Journal of Economics and Econometrics Vol. 54, No.2, 2011 pp. 58-92

ISSN 2032-9652 E-ISSN 2032-9660

Modelling unemployment in the presence of excess labour supply: An application to Egypt

MARGA PEETERS[†]

ABSTRACT

Due to its pyramid population structure, Egypt needs to create jobs at a high pace to absorb the many new entrants at its labour market. This article structurally models and quantifies the impact of these demographic shocks and the shedding of public sector jobs on unemployment. The findings indicate that Egypt needs to grow at 5% for many years to come. Job creation better occurs in the private than in the public sector. Egypt's public sector has been driving up government expenditures disproportionably, not only because of the numerous public sector employees but also because of high public wage growth.

JEL Classification: C32, J11, J21, J22, J23.
Keywords: Demography, labour supply, employment, public sector employment, public finance.

[†]Royal Netherlands Academy for Arts and Sciences and Netherlands Institute for Advanced Study (NIAS), Meijboomlaan 1, 2242 PR Wassenaar, the Netherlands. E-mail: huber@tinamargapeeters.eu. Without implicating them, I wish to thank Martin Fase, Iván Martín, Hoda Youssef and two anonymous referees for comments on an earlier version of this article. This work was supported by a Grant from The Netherlands Institute for Advanced Study (NIAS).

Journal of Economics and Econometrics Vol. 54, No. 2, 2011 pp. 58-92

Modelling in different styles will be appropriate for different purposes or different stages in the development of an area of economics

Christopher A. Sims, 1989

1 INTRODUCTION

Egypt is an emerging economy that was rapidly growing in the years before the global crisis. Its diversified economic activities, geographic strategic position and educated young and broad labour force makes it a high potential economy. While many developed economies around the globe struggle with increasing public expenditures because of an aging population, the Egyptian economy shows another picture. Its population is young and numerous. For the decades to come, the inflow of youngsters at the labour market will be high and the absorption of these entrants will remain one of the main policy problems to tackle for the Egyptian authorities. Sufficient job creation is crucial in the short to medium run in order to offer the young population prospects: a salary to live on, social security and career opportunities.

In this respect, the public sector labour market also deserves attention. In Egypt, as in most developing economies, this sector is large and its functioning is different from that of the private sector labour market. The public sector labour market is generally more inefficient and dominant. Its dominance can influence the wage setting and other employment practices in the rest of the domestic labour market. Moreover, its dominance can also hamper other developments in the private sector, where job creation primarily has to take place. In this light, the developments of the fiscal costs of employment in the government sectors across countries are an interesting angle to study public sector employment (see also Tansel (2005) on the case of Turkey or Christofides and Pashardes (2002) on Cyprus).

This article contributes to the existing studies that analyse the labour market prospects of Egypt in view of its demographic changes (see the works of Whaba in European Commission (2010), Hassan and Sassenpour (2008) and Assaad (2007)). Its novelty is the introduction of a small econometric model that distinguishes between the public and private sectors' labour markets that is suitable for simulating the

expected future labour supply shocks. In comparison with previous studies, the effects of demographic change are analysed in a more comprehensive economic framework that takes account of the dynamics of the labour market, distinguishing between the public and private sectors and incorporating fiscal balances. By means of this model, I quantify the effects of the labour supply for the public and private sector labour markets and public finances for the two decades covering the years 2011 until 2030.

The outline of this article is as follows. Section 2 provides background information on related studies and presents the main hypotheses. Section 3 describes the labour market developments in Egypt and compares these with developments in the neighbouring economies of Egypt and other emerging and developed economies. Section 4 presents the labour supply model and the results from simulating policy scenarios for the future developments of unemployment, the public and private labour markets and the public finances in Egypt under different assumptions on labour supply, demand shocks and public employment. Section 5 reflects on policy issues. Section 6 summarises and concludes.

2 LITERATURE, BACKGROUND AND MOTIVATION FOR THE MODEL USE

The broad pyramid structure of the Egyptian population shows that the inflow in the labour force will be high for decades to come. In comparison with other countries, such as the G-20, the level of "greening" which measures the population below 15 years of age in relation to the potential labour force in the age category 15 to 65 years, Egypt ranks highest. Another country ranking high is South Africa, or India (see for instance Aiyar and Mody (2011) on the Indian situation)[1].

Having an extremely young population, and being numerous, can be a virtue for a country from an economic point of view.[2] The rise of an

1 Other relevant literature is Bloom, Canning and Sevilla (2001) on demographic structure and economic growth,Nayab on Pakistan (2007), and Golley and Tyers (2011) on a comparison between China and India.

2 Groot and Peeters (2011) compare the population structures of 50 countries, of which 21 developing, and illustrate the demographic change between 2010 and 2050 for each of these countries in appendix B. It follows that Egypt's pyramid has a broad

economy's working-age population can give rise to high growth rates, a result known as the "demographic dividend". However, reaping this dividend will only occur in case those entering the labour force will find a job. Receiving a wage, one can consume or save, and both are beneficial for the economy (see for instance Keynes, 1936).

Public sector employment often comprises a major part of the total employment. It is larger in emerging than in developed economies. Dependent upon its size, developments in the public sector can be influential in wage setting and other employment practices in the rest of the labour market. The functioning of the public sector labour market is in this case dominant in the functioning of the total labour market.

The recent literature shows a main interest in public sector labour markets. Some studies measure and study their composition and size. Although public sector markets are large, they do not account for more than 15% of total employment in most developed countries (see Gregory and Borland, 2005).

Other studies address public-private wage differentials in developed (Lassibille, 1998) and developing economies (Assaad, 1997) to investigate the efficiency of the public sector labour markets, though the performance of the public sector is difficult to measure (Pestieau, 2007). There is a consensus that private sector labour markets are more flexible and productive than public sector labour markets. Moreover, public sector employment and public sector wages are rather countercyclical (Freeman (1987) on the US case).

Generally, the main objection to public sector employment boils down to costliness, in that the compensation of government employees imposes on the fiscal budget. This applies in particular to Egypt as the public finances are still in a dire state. Egypt's public debt was high at around 70 percent of GDP in 2010, and the public deficits have been high even in years with a good economic growth performance. Just before the global crisis, the Egyptian economy grew with 7% for three years in a row and the fiscal deficit was around 7-8% (see Herrera *et al.* (2010) for a review on recent developments).

---

base, implying that there are many young in comparison with those working age, but there are countries that outperform in this respect (Nigeria, Tanzania, Uganda).

Imposing or at least not conducive for the public balance is further the high level of unemployment. The unemployment and thus low participation rates, the existence of large informal markets and further discontent and social unrest were among the reasons that lead to revolts early 2011 (see also Radwan (2009) on the social impact of the global crisis in Egypt).

In discussing the size of the public sector in Egypt, the historical background plays a role. Egypt is an Arab country, in which the role of the public sector has always been large. The public sector consists of the general government and civil service where the latter includes central and local administration, the armed forces, police and fire services, and the provision of social services such as health and education.

Egypt has opted in the past to play a more active and direct role in shaping socio-economic structures. Development planning emerged as a significant tool of the state in performing its functions and responsibilities. I refer here to Said (1996) and Assaad (2007) that provide interesting in-depth analyses on the role of the Egyptian public sector and the labour market developments in the 1980s and the 1990s. It is in this historic perspective that one should understand the still quite dominant role of the public sector. I keep this in mind, but focus on the future and mainly the near past in our following sections.

This article bases the analyses on an econometric structural labour supply model following Tinbergen (see for instance Tinbergen (1938) or Klein (1969)).Such a model has the advantage that it takes account of causalities and dynamics at the labour market and other parts of the economy. Not only employment, but also wages and production and their segregation into public and private play a role.

Moreover, the model specifies the fiscal balances that are highly relevant for Egypt in view of its high public debt. The model is composed of behavioural and tautological equations where the first are calibrated or econometrically estimated, using past statistical information and econometric techniques. This framework is a useful tool to analyse the effects of the additional labour supply on the Egyptian labour market, resulting from demographic developments, in a coherent and consistent way.

Time series for the Egyptian economy are meanwhile largely available for the full decade 2000 to 2010, some even from 1982 onwards, and

thus sufficiently long. These series are the building blocks for our database to use for the estimation of our model and scenario analyses. As the literature on econometric model and policy making in international and national institutions has been showing, the merits of using coherent structural models or other statistical models generally is more conducive in obtaining adequate policy outcomes than policy making without using statistical facts and frameworks.[3] This holds the more so for emerging economies, such as Egypt, with its multiple policy challenges and endeavour for more transparency at the current juncture.

As econometric modelling is restricted, I further leave aside many features of the Egyptian economy that are not irrelevant but beyond the scope of this study. For instance, the low participation rates of women and their additional employment costs (see Assaad, El-Hamidi and Ahmed (2000)). Neither do I take into account here the role of remittances for the domestic economy (see Binzel and Assaad, 2011). For other features, such as migration, relevant in particular to transitioning economies I refer to other literature (see Coale and Hoover, 1958).

