Assessing Interactions among Education, Social Insurance, and Labor Market Policies in Morocco

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Abstract

This paper develops a general equilibrium model to assess the impact that integrated reforms of macroeconomic, education and social protection policies can have on employment. The model presents three innovations. First, it formalizes the production of skills in the economy by following sex-age cohorts through the various levels of the education and training systems, given dropout and repetition rates. Second, it incorporates a module that projects social insurance expenditures as a function of the demographic structure of the country and the rules of the pension system. Finally, it develops a very detailed description of the labour market, where informality reflects strategic decisions by workers and not necessarily exclusion. The model is applied to Morocco. The results of various simulations illustrate the importance of coordinating macro, education, and social protection policies in order to achieve meaningful effects on employment levels. In particular, we show that isolated interventions to improve the internal efficiency of the education system can aggravate the unemployment problem; that subsidies to investments are more efficient in sectors intensive in skilled labour; and that not controlling the growth of pension expenditures and the tax-wedge can depress employment in the formal sector.

Keywords: Unemployment, Education, Social Security, general equilibrium models, Morocco.

JEL classification: C68, H55, J24, J68

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Introduction

One of the main preoccupations of governments around the world is how to improve labor market outcomes: both generating sufficient jobs for all members of the labor force and increasing productivity, and therefore the earnings, associated with these jobs. The challenge is that there are multiple policies operating at various levels of the economy that affect labour market outcomes. These include macroeconomic and institutional policies that influence investments decisions, economic growth, and labor demand; education and training policies that affect the distribution of skills in the labor force; and, social protection policies that affect the bargaining power of workers, their mobility, as well as labor costs and the tax-wedge.[2] Designing a robust strategy to promote more and better jobs then requires been able to assess the *joint* effects of these policies.

Two general approaches can be considered. One is to conduct ex-post evaluations of a given policy intervention. These are powerful tools for guiding policymaking and are becoming more and more popular. They usually refer, however, to specific, narrow, and well targeted interventions. Their use is more limited when a comprehensive policy strategy – such as one to promote employment creation – is required. In this case, general equilibrium and macroeconomic effects are important and there is less room for "piloting" before implementation. The other approach thus is to use ex-ante simulations, which involve the design of an economic model linking policy levers to outcomes of interest. Current General Equilibrium models, however, are ill suited to analyze the interactions between macroeconomic, education, and social protection policies. The description of the labor market is also usually quite aggregated for a meaningful analysis of labor market outcomes (see Fields, 2007).

This paper presents three innovations in general equilibrium modeling for the evaluation of integrated policy reforms to promote employment creation.[3] First, it formalizes the production of skills in the economy by following sex-age cohorts through the various levels of the education and training systems, given dropout and repetition rates. Second, it incorporates a module that projects

[2] See for instance World Bank (2007) for a discussion on framework that integrates these policies.
[3] The model has been named SELMA which stands for Social security, Education, Labor, and Macroeconomic policies. Selma means secure in Arabic and is also the name of the Queen of Morocco but this is only a coincidence.

social insurance expenditures as a function of the demographic structure of the country and the rules of the pension system. Finally, it develops a very detailed description of the labour market, including an informal sub-sector in every sector of the economy. The model is applied to the Moroccan case to address two questions. First, how alternative education, SP, and macroeconomic policies affect key labor market outcomes including unemployment rates for workers with different levels of education. Second, how the effects of integrated policy packages compare to the effects of partial policy interventions. In terms of education policies the focus is on changes in internal efficiency: repetitions and dropout rates at various level of the education system. Regarding social protection policies we look at various reforms of the pension system that affect the evolution of the tax wedge. Finally, regarding macroeconomic policies we simulate the effects of incentives to promote investment in high value added sectors.

To motivate the type of modeling that we develop, the paper starts by discussing the problem of unemployment and employment creation in Morocco, which is common to other middle income countries[4]. It then introduces the main features of the model and describes, in general terms, the methodology used for calibration purposes. The last two sections present the results of policy simulations and offer general conclusions regarding the main results of the analysis.

I. Unemployment in Morocco and the Need for an Integrated Policy Framework

As several other middle income countries Morocco faces the dual problem of high unemployment rates particularly among youth, and low productivity of the jobs created. After a decade of per capita GDP growth close to zero, between 2001 and 2006 GDP per capita grew at an average of 2.5 percent per year. Faster growth allowed the national unemployment rate to decline from 13 percent in 2000 to 9.7 percent in 2006. In urban areas the unemployment rate was reduced from 21.2 percent to 15.5 percent. However the unemployment rate remained high among young educated individuals. This phenomenon co-exists with low levels of education in the labor force and skills shortages in strategic sectors. In 2005, 59.8 percent and 39.8 percent of those with post secondary education diplomas in the 15-24 and the 25-34 age categories were unemployed. This group will constitute more than one

[4] See the analysis of Marouani (2009) on Tunisia.

third of the new entrants to the labor market over the coming years. The problem is likely to be aggravated by demographic pressures on the labor market. Indeed, although the country is ending the second phase of its demographic transition, the labor force is expected to grow at an annual 1.8 percent over the next 10 years. This implies that there will be around 260,000 net new entrants to the labor force each year between now and 2020. If the current unemployed are taken into account, Morocco would need to create around 3.85 million jobs by 2020 to eliminate unemployment. That is an average of 295 thousand jobs per year; whereas in the years before 2006 the number of jobs created each year did not surpass 190 thousand. If as a result of better access to education and lower fertility rates the change in participation rates accelerates (say converging to OECD levels in 3 decades), labor force growth could approach 2.5 percent per year. Yet according to the World Bank (2010) Morocco would barely reach an average annual growth of 4.2 per cent during the 2007-2011 period.

