Demographic pressure, excess labour supply and public-private sector employment in Egypt - Modelling labour supply to analyse the response of unemployment, public finances and welfare

Peeters, Marga

25. May 2011

Demographic pressure, excess labour supply and public-private sector employment in Egypt

Modelling labour supply to analyse the response of unemployment, public finances and welfare

Marga Peeters[1]

May 2011

Abstract

The demographic structure of Egypt has the form of a pyramid, indicating that labour supply will grow at a relatively high rate for many years to come. Unless emigration flows will rise, Egypt needs to create jobs at a much higher pace than most other countries around the globe to absorb the new entrants at the domestic labour market. Adding to this is the currently high share of 30-40% of the Egyptian employees working in the rather inefficient public sector. In order to quantify future developments at the labour market, this paper presents a labour supply model to analyze the impact of the ongoing demographic supply shocks and the shedding of public sector jobs on unemployment in Egypt. The findings indicate that the demographic labour supply will increase unemployment in the short term as the Egyptian labour market will not be able to absorb the demographic labour supply, unless the Egyptian economy grows steadily at least at 5% for many years in a row. In the long term, the employment dividend can be reaped by productivity growth increases if the labour market starts functioning. The findings also point out that, for growth to accelerate rapidly, job creation should occur in the private and not in the public sector. The large public sector has been driving up government expenditures disproportionably, not only because of the existence of the high number of people employed in the public sector but also because of excessive public wage increases.

Keywords: Demographics, labour supply, employment, greening, public sector employment, public finance.

JEL-codes: C32, J11, J21, J22, J23.

[1] Presently, having a research sabbatical. Questions and comments are welcome at marga.peeters@gmail.com. I wish to thank Martin Fase, Iván Martín and Hoda Youssef for useful comments on a preliminary version of this paper, without implicating them.

CONTENTS

FIGURES

TABLES

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. It has a diversified economic activity, 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 due to an aging population, and a shrinking and aging labour force, 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 at the labour market of these entrants is one of the main challenges for the Egyptian authorities. Therefore, sufficient job creation is crucial in the short and 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. Public sector labour markets are often more inefficient and dominant. Its dominance can influence the wage setting and other employment practices in the rest of the labour market. Moreover, its dominance can also hamper developments in the private sector, where job creation will primarily have to take place. In this light, the developments of the fiscal costs of the employment in the government sectors across countries are an interesting angle to study public sector employment (see also Tansel on the case of Turkey, 2005, or Christofides and Pashardes, 2002, on Cyprus).

This paper contributes to the existing studies that analyse the labour market prospects of Egypt in view of its demographic changes (see the paper of Jackline Whaba in European Commission (2010), Hassan and Sassenpour (2008) and Assaad (2007)). Its novelty is that it introduces 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 complete economic framework that takes account of the dynamics of the labour market, distinguishes between the public and private sector and incorporates the 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 2011-2030.

The outline of this paper is as follows. Section 2 provides background information on related studies and presents the main hypotheses that are analysed. Section 3 describes the labour market developments in Egypt and compares them with the 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 summarizes 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 in relation to the potential labour force in the age category 15 to 65 years, Egypt ranks highest. Other countries ranking high are South Africa, but also India (see for instance Aiyar and Mody on the Indian situation, 2011)[2].

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

[2] 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.

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 countries 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 thus different from the functioning of the private sector 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 countries (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 on the US case, 1987).

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 is high at around 70 percent of GDP, 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).

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 of Egypt plays a role. Egypt is an Arab country, in which the role of the public sector has been big. 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 respect that one should understand the still quite dominant role of the public sector in Egypt. We can keep this in mind, but focus on the future and mainly the near past in our following sections.

This paper 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 also the fiscal balances that are highly relevant for Egypt in view of its high public debt stance. The model is composed of behavioural equations and tautological equations where the first are calibrated or econometrically estimated, using past statistical information and econometric techniques. This framework offers a useful tool to analyse the effects of the additional labour supply on the Egyptian labour market due to demographic developments coherently and consistently.

Time series for the Egyptian economy, needed for the construction of our databases, are meanwhile by and large available for the full decade 2000 to 2010 and on some times series even from 1982 onwards and thus sufficiently long. 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 careful other statistical models generally is more conducive in obtaining adequate policy outcomes than policy making without using statistical facts and frameworks. [3] This holds in the more so for emerging economies, as Egypt, with its multiple policy challenges and endeavour for more transparency at the current juncture.

As econometric modelling is restricted, we 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, 2000). Neither do we 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 we 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). The large share of the Egyptian population is young. Far more than half of the population (61%) was younger than 30 years. The expectation is that the pyramid structure will remain at least for the next two decades but, as shown, it will get slimmer at the bottom and taller. In 2030, the population below the age of thirty is expected to be 11 percentage points lower than in 2010 at 50%. Due to longer

