldest age group.

[13] The evolution of other variables such as consumption, wages, capital, interest rate and productivity are available upon request.

Fig. 3 Savings per capita by age. *Note*: Savings per capita for different age groups. According to the ▶ model's assumptions, the savings are equal to zero for the oldest age group (of ages 55 to 64). Agents have perfect foresight and anticipate the upcoming shock in their savings decision that is the main reason the staring point in different scenarios may not be the same. *Source*: Authors' calculations

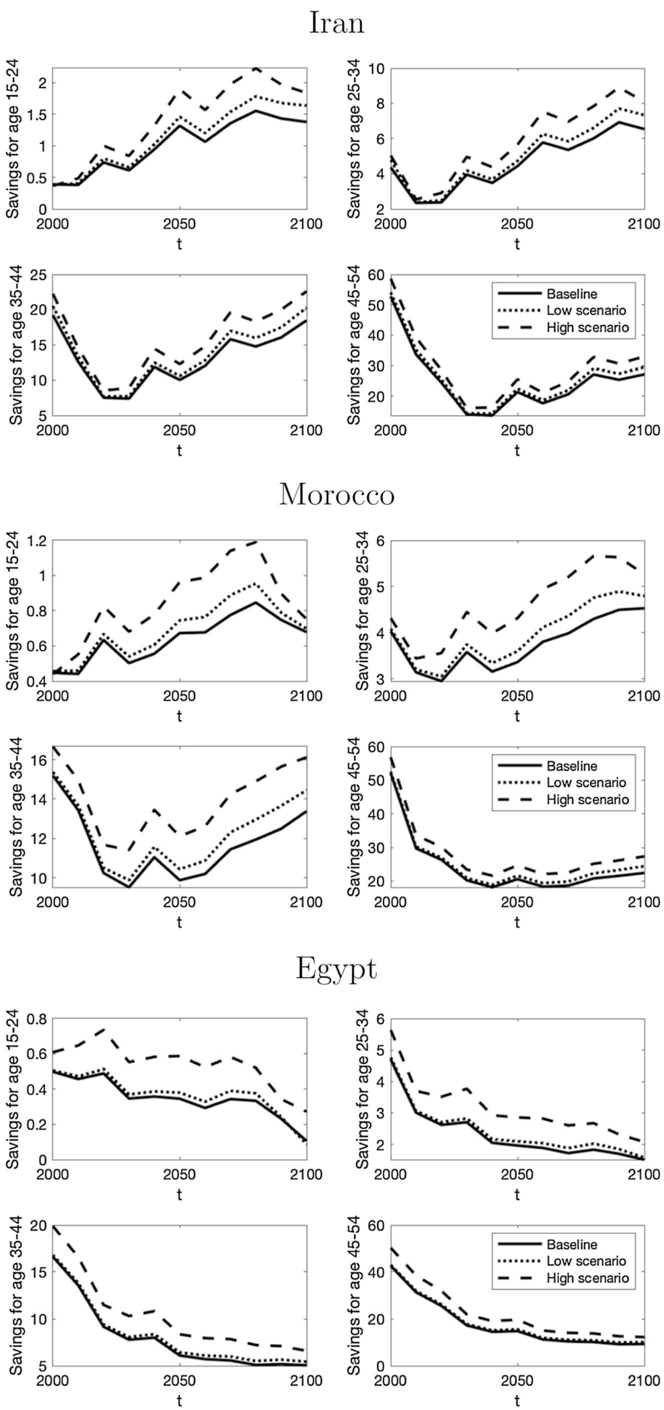
Egypt and Morocco this proportion is 6.8 and 6.3 respectively. This high level of educational attainment is not a guarantee to get a job and youth unemployment rates remain high, reaching 28.35, 21.88 and 32.59 in 2018, in Iran, Morocco and Egypt respectively; causing the youth to be economically and politically excluded (World Bank). Moreover each country face their unique challenges that have implications on growth but remain out of the scope of this study, such as corruption and sanctions in Iran. Addressing these issues in a formal setting adds to the complexity of the model and should be treated in future research.

Our results demonstrate significant benefits of the demographic shift on economic activity. Governments can play an active role helping those potential benefits take place and preparing the youth to be absorbed in the labor market by investing in labor intensive jobs and developing training programs.