The other problem is that the majority of the new jobs created are low-productivity and low-skilled, many in the informal sector. For instance, 90 percent of the jobs created since the year 2000 went to individuals without higher education diplomas. Also, the large majority (67 percent) of new jobs created since 2002 was in commerce and construction/public works sectors, which often tend to be informal jobs. The informal sector supplies 39 percent of non-agricultural jobs and 90 percent of jobs in the commerce sector. Another 10 percent of the jobs created where in agriculture. The agricultural sector still supplies 44 percent of the jobs and around half of those jobs are really unpaid on-farm family support.

As in other countries the Government of Morocco is dealing with the unemployment problem by introducing policies to promote investments and diversify the economy. The government thus has recently launched many initiatives including the "*Program for the Promotion of Strategic Sectors*"[5]. Around half a million jobs are expected to be created through this program by year 2020. The government is also introducing reforms in the education and training systems to better align the supply of skills with the demand. Part of these reforms focus on improving quality and reducing

[5] *Programme d'Emergence.*

repetition and dropout rates throughout the system. Little analysis, however, has been done to date regarding the potential impact on employment of these reforms.

The reforms are obviously complex and cannot be modeled in detail; the various interventions that affect the performance of teachers, for instance, and the quality of the education cannot be formalized within a CGE model. Our goal, instead, is to model the main manifestation of these reforms. In the case of the education reforms, for instance, changes in repetition and dropout rates that then affect the supply of different skills in the economy. The next section describes the main feature of the model.

II. An Introduction to the SELMA model

A first attempt to develop an integrated framework dealing with labor market issues was provided by Agenor and El Aynaoui (2003). Based on a modified version of the IMMPA[6] model, the authors introduce Harris-Todaro type mechanism to determine the supply of unskilled labor in the formal sector and, a monopoly union approach to determine skilled workers' wage in the private formal sector. The model takes into account internal and international migration. However IMMPA is quite stylized in terms of sectors and factors modeling. It is thus not suited for simulating the impact of a policy on a particular sector (Financial Sector for example) and does not allow to analyze the impact on a particular category of labor (technicians or university graduates for example). Moreover, it does not deal with social security reform (transfers to households are exogenous), does not take into account training and does not capture the demographic determinants of the labor market. The tool therefore is not fitted for analyzing the interactions between education, social security and macroeconomic policies.

SELMA is a multi-sector, sequential dynamic general equilibrium model. The main innovative features of SELMA are related to the modeling of the labor market, the supply of skills, and the representation of the social insurance system. Regarding the labor market, the model takes into account labor market segmentation along the following dimensions: urban/rural, formal/informal (there is an informal sector in each sub-sector of the economy except agriculture), public/private, and permanent/temporary employment. In terms of the types of skills and their supply, the model includes

[6] See Agenor, Izquierdo and Jensen (2007) for a detailed presentation of the IMMPA framework.

a module that follows individuals over time across various levels of the education system and through several diplomas/specializations in post secondary education.[7] In this version of the model the various skills supplied by the education system are aggregated into six skills categories (see Table 1). The model is also connected to a template that projects expenditures in the pension system by following over time the age/sex cohorts of contributors and retirees, their wages, and their pensions (the letter calculated according to specific policy rules or through replacement rates).[8] In this section we focus mainly on the innovations of the model while describing very briefly the standard applied general equilibrium specifications.

<Insert Table 1>

The production and factors demand block

The economy is disaggregated into 20 sectors. Within each sector, production factors are subdivided in 7 items: capital plus the six labour categories described above. The production function is a nested one. At the highest level we assume that the production of each sector is a Leontief function of value added and total intermediate consumption. The demand for capital and the 6 skills levels is modelled through a nested CES function at 5 levels, which allows to have differentiated elasticities of substitution between the different factors. Capital and highly skilled labour have been modelled as relatively complementary, following the Fallon-Layard hypothesis (1975) which has been confirmed by various empirical studies. Concerning the other factors we have aggregated them by pairs in CES bundles so as to have higher substitution elasticities between similar factors (for example the elasticity of substitution between university graduates and engineering schools graduates is higher than between these two categories and other labour categories).

