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How Large Are the Economic Dividends from Closing Gender Employment Gaps in the Middle East and North Africa?

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Abstract

This paper quantifies the gains in gross domestic product per capita from closing gender employment gaps in the Middle East and North Africa, using three neoclassical growth models. The paper starts with baseline impacts from the Gender Employment Gap Index, which suggests that in the long run, gross domestic product per capita would be around 50 percent higher in the typical economy in the region if gender employment gaps were closed (mean 54 percent, median 49 percent). However, the gains are heterogeneous, ranging from less than 10 percent in Qatar to more than 80 percent in the Republic of Yemen. The paper then explores short-term gains, when capital is fixed (or adjusts slowly), and gains in the medium-term, with sluggish implementation of reforms using the Long Term Growth Model, which roughly halves the gains (and lowers the gains by more than half in resource-rich countries). Finally, the paper incorporates the effects of changes in the skill distribution in a model incorporating capital-skill complementarities in production. Because gender employment gaps in the Middle East and North Africa tend to be larger among the unskilled, closing these gaps reduces average skill levels, moderating long-term gains by 5-10 percentage points. However, if women in the Middle East and North Africa continue the current trend toward greater educational attainment, the gains will be greater than in the baseline. All three models—the Gender Employment Gap Index, the Long Term Growth Model, and capital-skill complementarities—point to large increases in gross domestic product per capita from closing gender employment gaps.

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How Large Are the Economic Dividends from Closing Gender Employment Gaps in the Middle East and North Africa?*

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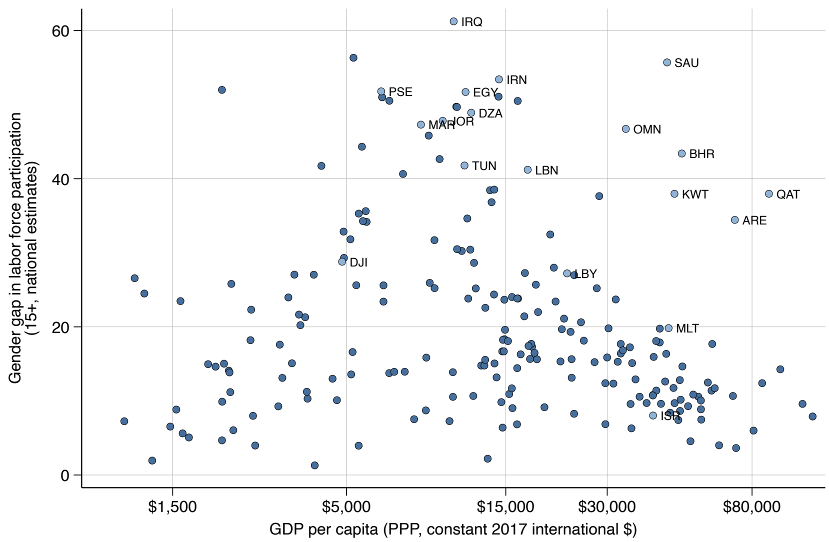
1. Introduction

Countries in the Middle East and North Africa (MENA) exhibit some of the largest gaps between men and women in observed rates of labor force participation (LFP; Figure 1).[1] How large would the gains in GDP per capita in MENA be from increasing female employment rates to close these gaps? In this paper we answer this question using three neoclassical growth models with different assumptions, time horizons, and adjustments for workforce skill. Across models, gains tend to increase with the magnitude of the employment gender gap. The long run gain for a typical country in MENA is very large—around 50%—though gains are more modest in the short and medium terms and vary substantially across countries.

Figure 1: The gender gap in rates of labor force participation across the development spectrum.



Note: Difference in labor force participation rates between men and women in percentage points. MENA countries in our paper are labelled. Source: WDI (we use NY.GDP.PCAP.PP.KD for GDP PC, SL.TLF.CACT.FE.NE.ZS for Female LFP and SL.TLF.CACT.MA.NE.ZS for male LFP).

Methodology. The simplest estimates of the impact on standards of living from closing gender employment gaps in MENA build on the Gender Employment Gap Index (GEGI) of Pennings (2022). That paper uses a standard Cobb-Douglas production function and the assumption of a constant long-run MMPK or savings rate to show that the long-run GDP per capita gains from closing gender gaps *equal* the size of the employment gaps themselves (expressed as a fraction of baseline employment). However, because the policy conversation tends to focus on shorter time horizons and MENA exhibits relatively low rates of private sector investment, we also produce

[1] Note that for the rest of the paper we focus on employment rates, rather than labor force participation, due to the difficulty of measuring job searching efforts in developing countries.

estimates of the short-run gains closing employment gender gaps while keeping the capital stock fixed (not produced in Pennings (2022)).

As the differences between long-run and short-run estimates are often large, we then study the transitional dynamics to 2050 (the medium-term) using the World Bank Long Term Growth Model (LTGM) of Loayza and Pennings (2022). The LTGM also allows for a slow-but-steady pace of increase in female employment rates. As around half of the countries in MENA are resource-rich, we simulate growth paths for these countries using the Natural Resource Extension of the Long Term Growth Model (LTGM-NR) of Loayza et al. (2022). The medium-run economic gains of closing gender employment gaps in this extension tend to be reduced because resource sectors are not in general labor intensive.

Finally, because gender gaps in employment are often larger for the non-college educated, and education levels among women in MENA have been rising rapidly, we calculate the effects of closing gender employment in a model with capital-skill complementarities (CSC) where closing gender gaps in employment rates could generate an additional boost in the accumulation of physical capital. This model also helps us to consider potential distributional effects through changes in the wage rates of unskilled and skilled workers.

In each of the three models—GEGI, LTGM and CSC—we first posit a production function and calibrate the model to a benchmark (MENA countries or the US). We then simulate the effect of closing the *same* gender gap in employment rates, which makes our estimates comparable across models. In each case, we present the size of the increase in output per person relative to the baseline (in the absence of the policy change). We then study the role of specific assumptions in explaining the magnitude of the effects. To measure employment rates, we use the data on employment-to-population ratios from Pennings (2022), with the share of workers across different levels of schooling from national estimates in ILOSTAT (for those MENA countries where the data is available).

Results. We find gains in output per capita from closing gender employment gaps that are large for most countries in MENA, but (i) are very heterogeneous across countries, (ii) are not as large in the short-to-medium term when physical capital is fixed or the speed at which gaps themselves close is incomplete, (iii) are generally smaller with capital-skill complementarities and an unchanged skill distribution, though higher if share of skilled female workers also increases.

Quantitatively, the increase in long-run GDP per capita in MENA from closing gender employment gaps averages 54% using a Cobb-Douglas production function and the GEGI (median 49%), which is very similar to that in the Arab Republic of Egypt (56%), which we use as a typical country. However, the average gains halve in the short-run if capital remains fixed (they also halve in Egypt). Using the long term growth model (LTGM) at 2050, where we incorporate the structure of the economy in our parameter values and model a transition path, gains lie between what we call the short run and the long run values, averaging 31% (median 34%), with Egypt increasing

GDP per capita by 2050 by 41%. In a set up that with both skilled and unskilled labor and CSC, average gains in output per person would amount to 39% (median 45% and Egypt 42%) if capital does not react, and 44% with full physical capital adjustment (median 51%, Egypt 47%). If we were to incorporate a conservative assumption for the projected change in the share of skilled labor, average gains would increase 11-12ppts, though gains in Egypt are 15ppts higher.

Related Literature. Apart from Pennings (2022), whose estimates we build upon in this study, there are three other studies that estimate the economic effects of closing gender employment gaps in MENA, although none of them focus on the region.[2] All of those studies report large economic benefits, though with different methodologies. One of the highest profile studies is produced by MGI (2015), who put the gains for MENA at 47% ("full potential" scenario in their exhibit 7), which are very similar to our long run estimates. Although their estimates are over a 10-year adjustment period, they actually reflect of a long-run steady state with fixed labor productivity.[3]

Cuberes and Teignier (2016) is the closest study to ours in terms of taking account of the skills distribution, though this paper takes an approach based on managerial talent in a Lucas (1978) span-of-control model rather than with capital-skill complementarities.[4] For MENA, they report almost identical gains from changes in employment rate (or participation) of around 50%, but an additional gain of 8% from fully utilizing female entrepreneurial talent.