While the financial sector is undergoing various reforms, studying the potential impact of such reforms under the present demographic trends on the real economy is essential to nourish public debate and to ensure the application of the best relevant policies. Our results reflect the significant positive impact of financial sector efficiency gain, which means that the policy makers need to address efficiency of the financial sector by taking different measures such as introducing competition in the financial sector, improving governance to boost productive investment, and by implementing an effective regulation to protect investors and bring certainty to the markets in the region. These policies should be accompanied by measures to enhance financial inclusion, as the financial exclusion notably for the youth and rural areas is a critical issue in the region (see Demirguc-Kunt et al. 2018).

In order to keep our model computable and simple enough, we had to make several strong assumptions. It is interesting to see what happens if these assumptions are relaxed or whether the data supports these assumptions:

- Absence of migration: Migration rates are negative for the countries of this study. This rate is the highest for Morocco with a significant human capital flight (with − 7.22 migrants per 1000 population in 2017 compared to 3.4 in Iran and 1.9 in Egypt, Word Bank). For the sake of simplicity, agents do not have a choice to migrate or not in the model, hence migration is exogenous and is implicitly taken into account in the calculation of the mortality rates since the model is calibrated in a way to reproduce the same population per age group as the UN data forecasts.


Iran
Savings for age 15-24
Savings for age 25-34
Savings for age 35-44
Savings for age 45-54
t
Baseline
Low scenario
High scenario
Morocco
Savings for age 15-24
Savings for age 25-34
Savings for age 35-44
Savings for age 45-54
t
Baseline
Low scenario
High scenario
Egypt
Savings for age 15-24
Savings for age 25-34
Savings for age 35-44
Savings for age 45-54
t
Baseline
Low scenario
High scenario

- Participation rates are constant and exogenous. This assumption is consistent with the data since the participation rates are quite stable over time and fluctuate between 40 and 50% since 1970 to 2018 (World Bank). Although women participation rates are considerably lower and should normally rise as fertility drops and women get more educated, the participation rates stagnate. Assaad et al. (2018) refer to this as MENA Paradox.
- Absence of the government providing education: The growth model in this study take into account the exogenous component of growth which is physical capital. One interesting extension of the model to an endogenous growth model by including education and its intergenerational externalities.
- The productive sector behaves competitively: In order to focus on the inefficiency of the financial markets and the labor market we have assumed that the firms behave competitively and the annuity markets are perfect. It would be very hard to interpret results if we have imperfections in all four markets.

7 Conclusion

In the MENA region, the demographic transition came relatively late but rather quickly, with a very sharp decline in fertility rates, leading MENA to be one of the youngest regions in the world. This evolution in the next few decades will eventually put an end to the dominance of the share youth in total population. Youth represent a major driver for economic growth, they are the key to a strong economic development. This paper studies the impact of this demographic change and the impact of a gain in the efficiency of the financial markets on economic growth in Iran, Morocco and Egypt.

We use a dynamic general equilibrium framework with overlapping generations and highlight that lower costs for investment lead to lower unemployment rates and higher output. The use of the OLG framework is due to the significant differences in unemployment rates for youth and old in the selected countries and more generally in the region, which is discussed being one of the main sources of political tensions in the region. Our results show that the age structure of the labor force is a key component for employment and production dynamics and a more efficient financial sector will reduce the gap among younger and older age groups to some extent.

The novelty of this paper is to extend the theoretical relationship between demographic change and financial efficiency, and to focus on Iran, Morocco and Egypt, each country facing the demographic transition at a different pace. To our knowledge there is no similar model. Moreover, we take into account the evolution of both physical capital and labor market age structure. Furthermore, this paper uses real data on population structure, which considers not only fertility rates, but also information about mortality rates that may have a different effect on GDP per capita. As a matter of fact, our simulation results should be taken into account ceteris paribus, we focus on countries that are facing various major internal and external shocks that can result in different outcomes for unemployment and growth from the one which is estimated in the paper.

Globally, the demographic forces lead to a significant decline in the unemployment rates for all age groups. Furthermore, the effect of a demographic shift on unemployment and GDP is mainly influenced by the dynamics of the share of youth in the working age population. GDP per capita rises and stabilizes as the share of older workers dominate the share of youth in the labor force. In the long run, the demographic transition alone accounts for 16, 14.2 and 10.3 p.p. decline in the unemployment rates in Iran, Morocco and Egypt. Moreover, it will lead to 70%, 62% and 44% increase in GDP per capita in Iran, Morocco and Egypt, hence faster demographic transition is associated with higher GDP per capita.