3 STYLISED FACTS OF LABOUR SUPPLY AND PUBLIC-PRIVATE SECTOR EMPLOYMENT

The structure of the Egyptian population has the form of a broad pyramid and is different from most countries around the globe with 32% of the population below fifteen in 2010 (see figure 1). Far more than half of the population (61%) was younger than 30 years in 2010. The expectation is that the pyramid structure will remain at least for the decades 2011-2030 but, as shown, it will get slimmer at the bottom and taller due to relatively lower fertility rates and longer longevity. In 2030, the expectation is that the population below the age of thirty is 11 percentage points lower than in 2010. Due to longer longevity, the expectations are that 2% of the population will reach the age of 75 or more, while this was less than 1% in 2010.[4]

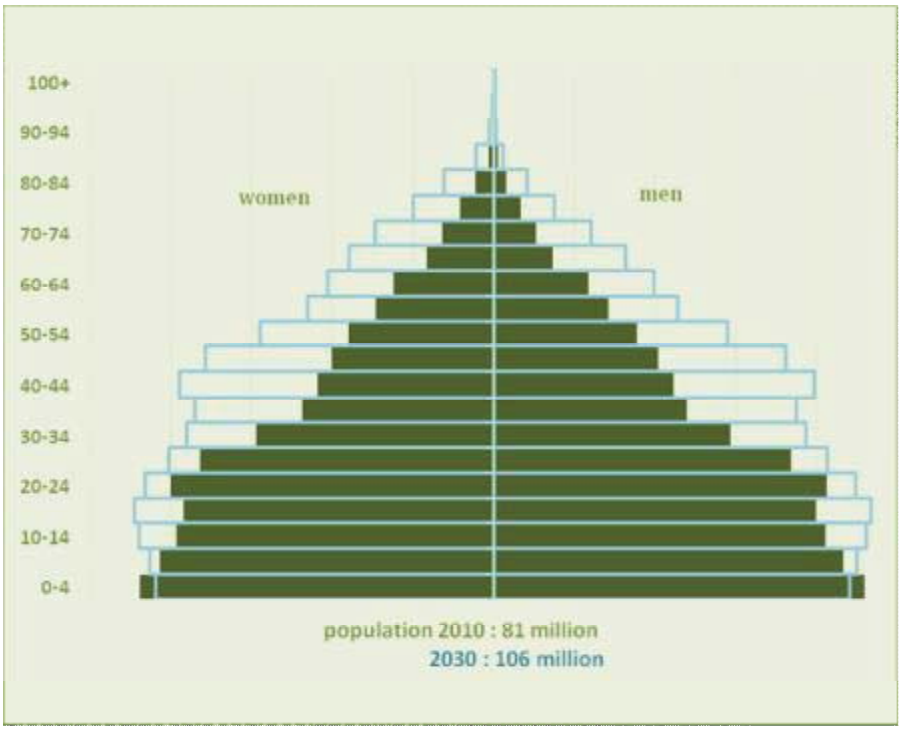
---

3 For a philosophical discussion about the use of models in economic science and decision-making, see the introduction of Sims (1989) or Don (2000). For the building and use of macro-econometric model for transitioning economies, see for instance Barrellet al. (2004) and De Haan, Naumovska and Peeters (2001). For advanced modelling techniques for transitioning economies, see Hall, Mizon and Welfe (2000).

4 The assumption on migration is that it will remain the same.

Although Egypt will have more elderly people in the near future, old age dependency rates will not rise because of the strong inflow in the working age population, that are people between 15 and 65 years. The structure of Egypt's population not only stands out compared with developed countries, it is also different from other major developing economies such as India, Indonesia and China and Egypt's neighbouring economies.[5]

Figure 1: Age structure of Egypt's population age in years on y-axis, people in persons on x-axis



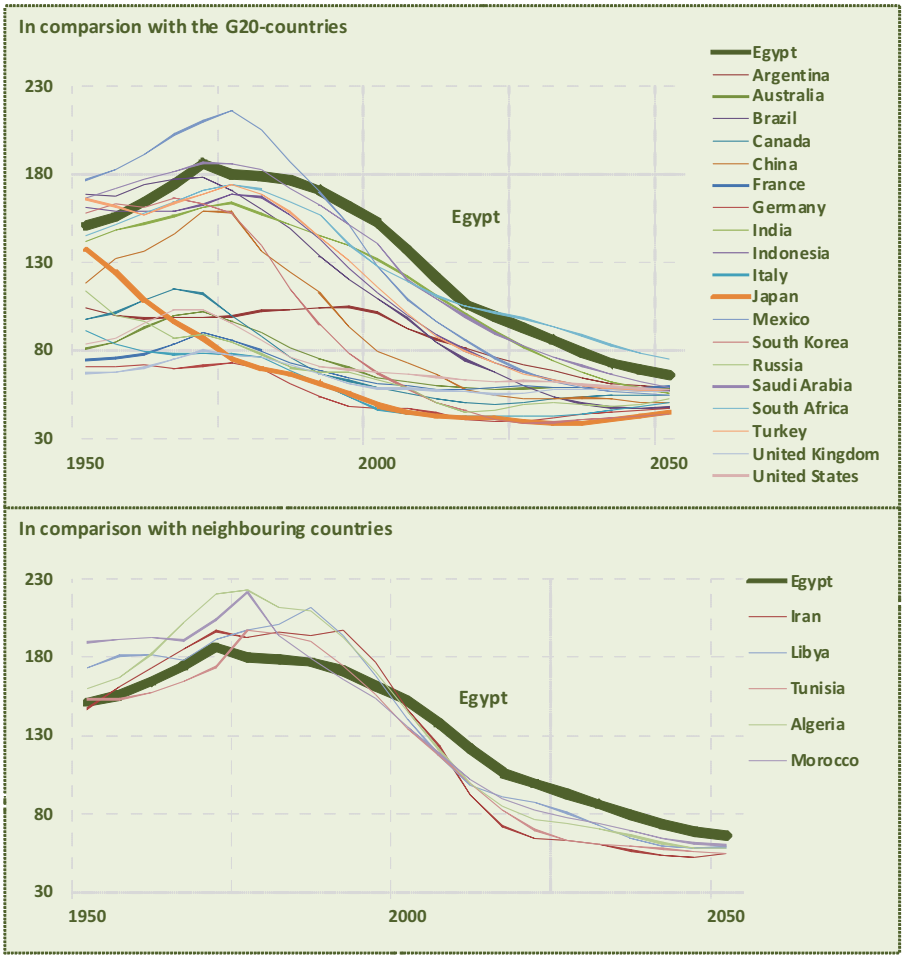
Source: Author's calculations based on the United Nations Population Information Network (POPIN), 2011, median variant.

This follows from figure 2. In comparison with all G20-countries - herewith including India, Indonesia and China – Egypt's youth, dependency rates are highest in the years to come (see the upper graph). The expectation is that only South Africa will overtake the

5 In terms of GDP per capita, Egypt is comparable with India, Indonesia and China. In 2010 it ranked just higher at 6,367 US dollar in terms of GDP per capita in purchasing power parity than India and Indonesia, but just lower than China.

position of Egypt from 2020 onwards. Compared with the neighbouring North African countries, Egypt has even higher youth dependency rates up to the year 2050 (see the lower graph). Egypt will thus remain relatively young for decades to come.

Figure 2: Youth dependency rates of Egypt in comparison with other countries

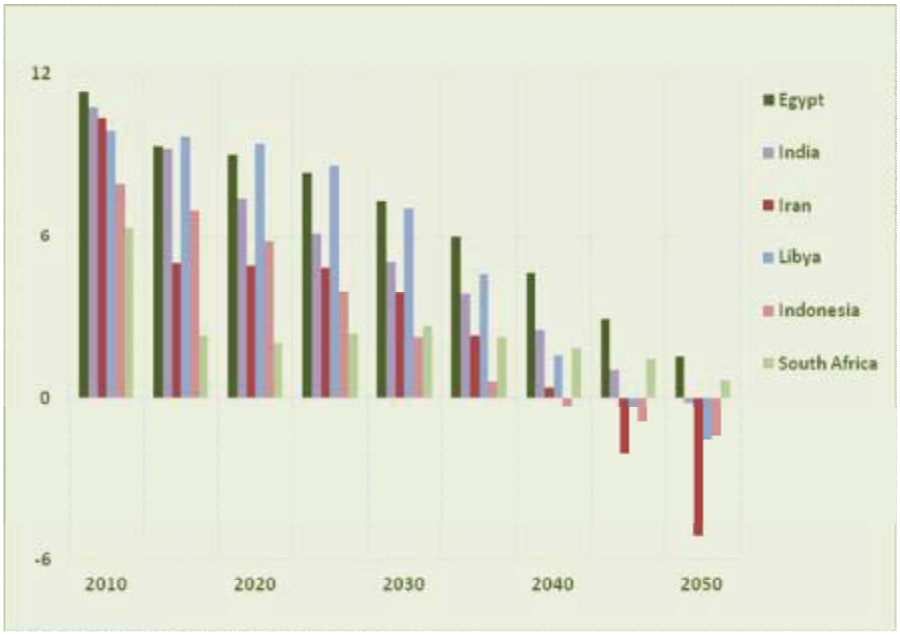


Source: Author's calculations on the basis of the United Nations Population Information Network (POPIN), 2011, medium variant. Notes: Dependency rates are calculated as the number of people aged from 0 to 14 to those aged 15 to 64.