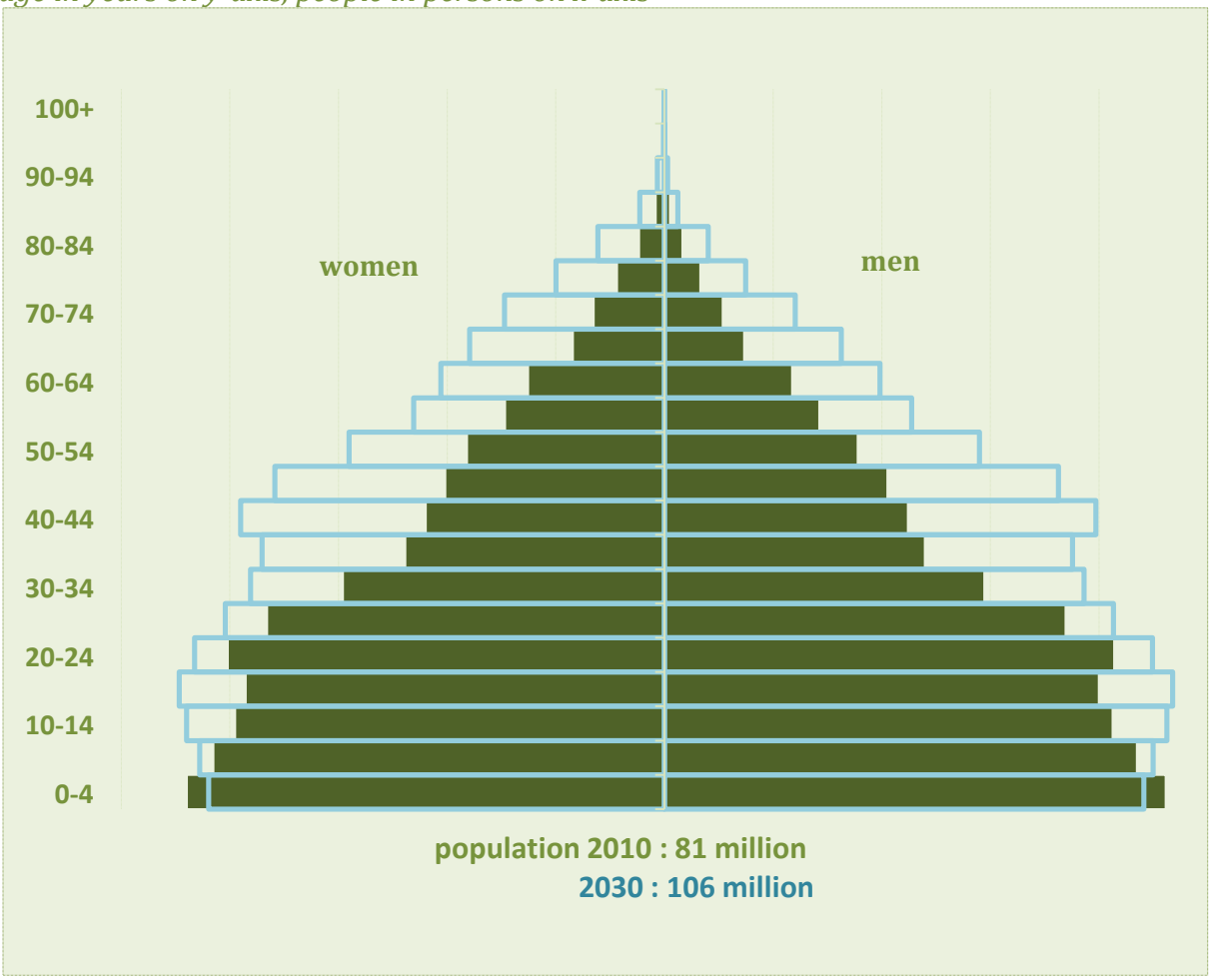
[3] For a philosophical discussion about the use of models in economic science and decision-making, see the introduction of Sims (1989) or Don (2000). For the building and use of macro-econometric model for transitioning economies, see for instance Barrell *et al.* (2004) or De Haan *et al.* (2001).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

longevity, the expectations are that 2% of the population will reach the age of 75 or more, while this was not even 1% in 2010.[4]

Although Egypt will have more elderly people in the near future, old age dependency rates will not go up much due to 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 developing economies such as India, Indonesia and China and its neighbouring economies.[5]

Figure 1 Age structure of the population of Egypt

age in years on y-axis, people in persons on x-axis



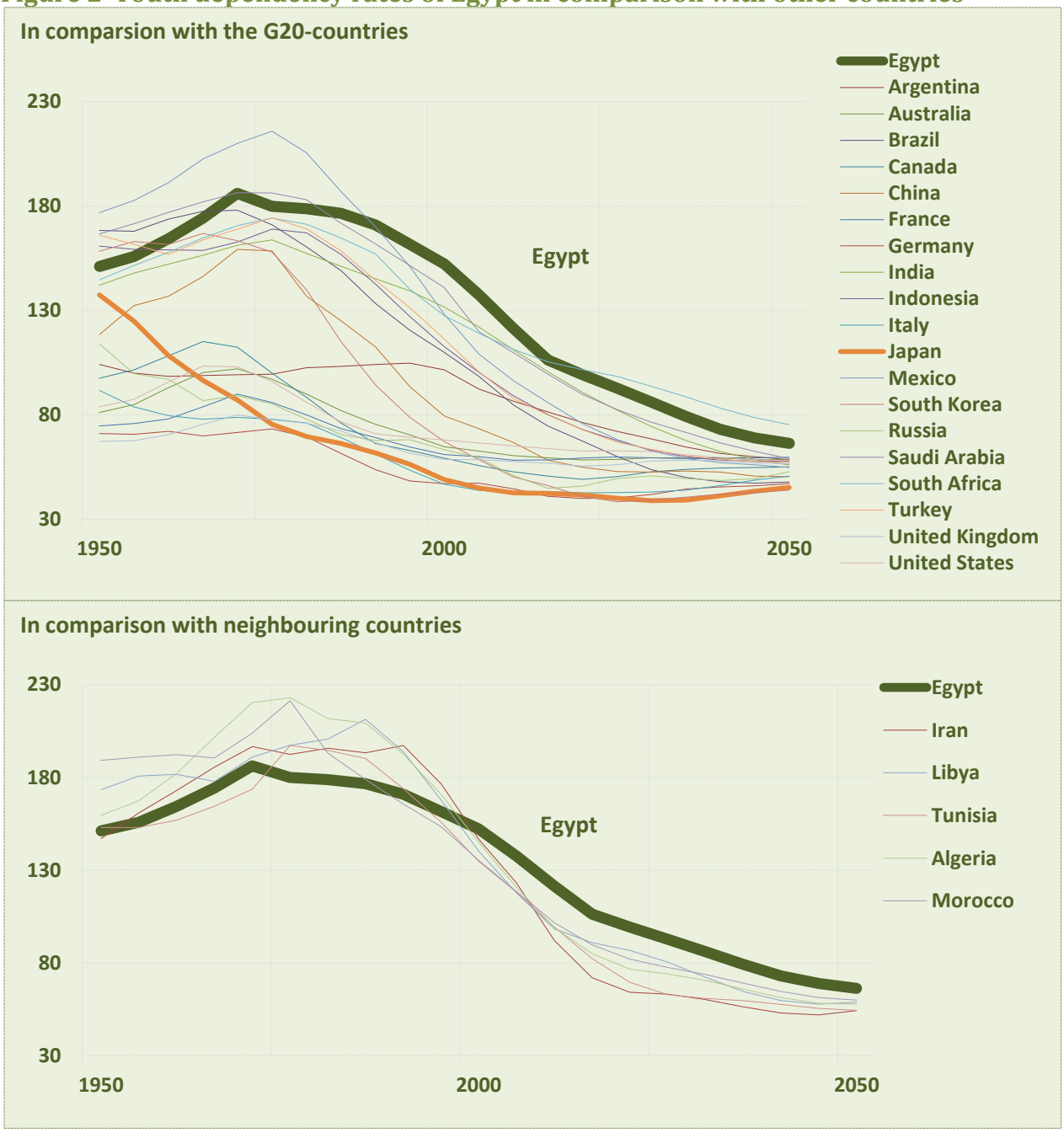
Source: Own calculations based on the United Nations Population Information Network (POPIN), 2011, median variant.

[4] The assumption on migration is that it will remain the same. This holds for all variants of the UN POPIN.

[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 GDP per capita in purchasing power parity than India and Indonesia, but just lower than China.