We use the cost for capital mobilisation as a proxy for financial sector efficiency, and develop two different scenarios for the financial sector development. Our results suggest that financial efficiency improvements lead to better economic performance in terms of higher GDP per capita and lower unemployment rates in the case of an inevitable demographic change in MENA region. If the financial sector succeeds in reducing the investment cost by half in each decade, it will lead to at least 3 p.p. fall in total unemployment rate by 2100. Of course, the gain is much higher for younger age groups and can reach 8.3 p.p. for those of ages between 15 and 24. Thus, we show that the unemployment rate volatility is the highest for the youngest age group, who just entered the labor force, and although the effect of a demographic shift always dominates the effect of a financial market improvement, the size of the effect changes according to the depth of the reform in the financial sector.

Appendix 1: The Demographic Shift Parameters

See Fig. 4, Table 5.

The growth rate of the population, Fig. 5, is a decreasing function, although for Iran and Morocco we observe a slight take off in the final periods of the simulation.

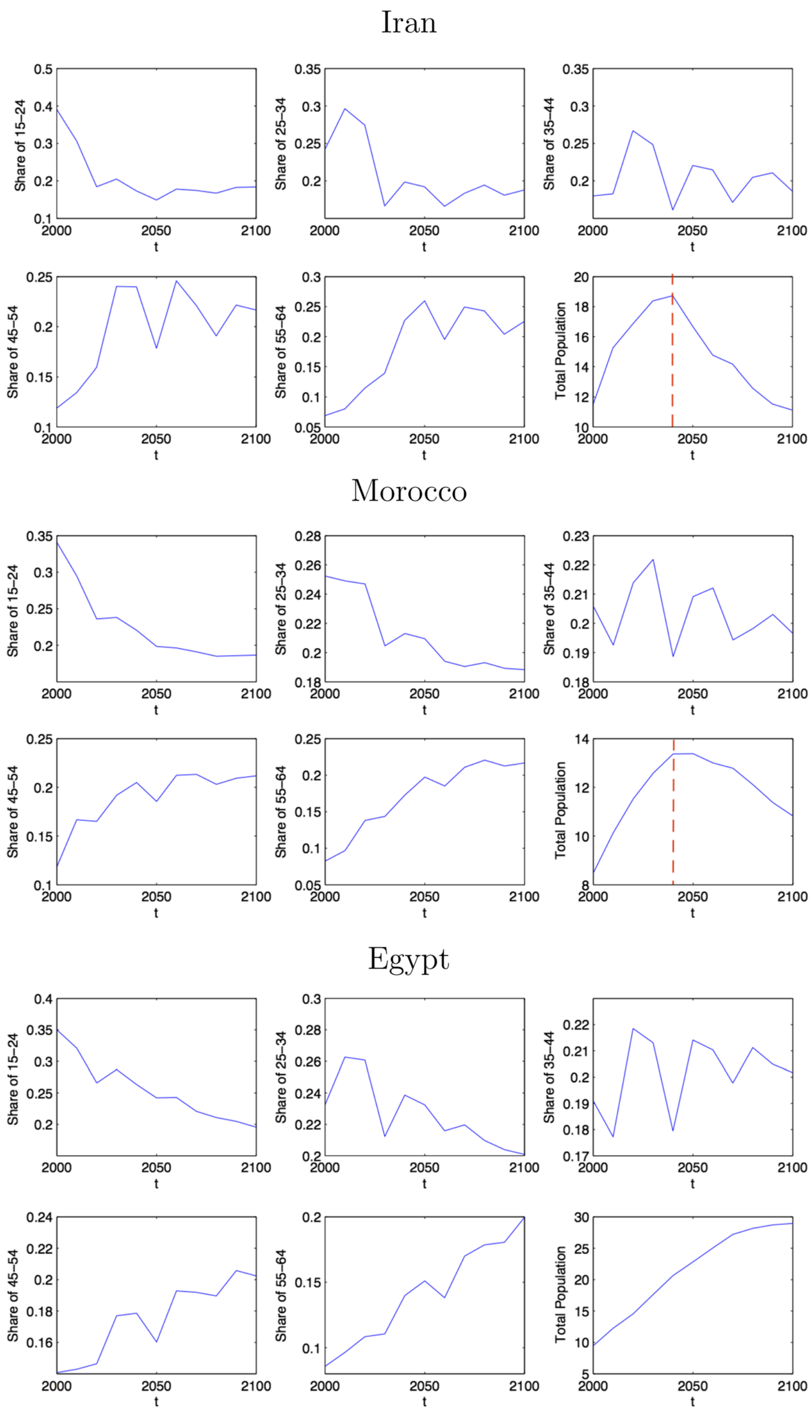


Fig. 4 Population dynamics by age group and total. *Note*: Population of each age group is represented as its share in the total active population (Authors based on UN data set)