The young population is causing a strong inflow in the working age population. While the simultaneous outflow of elderly out of the labour

force could compensate the inflow, this will not be the case for Egypt. Relatively much inflow of young will thus remain for many years to come. The five-year growth rates of the working age population will remain above 6% until 2030 (see figure 3)[6]. Egypt has working age growth rates that are diminishing over time, a pattern observed in most countries worldwide, but still has far higher rates than the other countries with the exception of Libya in 2015, 2020 and 2025. The additional labour demand should meet additional labour supply for unemployment rates to remain at their current levels. If not, they will even go further up.

Figure 3: Projected growth rates of the working age population for Egypt

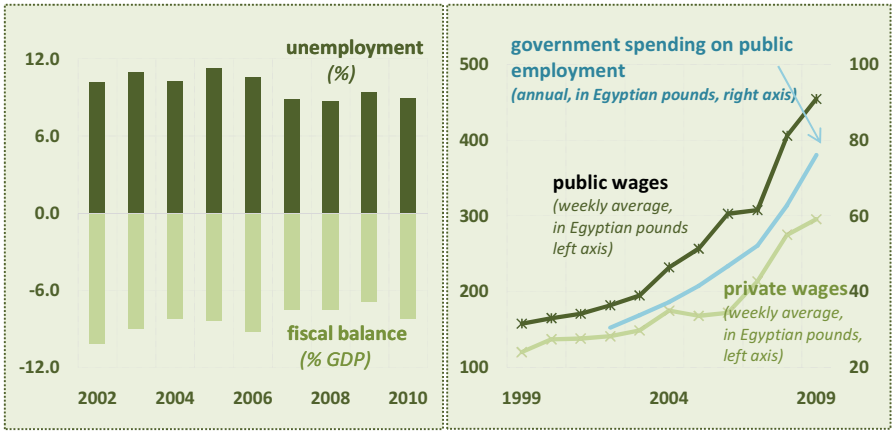


Source: Author's calculations on the basis of the United Nations Population Information Network (POPIN), 2011. Notes: These rates are calculated as the growth rate of the projected number of people between 15 and 64 in year t in comparison with year t-5.

6 The data from the United Nations are on a five-year basis. For this reason the growth rates calculated here are not annually, but for each five years, starting in 2010 and ending in 2050 in figure 3.

Egypt's current unemployment rate is high. Young entrants at the labour market do not easily find a job for that reason. The official unemployment rate was 10.2% of the working age population in fiscal year 2002 (see left graph in figure 4)[7]. Unemployment even reached 11.2% in 2005, but thereafter decreased to 8.7% in fiscal year 2008 and to 9.0% in fiscal year 2010 thanks to the prosperous economic growth. Just before the economic and financial crisis, in the fiscal years 2006, 2007 and 2008 economic growth reached around 7% at annual rates. The global crisis depressed growth to 4-5%. It remains puzzling that the crisis hardly affected the unemployment rates.

Figure 4: Unemployment and public spending on public employment in Egypt



Sources: Author's calculations based on information from the Central Agency for Public Mobilisation and Statistics (CAPMAS), the official office of statistics in Cairo. The fiscal balance and the fiscal spending on public employment come from the Egyptian Ministry of Finance.

One may expect that migration plays a major role, in particular emigration. As in most developing economies, Egypt has more emigrants than immigrants. Egyptian working abroad mainly go to the Middle East, the US or Europe. However, net migration rates, that define emigration minus immigration per 1000 inhabitants, have decreased since 1990-1995 according to the United Nations Population Information Network. In this period -3.7 persons migrated on an annual basis. In the subsequent period 1995-2000, this reduced to -2.9,

7 Some statistics in Egypt, such as on public finances, are provided for fiscal years. Fiscal year 2002, for instance, runs from July 2001 to June 2002.

in 2000-2005 to -1.0 and in 2005-2010 to -0.9. Also in comparison with other developing economies Egypt's migration rates are low. In Morocco, for instance, net migration per 1000 inhabitants was -4.3 in 2005-2010 and in Nigeria, a far more difficult country to migrate from, it was -0.4 in this period. Also in absolute terms less Egyptians migrated during last years, namely -189,000 in 1995-2000, -74,000 in 2000-2005 and -69,000 in 2005-2010. For this reason migration as such is further not incorporated in the analyses presented in this article.

In addition to the problems of the large inflows at the labour market and the persistently high unemployment rates, there is the dire state of the public finances. The government could help financing more projects in order to foster jobs. However, the persistently high fiscal deficit leaves not much room to manoeuvre(see the left graph in figure 4). The fiscal debt was high at more than 70% of GDP in fiscal year 2008, and rose thereafter, so interest payments are a main share of government spending. Another substantial share of public spending is the compensation for public employees (see Youssef, 2007).

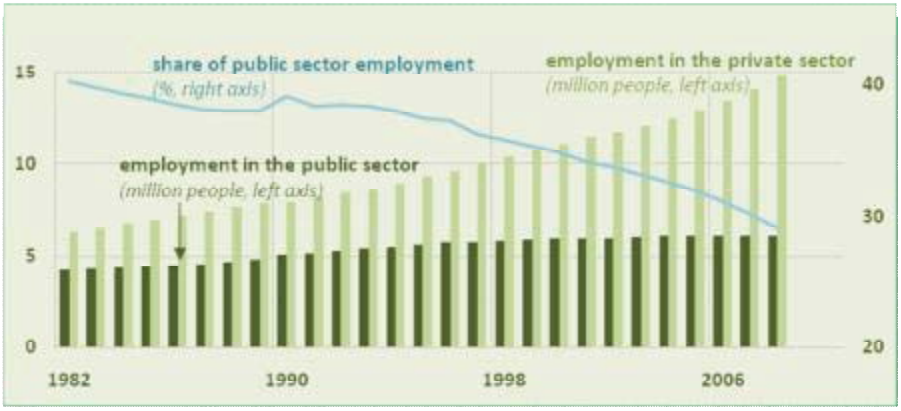
The trend in wages and social security payments for public employees, that is called compensation on public employees, is steeply upward sloping (see right graph in figure 4). Even in those years with depressed GDP-growth, that is in fiscal years 2009 and 2010, nominal public wages went up by more than 10%. As illustrated by Hassan and Sassenpour (2008) for the real private and public wages developments from 1995 until 2005[8], it follows also here that the wage developments in the private and public sectors differ a lot (figure 4). Not only the average level of wages has been far lower than in the public sector, so was wage growth, notably in depression year 2009.

In Egypt 30-40% of all employees (self-employed excluded) are working in the government sector. Consequently, not only the price effect of high wages but also the quantity effect of a high number of government employees pushes government spending upward or at least keeps these at a high level. Around 6 million people were working in the government sector during last decade. As the economy performed well, private sector employment grew from 7 million in 1982 to almost 15 million in 2008 (see figure 5). Thanks to this growth, the ratio

8 Hassan and Sassenpour (2008) used unpublished data from CAPMAS. Wage data used in figure 4 are officially published, indicating that transparency on public and private sector differences has increased which is a major step forward.

public to private sector employment has been falling to around 30% in 2008 (see right axis).This is a good development from a financing point of view. It improves public finances, as the government spends less money from the public budget on public sector employees. The taxpayer does thus pay less for (luxurious) public sector positions. Productivity also plays a role, a factor that I investigate in the next section.[9]

Figure 5: Public and private sector employment in Egypt



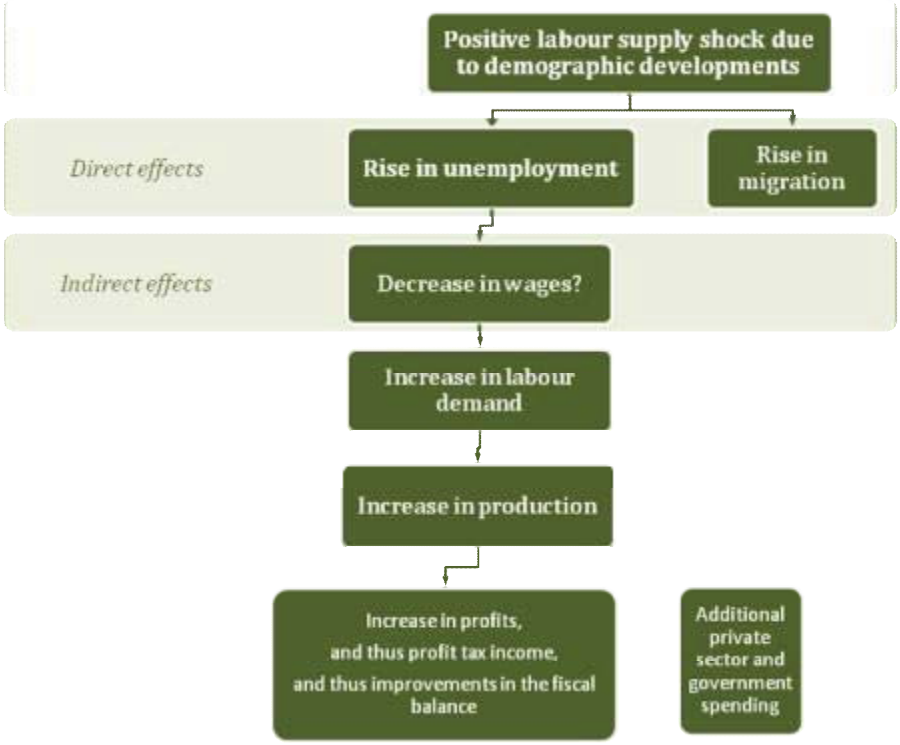
Sources: Author's calculations based on information from the Ministry of Economic Development in Egypt.