The final paper is Ostry et al. (2018), who argues that male and female labor are partially complementary in production.[5] They report an increase in output in MENA from closing gender gaps of about 60%, which is about 5-10ppts higher than our long-run gains, though they do not include dynamics of effects via the skill distribution.[6]

The rest of the paper is organized as follows. The next section revisits the results from Pennings (2022) for MENA, and simulates aggregate effects with and without adjustments in physical capital. Section 3 presents gains in output per person from the LTGM by 2050. Section 4 introduces capital-skill complementarities and studies potential distributional effects by examining the wages

[2] Devadas and Kim (2020), explore economic gains from closing gender gaps in the LTGM, including effects through TFP. They find that MENA is one of the regions with the largest gains.

[3] That is, MGI (2015) don't allow for higher female employment to reduce capital per worker, and hence output per worker, in the short run. Although MGI (2015) include effects through equalization of hours and sectoral gender allocation, their estimates for MENA are mostly due to equalization of labor force participation (their Exhibit 6).

[4] Cuberes and Teignier (2016) report economic *losses* of business-as-usual relative to a full-equality benchmark, rather than the economic *gains* of full equality, relative business-as-usual. The long-run effects reported by Cuberes and Teignier (2016), CT%, are scaled up $1/(1 - CT\%)$ for comparability. However, the short-medium-run effects (with fixed capital) are difficult to compare directly.

[5] That is, a team of a man and a woman is more productive than a team of two men or two women (other things equal). Standard economic models, including ours, imply that the labor of men and women are perfectly substitutable. More specifically, Ostry et al. (2018) argue "the economically relevant range turns out to be one of partial substitutability, or, equivalently, partial complementarity...[elasticity of substitution] estimates are clustered below 1 in the macro data, between 1 and 2 in the sectoral data, and between 2 and 3 in the firm-level data." (p6)

[6] These results are the average of gains with elasticity of substitution of 1.5 and 2 report in the top right corner of their Table 4.

of skilled and unskilled workers. Section 5 concludes with a comparison of models and some policy implications.

2. The Gender Employment Gap Index (GEGI) and physical capital adjustment

One of the simplest measures of the long-run effect of closing gender employment gaps is the basic Gender Employment Gap Index (GEGI) of Pennings (2022), which is defined as:

$$GEGI = GDP\ gains\,(\%) = \frac{L_M - L_F}{L} \times 100\% \tag{1}$$

where L_M and L_F are the number of male and female workers and $L = L_M + L_F$ is the total number of workers. The GEGI is just the size of the gender gap between male and female employment, as a fraction of total employment. The GEGI takes this form because the gender gap in the numerator measures the increase in total employment if female employment equaled male employment, and total employment in the denominator turns this into the growth rate of employment from closing gender employment gaps.[7] As discussed below, this percentage increase in employment is *also* the increase in GDP, because in the long run (with capital adjustment and other things equal) GDP is proportional to employment.

However, the capital adjustment built into the GEGI is only applicable in the long-term, and might not fully apply in countries where other frictions prevent the accumulation of capital—especially private capital. Private investment in MENA is low relative to other regions, averaging 12.5% of GDP (Figure A1 panel a) and is also trending down over the last decade (Figure A1 panel b). While steady state private investment rates are not directly related to the speed of capital adjustment in Solow-Swan models, they are indicative of a less dynamic private sector that is possibly constrained by other frictions, which could slow adjustment.[8]

In this section, we perform two exercises. We first report the long run GDP gains for MENA countries from the basic GEGI in Pennings (2022) and second we extend those results by comparing them to the gains if physical capital remains fixed (the short run). But first we discuss our benchmark neoclassical model in more detail.

Model Consider a simple Solow-Swan economy with a constant savings rate, no accumulation of human capital and no total factor productivity (TFP) or population growth. This economy has a standard Cobb-Douglas aggregate production function of the form in Equation 2, where Y denotes aggregate output, A denotes total factor productivity, K corresponds to the stock of physical capital,

[7] In the background of this formula is the assumption that the population of men and women is equal—and so the male employment acts as a counterfactual for female employment with no gender gap—which is not true for some MENA countries, as discussed further below.

[8] More specifically, the reason that higher steady state investment rates do not lead to faster adjustment is that there most of the higher steady state investment is just replacing the higher depreciation from a larger steady state capital stock. It is the change investment in response to a shock, not its steady state share of GDP, which determines the speed of adjustment. Investment rates are assumed to be fixed in standard Solow-Swan growth models, and hence as less responsive to shocks.

L is the number of workers, h is their average human capital (hL is the effective labor used in production), and β is the labor share of income:

$$Y = AK^{1-\beta} (hL)^{\beta} \tag{2}$$

Capital accumulates according to the standard capital accumulation identity $K_{t+1} = (1-\delta)K_t + I_t$ (I is investment), so in steady state $K/Y = s/\delta$, where s is the fixed savings rate (fraction of GDP) and δ is the depreciation rate.[9] Substituting this in Equation 2, we get the following expression for steady state GDP.[10]

$$Y = \left[A^{\frac{1}{\beta}} \times (\frac{s}{\delta})^{\frac{1-\beta}{\beta}} \times h \right] \times L, \tag{3}$$

Now consider the long-run effects of an exogenous increase in the number of workers from increasing female employment to close the gender employment gap (assuming no change in human capital per worker h). In steady state, everything in the brackets in Equation 3 are constant or a parameter, and so changes in output Y are *proportional* to changes in the number of workers. As such, the percentage increase in labor from closing gender gaps—the GEGI—is equal to the percentage change in output, $\Delta\%Y = \Delta\%L$.[11] In the transition, any short run increase in female employment will increase GDP, will increase output and hence savings and investment (which are a fixed share of GDP) until the capital-to-output ratio (and capital-to-labor ratio) is back to its steady state value.

However, in the short run the relationship is somewhat different because we assume that the physical capital stock K is effectively fixed in the short run. That is, we cannot use Equation 3, which is a steady state relationship. Instead return to the original production function Equation 2, take logs and totally differentiate:[12]

$$\Delta\%Y = (1 - \beta)\, \Delta\%K + \beta\Delta\%L \tag{4}$$

If the aggregate stock of physical capital does not react to the shock in employment in the short run $\Delta\%K = 0$, then by Equation 4 the change in output be $\Delta\%Y = \beta\Delta\%L$ only. In other words, if capital is fixed in the short run, then the size of the gains in GDP from closing gender employment gap are those from the GEGI, but shrunk down by the labor income share of GDP, β. In a typical calibration for the US, $\beta = \frac{2}{3}$, and so the gains are about a third smaller. However,

[9]Note that the savings and depreciation rates also pin down the capital-to-labor ratio k, which is also constant in steady state (which is used in the CSC model in section 4).

[10]To see this, divide both side of Equation 2 by $Y^{1-\beta}$ and rearrange to get $Y = A^{\frac{1}{\beta}} \left[\frac{K}{Y}\right]^{\frac{1-\beta}{\beta}} hL$, then substitute for the steady state relationship $\delta K = I = sY$.

[11]One can also have more complex models with population growth and TFP growth, but so long as these growth rates are unaffected by closing gender employment gaps, the results are the unchanged. As population is the same in the original steady state and the counterfactual, the increase in GDP will be the same as the increase in GDPPC, so we use these terms interchangeably.

[12]Here we are assuming no change in human capital per worker or TFP.

many countries in MENA have much lower labor shares, resulting in smaller adjustments, as we will see in quantitatively below.