Table 5 Demographic parameters. *Source*: Authors

t	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Iran											
$Z_{0,t}$	4.489	4.672	3.11	3.768	3.246	2.487	2.63	2.473	2.106	2.106	2.046
$\beta_{1,t}$	0.927	0.999	0.99	0.985	0.987	0.987	0.987	0.989	0.99	0.99	0.992
$\beta_{2,t}$	0.956	0.998	0.995	0.988	0.987	0.989	0.99	0.99	0.991	0.992	0.993
$\beta_{3,t}$	0.929	0.992	0.963	0.982	0.983	0.984	0.987	0.988	0.989	0.991	0.991
$\beta_{4,t}$	0.875	0.895	0.942	0.956	0.962	0.964	0.969	0.973	0.976	0.979	0.981
Morocco											
$Z_{0,t}$	2.895	2.989	2.721	2.995	2.948	2.655	2.552	2.442	2.241	2.114	2.019
$\beta_{1,t}$	0.868	0.872	0.952	0.946	0.951	0.951	0.95	0.954	0.958	0.96	0.965
$\beta_{2,t}$	0.931	0.911	0.976	0.98	0.98	0.983	0.984	0.984	0.986	0.988	0.989
$\beta_{3,t}$	0.993	0.967	0.974	0.979	0.982	0.984	0.987	0.989	0.99	0.992	0.993
$\beta_{4,t}$	0.961	0.976	0.941	0.949	0.958	0.964	0.97	0.976	0.98	0.983	0.986
Egypt											
$Z_{0,t}$	3.313	3.929	3.868	5.06	5.437	5.527	6.082	6	5.937	5.884	5.661
$\beta_{1,t}$	0.936	0.971	0.966	0.967	0.974	0.976	0.978	0.982	0.985	0.987	0.989
$\beta_{2,t}$	0.984	0.986	0.988	0.989	0.991	0.992	0.993	0.995	0.996	0.996	0.997
$\beta_{3,t}$	0.958	0.968	0.981	0.981	0.982	0.987	0.988	0.99	0.993	0.994	0.996
$\beta_{4,t}$	0.877	0.886	0.901	0.914	0.926	0.935	0.947	0.957	0.964	0.972	0.978

The values of $Z_{0,t}$ are calculated by normalizing the size of the youngest cohort in 1960 (i.e. $Z_{0,1960} = 1$)