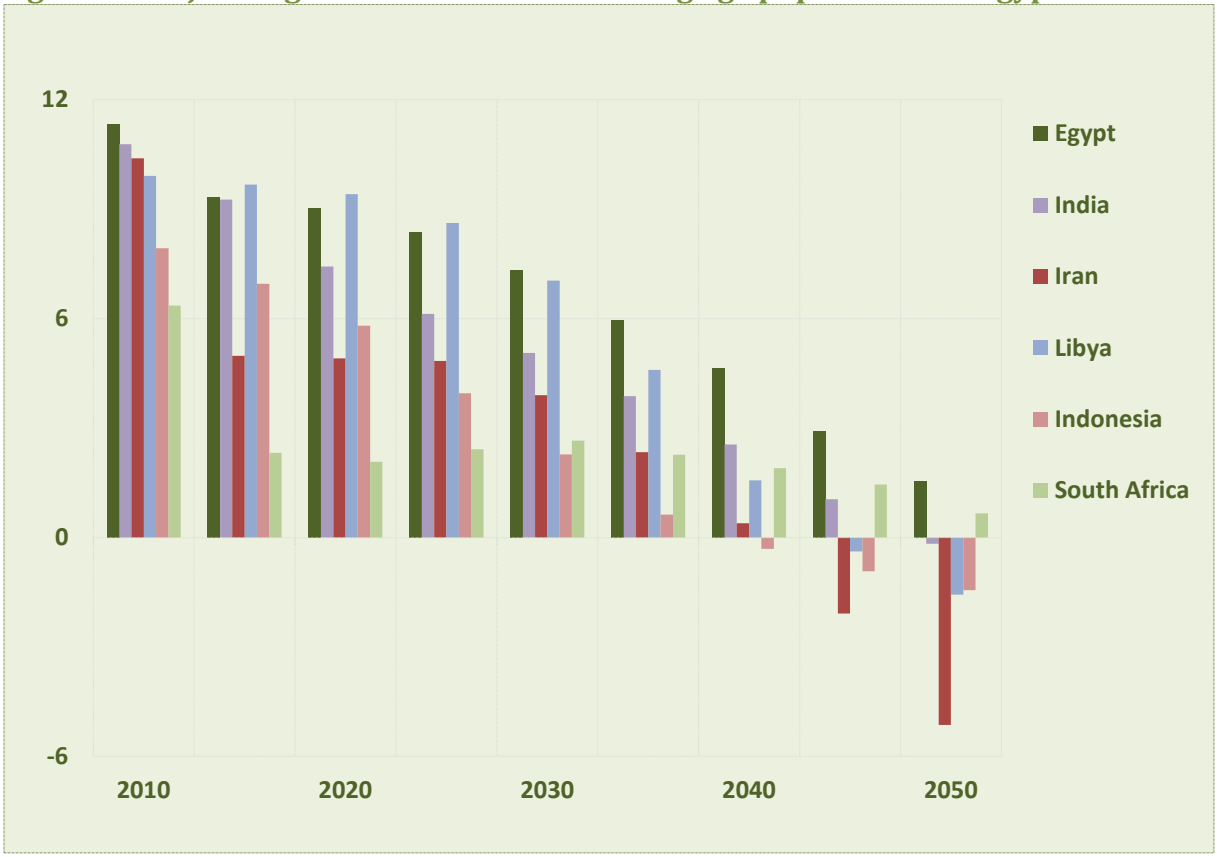
This follows from figure 2. In comparison with all G20-countries - herewith including India, Indonesia and China – Egypt's youth, dependency rates are highest in the years to come (see the upper graph). The expectation is that only South Africa will overtake the position of Egypt from 2020 onwards. Compared 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



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

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

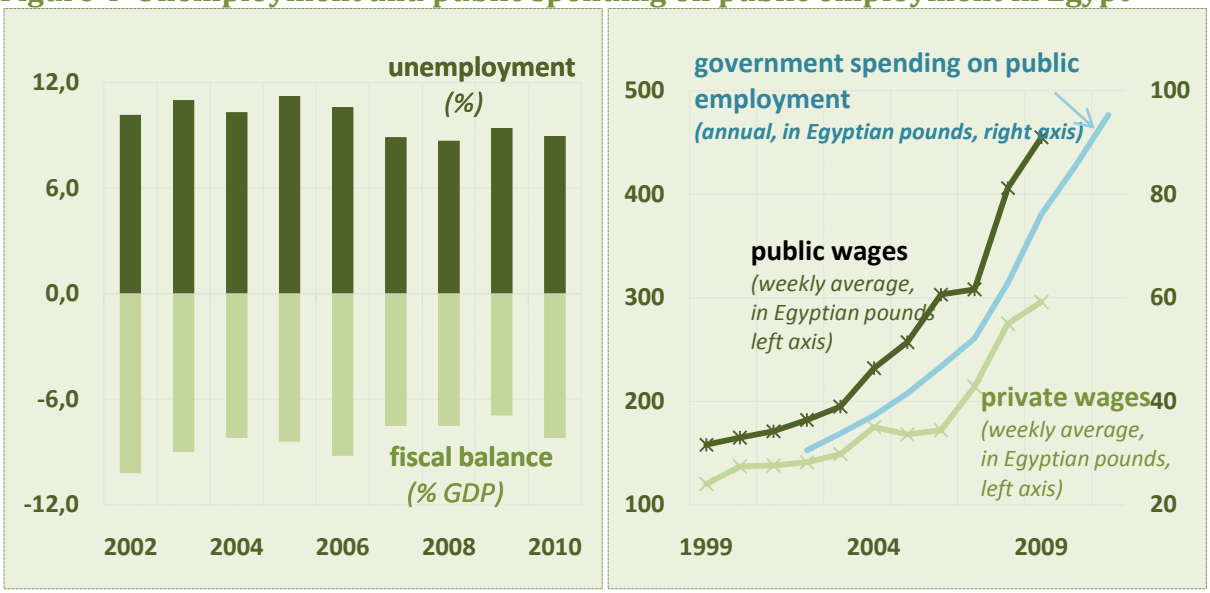


Note: These rates are calculated as the growth rate of the projected number of people between 15 and 64 in year *t* in comparison with year *t-5*.
Source: Own calculations on the basis of the United Nations Population Information Network (POPIN), 2011.

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 due to the remaining pyramid age structure. 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 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. Although this demographic pressure on the labour market is diminishing over time, 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.

[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.

Figure 4 Unemployment and public spending on public employment in Egypt



Sources: Made based on information from the Central Agency for Public Mobilization 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.

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 at 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 this hardly affected the unemployment rates.