Value added is a Constant Elasticity of Substitution (CES) function of a capital-highly skilled labour bundle (*KHS*) and a low skilled labour-unskilled labour bundle (*ULS*). Through this function the relative demand of the bundles depends on the evolution of their relative prices (*PKHS* and *PULS*) given the elasticity of substitution (σ_1). The value added and related demands for each sector *i* are thus characterized by:

[7] For a description of the HC accumulation model the reader is referred to Bodor, Robalino, and Rutkowski (2007).
[8] The basis of the template is the World Bank model PROST (see World Bank. 2005).

$$VA_i = A_1\left[\alpha_1 KHS_i^{(\frac{\sigma_1-1}{\sigma_1})} + (1-\alpha_1)ULS_i^{(\frac{\sigma_1-1}{\sigma_1})}\right]^{(\frac{\sigma_1}{\sigma_1-1})} \quad (1)$$

$$KHS_i = ULS_i\left[\frac{\alpha_i^1}{1-\alpha_i^1}\frac{PULS_i}{PKHS_i}\right]^{\sigma_1} \quad (2)$$

At the second stage, *KHS* and *ULS* are two CES functions of respectively capital (*K*) and a skilled-highly skilled labour demand bundle (*HSK*), and unskilled (*un*) and a low skilled labour demand bundle (*LS*). The first order conditions give us the derived demand of respectively *K*, *HSK*, *un*, and *LS*. We have:

$$KHS_i = A_2\left[\alpha_2 K_i^{(\frac{\sigma_2-1}{\sigma_2})} + (1-\alpha_2)HSK_i^{(\frac{\sigma_2-1}{\sigma_2})}\right]^{(\frac{\sigma_2}{\sigma_2-1})} \quad (3)$$

$$ULS_i = A_i^3\left[\alpha_3 LD_{i,un}^{(\frac{\sigma_3-1}{\sigma_3})} + (1-\alpha_3)LS_i^{(\frac{\sigma_3-1}{\sigma_3})}\right]^{(\frac{\sigma_3}{\sigma_3-1})} \quad (4)$$

$$K_i = HSK_i\left[\frac{\alpha_2}{1-\alpha_2}\frac{PHSK_i}{r_i}\right]^{\sigma_2} \quad (5)$$

$$LD_{i,un} = LS_i\left[\frac{\alpha_3}{1-\alpha_3}\frac{PLS_i}{awc_{i,un}}\right]^{\sigma_3} \quad (6)$$

where *r* is the return to capital in sector *i* and *awc* is the average wage cost by sector and skill including social security contributions (see equation 15)

At the third stage, *HSK* is a CES function of a composite highly skilled labour bundle (*HS*) and skilled labour (LD_{sk}). *LS* is CES of two low skilled categories LD_{lsa} and LD_{lsb}. The demand for these bundles and worker categories is derived through the same optimization process as above.

$$HSK_i = A_4\left[\alpha_4 HS_i^{(\frac{\sigma_4-1}{\sigma_4})} + (1-\alpha_4)LD_{i,sk}^{(\frac{\sigma_4-1}{\sigma_4})}\right]^{(\frac{\sigma_4}{\sigma_4-1})} \quad (7)$$

$$LS_i = A_5\left[\alpha_5 LD_{i,lsa}^{(\frac{\sigma_5-1}{\sigma_5})} + (1-\alpha_5)LD_{i,lsb}^{(\frac{\sigma_5-1}{\sigma_5})}\right]^{(\frac{\sigma_5}{\sigma_5-1})} \quad (8)$$

$$HS_i = LD_{i,sk}\left[\frac{\alpha_4}{1-\alpha_4}\frac{awc_{i,sk}}{PHS_i}\right]^{\sigma_4} \tag{9}$$

$$LD_{i,lsa} = LD_{i,lsb}\left[\frac{\alpha_5}{1-\alpha_5}\frac{awc_{i,lsb}}{awc_{i,lsa}}\right]^{\sigma_5} \tag{10}$$

At the fourth stage, *HS* is a CES function of two highly skilled workers categories, namely LD_{hsa} and LD_{hsb}. We have:

$$HS_i = A_6\left[\alpha_6 LD_{i,hsb}^{(\frac{\sigma_6-1}{\sigma_6})} + (1-\alpha_6)LD_{i,hsa}^{(\frac{\sigma_6-1}{\sigma_6})}\right]^{(\frac{\sigma_6}{\sigma_6-1})} \tag{11}$$

$$LD_{i,hsb} = LD_{i,hsa}\left[\frac{\alpha_6}{1-\alpha_6}\frac{awc_{i,hsa}}{awc_{i,hsb}}\right]^{\sigma_6} \tag{12}$$

Finally, in the last stage, labour demand is disaggregated into two categories: permanent workers covered by the social security system and temporary workers excluded from it. For the former labour demand by skill is a CES function of permanent and temporary labour demand (*PLD* and *TLD*).