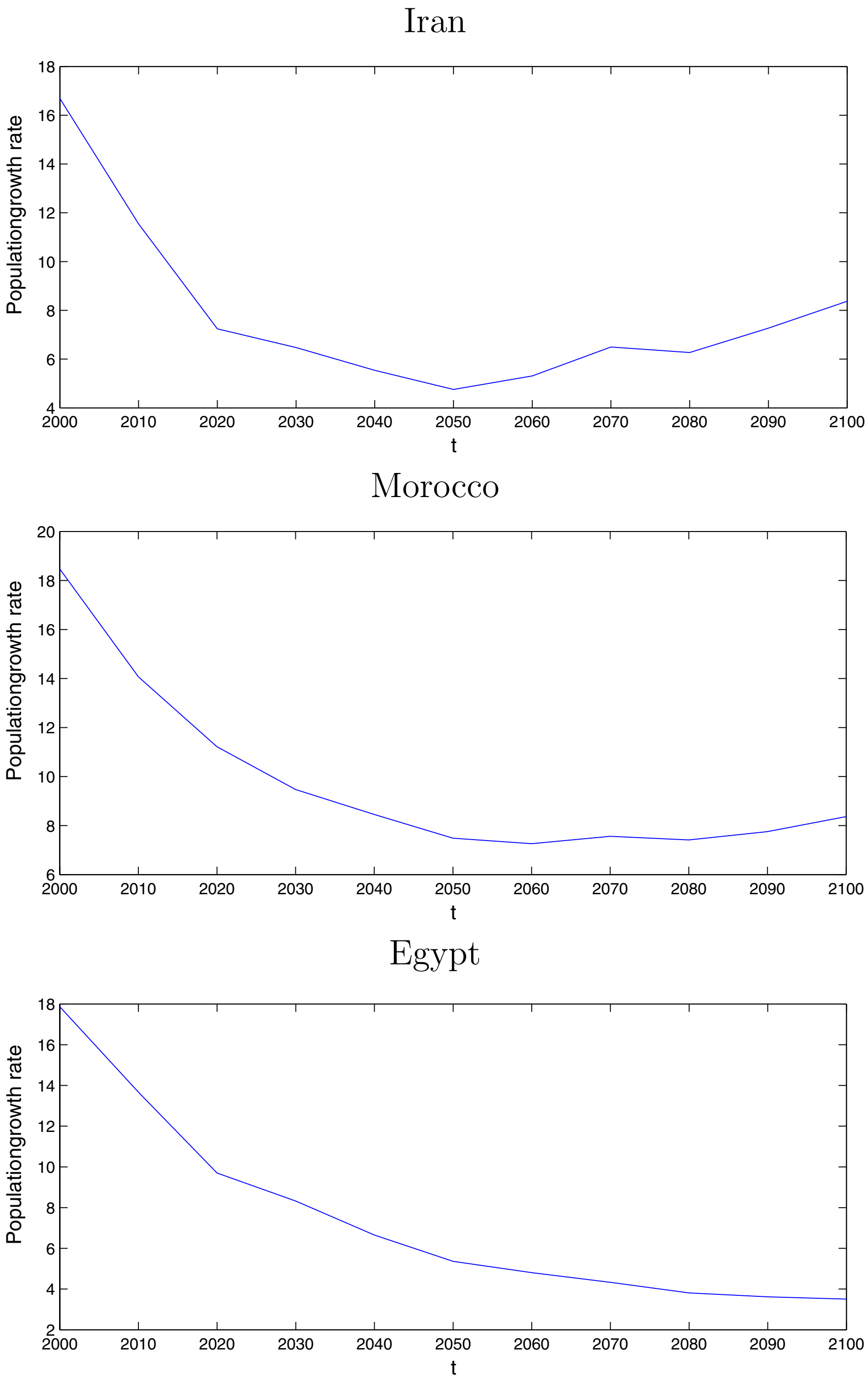


Fig. 5 Active population growth rate. *Source*: Authors based on UN data set

Appendix 2: Robustness Check for Cost of Investment

In this appendix we show that our results are robust to the initial value of $(1-\varphi)$. In order to do so, we suppose the initial value of $(1-\varphi)$ to be 0.1 instead of 0.2, which means that the cost of allocating capital is 10% in our baseline scenario, the definition of High and Low scenario remains the same, the value of $(1-\varphi)$ in each case is reported in Table 6.

The results qualitatively, remain the same, although the initial steady state changes slightly since the initial cost of capital is not the same. The simulation results for Iran are reported in Figs. 6, 7, 8 and 9.[14]

Table 6 The value of $(1-\varphi)$ or the cost of capital accumulation under different scenarios. *Source*: Authors

Period	1	2	3	4	5	6	7	8	9	10
Baseline	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
High	0.1	0.05	0.025	0.0125	0.0062	0.0031	0.00156	0.00078	0.00039	0.00019
Low	0.1	0.095	0.090	0.085	0.081	0.077	0.073	0.069	0.066	0.063

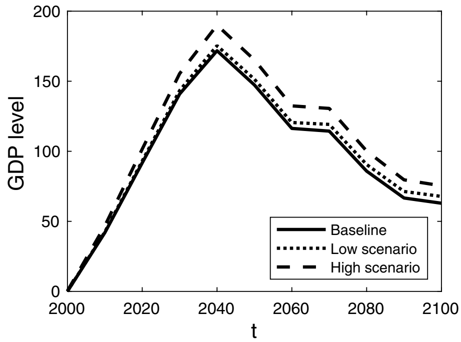


Fig. 6 GDP level (percentage deviation from the initial steady state) for Iran. *Source*: Authors

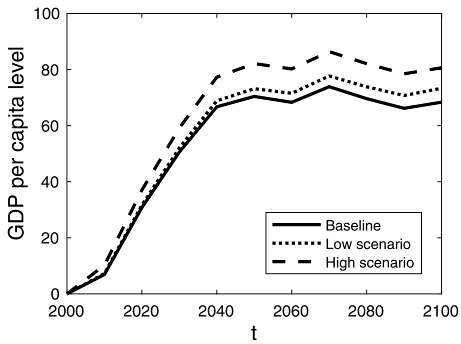


Fig. 7 GDP per capita (percentage deviation from the initial steady state) for Iran. *Source*: Authors

[14] We can perform the same exercise for Morocco and Egypt, the results remain the same.