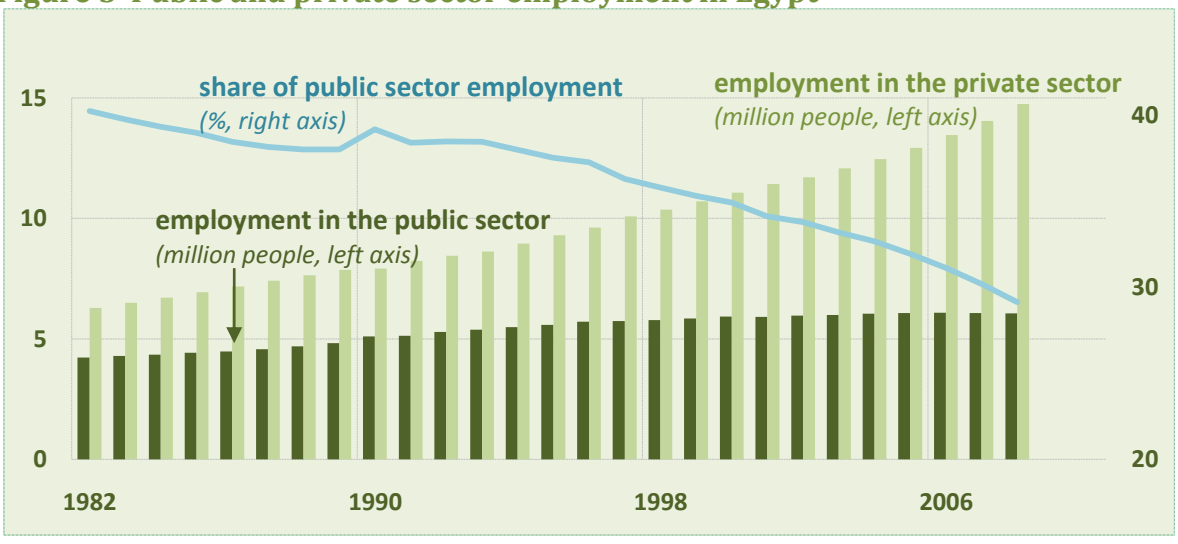
In addition to the to-be-absorbed large inflows at the labour market and the persistently high unemployment rates, there is the dire state of the public finances. The government could help financing more projects in order to foster jobs. However, the high fiscal deficits (see the left graph in Figure 4) leave not much room to manoeuvre. The fiscal debt is high at more than 70% of GDP, consequently interest payments are a main share of the government spending. Another substantial share of public spending is the compensation of public employment (see Youssef, 2007).

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

The trend in compensation on public employment is steep upwardly sloping (see right graph in Figure 4). Even in those years with depressed GDP-growth, 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 both sectors differ a lot (Figure 4). Not only the average level of wages has been far lower than in the public sector, so were wage increases 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 has 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 public to private sector employment has been falling to around 30% in 2008 (see right axis). This is a good development in itself. It improves public finances, as the government spends less money from the public budget on public sector employees. We investigate in the next section the extent to which there are differences in productivity between the public and the private sector.[9]

Figure 5 Public and private sector employment in Egypt



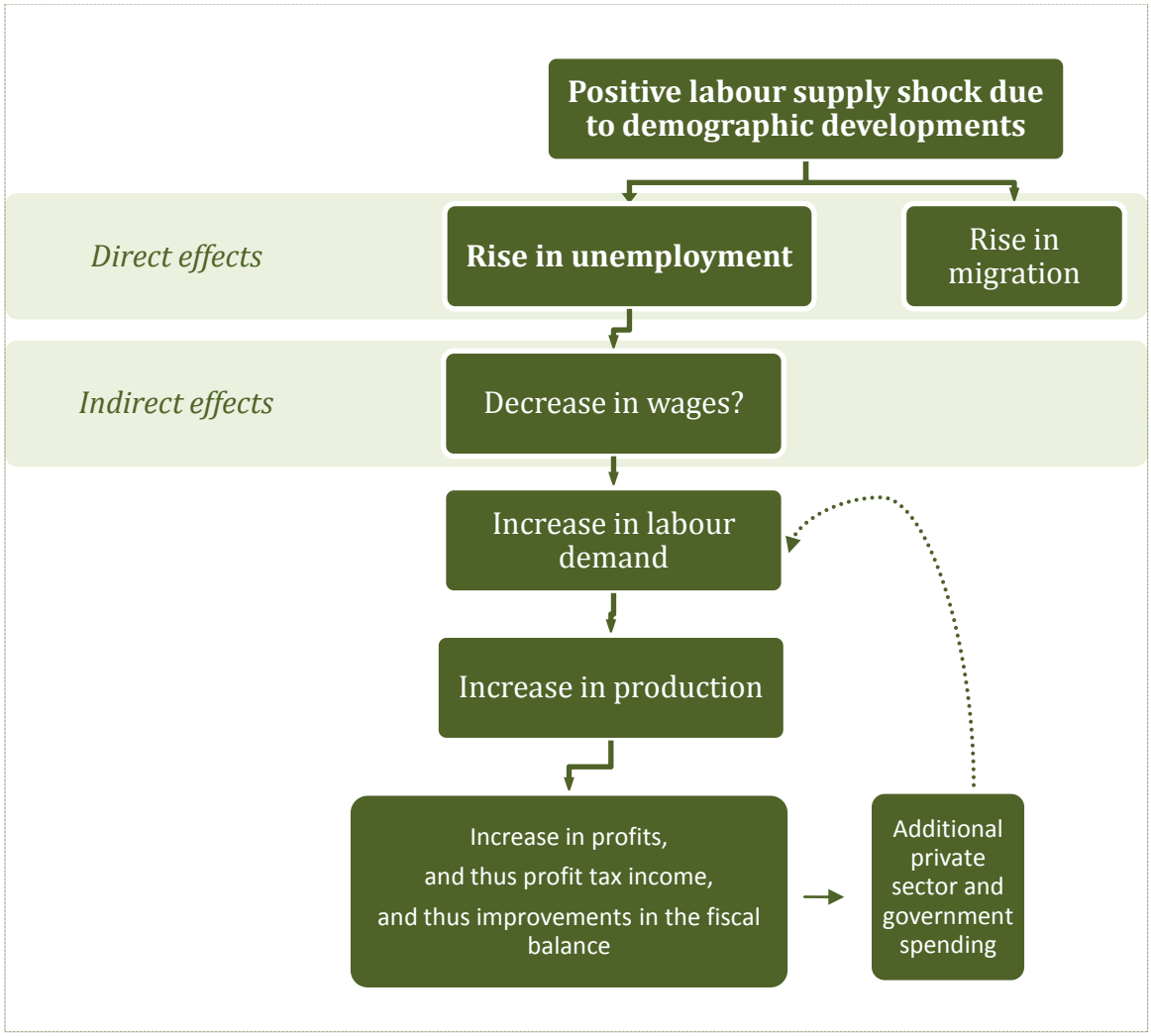
Sources: Made based on information from the Ministry of Economic Development in Egypt.

[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.
9 There is a broad literature in the field of productivity in government services, mainly for developed economies. See for instance Fase and Winder (1999).