Quantitative Results. Figure 2 shows the change in output per capita for each country in MENA under different scenarios when gender gaps in employment rates are closed. The blue bars show the increase in GDP per capita in the long run when capital fully adjusts (the basic GEGI of Pennings (2022)). For the 19 countries in MENA we examine in our paper (excluding Israel and Malta), the basic GEGI averages 49%, indicating that long-run GDP per capita would be 49% higher if gender employment gaps were closed—more than double the 19% average GEGI across all countries in Pennings (2022). However, this average represents substantial heterogeneity across countries.

The highest GEGI in our sample (and close to the highest in the world) is in the Republic of Yemen, where GDP per capita would be 86% higher in the long run if gender employment gaps were closed. Similarly high levels of GEGIs are found in Iraq (79%), the Syrian Arab Republic (74%), and Jordan (70%). In most countries, this is driven by very low employment rates of women in the baseline, typically around 10% or lower.

The most gender-equal country in the sample is Qatar, indicating that GDP per capita (GDPPC) would be 9% higher in the long run from closing the gender gap. These gains—and those for Bahrain, Kuwait, Oman, Saudi Arabia and UAE—are calculated using a modified version Equation 1, because these countries have much fewer women than men. Hence the gender gap in employment needs to be adjusted for the different population sizes of each gender.[13] While Qatar has the smallest GEGI in our sample even before adjustment (24%), the population-based adjustment greatly reduces the size of potential gains as employing more women mechanically has less effect on growth when women are a small fraction of the population.

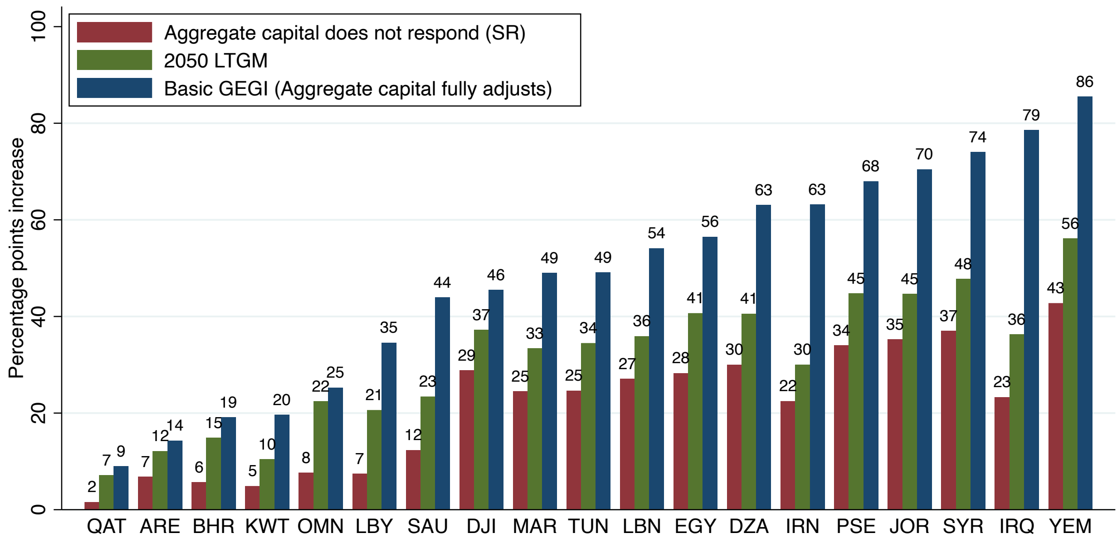
The red bars in Figure 2 show the effect of closing gender employment gaps if aggregate physical capital remains constant, assuming that the labor share (β) in each country is the same as that in the Penn World Tables 10. Note that for developing countries this averages around $\beta = 0.5$, lower than the 2/3 usually observed in developed countries. The labor share is even lower in MENA—averaging 41%—driven by very low labor shares in oil-rich countries (for Saudi Arabia, for example, it is only $\beta = 0.28$). The lower labor shares in MENA mean that despite large long-term gains from closing gender gaps, the short-run gains could be more modest (even assuming that such a large reform could be implemented quickly).

The smallest short-run gains are again in Qatar, where a (relatively) small GEGI is further reduced very low labor share of 18%. Kuwait, Bahrain, and the UAE also have short-run GEGIs of 5%-7%, driven by a relatively modest long-run GEGI and a low labor share.[14] The largest short run economic gains from closing gender gaps are still in Yemen, but are around half as large as under the long run assumption ($\beta = 0.5$). Still these hypothetical short run gains are significant, at 43%

[13] See Appendix 4 of Pennings (2022).

[14] Oman and Libya also have low short-run GEGIs, but in those cases a very low labor share is more important.

Figure 2: Gain in GDP from closing the gender employment gap (%) for each country in MENA—comparing GEGI (long run), short-run (fixed capital) and the LTGM-NR (by 2050)



Note: The blue lines are the Gender Employment Gap Index (GEGI) from Pennings (2022) (ARE, BHR, KWT, OMN, QAT and SAU are adjusted for unequal male-female populations). The green lines are the 2050 gains in output per capita from closing the gender gap by 2050 obtained calibrating the LTGM/LTGM-NR. The red lines are the GEGI adjusted by the labor shares from PWT 10 (or 0.5 if this number is below 0.5 and it is a non-resource rich economy).

increase in GDPPC.

3. Transitional gains to 2050 using the Long Term Growth Model (LTGM)

The analysis of the previous section raises two practical issues in estimating the effect of closing gender employment gaps on GDP growth. First, for most countries, there is a large difference between our short-run and long-run scenarios. How fast is the convergence from the short run to the long run? Second, the policy experiment in the GEGI—a one-off closing of gender employment gaps through higher employment rates of women—represents a fundamental change to the organization of societies in MENA, which can only be achieved over many years. As such, there is not only the issue of the speed of capital accumulation, but also the speed at which gender employment gaps themselves are closed.

In this section, we use a related Solow-Swan neoclassical growth model—the Long Term Growth Model (LTGM; Loayza and Pennings (2022))—to estimate a more realistic transition path for each MENA country. Specifically, our policy experiment in the LTGM is that the gender employment gap is fully closed by 2050 in each economy, with a linear progression towards that goal. This means, for example, that if there is a 60 percentage point (ppt) gap in employment rates—male employment rate is 78% and the female employment rate is 18% as for Saudi Arabia (with slightly outdated data)—then over a 30 year horizon to 2050 the female employment rate would increase by about 2 ppts per year. The LTGM also addresses the first concern by allowing for steady capital accumulation based on prevailing rates of investment as a share of GDP in each country.

In order to produce trajectories of adjustment, we calibrate the LTGM to each of the 19 countries in our MENA sample. For the 10 resource rich MENA countries (Algeria, Bahrain, the Islamic Republic of Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) we used the LTGM Natural Resource extension (LTGM-NR; Loayza et al. (2022)) rather than the standard LTGM since growth analysis using standard neoclassical models can be misleading. The LTGM-NR incorporates a resource sector (which does not use labor), and so takes into account the differential growth dynamics as well as reduced sensitivity of output to employment rates.[15]

The details of the calibration are in Appendix Tables A2 and A3. In short, we calibrate key parameters like the labor share β, the capital depreciation rate δ, and the initial capital-to-output ratio based on Penn World Tables 10 data (with some exceptions). Future investment rates are based on IMF forecasts from the World Economic Outlook (WEO) until 2028 (their final year), which converge linearly to the historical average for each country by 2050. Total Factor Productivity (TFP) growth rates are chosen to replicate WEO GDP growth forecasts to 2028 (given other growth drivers) which then converge linearly to a cross-country average by 2050.[16] Future human capital growth comes from the LTGM-Human Capital Extension, with a few exceptions, which uses the same definition of human capital as the World Bank Human Capital Index (Kraay (2018)).[17] We assume that females and males have identical human capital, which is a reasonable assumption in most countries, but we relax this assumption in the next section.