4 LABOUR SUPPLY MODEL FOR THE EGYPTIAN ECONOMY

This section specifies a model that describes the relations among macroeconomic variables that are relevant to the labour market and the fiscal sector. As I mainly analyse the impact of the changes in demographic structure, that is primarily affecting labour supply in Egypt, I baptise it the *labour supply* model. Figure 6 illustrates the main flows in the model in a flow chart. In the next sections, I discuss the direct effects on unemployment and the indirect effects on wages. I first present the model specification, followed by a presentation of the results in four main scenarios. The data appendix of this article describes the database and the technicalities for constructing the baseline for the model.

9 There is much literature on productivity in government services, mainly for developed economies. See for instance Fase and Winder (1999).

Figure 6: Transmission of a positive labour supply shock



Source: Author.

4.i Labour supply model specification

The labour supply model gives a simplified illustration of the relations among key variables at the labour market. In addition, it models the impact of developments at the labour market on the real economy and on the flows of public finances. The important feature is the segregation of the labour market into two sectors: the public and the private.

The model specifies the labour market as follows. Unemployment (U) is per definition specified as excess labour supply as a percentage of labour supply. Denoting labour supply as L_s and labour demand as L_d, where both are measured in number of persons, it then follows that

$$U := 100 * \frac{L_s - L_d}{L_s}$$

(1)

Labour supply is an exogenous variable in our model. Demographic factors mainly determine its size but also behavioural characteristics matters in practice, such as whether or not people of the working age population enter the labour market and supply labour. I focus in our analyses primarily on the demographic supply shocks, though one could easily extend the model for other purposes.

Labour demand is endogenous and segregated into public (L_d^{publ}) and privatesector employment (L_d^{priv}), as follows

$$L_d := L_d^{publ} + L_d^{priv}$$

(2)

The government determines the demand for public sector employment, specified here as a random walk with a drift (δ) as

$$L_d^{publ} = L_{-1}^{publ} + \delta_{Ld^{publ}} + \varepsilon_{Ld^{publ}}$$

(3)

with subscript-*1* referring to the previous year and $\varepsilon_{Ld^{publ}}$ being a disturbance term that is normally distributed, with zero mean and a constant variance.

Whereas economic developments do not affect public sector employment, they affect private sector employment. An Error-Correction Model (ECM) specifies labour demand in the private sector, dependent upon real gross domestic product (GDP), denoted y, in the long term. Nominal wages in the private sector (W^{priv}) deflated by the general price index (P) affect labour demand in the short term. This reads as

$$\Delta log(L_d^{priv}) = \alpha_{Ld^{priv}}\{log(L_{d,-1}^{priv}) - \beta_{Ld^{priv}} log(y_{-1})\} + \gamma_{Ld^{priv}} \Delta \log\left(\frac{W^{priv}}{P}\right) + \varepsilon_{Ld^{priv}}$$

(4)

The adjustment parameter α and the long- and short-term parameters, that is the β and γ, are calibrated and estimated with actual data for

the situation of Egypt. The so-called "employment elasticity" $\beta_{Ld^{priv}}$, that has received already a lot of attention in previous work (see Wahba in European Commission (2010) and Hassan and Sassenpour (2008)), will also receive much attention in our analyses here. The next section provides more information on this.ε is again a disturbance term with the normality assumptions. Similarly, the subsequent equations here below contain such disturbance terms.

Just like public employment, the setting of public wages is a government decision that is independent of market or business cycle developments. Therefore, it is specified here as a random walk with a drift ($\delta_{W^{publ}}$) as

$$W^{publ} = W_{-1}^{publ} + \delta_{W^{publ}} + \varepsilon_{W^{publ}} \quad (5)$$

The setting of private wages is much more difficult to specify in a simple equation. It depends on many different factors. In market economies, private sector wages generally depend on the consumer price inflation, productivity growth and unemployment. The higher the inflation or the higher the productivity or the lower the unemployment rate, the more power employees have to negotiate a high wage rate. In Egypt, the labour market is not yet functioning according to market principles. Especially the high unemployment rate has kept the private wage level extremely low. I therefore assume wages in our analyses to follow a random walk with a drift as

$$W^{priv} = W_{-1}^{priv} + \delta_{W^{priv}} + \varepsilon_{W^{priv}} \quad (6)$$

Nevertheless, I experiment also with a more elaborate wage equation in our analyses (see the scenarios in section *4.v*).

The model specifies the real side of the economy from a supply side approach. Real GDP in the public sector, that is government services and products, depends on public sector employment:

$$\Delta \log y^{publ} = \rho_{y^{publ}} \Delta \log L_d^{publ} + \varepsilon_{y^{publ}} \quad (7)$$

Private sector employment produces the services and products in the private sector, so it determines real GDP of the private sector. I follow

other macro-econometric model studies (see Barrell *et al.* (2004) or Demertzis *et al.* (2007)) and specify a long run relationship:

$$\Delta \log y^{priv} = \alpha_{y^{priv}} \left\{ \log y_{-1}^{priv} - \beta_{y^{priv}} L_d^{priv} \right\} + \varepsilon_{y^{priv}}$$

(8)

Total nominal GDP equals nominal public sector GDP in addition to nominal private sector GDP. As only one price-level holds this boils down to:

$$y := y^{publ} + y^{priv}$$

(9)

I define the welfare (*WF*) as,

$$WF := \frac{p * y}{POP}$$

(10)

which defines nominal *GDP*, that equals *p*y*, divided by the total population *POP*. This welfare measure is thus the nominal GDP per capita.

Developments at the labour market and real side of the economy feed into the public finances. Government total taxes (T) consist of profit taxes (T^{profit}), income taxes (T^{income}) and other taxes (T^{other}):

$$T := T^{profit} + T^{income} + T^{other}$$

(11)

Profit taxes are earned by taxing the profits of the private sector, that is the revenues ($p * y^{priv}$) after the payment of the employees' salaries ($W^{priv} * L^{priv}$). Denoting the tax rate on income as (τ^{profit}), it follows that

$$T^{profit} := \tau^{profit} (p * Y - W^{priv} * L^{priv})$$

(12)

The taxation of the total incomes of employees in the public and private sector determines the income taxes, specified as

$$T^{income} := \tau^{income} (W^{publ} * L^{publ} + W^{priv} * L^{priv})$$

(13)

where τ^{income} is the average tax rate on wage income.

A main share of the government spending is the spending on government employees, that is the average nominal public sector wage times the number of employees,$W^{publ} * L^{publ}$. The model further incorporates that the government *can* pay a benefit to people that are unemployed. The total government spending on unemployed equals the average benefit denoted as W^{soc} times the number of unemployed persons, which equals $L^s - L^d$. Apart from government wages and unemployment benefits there existother government expenditures (G^{other}).The specification for total government spending (G) is thus

$$G := W^{publ} * L^{publ} + W^{soc} * \left(L^s - L^d\right) + G^{other}$$

(14)

Finally, the government balance as a percentage of nominal *GDP*(GBY) follow as the government expenditures deducted from the total taxes as a share of *GDP*:

$$GBY := 100 * \frac{T - G}{p * y}$$

(15)

In sum, this model has fifteen equations and consequently fifteen endogenous variables. The appendix gives the full list of endogenous as well as exogenous variables.

4.ii Calibrated and estimated elasticities and other parameters

With the labour supply model as specified by the equations (1)-(15),I perform several scenarios that are described in the following subsections. The annual time series used for Egypt cover the period 1982-2010 (see also their illustration in the figures 1-5). The data appendix describes the details.

The parameters in the labour demand (4) and wage equation for the private sector (5), as well as the production equations (7)-(8) are estimated simultaneously by ordinary least squares. Some argue that the employment elasticity$\beta_{Ld^{priv}}$, that defines the change of labour demand in response to a percentage change in private production, should equal the production elasticity of labour that is $\beta_{Ld^{priv}} = 1 - \beta_{y^{priv}}$(see for instance Hassan and Sassenpour (2008)).I test for this

restriction, but it does not hold. Our estimate for the employment elasticity is 0.92 and highly significant (see table 1). This relatively high elasticity indicates that production in the private sector is labour-intensive. The reason may be that I take into account the private sector only, instead of the whole economy used in previous studies, so the results indicate that productivity in the private sector is high.[10] Interestingly, also real wages are significant in the labour demand equation for the private sector. I calibrate the elasticity in the private production function at 1.00, as the estimated parameter exceeds 1.00 and is highly significant. This indicates that a one percent increase in labour leads to a one percent increase in production in the long run in our model. .