$$LD_{i,lf} = A_{lf}\left[\alpha_{lf} PLD_{i,lf}^{(\frac{\sigma_{lf}-1}{\sigma_{lf}})} + (1-\alpha_{lf})TLD_{i,lf}^{(\frac{\sigma_{lf}-1}{\sigma_{lf}})}\right]^{(\frac{\sigma_{lf}}{\sigma_{lf}-1})} \tag{13}$$

$$PLD_{i,lf} = TLD_{i,lf}\left[\frac{\alpha_{lf}}{1-\alpha_{lf}}\frac{1}{(1+sce_{i,lf}+ui_{i,lf})}\right]^{\sigma_{lf}} \tag{14}$$

Wages of permanent workers include employers' social security contributions (*sce*) and unemployment insurance (*ui*). We distinguish legal (*lsce*) and effective rates of contribution to social security (the difference λ is due to exemptions, evasion, etc.). The model also takes into account the cost of the implicit cost of severance pay, using as proxy an implicit unemployment insurance rate. We have:

$$awc_{lf} = w_{lf}\frac{((1+sce_{lf}+ui_{lf})*PLD_{lf}+TLD_{lf})}{LD_{lf}} \tag{15}$$

$$sce_{lf} = \lambda_{lf} * lsce_{lf} \tag{16}$$

The labour supply block

As mentioned above, one innovation in SELMA is the detailed projection of various skills levels based on repetition and drop-out rates at various levels of the education system, including 85 combinations of diplomas and specialisations in higher education and vocational training. There are 6 skills levels associated with primary education depending on the grade an individual completed. Similarly 3 skill levels are associated with low secondary education and another 3 skill levels with upper secondary education. There are 9 skill levels associated with vocational training depending on the level of vocational training[9] and the length of the vocational training (1 or 2 years). In higher education the various areas of specialization,[10] combine with the length of study (varying between 2 to 7 years depending on the specialization) and whether the education is provided by public or private institutions of higher education, thus generating 64 distinct skill levels within the model.

At each time t, these skills are aggregated into 6 types of labour. Here we describe how we allocate the total supply of labour across economic sectors and formal/informal markets. In essence, there are three stages. In the first stage we model the migration process between the rural and urban labour markets. At the second stage, the urban labour market is divided into a formal and an informal segment. The informal labour supply is also then subdivided into independent workers and wage earners.

At the first level, following Cogneau et al. (1996), the migration process from rural to urban areas is modelled through an extended Harris-Todaro function. Thus, the relative supply of labour in the urban (*LSU*) and rural (*LSR*) sectors is a function of the expected wage in the urban sector (*auw*) and the observed wage in the rural sector (*nwr*). This function incorporates an elasticity of mobility (ε_1) of labour from rural to urban areas. The expected urban average wage (*E(auw)*) is a weighted average of the wages in the urban sector (informal, formal private and public) multiplied by the probability of finding a job in the urban sector (1-*u*). We have:

[9] *Certificat d'apprentissage, Spécialisation, Qualification, Technicien and Technicien Spécialisé*

[10] 10 specializations altogether: *Médecine Dentaire; Médecine et Pharmacie; Enseignement Originel; Sciences Juridiques, Economiques et Sociales; Lettres et Sciences Humaines; Sciences; Sciences et Techniques; Technologie; Sciences de l'Ingénieur; Commerce et Gestion*

$$\frac{LSU}{LSR} = c_1\left[\frac{E(auw)}{nwr}\right]^{\varepsilon_1} \tag{17}$$

$$E(auw) = \frac{(1-u)}{LSU}\begin{pmatrix} \sum_{i=\inf o} nwi_i(TLD_i + PLD_i) + \sum_{i=pformu} nwf_i(TLD_i + PLD_i) + \\ nwg(TLD_{gov} + PLD_{gov}) \end{pmatrix} \tag{18}$$

where *TLDi* and *PLDi* are the total labour demand of temporary workers and permanent workers in sector i, as defined above; nwi_i are wages in the informal sector, nwf_i wages in the formal sector, and *nwg* the wage in the government sector.

Regarding the split between formal and informal sector, we assume that the supply of labour in the latter results from a cost-benefit analysis made by workers and is not simply a residual. This view is consistent with the recent empirical evidence that shows that informality is both the result of exclusion (the traditional view) and strategic decisions that respond to perceive benefits (e.g., flexibility, no taxation) and perceived costs (lower wages, lack of access to formal institutions). In this framework, an increase in labour productivity in the formal sector or stronger public institutions would reduce informality by increasing the opportunity cost of not participation in the formal sector of the economy (see Perry et al., 2007). Thus, we model labour mobility between the formal and informal sector in the same way as we model mobility between rural and urban sectors: the ratio of labour supply in the formal (*LSF*) and informal sectors (*LSI*) is a function of the expected wage in the formal sector (*E(afw)*) and the observed wage in the informal sector (*aiw*). The mobility elasticity (ε_2) however is assumed to be lower than ε_1 given that the cost of migration from the rural areas to the urban areas is likely higher than that related to the movement between informal and formal sectors. We have:

$$\frac{LSF}{LSI} = c_2\left[\frac{E(afw)}{aiw}\right]^{\varepsilon_2} \tag{19}$$

$$E(afw) = (1-u)\frac{\sum_{i=pformu} nwf_i(TLD_i + PLD_i) + nwg(TLD_{gov} + PLD_{gov})}{LSF} \tag{20}$$