Our analysis focuses on the *difference* between the estimated growth path with and without higher female employment, and hence the specifics of the calibration for each country are differenced out.

Results. The increase in GDP per capita (GDPPC) from closing the gender employment gap in MENA countries by 2050 averages around 31% (median 34%) and as is in between the short run and long run GEGIs in Figure 2 (green bars). The relative sizes of the effects are shown in Figure 3.[18] The boost to growth is about similar in the long-run GEGI and 2050 LTGM in countries with the smallest gains like Qatar, but are around 30ppts larger in the countries with the largest gaps like Yemen. Across all countries, the gains are about 50% (not 50ppts) larger in the basic

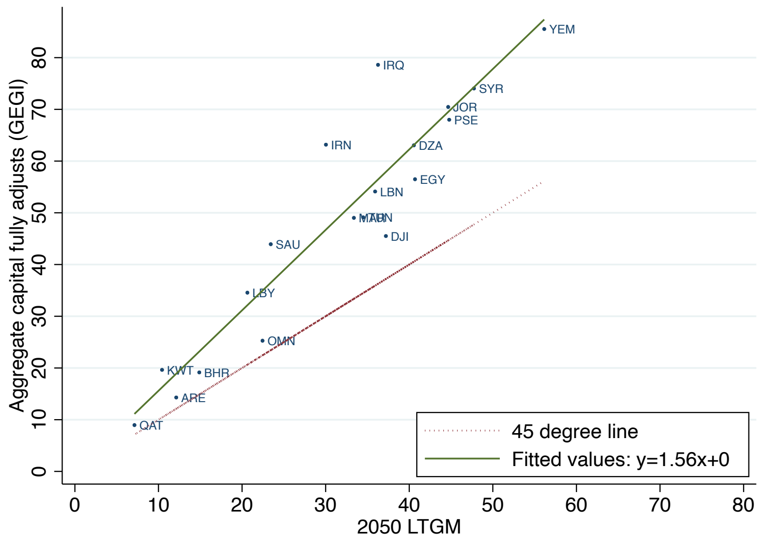
[15] For the commodity sector: Capital shares in oil and natural gas sectors are set according to GTAP 2004-14 averages (the other factor is reserves, which generate rents). Initial gross exports come from UN Comtrade, initial reserves come from BP Energy (most recent observation), discoveries are set to a historic average from BP-Energy data) and export prices are set constant, based on World Bank Commodity forecasts from 2021.

[16] The cross-country average is based on potential for future structural transformation based on current share of employment in agriculture: $0.2\% + 5 \times AgEmpShare$ (to a maximum of 1.5%).

[17] Specifically, human capital is based on Learning-adjusted years of schooling and health (stunting and adult survival rates). Human capital embedded in each age cohort, but only boosts productivity for cohorts of working age. Human capital data is taken from the components of the World Bank Human Capital Index, with historical years of schooling (for older generations) taken from the Barro-Lee educational dataset or Cohen-Soto-Leker when Barro-Lee is missing.

[18] We report the adjusted GEGI for ARE, BHR, KWT, OMN, QAT and SAU.

Figure 3: Gains to GDPPC from closing the Gender Employment Gap (%): GEGI vs. 2050 LTGM

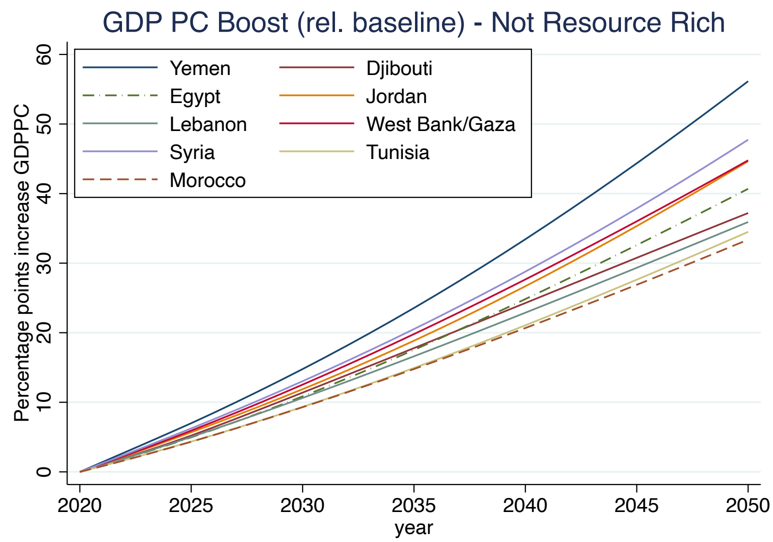


Note: x axis values are the 2050 gains in output per capita from closing the gender gap by 2050 obtained calibrating the LTGM/LTGM-NR, green lines from figure 2. y axis values are the Gender Employment Gap Index (GEGI) from Pennings (2022) (ARE, BHR, KWT, OMN, QAT and SAU are adjusted for unequal male-female populations), blue lines from figure 2. The regression run to obtained the fitted values equation does not assume no constant (the 0 constant is obtained as a result of the regression).

GEGI than the LTGM by 2050 (Figure 3).

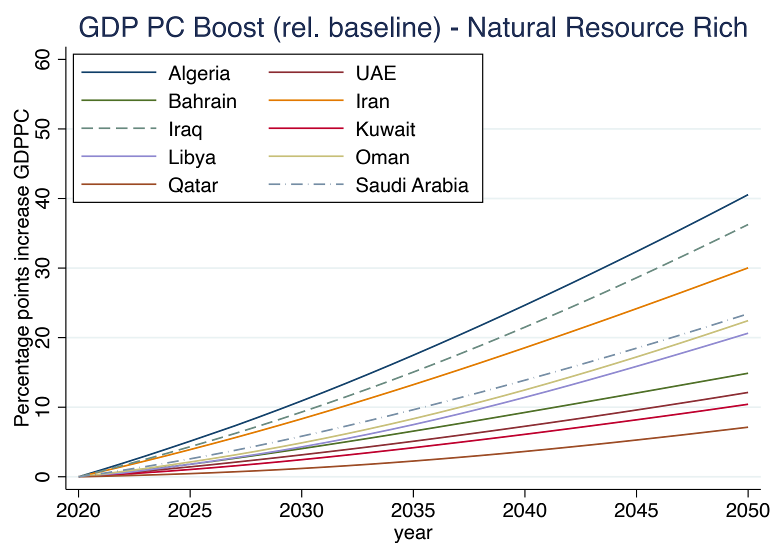
The time path of the boost to growth in the LTGM is shown in Figure 4 and Figure 5. The adjustment path is only slightly non-linear, so a good approximation of the boost to growth at 2035 is around half of the boost to growth by 2050. These paths also suggest that medium term growth gains of boosting female employment are substantial, even if the implementation takes some time. For example, a steady reform process starting in 2020 would have produced gains of 25% of GDP in Yemen and 18% of GDP in Algeria by 2035.

Figure 4: Impact of closing gender gaps by 2050 in MENA Non-Resource-Rich countries



Note: The GDP PC boost path from closing the gender gap by 2050 (relative to the baseline) is obtained calibrating the main LTGM for the 9 non resource rich countries with and without closing the gender gap. Then, the increase year by year is $\left(\frac{GDPPC_{\text{gender gap close}}}{GDPPC_{\text{baseline}}} - 1\right) * 100$.

Figure 5: Impact of closing gender gaps by 2050 in MENA Resource-Rich countries



Note: The GDP PC boost path from closing the gender gap by 2050 (relative to the baseline) is obtained calibrating the LTGM-NR for the 10 resource rich countries with and without closing the gender gap. Then, the increase year by year is $\left(\frac{GDPPC_{\text{gender gap close}}}{GDPPC_{\text{baseline}}} - 1\right) * 100$.