Table 1: Estimated and calibrated parameters of the labour supply model

Labour demand private sector (equation 4)	Production private sector (equation 8)	Public finances
$\alpha_{Ld,priv} = -0.5$ (-)	$\alpha_{y,priv} = -0.4$ (-)	$\tau^{income} = 0.1$
$\beta_{Ld^{priv}} = 0.92$ (52.6)	$\beta_{y,priv} = 1$ (-)	$\tau^{profit} = 0.2$
$\gamma_{Ld^{priv}}$ =-0.05 (-3.6)		$W^{soc} = W^{priv}/20$
$R^2 - adj = 0.83$	$R^2 - adj$ =0.30	

Source: Author's estimations and calibrations. Notes: Values in brackets are Student t-values where a bar, -, implies that the parameter is calibrated.

The public production equation (7) does not deliver sensible estimates. The historically large government sector of Egypt produces goods and services, but labour demand in the public sector is unrelated to production growth. For this reason public production follows also a random walk (so $\rho_{y^{publ}} = 0$).This is in line with macro-econometric models for developed economies (see Demertzis *et al.*, 2006).

Table 1 also lists the calibrated values for the tax rates (see last column).Officially, Egypt does not have unemployment benefits but I expect social policy to improve as the country develops further. Here, I assume that there is compensation for unemployed people (see same column) that follows the private sector wages, divided by 20. This boils down to about 100 euro in 2010. Although this is somehow arbitrary, it

10 For earlier samples, the estimate by Hassan and Sassenpour for Egypt was 0.59; while Whaba uses in her analyses 0.68 for Egypt (see European Commission, 2010).

gives us insights, as I should evidently assume that public spending rises in line with unemployment.

Table 2: Simulation effects under varying assumptions and shock sizes in percentage points deviation from the baseline

Shock size or parameter value	Year	Labour supply shock		Demand shock	
		U	GFB	U	GFB
Labour supply shock 0.75%	2020	1.9	-0.1		
Labour supply shock 0.75%	2030	3.9	-0.3		
Labour supply shock 1.75%	2020	4.6	-0.3		
Labour supply shock 1.75%	2030	10.0	-0.7		
Labour supply shock 2.75%	2020	7.5	-0.6		
Labour supply shock 2.75%	2030	17.4	-1.3		
Demand shock 3%	2020			-3.0	3.6
Demand shock 3%	2030			-4.1	4.0
Demand shock 5%	2020			-5.3	5.6
Demand shock 5%	2030			-7.4	6.2
Demand shock 7%	2020			-7.8	7.2
Demand shock 7%	2030			-11.2	7.9
$\beta_{Ld^{priv}}$= 0.92	2020	4.6	-0.3	-5.3	5.6
$\beta_{Ld^{priv}}$= 0.92	2030	10.0	-0.7	-7.4	6.2
$\beta_{Ld^{priv}}$= 0.75	2020	4.6	-0.3	-3.9	5.0
$\beta_{Ld^{priv}}$= 0.75	2030	10.0	-0.7	-4.8	4.8
$\beta_{Ld^{priv}}$= 0.50	2020	4.6	-0.3	-2.3	4.3
$\beta_{Ld^{priv}}$= 0.50	2030	10.0	-0.7	-2.5	3.4
τ^{profit} = 0.2	2020	4.6	-0.3	-5.3	5.6
τ^{profit} = 0.2	2030	10.0	-0.7	-7.4	6.2
τ^{profit}= 0.3	2020	4.6	-0.3	-5.3	9.4
τ^{profit} = 0.3	2030	10.0	-0.7	-7.4	9.9
τ^{income} = 0.1	2020	4.6	-0.3	-5.3	5.6
τ^{income} = 0.1	2030	10.0	-0.7	-7.4	6.2
τ^{income} = 0.2	2020	4.6	-0.3	-5.3	8.6
τ^{income}= 0.2	2030	10.0	-0.7	-7.4	9.3

Source: Author's calculations based on the econometric labour supply model, see subsection 4.i. Notes: The responses of the demand shock and the labour supply shock, simultaneously, follow by adding the effects of both scenarios.

Unemployment benefits should follow market wage developments and for an emerging economy as Egypt, the benefit assumption made seems on the low rather than on the high side. Be it not direct spending on a benefit, than be it spending on unemployment schooling schemes, or support for food. Different calculations, for instance, for a share of this public spending can be derived straightforwardly because the model is linear.

The scenarios described in the following subsections use these parameter values. Moreover, I use also other values in the scenarios of our sensitivity analyses to test the impact of the estimated and calibrated parameters in this article (see table 2).

The baseline for the results covers the years 2011-2030. It contains naïve forecasts for the period 2011-2030, implying that I keep the values of the variables at their levels in 2010. The baseline as such is irrelevant to the outcomes of the analyses as the model is linear and our interest concerns the deviations from the baseline (in percentages or percentage points).The labour supply shock, as described in scenario A is our starting point (see subsection 4.iii). The subsequent scenarios presents the results as deviations from the baseline along with scenario A in order to illustrate to what extent the effects of the labour supply shock can be counteracted.

4.iii Scenario A – The impact of positive labour supply shocks in 2011-2030

For each of the years 2011 until 2030 I simulate a labour supply shock of 1.75%, which means in practice that labour demand grows at 1.75% at an annual rate, corresponding with the expected increases in the working age population as projected by the United Nations for this period (see figure 3)[11,12].

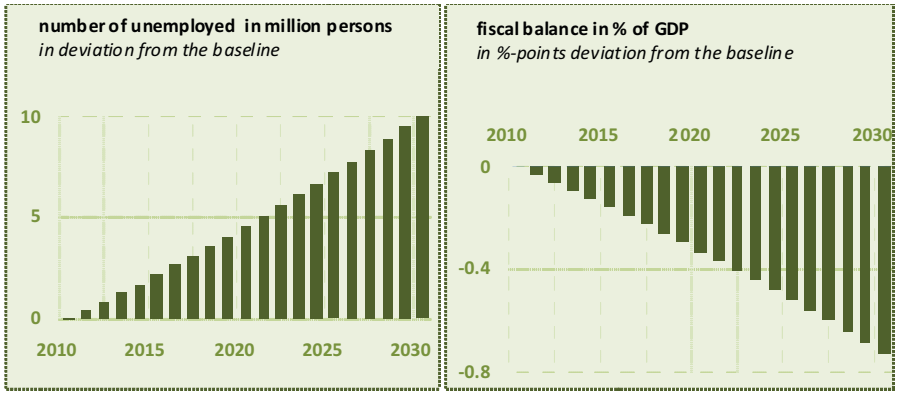
As follows from figure 7, this additional labour supply leads to an increase of almost 5 million unemployed persons in 2020 and 10 million in 2030 in comparison with the baseline, which equals half a million jobs per year. It entails a tripling of the current unemployment rate from 9% in 2010 to 30% in 2030. The real side of the economy does not change, as the additional supply does not create additional demand and neither does it offer a positive impetus for the production process, as the newly entered persons at the labour market do not (yet) participate in the production process. Assuming that each unemployed

11 See the data appendix for more information on the size of the shock.

12 This shock size is lower than used in previous studies (Hassan and Sassenpour (2008) take 2.9%). Wahba (see European Commission, 2010) even assumes that total employment rises by 3.5% annually and that the unemployment rate remains constant, which results in projections of 715.000 jobs to be created annually in 2006-20. In view of Hassan and Sassenpour's and Wahba's analyses, our labour supply shock scenario is thus more prudent.

person receives compensation from the government, the government balance deteriorates in comparison from the baseline, as there are more people unemployed than in the baseline. In this case the fiscal balance as a percentage of GDP is 0.8%-point lower than in the baseline in 2030 (see figure 7).

Figure 7: Simulation effects in response to supply shocks of 1.75% in 2011-2030

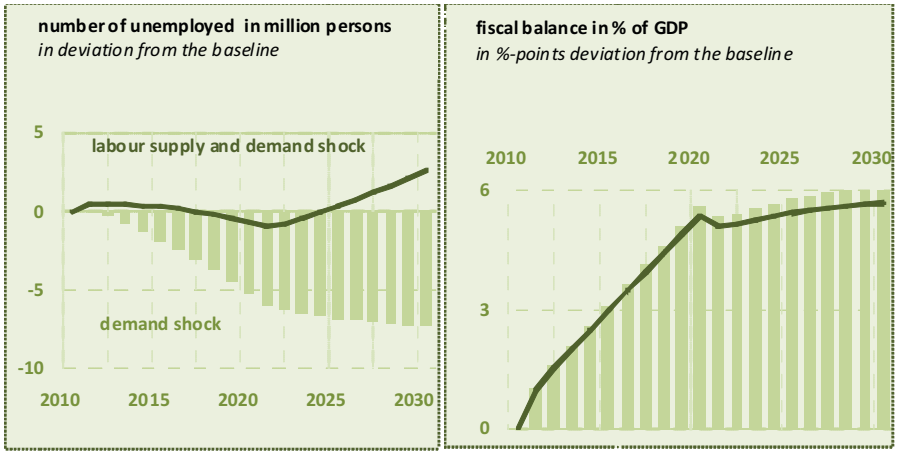


Source : Author's calculations on the basis of the econometric labour supply model as specified in section 4.i.