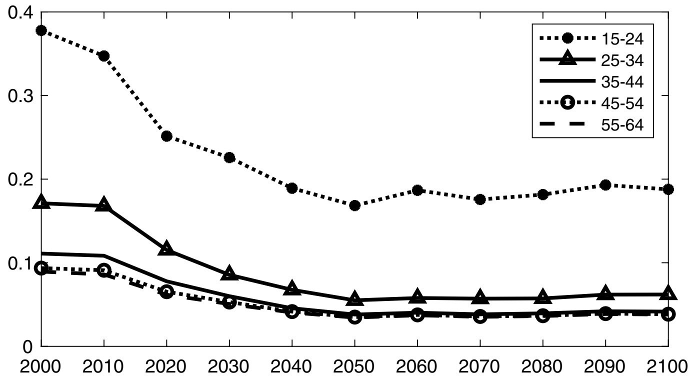


Fig. 8 Unemployment rate evolution by age after the demographic shift (baseline) for Iran. *Source*: Authors

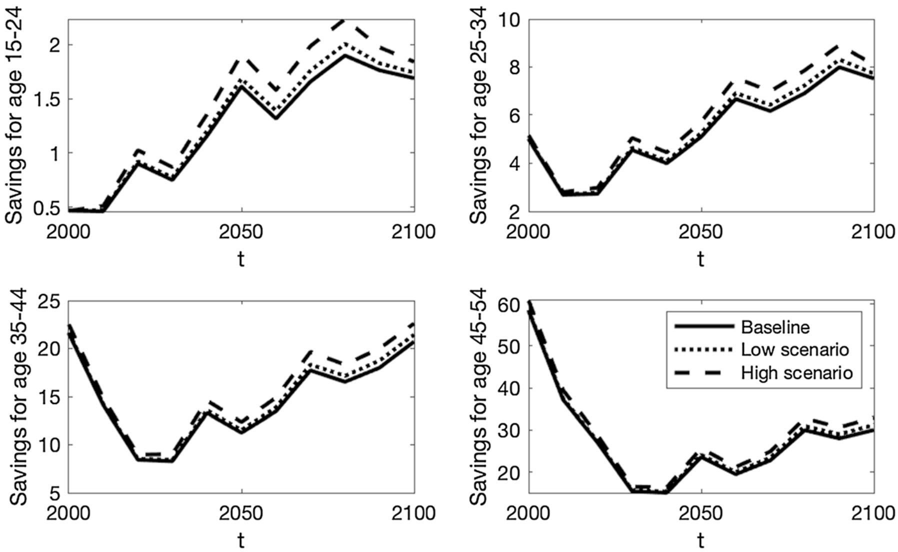


Fig. 9 Savings per capita evolution by age for Iran. Note: Savings per capita for different age groups, according to model's assumptions, the savings is nul for the last age group (55–64). *Source*: Authors

Appendix 3: Robustness Check, Constant Human Capital

One may argue that our results are merely a mechanical response to the different age-specific human capital, reported in Table 1.

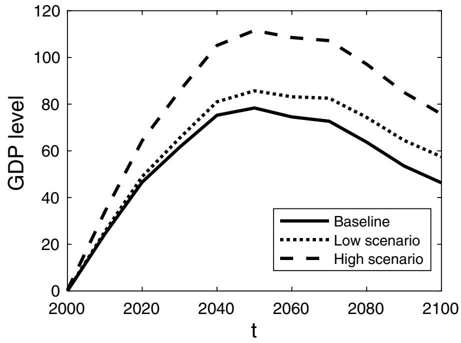


Fig. 10 GDP level (percentage deviation from the initial steady state). *Source*: Authors

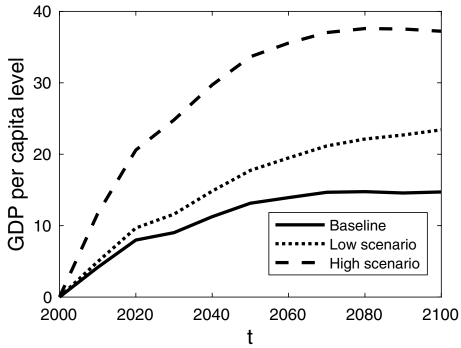


Fig. 11 GDP per capita evolution (percentage deviation from the initial steady state). *Source*: Authors