In terms of wages we consider a disequilibrium framework: wages do not clear the urban labour market. Following Cogneau et al. (1996), they are modelled as an extended wage curve.[11] Thus, we assume that the average formal private wage (*afw*) is a function of the unemployment rate (*u*), the public wage (*gw*) and the minimum wage (*min w*).[12] The following equation is thus estimated econometrically:

$$\ln(afw) = \beta_1 + \beta_2 \ln(gw) + \beta_3 \ln(\min w) + \beta_4 u \qquad (21)$$

Sectoral wages by skill (*wf* and *wi*) are then assumed to be equal to the average wages (*afw* and *aiw*) by skill defined above multiplied by an exogenous wage differential by sector and skill (*fwdist* and *iwdist*).

$$wf_i = afw * fwdist_i \quad i \in PFORMU \qquad (22)$$

$$wi_i = aiw * iwdist_i \quad i \in INFO \qquad (23)$$

where PFORMU is the set of private formal subsectors and INFO is the set of informal subsectors.

The formal labour force is split between independent workers and wage earners. We assume that the initial proportions of these two categories in the informal labour force are fixed.

The social security block

A social security account is modeled separated from the government budget. The account receives employers and employees social security contributions (their total amount being endogenous) and pays benefits to households. The benefits are split into three components: old-age pensions, disability and survivorship pensions, and "other benefits".

To determine the level of these benefits we run the PROST (Pensions Reform Options Simulation Tool) model with the rules of the Moroccan pension system. PROST was developed by the World Bank Human Development Network. The model projects the population by age and gender. Given information about retirement patterns (the probability of retiring at a

[11] See Blanchflower and Oswald (1994) for a comprehensive presentation on wage curves.
[12] Minimum wages are set as a binding constraint.

given age), average vesting periods (the expected number of years of contributions at a given age), average earnings by age, and the rules of the pension system (e.g., the accrual rate and minimum/maximum pensions and replacement rates) the model can be used to calculate the ratio between pension expenditures and the wage bill[13].

PROST feeds SELMA with the evolution of dependency ratios and average replacement rates (the ratio between the average pension and the average wage in the economy). SELMA uses these two inputs to compute total pensions and other social security expenses, which are proportional to the total wage bill.[14]

The income and expenditures block

Households earn their income from wages, returns to capital, interests on bonds and transfers (mainly government and social security transfers and migrants' remittances). Their expenditures are composed of consumption of goods and services, social security contributions, interest payments and transfers. The composition of their basket of goods and services is determined through the maximization of a Linear Expenditure System (*LES*) function under their budget constraint.

The government earns income from various taxes (income taxes, corporate taxes, tariffs, production and consumption taxes) and from foreign transfers. Its expenditures consist of government consumption (mainly civil servants wages), social transfers and interest payments on public debt.

The foreign trade block

The allocation of output between domestic and foreign markets is modeled as a Constant Elasticity of Transformation (*CET*) function. On the demand side, the Armington assumption is adopted to describe imperfect substitution between domestic products and imports. The small country assumption holds for imports, which implies that world import prices are exogenous, however, an

[13] A mathematical description of the model can be found in World Bank (2004).

[14] Total pensions, for *instance*, are equal to: the total number of workers x the dependency ratio x the average wage x the replacement rate. Or, equivalently, equal to the wage bill x the dependency ratio x the replacement rate.

export demand function is modeled, which means that Moroccan exporters can reduce their prices if they want to increase their market share on international markets.

The closures of the model

SELMA has 5 closures: a macro closure, a government closure, an external balance closure, a closure of the social security system and a labor market closure.

Concerning the macro closure, this version of SELMA is savings driven (households' marginal propensity to save is exogenous). The government closure chosen consists in fixing government expenditures (their growth rates) and tax rates and leaving the government budget balance endogenous to allow an assessment of the fiscal sustainability of the various scenarios. The foreign balance closure consists in fixing the exchange rate and leaving the current account balance endogenous to allow for the possibility of simulating the impact of exchange rate variation on the relevant variables. The social security balance is also endogenous. Finally the labor market closure of the SELMA model consists in a joint determination of unemployment and average formal wage through the wage curve described above.

The dynamics of the model

The model dynamics are of the sequential type. Capital accumulation is sectoral. Each year the stock of capital of each sector corresponds to the sum of the stock of last year and new investment minus the depreciation of capital. Following Bchir et al. (2002), sectoral investment (*INVi*) has been modeled as a function of the sectoral stocks of capital (*KDi*), sectoral rates of return to capital (*rki*) and capital acquisition costs (*PK*) net of subsidies (*subv*):

$$INV_i = gamma * KD_i * e^{\frac{lambda_i * rk_i}{PK_i - subv_i}} \quad (22)$$

where gamma is an endogenous adjustment variable. It permits to ensure that total investment is equal to total savings. Sectoral investment increases with sectoral rates of return to capital, government subsidies and decreases with sectoral acquisition costs of capital.