4.iv Scenario B – The impact of sustained positive demand shocks in 2011-20

For each of the years 2011 until 2030 I simulate that there is a labour supply shock, as illustrated in scenario A, and in addition a positive demand shock of 5% of the GDP growth (year-on-year) in the period 2011-2020. The size of these shocks is lower than the economic growth of around 7% that Egypt recorded in the fiscal years up to the global crisis, namely in 2005-07, but it is higher than Egypt's performance average over the last two decades. Moreover, this shock is representing a demand shock that could originate from for instance high export growth (due to higher foreign demand) or high domestic investment (higher inward foreign direct investment). The demand shock gives rise to more demand for labour in the private sector (equation 3), and this higher employment in return pushes up GDP (see figure 8).

Figure 8: Simulation effects in response to positive demand shocks in 2011-2020



Source : Author's calculations on the basis of the econometric labour supply model as specified in section 4.i.

The demand shock compensates for the labour supply shock in terms of unemployment and the latter falls even slightly below the baseline scenario in 2020. Due to the high demand, the private sector creates more than 5 million jobs. The fiscal balance improves as GDP is higher, being the denominator effect. Moreover, the profit taxes as well as labour income taxes rise. In sum, this scenario therefore gives a much brighter picture of the developments of unemployment, the fiscal balance, and the welfare effect. Figure 11 illustrates the simulated welfare effect for different demand shocks of 3, 5 and 7%.

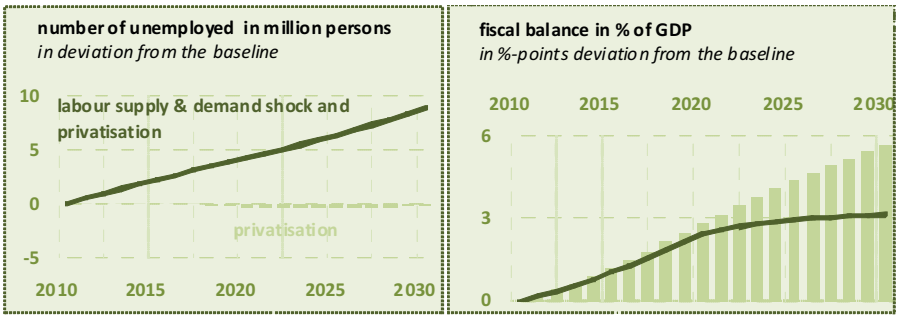
4.v Other scenarios

Many other scenarios could be analysed by using this labour supply model. I here below only sketch two.

In the first scenario, the government reforms the government sector and privatises some public enterprises, under the assumption that the privatisation process does not lead to forced dismissals during the first ten years. For each of the years 2011 until 2020 100,000 public employees become employees in the private sector. From 2021 to 2030, the government continues shedding labour, by 100,000 employees per year. Consequently, the government employs two million people less

after these two decades and the private sector employs one million former public sector employees more after the first decade.

Figure 9: Simulation effects in response to decreases in public employment in 2011-2030



Source : Author's calculations on the basis of the econometric labour supply model as specified in section 4.i.

In this scenario, unemployment hardly changes during 2011-2020, as there is only a shift of employees from the public to the private sector (see figure 9). During 2021-2030, the one million public employees shed by the government can find a job in the private sector thanks to the newly created jobs out of the higher economic activity. Unemployment falls for some years in a row by about 400,000 persons in deviation from the baseline. The fiscal balance as a percentage of GDP improves significantly, as the private sector pays the wage bill of the two million former public sector employees. The increase in the balance goes up to 6%-points in deviation from the baseline in 2030. In the combined scenario of a privatisation and the labour supply shock, the fiscal balance improves less due to the higher number of unemployed persons.

In a second scenario, I assume that private wages are determined in the market sector according to market performance by means of a long-term relationship between the real wage (W^{priv}/P), production per employee in the private sector (y^{priv}/L^{priv})and the unemployment rate.Equation (6) therefore replaces equation (6-alt). Attempts to estimate the wage equation for Egypt for the period 2000-2010 do not deliver economically sensible parameter estimates, which gives us the information that private sector wages did not react to productivity and unemployment during the sample period used for estimation. Instead, I

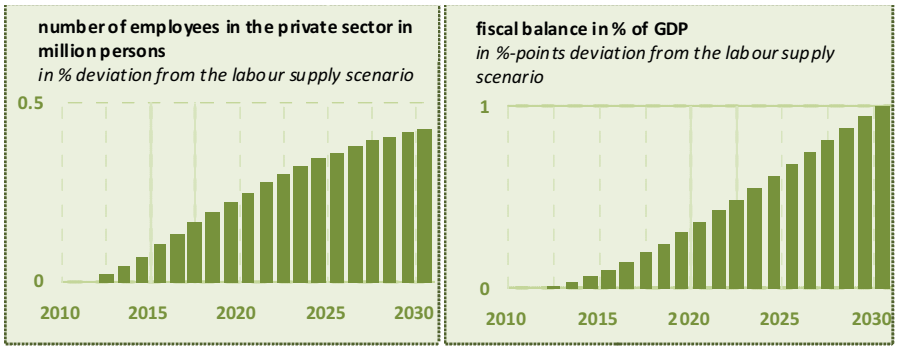
calibrate the parameter at the values for the wage equation of Eastern European countries from Barrell *et al.* (2004) that reads as

$$\Delta \log(\frac{W^{priv}}{P}) = -0.13\left\{\log\left(W_{-1}^{priv}\right) - 0.6\log\left(\frac{y_{-1}^{priv}}{L_{-1}^{priv}}\right) + 0.02\ U\right\}$$

(6-alt)

I consider this hypothetical market rule as a "desired" relationship, in which wages react to changes in productivity and unemployment. Simulating again the 1.75% labour supply shock resulting from demographic developments, wages temporarily decrease in reaction to the higher unemployment. In return, this lower wages trigger a rise in labour demand in the private sector (equation (4)). The wage mechanism is thus at work. Figure 10 illustrates the effects of the number of employees in the private sector in comparison with those of the labour supply shock scenario. It follows that he private sector creates half a percent more jobs and public finances improve by 1% of GDP in case the wage mechanism is at work. Therefore, while wages fall in the short run, the long-run results are more beneficial for the whole economy.

Figure 10: Simulation effects of market wages reacting to unemployment and productivity



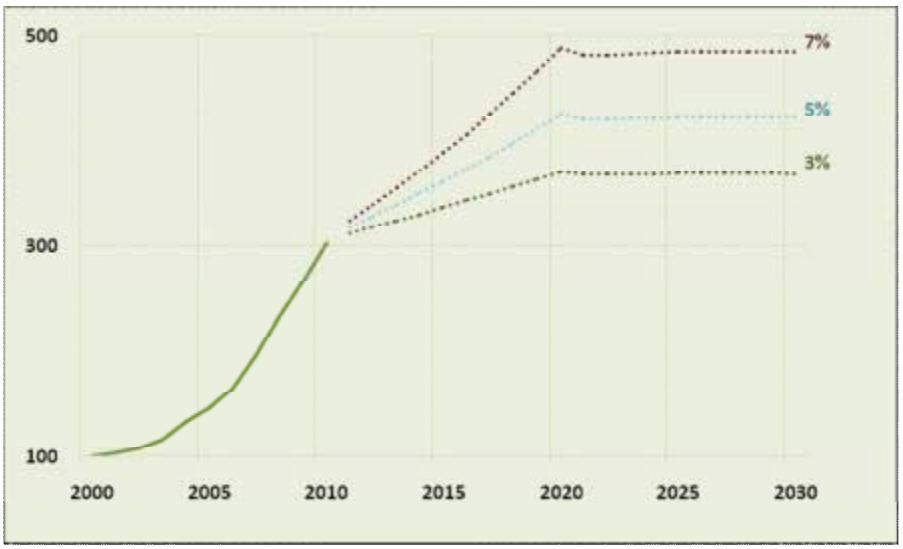
Source: Author's calculations on the basis of the econometric labour supply model as specified in section 4.i.

4.vi Sensitivity analyses with varying assumptions and shock sizes

As the responses to the shocks depend of course to a certain extent on the underlying assumptions and parameter estimates, this subsection presents the results of sensitivity analyses. Table 2 presents the

responses to the labour supply as well as the demand shock scenarios for supply size shocks of 0.75% and 2.75%, labour demand shocks of 3, 5 and 7%, employment elasticities of 0.75 and 0.50, and profit and income tax rates of 10%, 20% and 30%, each for the year 2020 and 2030.