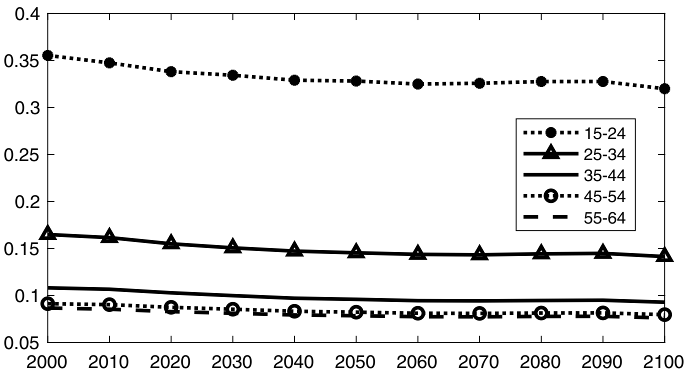


Fig. 12 Unemployment rate evolution by age after the demographic shift. *Source*: Authors

In this appendix we perform the simulations for Morocco, and suppose a constant human capital for all age groups, i.e. $h_i = 2.5 \quad \forall i = 1, \ldots, 4$ The simulation results are reported in Figs. 10, 11, 12 and 13.[15]

[15] We can perform the same exercise for Iran or Egypt the results remain the same.

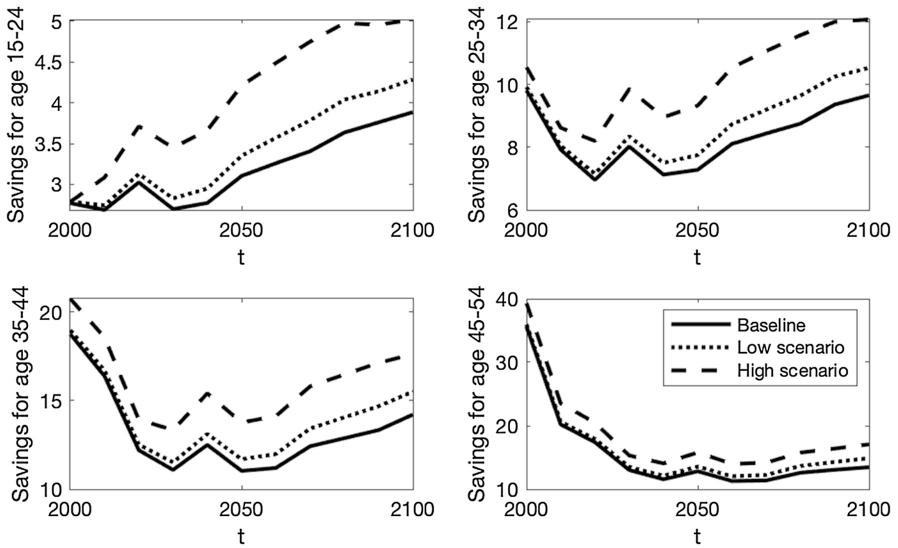


Fig. 13 Savings per capita evolution by age for Morocco. *Source*: Authors

References

Abel, A. B. (2003). The effects of a baby boom on stock prices and capital accumulation in the presence of social security. *Econometrica*, *71*(2), 551–578.

Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance? *Journal of Economic Growth*, *20*(2), 105–148.

Assaad, R. A., Hendy, R., Lassassi, M., & Yassin, S. (2018). Explaining the MENA paradox: Rising educational attainment, yet stagnant female labor force participation. IZA DP No. 11385.

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, *104*, 184–198.

Ben Naceur, S., & Ghazouani, S. (2007). Stock markets, banks, and economic growth: Empirical evidence from the mena region. *Research in International Business and Finance*, *21*(2), 297–315.

Ben Naceur, S., Ghazouani, S., & Omran, M. (2008). Does stock market liberalization spur financial and economic development in the MENA region? *Journal of Comparative Economics*, *36*(4), 673–693.

Bloom, D., Canning, D., & Sevilla, J. (2003). *The demographic dividend: A new perspective on the economic consequences of population change*. Santa Monica, CA: Rand Corporation.

Bloom, D. E., & Canning, D. (2004). *Global demographic change: Dimensions and economic significance*. Technical report, National Bureau of Economic Research.

Bloom, D. E., Kuhn, M., & Prettner, K. (2017). Africa's prospects for enjoying a demographic dividend. *Journal of Demographic Economics*, *83*(1), 63–76.

Börsch-Supan, A., Ludwig, A., & Winter, J. (2006). Ageing, pension reform and capital flows: A multi-country simulation model. *Economica*, *73*(292), 625–658.

Boucekkine, R., De la Croix, D., & Licandro, O. (2002). Vintage human capital, demographic trends, and endogenous growth. *Journal of Economic Theory*, *104*(2), 340–375.

Chakraborty, S. (2004). Endogenous lifetime and economic growth. *Journal of Economic Theory*, *116*(1), 119–137.