Yearly labor supply growth by skill is determined using a Human Capital projection model (Bodor, Robalino, and Rutkowski (2007). The HC model projects labor force by age, gender, and skill type based on mortality and fertility rates, labor force participation rates, and enrollment, repetition, and dropout rates at various levels of the education system.

The first step is to project the total population by age and gender on the basis of expectations about future fertility and mortality rates. Hence a vector *Pop(g,a,t)* is computed where g is gender, *a* refers to age and *t* is time.

The next step is to project the supply of skills by the education sector. This supply is characterized by the vector Skill(σ,g,a,e,t) where *σ* indicates whether the individual is enrolled in the education system and *e* indicates the level of educational attainment.

We start by modeling enrollment in primary education. We have:

$$\begin{aligned} &Skill(\sigma=1,g,a=6,e=P1,t)=Pop(g,a=6,t)*SR(g,a=6,t)\\ &Skill(\sigma=2,g,a=6,e=NoEd,t)=Pop(g,a=6,t)*\left[1-SR(g,a=6,t)\right], \end{aligned} \quad (23)$$

where *SR(g, a=6, t)* is the scholarization rate at the mandatory primary education entry age. (*P1* refers to "1st year of primary education", *NoEd* refers to "no education".) Those who do not enter primary education are registered as "out of school" population without education.

Based on the time series on education enrollment stocks, advancement rates, repetition rates and drop-out rates a skills development transition matrix *TR* is generated, where *E* is the number of distinct educational attainment categories. TR(e_1, e_2) is the probability of "advancing" from education category e_1 to education category e_2. In the special case when $e_1 = e_2$, TR(e_1, e_2) refers to repetition probability. TR(e_1, E+1) is defined as the probability of successfully completing educational level e_1 and leaving the education system. Thus, a particular education level e can be reached because individuals advance in their education or repeat. In the general case we therefore have:

$$\Delta Skill(\sigma=1,g,a,e,t]=\left[1-Mort(g,a-1,t-1)\right]*\sum_{i=1}^{E}Skill(\sigma=1,g,a-1,i,t-1)*TR(i,e) \quad (24)$$

where *Mort(g,a,t)* is the gender and time specific mortality probability of dying between ages *a-1* and *a*. Clearly, for many cases TR(i.e)=0, meaning that here is no transition path between i and e.

Those who finish successfully their intended level of education are transitioned out the school system according to the following equation:

$$\Delta Skill(\sigma=2,g,a,e,t)=\left[1-Mort(g,a-1,t-1)\right]*Skill(\sigma=1,g,a-1,e,t-1)*TR(e,E+1) \quad (25)$$

The probability of dropping out of school is the difference between *1* and the sum of the elements in a given row of the transition matrix. We have:

$$\Delta Skill(\sigma = 2, g, a, e, t) = \left[1 - Mort(g, a-1, t-1)\right] * Skill(\sigma = 1, g, a-1, e, t-1) * \left(1 - \sum_{i=1}^{E+1} TR(e, i)\right) \quad (26)$$

Finally, the evolution of those who already left the education system is according to the following equation:

$$\Delta Skill(\sigma = 2, g, a, e, t) = \left[1 - Mort(g, a-1, t-1)\right] * Skill(\sigma = 2, g, a-1, e, t-1) \quad (27)$$

The third step is to model the participation in the labor force among those individuals who are out of the education system. Given information on the size of the labor force and labor force participation rates the following identity needs to hold:

$$LF(g, a, e, t) = LFPR(g, a, e, t) * \sum_{i=1}^{2} Skill(i, g, a, e, t) \quad (28)$$

where *LF* is the labor force array and *LFPR* is the labor force participation array. From (280) we then estimate ELFPR(g,a,e,t), or the effective labor force participation rates that only apply to individuals out of the school system.

Government wages increase at a fixed rate set by the government. The other exogenous variables (mainly transfers) are supposed to vary each year at the same rate as GDP.

III. Calibration of SELMA in the Moroccan Context

Part of the calibration involves setting the initial value of macro-economic aggregates (e.g., relative wages and the distribution of the labor force by sector) and this is straightforward given the availability of national accounts and labor force surveys. The other part, however, refers to unobservable parameters such as the elasticities of substitution in the production functions. One would like, for instance, to estimate the distributions of these parameters to replicate the statistical properties of known time series predicted by the model. Such exercises have actually been conducted in the case of small ¨toy models¨ (see Abdelkhalek and Dufour, 2006), but are difficult to implement

in the case of large scale models such as SELMA. The model, however, is not intended to be used for prediction purposes. The more modest objective is to help the analyst understand the direction and order of magnitude of changes in output variables resulting from policy interventions, and how these policies interact, based on a set of reasonable assumptions regarding the value of the various parameters. To test the robustness of the results we conduct sensitivity analysis, allowing the values of the main elasticities to vary within pre-defined lower and upper bounds. Below we summarize the data used and the calibration process.