Figure 11: Simulated effects of GDP per capita at different GDP growth rates in domestic currency, indexed at 2000=100



Source: Author's calculations based on the econometric labour supply model. Notes: This contains actual figures until and including 2010 and population growth projections for 2011-2030 according to the UN. See scenario B and Table 2 for the GDP growth assumptions.

The speed of job creation in the private sector is crucial. As private sector productivity is high (see equation (8)), each newly created job translates in additional production that can in return lead to newly created jobs. The employment elasticity $\beta_{Ld^{priv}}$ is most relevant in this context. In our scenarios as presented in the previous sections, this elasticity is high at 0.92, assuming that a 1% rise in GDP increases private sector employment 0.92%. The results in table 2 show that in case of a sustained demand shock of 5% in each year of the period 2011-2020, unemployment decreases 3.9 million people instead of 5.3 million in case the employment elasticity is 0.75 instead of 0.92, *ceteris paribus*. This is thus a difference of 1.4 million people, only due to the difference in employment elasticity. I recall that the employment elasticity was empirically confirmed to have the high size with a high

t-value (see table 1), for which reason the estimate of 0.92 is the most likely outcome. It reflects the rapidly emerging labour market developments in Egypt.

Finally, figure 11 illustrates that the development of welfare levels vary significantly under different assumptions of the economic growth rate.

5 POLICY REFLECTIONS

The simulation results in the previous section show that Egypt faces a tripling of its current unemployment rate over the two decades 2011-2030 in case the economy stopped growing. This is under the assumption that the size of labour supply grows at 1.75% each year, in line with the demographic developments as projected by the United Nations for the working age population of people in Egypt between 15 and 65.In this case, the increase in unemployed people is 500,000 each year, or 10 million over the 20-year time span. In making these calculations, this article remains on the prudent side in comparison with previous studies. Labour supply can increase faster, due to the active participation of groups of people (for instance women and workers in the informal sector). For the sake of quantifying the effects, let us stick to the assumption that labour supply growth is (only) 1.75%.

Then, different policy actions can anticipate these big supply shocks. For instance, a sustained economic growth of 5% would create around 300,000 to 500,000 jobs each year. This would suffice to absorb the new entrants at the labour market. The additional labour supply would not lead to excess unemployment in comparison with the baseline. In view of Egypt's economic performance in historical perspective, an economic growth at 5% does not seem infeasible, although keeping this growth performance for a long period may be difficult. This holds even for an emerging economy as Egypt as no recessionary years should occur. As half a million young people enter the labour market each year during 2011-2030, economic growth has to remain at high positive levels for the decade 2021-2030 even if economic growth remains high at 5% during the first ten years (2011-2020).

There are several ways to stimulate economic growth. For instance, the government can gear its policy and measures towards attracting more foreign direct investment.

Our empirical findings here show that productivity in Egypt's private sector exceeds productivity in the public sector. It is because of this higher productivity that it is better to create new jobs in the private instead of in the public sector. Job creation in the private sector increase production rapidly and this in turn can trigger new job creation. Moreover, private sector developments are far more beneficial in terms of public finances. The public sector receives more taxes in the form of profit and income taxes and the outlays on the compensation of the employees do not impose on the public budget.

A possible venue is also to privatise public enterprises. This would improve directly the public balances and increase efficiency and productivity in case the shed public sector employees find a job in the private sector. Taking policy measures to privatise public enterprises seems therefore, at least to some extent, a viable way to counteract the labour supply shock effects that the Egyptian economy is undergoing. The situation can even improve further in case market mechanisms start to function better. The rises in public wages by 10 to 30% in the years 2007-09 deteriorated the fiscal balance and widened the gap with the market wage developments. A further widening of the gap does not seem justifiable. Incentives are to be placed to make job creation and working in the private sector attractive, as it catalyses economic activity and hence open new jobs that the Egyptian economy needs for absorbing the new entrants at the labour market. Egypt can reap the demographic growth dividend by the boost in production due to the young and numerous labour forces once the private sector starts to function better and price and wage mechanisms are at work. Although wage setting in the private sector is evidently not a task for the government, the latter should support its working according to market principles. [13]

The labour market prospects that Egypt faces are not unique. Other countries, among them many Arab countries, also foresee big increases in labour supply in the short to medium term (see Groot and Peeters (2011)). In combination with the current loose domestic labour markets, and only scarce labour market opportunities in the

13 The 6th give-year plan 2007-2012 (see the website of Egypt's Ministry of Planning) states that employment rises by 3.5% each year and that unemployment decreases to 5.5% in 2012/11 (see chapter 6, page 140 and 144). It does not distinguish between private and public processes. This plan was launched before the revolution that started early 2011.

neighbourhood (such as in the Gulf peninsula), job creation in the *private sector* should be priority number one on their policy agenda. Acknowledging that public sector jobs are highly relevant (teachers, health care), public sector employment, in abroad sense, should become more efficient. In comparison with other countries, a further growth of public sector employment in Egypt should not occur. Otherwise stated, policy should be geared towards private sector development.

6 SUMMARY, CONCLUSIONS AND FUTURE RESEARCH SUGGESTIONS

This study simulates the future development of the labour market supply in Egypt according to long-term population prospects of the United Nations. In addition to other studies in the scientific literature, it specifies and estimates a labour supply model with actual publicly available time series on the Egyptian economy. This model is useful for performing a wide range of scenarios. It not only takes into account unemployment and employment developments, but also specifies wage developments as well as the real and fiscal side of the Egyptian economy.

Moreover, as a special feature, the labour supply model segregates the economy into the *private* and *public* sector. This is especially for Egypt highly relevant. The Egyptian economy still has a large public sector, employing 30-40% of the total employment. The compensation for employees is a big share of the government expenditures, while the public debt and deficit are still persistently high.

Labour demand by the public sector is a policy variable, as the government decides on it. It is therefore exogenous. The same holds for government wages. This implies, for instance, that a reduction in economic activity is not felt in the government sector. Wage setting in the private sector and its impact on the economy can however be simulated, according to market principles. This offers the opportunity to study the effects of recessions or booms on the price mechanism of Egypt's labour market and public finances.

This study shows the benefits of creating jobs in the *private* and not the public sector. Not only public finances are far better off in case this would happen, but also the labour market can start functioning better with lower or non-increasing unemployment in comparison with the

current stance (9% in 2010). Egypt is thus not a Lewis type economy with infinite supply where demographic growth first needs to diminish in order for wages to adjust (see Lewis, 1954).

Other important empirical results follow from the labour demand equation. The employment elasticity, reflecting the change in labour demand in response to a change in real GDP, is estimated and found to be high at 0.92 and significant for the sample 2000-2008. In reaction to a positive shock in production, the demand for labour in the private sector is thus relatively high. As the public sector shows no relation between labour demand and production, and vice versa, the private sector creates additional jobs in response to demand shocks and productivity is relatively high.

According to our findings, a steady economic growth rate of 5% during a decade helps the Egyptian economy in its endeavour to create jobs in the private sector at a pace of 500.000 per year. In this scenario, the numerous new entrants at the domestic labour market are able to find a job in the short-term. In this case, the country reaps the growth dividend from the demographic structural change.

The labour supply model is easy to use. One could use it also to analyse developments in the Egyptian economy in detail. Over time, when longer time series exist, the behavioural equations can be re-estimated. In view of the rapid developments, parameter estimates changes, but tests on structural breaks become feasible and statistically sound in the course of time with larger sample sizes. The fact that Egypt is an emerging economy, with still relatively short data series at this stage, is not hampering our analyses. This labour supply model is an analytical tool for Egypt, as so many tools are around for economies at similar development degrees as Egypt across the globe. Its usefulness in fact also lies in the construction of its database. Consistency in statistics, in time and among the different delivering public institutions is of utmost importance to reach reliable estimates for the behavioural equations. In the current situation, there is already ample information, but there is much room for improving the consistency and transparency concerning the construction of the statistical information. This is indispensable for analysing recent and on-going development and for preparing the inputs for policy recommendations.

The emerging state of the Egyptian economy, exceeding potentially the growth of many countries across the globe, justifies further in-depth

future research based on more facts and thorough analyses. We should welcome studies on productivity measures at the macro and micro level, along with labour market information on employment and wages on a disaggregate level, for shedding more light on the actual functioning of Egypt's labour market and other sectors of the economy.

REFERENCES

Aiyar, S. and A. Mody. 2011. "The Demographic Dividend: Evidence from the Indian States." International Monetary Fund Working Paper No. 11/38.

Assaad, R. 1997. "The Effect of Public Sector Hiring and Compensation Policies on the Egyptian Labour Market." World Bank Economic Review 11(1): 85-118.

Assaad, R. 2007. "Labor Supply, Employment and Unemployment in the Egyptian Economy 1988-2006." Economic Research Forum Working Paper No. 0701.