4. Accounting for distributional effects using a model of capital-skill complementarities

While gender gaps in educational attainment in MENA have almost closed in the past 20 years (El-Kogali and Krafft, 2019), accounting for heterogeneity in skills is still important for estimating the economic effects of closing the gender gaps for at least three reasons. The first reason is the rapidly increasing educational attainment among women, which could plausibly continue during our simulation period. Figure 6 shows the gender gap in average years of schooling among 15-24 year-old men and women. In 2015, in this age category, years of schooling averaged 9.4 years for men and 9.2 for women, and the average for women was actually higher in many countries in the region including Algeria, the Islamic Republic of Iran, Libya, Qatar, and Tunisia. Moreover, in the region, a higher fraction of women is enrolled in tertiary education compared to men (43% vs. 39%).[19] If the share of college educated women in the region continues to increase, potential gains in employment rates among women would likely generate additional increases output.

The second reason is that in most MENA countries, female employment rates are much higher for skilled women than for unskilled women, using college education as a proxy for skill. Figure 7 shows that in a sample of eight MENA countries with full data availability, gender gaps tend to be larger among unskilled workers compared to the relatively skilled.[20] For example, in Algeria (DZA), the employment rate among college educated women (32%) is roughly half that of men (56%). However, for non-college educated women the employment rate is less than a sixth that of men (10% vs 66%). The same is true in Egypt, where employment rates for skilled women are 60% of men's whereas for the unskilled it is around a fifth. This implies that if gender employment gaps were closed, more of the women who would start work would be unskilled, with potentially significant effects on the wage distribution and the size of potential gains.

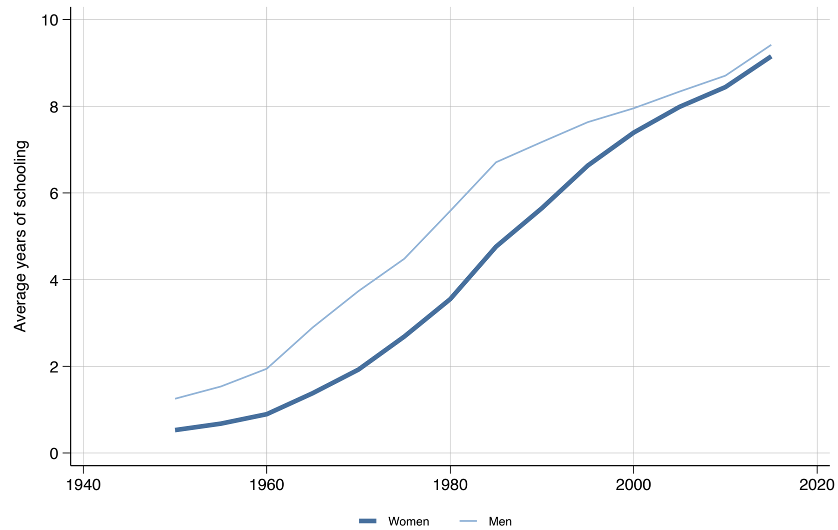
The final reason is that the past 75 years have seen an increase in the skill premium in the US and elsewhere, which standard Cobb-Douglas production functions (as in earlier sections) are unable to explain. If skills are particularly important in production for operating complex capital equipment, then changes in the skill distribution of the economy through changes in female employment and education can have large knock-on effect on the stock of capital per worker, which could amplify output changes.

In this section we estimate the effects of changes in skills shares with higher female employment using the production function in Krusell et al. (2000) and first posited by Stokey (1996), where physical capital and skill are complements. This production function helps us also to examine the potential distributional impacts on changes in wages from changes in female employment rates.

[19]Source: World Bank World Development Indicators for 2020, the latest year available.

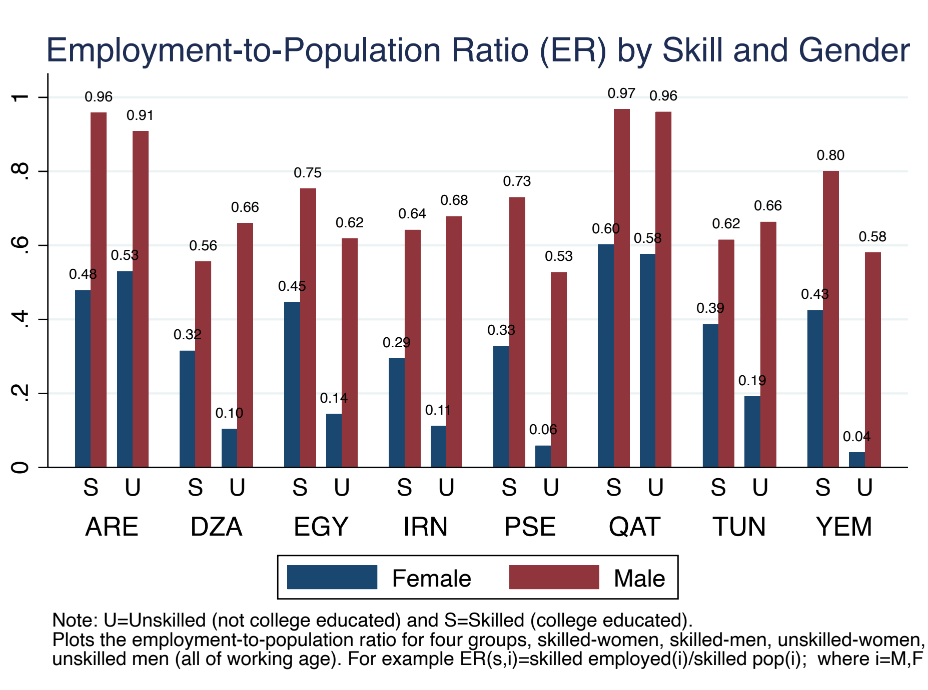
[20]The exceptions are Qatar and United Arab Emirates, where employment rates are similar across men and women.

Figure 6: Average years of schooling in MENA among women and men 15-24 years old.



Source: Own calculations using the Barro and Lee (2013) dataset. We use population weights to obtain the regional average.

Figure 7: Gender Employment Gaps by Skill Level



Model Description. We replace the standard Cobb-Douglas of Equation 2 with a constant elasticity of substitution production function, where S and U denote the number of skilled and unskilled workers, respectively, with $L = S + U$:

$$Y = A\left[\mu\left[\lambda K^{\theta} + (1-\lambda) S^{\theta}\right]^{\frac{\rho}{\theta}} + (1-\mu) U^{\rho}\right]^{\frac{1}{\rho}}, \tag{5}$$

where $1/(1-\theta)$ is the elasticity of substitution between capital and skilled labor while $1/(1-\rho)$ is the elasticity of substitution between capital (or skilled labor) and unskilled labor. Under this specification, the elasticity of substitution between capital and unskilled labor and between skilled labor and unskilled labor is the same. This production function exhibits capital-skill complementarities when $\rho > \theta$ (when the elasticity of substitution between capital and unskilled labor $1/(1-\rho)$ is higher than the elasticity of substitution between capital and skilled labor $1/(1-\theta)$).

There are other potential combinations for the nesting of K, S, and U, but we follow Krusell et al. (2000) who have used this production function (distinguishing in addition between equipment and physical structures) to quantify the role of capital-skill complementarities (as opposed to skill-biased technical change) in explaining the increase in the skill premium in the US that accompanied the increase in the supply of skilled labor. They estimate the parameters in Equation 5 using US data, and find that the values for ρ and θ are consistent with complementarities between skill and capital. Krusell et al. (2000) in turn cite the evidence in Goldin and Katz (1998) and Hamermesh (1996) for a nesting consistent with Equation 5. More recently, Duffy et al. (2004) document additional evidence of complementarities between capital and skilled labor using the specification in Equation 5.