Initial Conditions

The model was calibrated from a 2003 database for the Moroccan economy. The social accounting matrix (SAM) has been built on the basis of the national accounts provided by the Moroccan "Direction de la Comptabilité Nationale" and of the data from the labor force survey and the informal sector survey provided by the "Direction de la Statistique." The SAM distinguishes 32 activities (13 of which are informal) and 19 commodities. It is composed of 5 agents (Households, Firms, Government, Social Security and Rest of the World) and 7 factors (described above). The investment matrix has also been provided by the "Direction de la Statistique".

The1998 household survey was used to estimate relative wages by skill (unfortunately, the most recent 2002 household survey did not include information on earnings). To this end, the various skills available in the survey were collapsed into the six skills used in the model. Relative wages where then used to estimate average earnings by skills, given wage bills by sector coming out of the social accounting matrix, and the distribution of skills in each sector provided by the labor force survey.

The parameters

The elasticities of substitution and transformation of the CES and CET functions have been fixed a priori at "reasonable levels."[15] For the production function elasticities we have for example a much lower elasticity between capital and highly skilled labor than between the other factors[16].

[15] See table A1 in the appendix
[16] Fallon and Layard (1975) hypothesis.

The derivation of the scale and share parameters of the functions follows the usual procedure. Based on the initial values of the variables and exogenous parameters the scales/shares are computed endogenously.

The parameters of the Human Capital accumulation model were estimated on the basis of data on student flows (enrollment, dropout, repetition and advancement rates) across different levels of the education system provided by the Ministry of Education. The flows are subject to change as the demographic composition of the population changes even if the transition variables of the education system remain constant.

Finally, the parameters of the wage curve were estimated using time-series on wages provided by the "Caisse Nationale de Sécurité Sociale" (CNSS).

IV. Policy Simulations

This section starts by presenting the dynamics of key macroeconomic aggregates under the status-quo or baseline scenario. It then discusses the impact of alternative policy interventions in the education and social protection system, implemented individually or as a package (see Table 2). The focus is on the following aggregates: (i) the growth rate of GDP; (ii) the level of investments; (iii) the fiscal deficit; (iv) the aggregate unemployment rate in urban areas; (v) the size of the informal sector in terms of its contribution to total urban employment; and (vi) unemployment rates by skills level. The tables with the results of the various simulations are presented in the Appendix.

Baseline Dynamics

In the baseline scenario the model is calibrated to replicate actual GDP growth rates between 2003 and 2008, World Bank Global Economic Prospects (2010) estimations for the period 2009-2011, and IMF projections for the period 2012-2015. The significant role played by agriculture in the Moroccan economy and the irregularity of rainfall explain the amplitude of GDP variation observed in the 2003-2008 period (between 2.7% and 7.8%) In fact, the relatively low economic growth rate in 2007 was due to a severe drought (real non agricultural GDP grew at 6.6% according to the IMF).

The projected fiscal deficit, investment levels and the current account balance are also consistent with official projections (see Table A2).

The results show that despite a positive outlook in terms of economic growth unemployment rates in urban areas would go down only very gradually.[17] Hence, the model projects that the urban unemployment rate would first decrease at around 11.7 percent[18] in 2008 then increase to 11.9 percent in 2010. Only in year 2012 (if growth projections are confirmed) unemployment would start to gradually decline converging to 9.8 percent in 2015. These results are consistent with the aggregate projections that one would obtain assuming that the aggregate employment-output elasticity remains unchanged (see World Bank 2007, Chapter 2).

The dynamics of unemployment rates are very different between skills categories; prospects are especially worrisome for Specialized Technicians. For unskilled workers, unemployment rates could rapidly converge to "natural levels." In part this occurs as their share among new entrants in the labor force diminishes. For low-skilled workers unemployment rates are also on a downward trend although it would take them longer (around year 2015) to reach natural levels. For highly skilled workers initial unemployment rates are higher and could increase over the short term, but would start declining after year 2012. Still, by year 2015, 27 percent of university graduates in non-technical fields and 11 percent of graduates in technical fields would remain unemployed. The situation is more critical, however, for Specialized Technicians. They start with the highest unemployment rates (41 percent) but because of a rapid increase in their number, unemployment rates could continue to climb stabilizing at around 48 percent in year 2015. This result is driven of course by the assumptions of the downward rigidity of wages that are not able to fall to stimulate labor demand sufficiently.

The main message from the baseline scenario is that additional policy interventions would be necessary to reduce unemployment rates, particularly among high skilled workers. First there is a need to control student flows. The current education/training system (mostly heavily subsidize public

[17] By slowing growth rates in 2010-2011 the global crisis should induce a slight increase in unemployment.
[18] For consistency reasons, labor data in the model are in full-time equivalents, which means that the baseline unemployment rate is higher than the official one. Indeed, employment and unemployment figures are presented in number of people mixing full time and partial time workers. In a general equilibrium model this transformation is necessary since one cannot add someone who works one month and someone who works 9 months. This means that our unemployment figures are also in full-time equivalents and thus higher than official ones.

universities that do not control the intake of students) does not respond to market signals and therefore can oversupply certain skills. The simulations indicate, for instance, that the current flows of Specialized Technician are simply too high for current demands. But demand side interventions are also necessary to create more jobs at the aggregate level. The next sections discuss the impact of some of these policies.