4. A 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 we mainly analyse the impact of the changes in demographic structure, that is primarily affecting labour supply in Egypt, we baptize it the *labour supply* model. Figure 6 illustrates the main flows in the model in a flow chart. In the next sections, we discuss the direct effects on unemployment and the indirect effects on wages. We first present the model specification, followed by a presentation of the results in four main scenarios. The data appendix of this paper describes the database and the technicalities for constructing the baseline for the model.

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

$$U := 100 * \frac{L_s - L_d}{L_s} \tag{1}$$

Labour supply is an exogenous variable in our model. Demographic factors mainly determine its size but also behavioural characteristics will in practice matter, such as whether or not people of the working age population enter the labour market and supply labour. We will 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 private sector employment (L_d^{priv}), as follows

$$L_d := L_d^{publ} + L_d^{priv} \tag{2}$$

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

$$L_d^{publ} = L_{-1}^{publ} + \delta_{Ld^{publ}} + \varepsilon_{Ld^{publ}} \tag{3}$$

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 by 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

$$\Delta log(L_d^{priv}) = \alpha_{Ld^{priv}}\{log(L_{d,-1}^{priv}) - \beta_{Ld^{priv}}\, log(y_{-1})\} + \gamma_{Ld^{priv}}\Delta\log\left(\frac{W^{priv}}{P}\right) + \varepsilon_{Ld^{priv}} \quad (4)$$

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. See the next section. ε is again a disturbance term with the normality assumptions. Similarly, the subsequent equations here below contain such disturbance terms.

As 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, the higher the productivity or the lower the unemployment rate, the more power employees have to negotiate a high wage rate. The labour market in the Egyptian economy is however not yet functioning according to market principles. Especially the high unemployment rate has kept the private wage level extremely low. We 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, we experiment also with a more elaborate wage equation in our analyses (see the other 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:

$$\Delta \log y^{publ} = \rho_{y^{publ}} \Delta \log L_d^{publ} + \varepsilon_{y^{publ}} \tag{7}$$

Private sector employment produces the services and products in the private sector, so it determines real GDP of the private sector. We follow other macro-econometric model studies (see Barrell *et al.* (2004) or Demertzis *et al*. (2007)) and specify a long run relationship:

$$\Delta \log y^{priv} = \alpha_{y^{priv}} \{\log y_{-1}^{priv} - \beta_{y^{priv}} L_d^{priv}\} + \varepsilon_{y^{priv}} \tag{8}$$

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:

$$y := y^{publ} + y^{priv} \tag{9}$$

We define the welfare (*WF*) as,

$$WF := \frac{p * y}{POP} \tag{10}$$

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

$$T := T^{profit} + T^{income} + T^{other} \tag{11}$$

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

$$T^{profit} := \tau^{profit} \, (p * Y - W^{priv} * L^{priv}) \tag{12}$$

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

$$T^{income} := \tau^{income} (W^{publ} * L^{publ} + W^{priv} * L^{priv}) \tag{13}$$

where τ^{income} is the 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 also 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 exist other government expenditures (G^{other}). The specification for total government spending (G) is thus

$$G := W^{publ} * L^{publ} + W^{soc} * (L^s - L^d) + G^{other} \tag{14}$$

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:

$$GBY := 100 * \frac{T - G}{p * y} \tag{15}$$

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), we 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). We 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. As we take into account the private sector only, instead of the whole economy used in previous studies, 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. We 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*
$\alpha_{Ld,priv} = -0.5$	$\alpha_{y,priv} = -0.4$	$\tau^{income} = 0.1$
(-)	(-)	
$\beta_{Ld^{priv}} = 0.92$	$\beta_{y,priv} = 1$	$\tau^{profit} = 0.2$
(52.6)	(-)	
$\gamma_{Ld^{priv}}$ =-0.05		$W^{soc} = W^{priv}/20$
(-3.6)		
$R^2 - adj = 0.83$	$R^2 - adj$ =0.30	

Source: Own estimations and calibrations.
Note: Values in brackets are Student *t*-values where a bar, -, implies that the parameter is calibrated.

[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).

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 we expect social policy to improve as the country develops further. Here, we assume that there is compensation for unemployed people (see same column) that follows the developments in the private sector wages, divided by 20. This boils down to about 100 euro in 2010. Although this is somehow arbitrary, it is indicative, as we should evidently assume that public spending rises in line with unemployment. 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. Calculations for a share of this public spending, for instance, can be carried out straightforwardly as the model is linear.

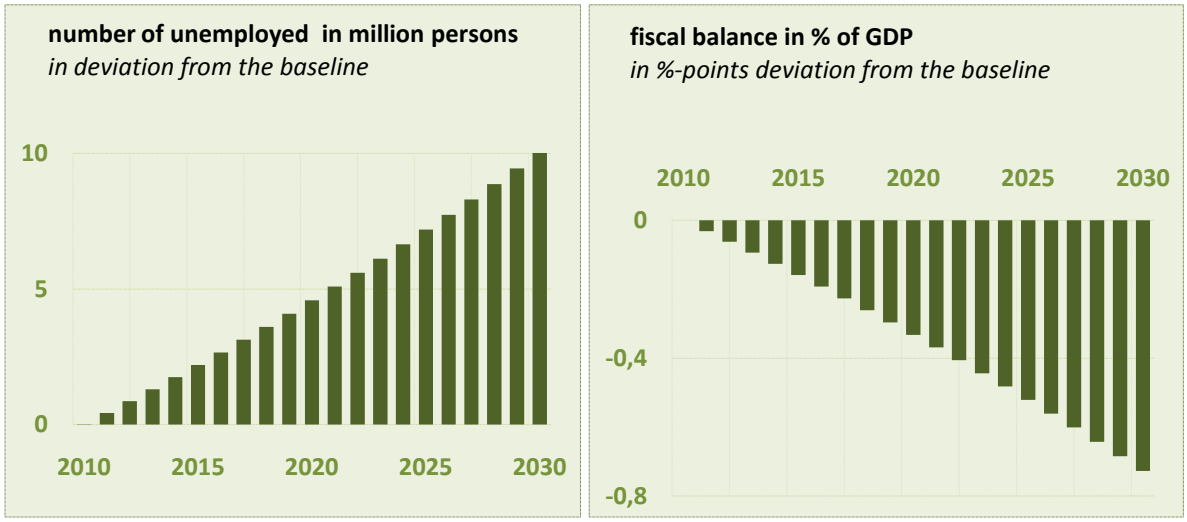
The scenarios described in the following subsections use these values. However, we use also other values in the scenarios of our sensitivity analyses to test the impact of the estimated and calibrated parameters in this paper (see Table 2)

The constructed baseline covers the years 2011-2030. It contains naïve forecasts for the period 2011-2030, implying that we 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 under the assumptions that have been made.