We divide Equation 5 by L to obtain output per worker, and use s and u to denote the shares of skilled and unskilled workers, respectively, with $s + u = 1$:

$$y = A\left[\mu\left[\lambda k^{\theta} + (1-\lambda) s^{\theta}\right]^{\frac{\rho}{\theta}} + (1-\mu) u^{\rho}\right]^{\frac{1}{\rho}}. \tag{6}$$

We also assume a law of motion for physical capital as in the Solow-Swan framework and assume that there is no accumulation of skill (the shares of unskilled and skilled labor are given except for changes that follow changes in female employment). We solve for the steady-state level of output and physical capital under different scenarios for gender employment gaps.

Model Calibration. We use US values for the different parameters in the model. For the elasticities of substitution, we use the estimates from Krusell et al. (2000): $\rho = 0.401$, which implies an elasticity of substitution between unskilled labor and capital of $1/(1-\rho) = 1.67$ (substitutes), and $\theta = -0.495$, which implies an elasticity of substitution between skilled labor and capital of $1/(1-\theta) = 0.67$ (complements). We set the depreciation rate $\delta = 0.039$ (the average rate in the US for the past 20 years) and assume a rate of population growth $n = 0.03$ (UN World Population Prospects).[21] For simplicity, we set $A = 1$ and $\mu = \lambda = 0.5$ (this way, only the two parameters ρ and θ will govern the choice of k given s and u). Finally, we calibrate the savings rate v to match the capital-output ratio in the US (around 3), which yields $v = 0.21$.

To obtain the shares of skilled workers in each country in the baseline, we multiply the share of

[21] The rate of depreciation is the average for US for the period 1999-2019 in PWT 10.01.

working-age population with college by their corresponding employment rate, separately for men and women. Similarly, to obtain the share of unskilled workers, we multiply the share of working-age population with less than college in each country by their corresponding employment rate, separately for men and women. We then follow Pennings (2022) and assume that in most countries there are 100 women and 100 men to simply aggregate employment rates for men and women within each level of skill. In Qatar and United Arab Emirates, which have large populations of migrant workers, we adjust for the relative size of the male and female populations.

Results with the current skill distribution. We consider first an increase in employment rates to close gender gaps for *both* skilled and unskilled women, using existing education rates. Recall that from Figure 7, most countries in MENA have larger gender employment gaps for unskilled women, and so closing gender employment gaps will lead to large increases employment among the unskilled, reducing average skill rates.

The left panel of Table 1 presents the impact of this change on the skill distribution s (summarized by the share of skilled workers), and aggregate labor supply (L), capital per worker (k) and output per worker (y). Consider the case of Egypt. Closing the gender gap in Egypt would decrease the share of skilled workers in 22% while increasing the number of workers in 56% (columns 1 and 2). If the stock of physical capital remains fixed, output per person would increase by 42% (column 7). If the stock of capital fully adjusts to the shock, the total effect on standards of living would be only 5pp higher (from 42 to 47%).

Table 1: Aggregate effects from closing gender employment gaps relative to the baseline (baseline scenario = 1).

Country	s	L	k	y	w_U	w_S	Output per person. Short run.	Output per person. Long run.	Output per person. Change in L alone.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
YEM	0.63	1.84	0.890	0.890	0.915	1.308	1.593	1.638	1.84
TUN	0.83	1.49	0.958	0.958	0.954	1.120	1.378	1.428	1.49
EGY	0.78	1.56	0.942	0.942	0.938	1.168	1.416	1.470	1.56
DZA	0.83	1.62	0.958	0.958	0.954	1.120	1.484	1.552	1.62
QAT (adj)	1.06	1.09	1.013	1.013	1.015	0.965	1.093	1.104	1.09
PSE	0.83	1.69	0.963	0.963	0.948	1.127	1.536	1.627	1.69
IRN	0.81	1.63	0.961	0.961	0.939	1.148	1.482	1.567	1.63
ARE (adj)	1.06	1.16	1.005	1.005	1.022	0.958	1.137	1.166	1.16

Note in the production function in Equation 6 that if the shares of skilled and unskilled workers remain constant, the effect on output per person in the long run from a change in the number of workers would be identical to the change under a standard Cobb-Douglas production function (Equation 2). That is, only changes in the share of skilled labor will affect capital per worker in a Solow-Swan economy with capital-skill complementarities. The last column of Table 1 shows the effect on output per person from closing the gender gap while keeping the skill distribution constant. In the case of Egypt, output per person would increase in 56%, which is almost 10 ppts higher than the full effect in column 8 from changes in the share of skilled workers. In other words, when there are capital-skill complementarities, if closing gender employment gaps does not lead to an increase in the share of skilled workers in the economy, then the effect on output per person would be less strong compared to a pure change in the total number of workers since the complementarities between skill and capital would lead to a decrease in the stock of capital per worker (as illustrated in column 3). In the simulations for Qatar and the United Arab Emirates, for example, closing the gender gap in employment rates would result in higher shares of skilled workers, which in turn would generate higher rates of capital per worker and gains in output per person higher relative to the Cobb-Douglas economy in Equation 2.

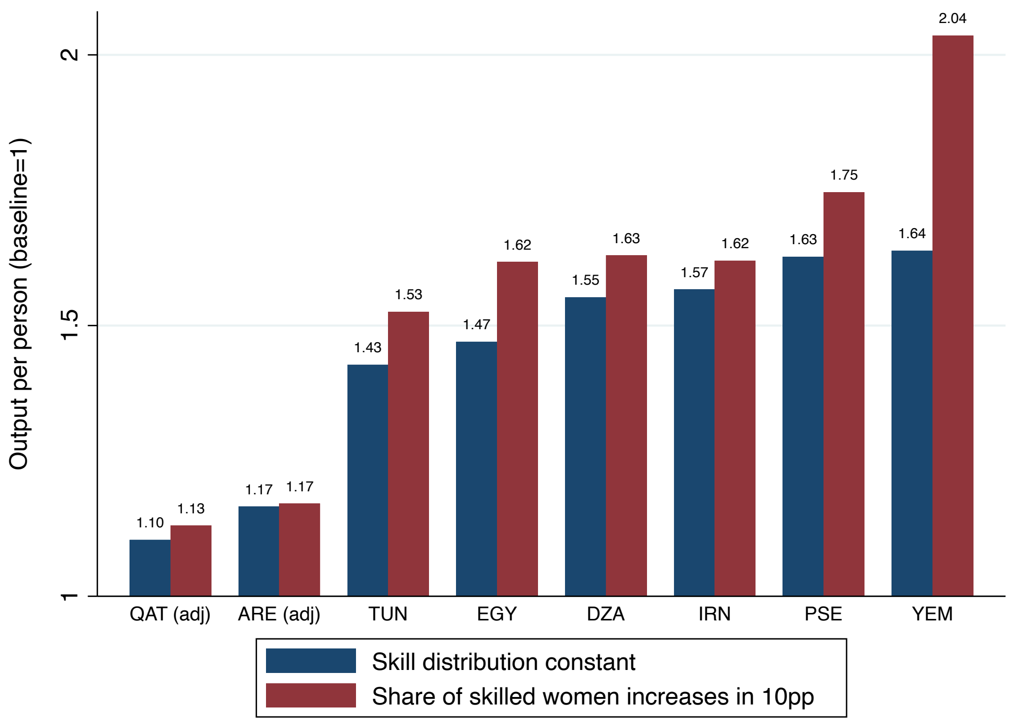
Results under higher education rates among women. To illustrate more generally how changes in the skill distribution would boost physical capital under capital-skill complementarities, we simulate in Table 2 the effects from closing the gender gap while also increasing the share of high-skill (college educated) women in the working-age population in 10 ppts. The share of skilled workers would now increase in every country except in the Islamic Republic of Iran, resulting in significantly higher levels of capital per worker. In the case of Tunisia, for example, the share of skilled workers would increase in 11%. Output per person if capital remains fixed would increase in 45%, and an extra 8 ppts if physical capital fully adjusts. Now the change in output per person under full capital adjustments would be higher relative to a standard Cobb-Douglas scenario (53% in column 8 vs. 49% in column 9), because the additional share of skilled workers would boost physical capital (and increase the stock of capital per worker) due to the complementarities between the two.