D'Albis, H. (2007). Demographic structure and capital accumulation. *Journal of Economic Theory*, *132*(1), 411–434.

de la Croix, D., Pierrard, O., & Sneessens, H. R. (2013). Aging and pensions in general equilibrium: Labor market imperfections matter. *Journal of Economic Dynamics and Control*, *37*(1), 104–124.

Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution*. Washington, DC: The World Bank.

Diamond, P. A. (1981). Mobility costs, frictional unemployment, and efficiency. *Journal of Political Economy*, *89*(4), 798–812.
Favero, C., Gozluklu, A. E., & Yang, H. (2015). *Demographics and the behavior of interest rates*. Working papers, Warwick Business School, Finance Group.
Favero, C. A., Gozluklu, A. E., & Tamoni, A. (2011). Demographic trends, the dividend-price ratio, and the predictability of long-run stock market returns. *Journal of Financial and Quantitative Analysis*, *46*(05), 1493–1520.
Geanakoplos, J., Magill, M., & Quinzii, M. (2004). Demography and the long-run predictability of the stock market. *Brookings Papers on Economic Activity*, *2004*(1), 241–325.
Greenwood, J., Sanchez, J. M., & Wang, C. (2013). Quantifying the impact of financial development on economic development. *Review of Economic Dynamics*, *16*(1), 194–215.
Hagedorn, M., & Manovskii, I. (2008). The cyclical behavior of equilibrium unemployment and vacancies revisited. *American Economic Review*, *98*(4), 1692–1706.
Heijdra, B. J., & Ligthart, J. E. (2006). The macroeconomic dynamics of demographic shocks. *Macroeconomic Dynamics*, *10*(3), 349–370.
Heijdra, B. J., & Mierau, J. O. (2011). The individual life cycle and economic growth: An essay on demographic macroeconomics. *De Economist*, *159*(1), 63–87.
Heijdra, B. J., & Reijnders, L. S. (2016). Human capital accumulation and the macroeconomy in an ageing society. *De Economist*, *164*(3), 297–334.
Lagerlöf, N.-P. (2006). The Galor–Weil model revisited: A quantitative exercise. *Review of Economic dynamics*, *9*(1), 116–142.
Lee, R., & Mason, A. (2007). *Population aging, wealth, and economic growth: Demographic dividends and public policy*. Background Paper for the World Economic and Social Survey. Department of Economic and Social Affairs, New York, United Nations.
Leibenstein, H. (1966). Allocative efficiency vs." x-efficiency". *The American Economic Review*, *56*(3), 392–415.
Lesmond, D. A., Ogden, J. P., & Trzcinka, C. A. (1999). A new estimate of transaction costs. *Review of Financial Studies*, *12*(5), 1113–1141.
Liao, P.-J. (2011). Does demographic change matter for growth? *European Economic Review*, *55*(5), 659–677.
Martins, J. O., Gonand, F., Antolin, P., de la Maisonneuve, C., & Yoo, K.-Y. (2005). The impact of ageing on demand, factor markets and growth. OECD Economics Department Working Papers n° 420, Éditions OCDE, Paris.
Mason, A. (2005). Demographic transition and demographic dividends in developed and developing countries. In *United Nations expert group meeting on social and economic implications of changing population age structures* (vol. 31). Citeseer.
Mortensen, D. T., & Pissarides, C. A. (1994). Job creation and job destruction in the theory of unemployment. *The Review of Economic Studies*, *61*(3), 397–415.
Pagano, M. (1993). Financial markets and growth: An overview. *European Economic Review*, *37*(2–3), 613–622.
Pissarides, C. A. (1985). Short-run equilibrium dynamics of unemployment, vacancies, and real wages. *The American Economic Review*, *75*(4), 676–690.
Sibai, A. M., Rizk, A., & Kronfol, K. M. (2014). *Ageing in the Arab region: Trends, implications and policy options*. Beirut, Lebanon: The United Nations Population Fund (UNFPA), Economic and Social Commission of Western Asia (ESCWA) and the Center for Studies on Aging (CSA).
Skirbekk, V. (2004). Age and individual productivity: A literature survey. *Vienna Yearbook of Population Research*, *2*(1), 133–154.
United Nations, Department of Economic and Social Affairs, Population Division (2015). World population prospects: The 2015 revision. New York.
United Nations, Department of Economic and Social Affairs, Population Division. (2019). World population prospects 2019: Highlights (st/esa/ser.a/423).
Yaari, M. E. (1965). Uncertain lifetime, life insurance, and the theory of the consumer. *The Review of Economic Studies*, *32*(2), 137–150.