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

For each of the years 2011 until 2020 we 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 10 million unemployed persons in 2020 and 20 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 person receives compensation from the government, the government balance will deteriorate 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 will be 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 2011-30



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

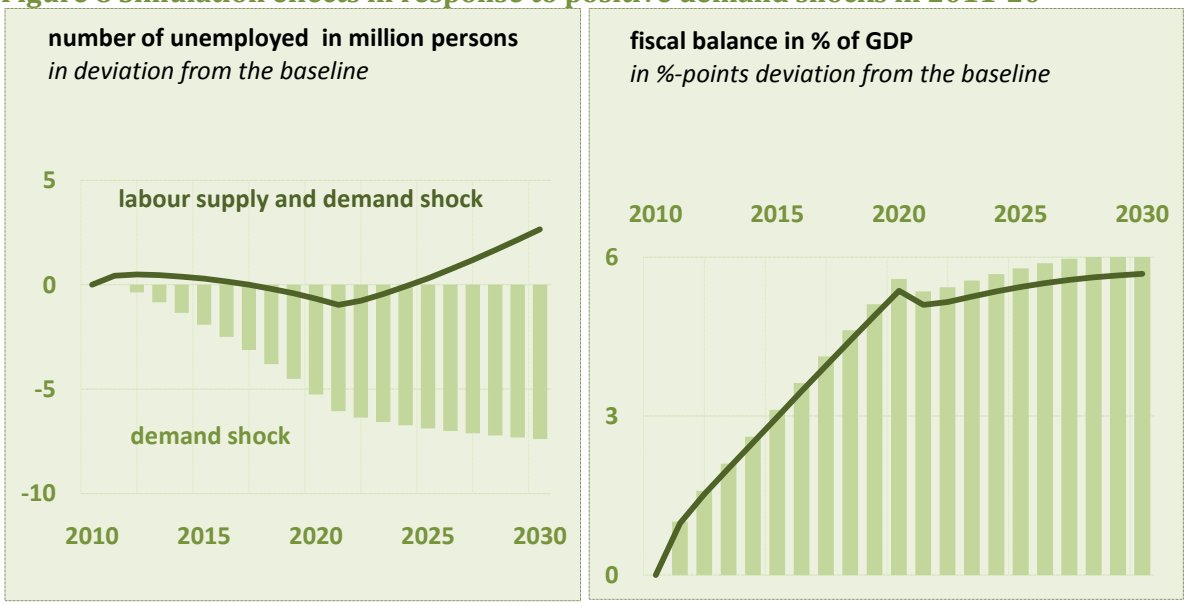
[11] See the data appendix for more information on the size of the shock.

[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 will rise by 3.5% annually and that the unemployment rate will remain 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.

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

For each of the years 2011 until 2020 we 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 slightly 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. 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%.

Figure 8 Simulation effects in response to positive demand shocks in 2011-20



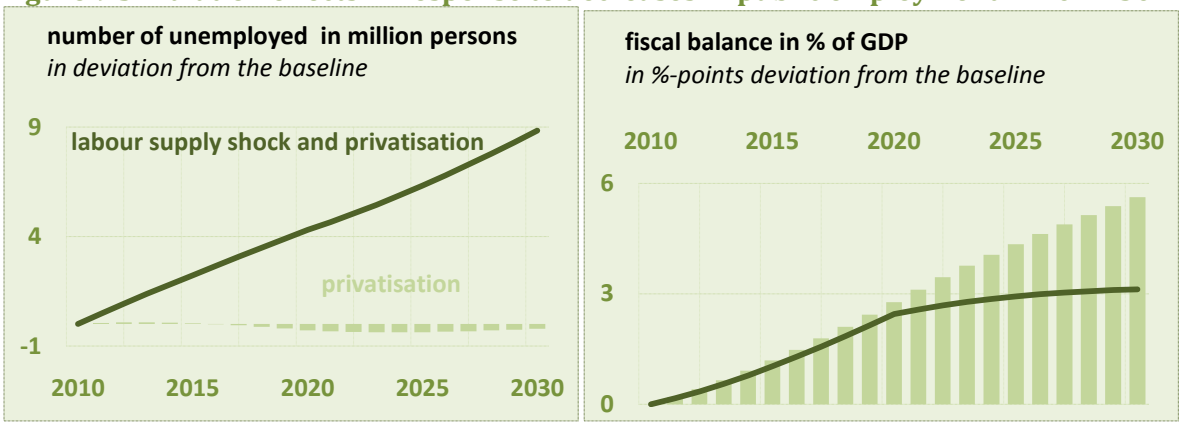
Source : Own calculations on the basis of the econometric labour supply model as specified in section 4.i.

4.v.Other scenarios

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

In the first scenario, the government will reform the government sector and privatise some public enterprises. We assume 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 will employ two million people less after these two decades and the private sector will employ one million former public sector employees after the first decade.

Figure 9 Simulation effects in response to decreases in public employment in 2011-30



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

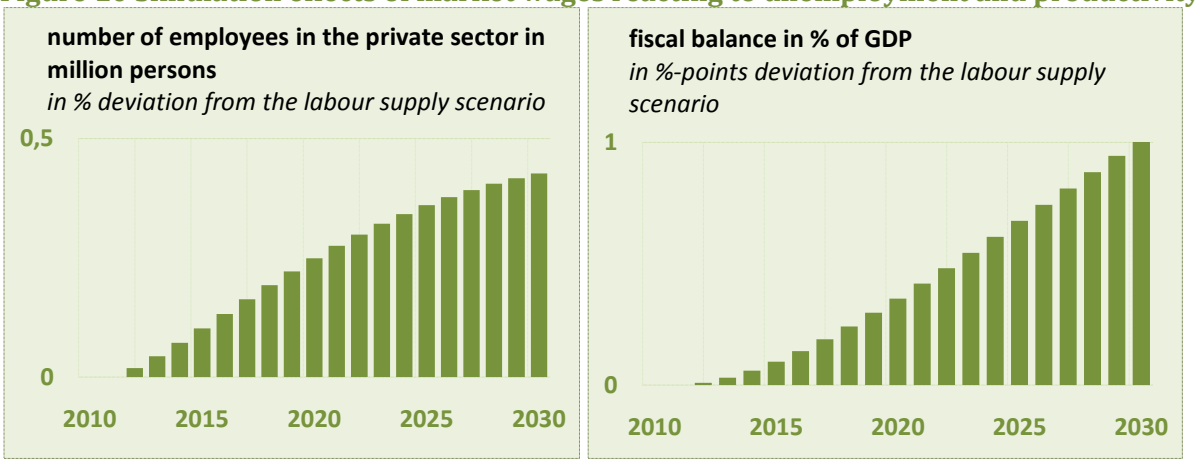
In this scenario, unemployment hardly changes between 2011-2020 as there is only a shift of employees from the public to the private sector. Also, the one million public employees shed by the government during 2021-2030 can find a job in the private sector thanks to the newly created jobs out of the 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, we 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. We therefore replace equation (6) by equation (6-alt) that you find here. Attempts to estimate the wage equation for Egypt for the period 2000-2010 does 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, we calibrate the parameter at the values for the wage equation of Eastern European countries from Barrell *et al.* (2004) and reads as

$$\Delta \log\left(\frac{W^{priv}}{P}\right) = -0.13\left\{\log\left(W_{-1}^{priv}\right) - 0.6\log\left(\frac{y_{-1}^{priv}}{L_{-1}^{priv}}\right) + 0.02\,U\right\} \qquad \textit{(6-alt)}$$

We 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 and unemployment rises, wages temporarily decrease in reaction to the higher unemployment. In return, this triggers a rise in labour demand in the private sector (equation (4)). 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, although wages fall, the long-run results are more beneficial for the whole economy.