Table 2: Aggregate effects from closing gender employment gaps while increasing the share of skilled women in the working-age population in 10 ppts. Changes relative to the baseline (baseline scenario = 1).

Country	s	L	k	y	w_U	w_S	Output per person. Short run.	Output per person. Long run.	Output per person. Change in L alone.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
YEM	1.38	1.88	1.083	1.083	1.070	0.831	1.909	2.036	1.88
TUN	1.11	1.49	1.024	1.024	1.029	0.935	1.451	1.525	1.49
EGY	1.11	1.58	1.024	1.024	1.029	0.935	1.528	1.618	1.58
DZA	1.06	1.61	1.012	1.012	1.015	0.966	1.540	1.630	1.61
QAT (adj)	1.18	1.09	1.037	1.037	1.045	0.902	1.115	1.131	1.09
PSE	1.08	1.72	1.015	1.015	1.025	0.947	1.617	1.746	1.72
IRN	1.00	1.62	1.000	1.000	1.000	1.000	1.515	1.620	1.62
ARE (adj)	1.14	1.16	1.010	1.010	1.056	0.901	1.141	1.171	1.16

Figure 8 summarizes the effect on output per person under the two different scenarios in the long run (when physical capital fully adjusts), with and without changes in the educational attainment of women. Increases in the share of skilled women would generate additional gains of around 8 pp in Algeria, 9 pp in Tunisia, 12 pp in West Bank and Gaza, and 15 pp in Egypt. The median long-run increase in GDPPC in the region is 45% with current educational attainment of women, and 57% when educational attainment of women also increases.

Figure 8: Gains in output per person in the long run from closing the gender employment gap. Changes relative to the baseline under different scenarios (baseline = 1).



Effects on Wages. Closing the gender employment gap will also affect the wage rate of both unskilled and skilled workers (w_U and w_S respectively). In the first experiment, gender employment gaps are in general larger among the unskilled, and so closing them makes skilled labor relatively scarcer. The center columns of table 1) show that for most countries in the region, the corresponding wage rate of skilled labor would increase (by around 17% for Egypt, for example) while the wage rate of the relatively unskilled would decrease (by around 6% for Egypt).[22]

In the second scenario where the trend towards higher female education rates continues (+10ppts in the population skill share for women), the pattern is reversed as skilled workers become relatively more common. The middle section of Table 2 shows that there are generally higher wages for unskilled workers, and lower wages for the relatively skilled. In the case of Tunisia, for example, the share of skilled workers would increase by 11% but their wage rate would decrease by 7%. In contrast, the wage of unskilled workers would increase by 3%.

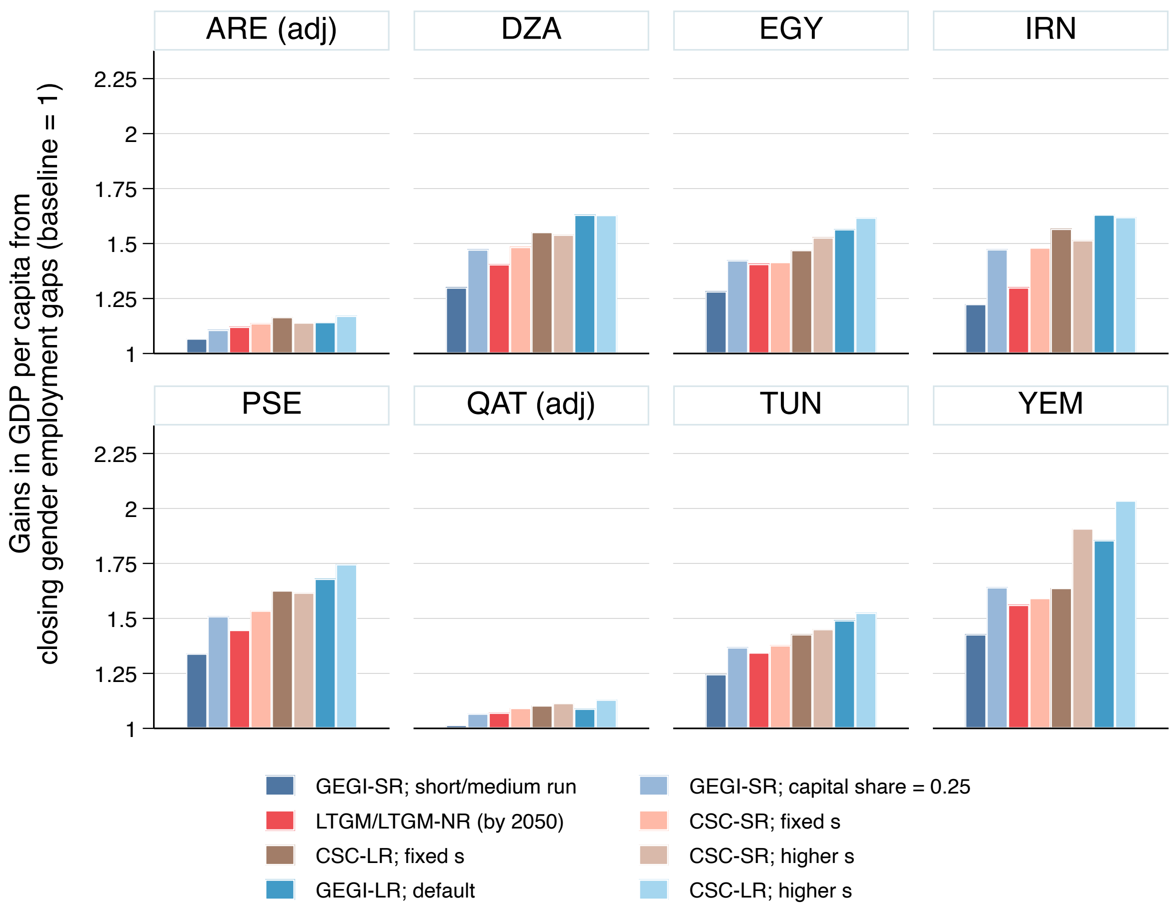
5. Conclusions

In this paper we attempt to help to discipline the policy conversation around the size of the economic gains from closing gender employment gaps in the Middle East and North Africa. We

[22]Qatar and UAE are the exceptions here, though the effect on wages in these countries is quantitatively small due to the relative shortage of women.

compute the gains in GDP per capita using a range of neoclassical growth models with different aggregate production functions and different assumptions, including different structures of production, the possibly slow response of capital accumulation (in a region with a private sector lacking dynamism) and policy implementation, and potential changes in the skill distribution. The results are summarized for eight sample countries in Figure 9, which suggest that while the considerations are important, the models produce results that are consistent in several areas. We suggest four takeaways.

Figure 9: Comparing Gains in GDPPC Across Models



The first takeaway is that for most countries the economic gains from closing gender employment gaps in MENA are *quantitatively large*—around 50% in the typical country in the long run (GDPPC is 1.5 times the baseline in Figure 9).

Second, the gains are heterogeneous across countries, ranging from 10% or smaller in Qatar and approaching 100% of GDP per capita in Yemen. Moreover, the models generally agree on the ranking of the size of the gains (Yemen's gains are always the largest and Qatar's are always the smallest) suggesting the most important factor is the size of the underlying gender gap itself, rather than other features of the economic environment.

Third, we find that the economic gains are substantially smaller in the short or medium run when capital cannot adjust, though they are still economically significant for the typical country. The biggest proportional reduction in gains when comparing the long run to gains when capital does not react are in the GEGI-SR models in resource rich countries that have the lowest labor shares (such as Qatar or the Islamic Republic of Iran). The reduction in gains are much smaller in the model with Capital-Skill complementarities (CSC), in part because that model has a much higher labor share. Indeed, imposing uniform and low capital shares of 0.25 in the GEGI models—implying a labor share of 0.75 (similar to that assumed in the CSC model in Section 4), leads to similar gains. The LTGM/LTGM-NR impacts by 2050 show that even after 25-30 years the gains still substantially smaller than those in the long run, though are large in absolute size.