Assaad, R., F. El-Hamidi and A.U. Ahmed. 2000. "The Determinants of Employment Status in Egypt." International Food Policy Research Institute FCND Discussion Paper No. 88, Washington.

Barrell, R., D. Holland, N. Pain, M.A. Kovacs, Z. Jakab, K. Smidkova, U. Sepp and U. Cufer. 2004. "An Econometric Macro-Model of Transition: Policy Choices in the Pre-Accession Period." Macroeconomics No. 0403004 EconWPA.

Binzel, C. and R. Assaad. 2011. "Egyptian Men Working Abroad: Labor Supply Responses by the Women Left Behind." IZA Discussion Paper No. 5589.

Bloom, D. E., D. Canning and J. Sevilla. 2001. "Economic Growth and the Demographic Transition, Massachusetts Avenue, Cambridge." NBER working paper No. 8685.

Christofides, L.N. and P. Pashardes. 2002. "Self-Paid-Employment, Public/Private Sector Selection and Wage Differentials." Labor Economics 9(6): 737-762.

Coale, A.J. and E.M. Hoover. 1958. Population Growth and Economic Development in Low Income Countries. Princeton: Princeton University Press.

De Haan, L., A. Naumovska and H.M.M. Peeters. 2001. "MAKMODEL: A Macroeconometric Model for the Republic of Macedonia." Dutch Central Bank Research Memorandum WO&E No. 665.

Demertzis, M., P. van Els, S. Grob and H.M.M. Peeters. 2006. "EUROMON: The Multi-Country Model of De Nederlandsche Bank." Dutch Central Bank Occasional Studies 4(1).

Don, H.J.H. 2004. "How Econometric Models Help Policy Makers – Theory and Practice."De Economist 152(2):177-195.

European Commission. 2010. "Labour Market Performance and Migration Flows in Arab Mediterranean Countries: Determinants and Effects." European Economy Occasional Papers No. 60, in particular volume 3 titled "National background papers Mashreq (Egypt, Palestine, Jordan, Lebanon, Syria)".

Fase, M.M.G. and C.C.W. Winder. 1999. "Baumol's Law and Verdoorn's Regularity.", De Economist 147(3):277-291.

Freeman, R.B. 1987. "How do Public Sector Wages and Employment Respond to Economic Conditions?", Chapter 9 in Public Sector Payrolls, D.A. Wise eds., pp. 183-216.

Golley, J. and R. Tyers. 2011. "Contrasting Giants: Demographic Change and Economic Performance in China and India", CAMA Working Paper 10.

Gregory, R.G. and J. Borland. 2005. "Recent Developments in Public Sector Labor Markets." Handbook of Labour Economics, Chapter 53.

Hall, S. and G.E. Mizon and A. Welfe. 2000. "Modelling Economies in Transition: An Introduction." Economic Modelling 17(3):339-357.

Hassan, M. and C. Sassanpour. 2008. "Labor Market Pressures in Egypt: Why is the Unemployment Rate Stubbornly High?" Journal of Development and Economic Policies 10(2).

Herrera, S., H. Selim, H. Youssef and C. Zaki. 2010. "Egypt Beyond the Crisis: Medium-Term Challenges for Sustained Growth." World Bank Policy Research Working Paper No. 5451.

Keynes, J.M. 1936.The General Theory of Employment, Interest and Money, Macmillan Cambridge University Press.

Klein, L.R. 1969. "Estimation of Interdependent Systems in Macroeconometrics."Econometrica 37(2) 171-92.

Lassibille, G. 1998. "Wage Gaps Between the Public and Private Sectors in Spain." Economics of Education Review 17(1): 83-92.

Lewis, W.A. 1954. "Economic Development with Unlimited Supplies of Labour." Manchester School of Economic and Social Studies 22:139-91.

Malthus, T.R. 1798. "An Essay on the Principle of Population, as it Affects the Future Improvements of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet and other writers." Summary view in Penguin Classics.

Nayab, D. 2007. "Demographic Dividend or Demographic Threat in Pakistan." Pakistan Institute of Development Economics Working Paper No. 2006:10.

Pestieau, P. 2007. "Assessing the Performance of the Public Sector." CREPP Working Papers No. 03.

Peeters H.M.M. and L.F.M. Groot 2011. "A Global View on Demographic Pressure and Labour Market Participation." EERI Research Paper Series No 2011/18, Economics and Econometrics Research Institute, Brussels.

Radwan, S. 2009. "Economic and Social Impact of the Financial and Economic Crisis on Egypt." Study prepared for the International Labour Organisation.

Said, M.A.S. 1996. "Public Sector Employment and Labor Markets in Arab Countries: Recent Developments and Policy Issues." Cambridge University Working paper No. 9630.

Sims, C.A. 1982. "Policy Analysis with Econometric Models." Brookings Papers on Economic Activity 13(1):107–64

Sims, C.A. 1989. "Models and Their Uses." Institute for Empirical Macroeconomics and University of Minnesota, Discussion Paper No. 11.

Tansel, A. 2005. "Public-Private Employment Choice, Wage Differentials, and Gender in Turkey." Economic Development and Cultural Change 53(2) 453-77.

Tinbergen, J. 1938. "On the Theory of Business-Cycle Control." Econometrica 6(1) 22-39.

Youssef, H.A. 2007. "Towards Inflation Targeting in Egypt – Fiscal and Institutional Reforms to Support Disinflation Efforts." European Economy Economic Papers No. 288, European Commission Brussels.

APPENDIX ON DATA SOURCES AND VARIABLES USED IN THE ANALYSES

The time series used in the labour supply model all originate from public Egyptian sources. The figures presented in section 3 on public and private sector employment and nominal GDP for the public and private sector come from the Egypt's *Ministry of Economic Development*. The public and private wages, the unemployment rate and real GDP come from the official office of statistics *Central Agency for Public Mobilisation and Statistics (*CAPMAS) and the fiscal variables originate from the Egyptian *Ministry of Finance*.

In order to keep consistency within the framework of the model, I derived some variables from others. For instance, I derived labour supply via the unemployment identity (see equation 1) from the unemployment rate and the total employment, which equals the employment in the public and private sector (equation 2). However, some inconsistencies among data sources remain. An example is the government expenditures on the compensation of employees. According to my calculations based on data on the average weekly public wage times series (from CAPMAS) and the government employees (from the Ministry of Economic Development), the compensation of employees accounts for roughly 45% of the total government expenditures (that come from the Ministry of Finance) in the years 2000-2008. This does not correspond with the compensation of employees of 25% that the Ministry of Finance provides. In these analyses, I stick to the former, as it is consistent with the other data I use here.

For the years, 2000-2010 full time series are available, apart from public and private employment in 2009 and 2010 and public and private wages in 2010. I forecast these data points using univariate autoregressive regressions estimated by means of Ordinary Least Squares. In this way, the database for the period 2000-2010 was completed.

Thereafter, I constructed a baseline by naive forecasting. That is, I extrapolated all level variables by keeping them constant at the values of 2010 for the whole projection period 2011-2030 with keeping the drifts at zero (see equations (3),(5)-(6)). Please notice that the baseline as such is not relevant to the results presented, as the model is linear and I concentrate on deviations from the basis throughout the analyses.

I determined the size of the labour supply shocks by interpolating linearly the working-age-population (people between 15 and 65) projections for Egypt of the five-year cohorts for 2010 until 2030 and calculated the annual growth rates. The average annual rate of the working age population is precisely 1.75%. I used this rate throughout the scenario analyses for projecting labour supply growth, as it seems the most likely outcome. By using the projection of the working age population growth for projecting the labour supply growth, I maintain the assumption that there are over time no proportional changes in the number of students, chronically ill people, migrants, or others between the age of 15 and 65.

All statistical information and programmes used in this article are available upon request.

The full list of *endogenous* variables in this article reads in alphabetical order along with their name and unity of measurement as follows:

G= government spending, in million Egyptian pounds

GBY=fiscal balance, as a percentage of nominal GDP

L_d= total employment, in million persons

L_d^{priv}= employment in the government sector, in million persons

L_d^{publ}= employment in the public sector, in million persons

T=total taxes, in million Egyptian pounds

T^{income}=taxes on income, in million Egyptian pounds

T^{profit}= taxes on profits, in million Egyptian pounds

U=unemployment, as a percentage

W^{priv}= average wage per public sector employee, in Egyptian pounds

W^{publ}= average wage per public sector employee, in Egyptian pounds

WF=welfare, measured as GDP per capita in Egyptian pounds

y= GDP in values, in million Egyptian pounds

y^{priv}= $GDP$of the private sector in volumes, in million Egyptian pounds

y^{publ}= GDP of the public sector in volumes, in million Egyptian pounds

In addition, there are the following *exogenous* variables:

G^{other}= government spending, in million Egyptian pounds

L_s= labour supply, in million persons

P=price index - representing producer as well as consumer prices

POP=total population, in million persons

τ^{income}=income tax rate

τ^{profit}=profit tax rate

T^{other}=other taxes than profit and income taxes, in million Egyptian pounds

W^{soc}=average unemployment benefit per unemployed person, in Egyptian pounds