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



Source : Own 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.

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

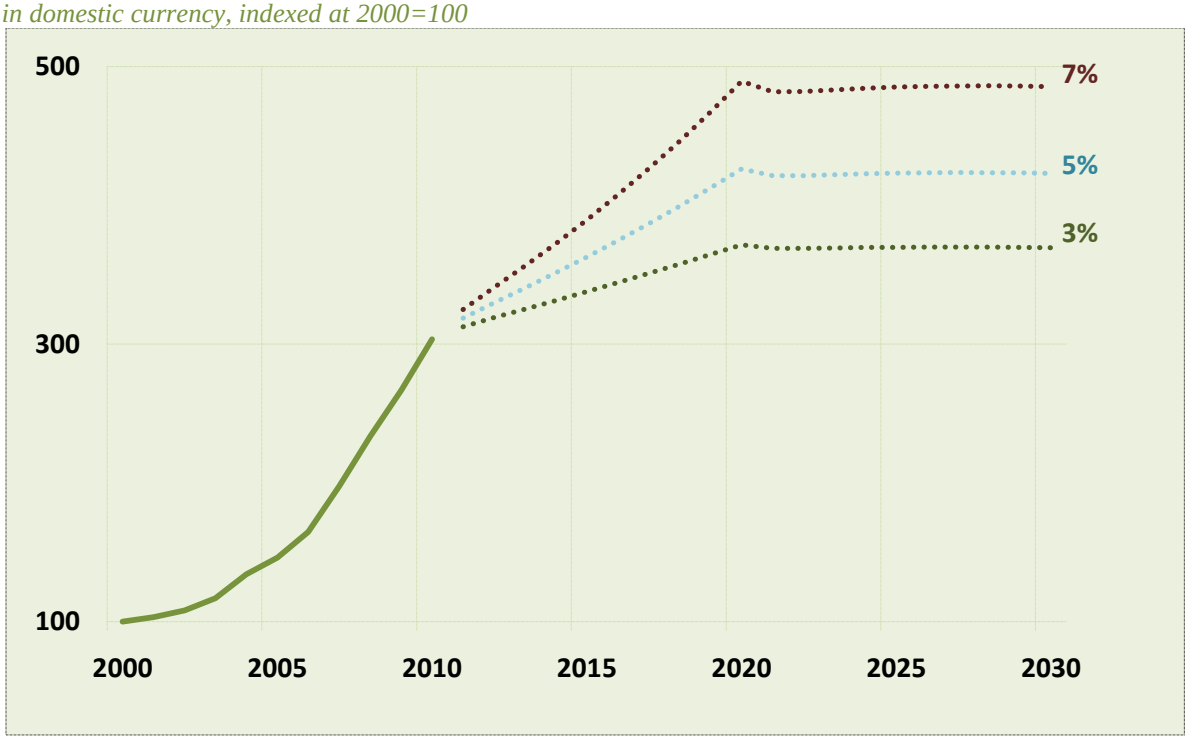
Shock size or parameter value	*Year*	*Labour supply shock*		*Demand shock*	
		U	*GFB*	*U*	*GFB*
Labour supply shock 0.75%	2020	1.9	-0.1		
Labour supply shock 0.75%	2030	3.9	-0.3		
Labour supply shock 1.75%	2020	4.6	-0.3		
Labour supply shock 1.75%	2030	10.0	-0.7		
Labour supply shock 2.75%	2020	7.5	-0.6		
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
$\tau^{profit} = 0.2$	2020	4.6	-0.3	-5.3	5.6
$\tau^{profit} = 0.2$	2030	10.0	-0.7	-7.4	6.2
$\tau^{profit} = 0.3$	2020	4.6	-0.3	-5.3	9.4
$\tau^{profit} = 0.3$	2030	10.0	-0.7	-7.4	9.9
$\tau^{income} = 0.1$	2020	4.6	-0.3	-5.3	5.6
$\tau^{income} = 0.1$	2030	10.0	-0.7	-7.4	6.2
$\tau^{income} = 0.2$	2020	4.6	-0.3	-5.3	8.6
$\tau^{income} = 0.2$	2030	10.0	-0.7	-7.4	9.3

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

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 need to new job creation. This follows from Table 2, where 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 will decrease 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. We 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.

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



Source: Own calculations based on the econometric labour supply model.
Note: 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.

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 would stop 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 between 15 and 65. The increase in unemployed people will be 500,000 each year, or 10 million during the 20-year time span. In making these calculations, we remain on the prudent side. 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 will (only) be 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 in this case 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 will enter the labour market each year during 2011-2030, as follows from the analyses, economic growth will have to remain at high positive levels for the decade 2021-2030 even if economic growth is 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 findings further show that productivity in Egypt's private sector if higher than productivity in the public sector. It is because of this higher productivity that new jobs better be created 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 jobs creation. Moreover, private sector developments are far more beneficial for public finances. The

public sector receives more taxes in the form of profit and income taxes and the outlays on the compensation of the new employees do not impose on the public budget.

A possible venue is also to privatising public enterprises. This would improve directly the public balances and increase efficiency and productivity in case the shed public 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 functioning 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 will catalyze economic activity and therewith 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. In combination with the current loose domestic labour markets, and only scarce labour market opportunities in the neighbourhood (such as in the Gulf peninsula), job creation in the *private sector* should be priority number one on their policy agenda. Although 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 in comparison with the private sector employment should not occur. Anyhow, developments in the public sector ought not to hamper private sector job creation.

[13] The revolution early 2011 changed the situation in Egypt, but the 6th Five-year plan 2007-2012 (see Ministry of Planning, website) stated that employment rises by 3.5% each year and that unemployment will decrease to 5.5% in 2012/11 (see chapter 6, page 140 and 144). It does not distinguish between private and public processes.