Fourth, we find that long run economic gains with capital-skill complementarities and an unchanged skill distribution are generally a little smaller than those in the baseline GEGI model (5-10ppts) because existing gender gaps are larger for unskilled women, and so closing gender gaps reduces the level of skills. However, these smaller losses are more than offset if women continue to improve their educational attainment.

Policy implications. Our results highlight the importance of implementing reforms to facilitate female employment for long-run economic growth in MENA, especially in the countries with the largest gender gaps. While these gains are usually very large, they can also take a long time to be fully realized, so policymakers will need some patience, and should not abandon a reform path if gains are not apparent in the short term. They also suggest that a range of complementary reforms are necessary, with higher female educational attainment amplifying the gains, and greater private sector dynamism speeding the realization of gains.

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Appendix

Table A1: 2050 boost from closing the gender gap in the rate of FLFP relative to the baseline (percentage points)

Country*	GDP Per Capita (1)	Capital Per Worker (2)	Wage Rate (3)
ARE*	12	-10	-6
BHR*	15	-14	-9
DJI	37	-16	-6
DZA*	41	-24	-13
EGY	41	-19	-10
IRN*	30	-29	-20
IRQ*	36	-32	-23
JOR	45	-26	-14
KWT*	10	-14	-11
LBN	36	-24	-13
LBY	21	-26	-10
MAR	33	-20	-11
OMN*	22	-21	15
PSE	45	-25	-14
QAT*	7	-9	-7
SAU*	23	-26	-20
SYR	48	-29	-16
TUN	34	-20	-11
YEM	56	-29	-16

*/Countries whose calibration was produced using LTGM-NR.

Table A2: Summary of LTGM calibration (parameters and growth drivers)

Country*	Labor Share	Initial Capital to Output	Depreciation Rate (%)	Male employment-to-population ratio (15-64)	Female employment-to-population ratio (15-64)	TFP growth (2021-50 average, %)	Human Capital growth (2021-50 average, %)	Investment (2021-50 average, % GDP)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ARE*	0.48	2.1	3.7	0.93	0.51	0.8	1.0	26.7
BHR*	0.30	3.4	3.4	0.88	0.44	0.6	1.2	32.4
DJI	0.63	2.3	6.6	0.39	0.15	0.5	1.1	28.4
DZA*	0.48	3.6	4.4	0.65	0.15	0.1	0.8	35.8
EGY	0.50	1.7	5.4	0.64	0.18	1.0	0.6	19.3
IRN*	0.36	4.6	3.9	0.68	0.15	0.1	0.7	37.2
IRQ*	0.30	2.5	5.0	0.68	0.08	1.3	0.0	13.0
JOR	0.50	3.4	2.9	0.48	0.08	0.7	0.2	23.3
KWT*	0.25	2.3	6.5	0.88	0.49	1.0	1.1	19.3
LBN	0.50	2.3	3.5	0.65	0.19	0.4	0.0	22.8
LBY*	0.22	3.8	4.3	0.55	0.27	4.3	0.7	15.8
MAR	0.50	2.9	5.1	0.66	0.23	0.5	0.9	27.3
OMN*	0.30	2.3	4.0	0.88	0.27	0.1	0.7	24.8
PSE	0.50	3.1	3.3	0.55	0.11	0.6	1.1	22.9
QAT*	0.18	3.4	7.2	0.96	0.58	1.9	1.0	30.0
SAU*	0.28	2.4	5.9	0.78	0.18	0.1	0.7	26.5
SYR	0.50	2.3	4.9	0.71	0.11	1.2	1.0	11.5
TUN	0.50	2.7	4.4	0.66	0.22	0.7	0.5	21.1
YEM	0.50	2.3	3.0	0.59	0.05	1.4	0.6	11.7

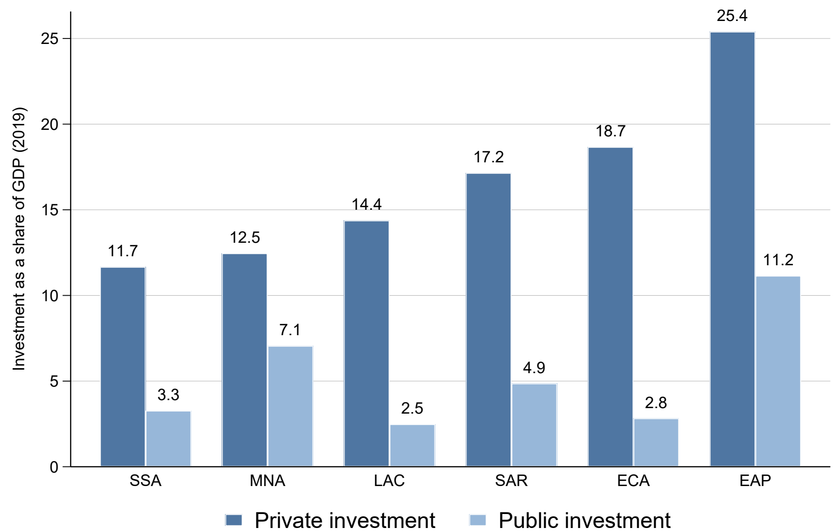
* 10 Countries whose calibration was produced using LTGM-NR.

Table A3: Calibration of the Natural Resource Sectors in MENA)

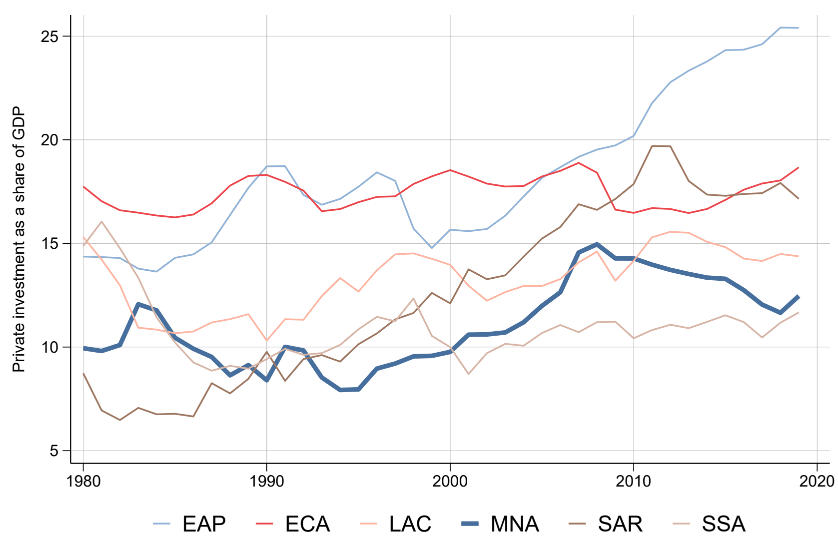
Country	Labor Share (PWT10) (1)	Labor Share in non-resource sector (implied) (2)	Oil and Gas Sector Size (% GDP) (3)
ARE	0.48	0.73	35
BHR	0.30	0.40	26
DZA	0.48	0.65	28
IRN	0.36	0.43	16
IRQ	0.30	0.45	34
LBY	0.22	0.5	56
OMN	0.30	0.49	39
QAT	0.18	0.39	56
SAU	0.28	0.36	23

Figure A1: Average investment rates across regions.

(a) Rates of private and public investment. 2019.



(b) Private investment as a share of GDP. 1980-2019.



Source: Own calculations using the Investment and capital stock database 2019 (ICSD; IMF). The grouping of countries into regions follows the World Bank classification. SSA: Sub-Saharan Africa; MNA: Middle East and North Africa; LAC: Latin America and the Caribbean; SAR: South Asia; ECA: Europe and Central Asia; EAP: East Asia and Pacific.