6. Summary, conclusions and future research suggestions

This study simulates the future development of the labour market supply in Egypt according to long-term prospects for Egypt of the United Nations. In addition to other studies, it specifies and estimates a labour supply model with actual publicly available time series on the Egyptian economy that is useful for performing a wide range of scenarios. It not only takes into account unemployment and employment developments, but it also models wages 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 that employs 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 can be simulated, according to market principles. This offers the opportunity to study the impact of recessions or booms on the price mechanism of the labour market and the fiscal position.

This study shows the benefits of creating jobs in the *private* and not the public sector. Not only public finance will be 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 wages will only start rising after the demographic growth starts diminishing (see Lewis, 1954).

Other important empirical results follow from the labour demand equation. The employment elasticity, that reflects 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, it is the private sector where jobs are created and where productivity is high.

According to our findings, a steady economic growth rate of 5% during the next decade will help 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 new entrants at its domestic labour market, originating from the demographic pyramid structure, at these high growth rates are helped in that they will even be able to find a job in the short-term. The growth dividend from the demographic structural change will is this case be fully reaped.

The labour supply model is easy to use and could be used for analysing more detailed developments of the Egyptian economy. Over time, when longer time series exist, the behavioural equations can be re-estimated. In view of the rapid developments, parameter estimates will change, but tests on structural breaks will become feasible and statistically founded due to the 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 consistency and transparency about the construction of the statistical information can be improved. This is indispensable for analysing recent and ongoing 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. Studies on productivity measures at the macro and micro level, along with labour market information on employment and wages on a disaggregate level, would be very welcome to shed more light on the actual functioning of the labour market.

References

Aiyar, Shekhar and Ashoka Mody, 2011, The demographic dividend: Evidence from the Indian states, International Monetary Fund Working paper no 11/38.

Assaad, Ragui, 1997, The effect of public sector hiring and compensation policies on the Egyptian labor market, *World Bank Economic Review* 11(1): 85-118.

_____, 2007, Labor supply, employment and unemployment in the Egyptian economy 1988-2006, Economic Research Forum Working paper 0701.

_____, Fatma El-Hamidi and Akther U. Ahmed, 2000, The determinants of employment status in Egypt, International Food Policy Research Institute FCND Discussion Paper Paper 88, Washington.

Barrell, Ray, Dawn Holland, Nigel Pain, Mihaly Andras Kovacs, Zoltan Jakab, Katerina Smidkova, Urmas Sepp and Uros Cufer, 2004, An econometric macro-model of transition: Policy choices in the pre-accession period, Macroeconomics 0403004 EconWPA.

Binzel, Christine and Ragui Assaad, 2011, Egyptian men working abroad: Labor supply responses by the women left behind, IZA Discussion Paper 5589.

Bloom, David E. and David Canning, 1999, From demographic lift to economic liftoff: The case of Egypt. Conference paper from growth beyond stabilisation: Prospects for Egypt, Egypt Centre fro Economic Studies, Cairo.

_____, David Canning and Jaypee Sevilla, 2001, Economic growth and the demographic transition, Massachusetts Avenue, Cambridge, NBER working paper 8685.

Christofides, Louis N. and Panos. Pashardes, 2002, Self-paid-employment, public/private sector selection and wage differentials, *Labor Economics* 9(6): 737-762.

Coale, Ansley J. and Edgar M. Hoover, 1958, Population growth and economic development in low income countries. Princeton: Princeton University Press.

De Haan, Aneta Naumovska and Marga Peeters, 2001, MAKMODEL: A macroeconometric model for the Republic of Macedonia, Dutch Central Bank Research Memorandum WO&E 665.

Demertzis, Maria, Peter van Els, Sybille Grob and Marga Peeters, 2006, EUROMON: The multi-country model of De Nederlandsche Bank, Occasional Studies 4(1).

Don, Henk 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 60, see in particular volume 3 titled "National background papers Mashreq (Egypt, Palestine, Jordan, Lebanon, Syria)".

Fase, Martin M. G. and Carlo C. W. Winder, 1999, Baumol's law and Verdoorn's regularity, *De Economist* 147(3):277-291.

Freeman, Richard B., 1987, How do public sector wages and employment respond to economic conditions?, Chapter 9 in Public sector payrolls, ed. David A. Wise, 183-216.

Golley, Jane and Rod Tyers, 2011, Contrasting giants: Demographic change and economic performance in China and India, CAMA Working Paper 10.

Gregory, Robert G. and Jeff Borland, 2005, Recent developments in public sector labor markets, Handbook of labour economics, chapter 53.

Hall, Stephen and Grayham E. Mizon and Aleksander Welfe, 2000, Modelling economies in transition: An introduction, *Economic Modelling* 17(3):339-357.

Hassan, Mohamed and Cyrus Sassanpour, 2008, Labor market pressures in Egypt: Why is the unemployment rate stubbornly high?, Journal of Development and Economic Policies, 10(2).

Herrera, Santiago, Hoda Selim, Hoda Youssef and Chahir Zaki, 2010, Egypt beyond the crisis: Medium-term challenges for sustained growth, World Bank Policy Research Working Paper 5451.

Keynes, John Maynard, 1936, The general theory of employment, interest and money, Macmillan Cambridge University Press.

Klein, Lawrence R., 1969, Estimation of interdependent systems in macroeconometrics, Econometrica 37(2) 171-92.

Lassibille, Gerard, 1998, Wage gaps between the public and private sectors in Spain, *Economics of Education Review* 17(1): 83-92.

Lewis, W. Arthur, 1954, Economic development with unlimited supplies of labour, Manchester School of Economic and Social Studies 22:139-91.

Malthus, Thomas Robert, 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, Durre, 2007, Demographic dividend or demographic threat in Pakistan, Pakistan Institute of Development Economics working paper 2006:10.

Pestieau, Pierre, 2007, Assessing the performance of the public sector, CREPP Working Papers 03.

Radwan, Samir, 2009, Economic and social impact of the financial and economic crisis on Egypt, Study prepared for the International Labour Organisation.

Said, Mona Abdel Salam, 1996, Public sector employment and labor markets in Arab countries: Recent developments and policy issues, Cambridge University Working paper 9630.

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

_____, 1989, Models and their uses, Institute for Empirical Macroeconomics and University of Minnesota, Discussion Paper 11.

Tansel, Aysit, 2005, Public-private employment choice, wage differentials, and gender in Turkey, Economic Development and Cultural Change, 53(2) 453-77.

Tinbergen, Jan, 1938, On the theory of business-cycle control, Econometrica 6(1) 22-39.

Youssef, Hoda A., 2007, Towards inflation targeting in Egypt – Fiscal and institutional reforms to support disinflation efforts, European Commission Brussels, European Economy Economic Papers 288.

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 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 Mobilization 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 on the basis of 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.

For the years 2000-2010 all 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 we 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 paper are available upon request.

The full list of *endogenous* variables in this paper 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