Before moving to policy simulations we perform sensitivity analysis of the main variables of the reference scenario (growth and unemployment) with respect to changes in the main elasticities used to calibrate the model. For each elasticity we set lower and upper bound values that are respective half and double the actual values. We start with trade elasticities and then we move to the production function elasticities (table 2). The results are summarized in tables A3 and A4.

The results of the sensitivity analysis show that increasing (decreasing) the elasticities of substitution and transformation of import demand and export supply functions leads to higher (lower) economic growth and lower (higher) unemployment rates (table A3). Indeed, higher trade elasticities induce more trade and given that Morocco's trade balance is negative this induces more foreign savings. Given the macroeconomic closure chosen, this induces an increase in investment and thus higher growth rates and consequently lower unemployment. However the range of variation of GDP growth rates between the actual value and the lower or upper bounds is on average 0.06 percent and the range of variation of unemployment rates is on average 0.2 percent.

The results also show that increasing the various elasticities of substitution of the nested production function induces lower GDP growth and lower unemployment (Table A4). This apparent paradox (lower unemployment despite lower growth) is resolved when we observe that increasing these elasticities has a negative impact on rural/urban migration. Indeed as labor demand increases due to higher substitution possibilities between labor categories there are less potential candidates for rural/urban migration (-50,000 on yearly average). This relative increase in labor demand in the agricultural sector explains the relatively lower GDP growth rate, given the differences between agriculture and the other sectors in terms of wage and productivity. Nonetheless, the range of variation in GDP growth rates is, on average, 0.05 percent and the range of variation of unemployment rates is on average 0.5 percent. While the effect on unemployment of varying the

elasticities of substitution between factors of production is higher than varying trade elasticities the range of variation seems reasonable.

Dynamics under alternative policy interventions

The four sets of policies considered in the analysis are presented in Table 2. The first set consists of policies that improve the technical efficiency of the education system. In essence, reductions in drop-out and repetitions rates at various levels of the education system. These affect the supply of various skills of labor through the Human Capital projection module. Second, policies related to the social security system. One is the absence of reforms in the pensions system that implies a continuous increase in the tax-wedge to cover expenditures. The other, is a reform program that gradually reduces replacement rates, which permits to reduce pension expenditures and thus to avoid an increase in workers' contributions. The third set of policies is assumed to affect total factor productivity growth. These policies could include improvements in the design of the continuous training system, better quality and relevance in higher education and vocational training, and/or those that support the adoption and diffusion of new technologies. Of course, we are not able to model the direct impact of this type of policies, but explore what would happen if, through their implementation, TFP increases. The fourth set of policies is related to the implementation of the current government programs to promote the development of high-value added economic sectors. To this end we simulate the effects of higher investments in agro-industry, the financial sector, the mechanical industry and electronics.

The simulations look at the marginal impacts of each of the policy packages, as well as their joint effects.

<Insert Table 2>

Education and training policies. An important insight from the simulations is that simply improving internal efficiency at various levels of the education system might not contribute much to growth or employment creation. In theory, better internal efficiency would imply a higher stock of human capital, lower labor costs for skilled workers and faster GDP growth over the long term.

However, the simulation of a policy that increases internal efficiency across education levels shows that the impacts on GDP growth would be negligible over the short and medium term (between -0.2 and 0.1 percentage point). The effects on the aggregate unemployment rate would also be small at least until year 2012 when it could be reduced by 0.5 percentage point (see Table A5). In the medium run (2015) aggregate unemployment would increase by 0.9 percentage point due to the increasing share of highly skilled workers in the labor force and to the increase in unemployment rates for this category of workers.

The simulation also shows that the dynamics of unemployment rates are not uniform across skills. The relative effects are complex and depend on demographics (which affect the supply) and on the structure of the production function (which affect the demand). Overall, however, the model shows that internal efficiency alone could hurt unskilled and highly skilled workers, and benefit those in the middle.

Unemployment rates could increase among unskilled workers at the benefit of low skilled workers without VT diplomas. Indeed, higher internal efficiency at all levels of the education sector reduces the supply of unskilled workers and therefore drives up their wages. Because they become more expensive relative to low skilled-workers, particularly those without VT diplomas, a substitution effect takes place. Hence, unskilled workers (*un*) loose jobs while low skilled workers without VT diploma (*lsb*) gain jobs. Unemployment rates for the latter could be reduced significantly over the medium and long term.

A similar story can be told about workers with only secondary education or 9^{th} grade plus VT (*lsa*). Indeed, lower dropout rates reduce the number of individuals who drop out of primary education and/or before completing 9^{th} grade and obtain a VT diploma, or enter the labor market with only secondary education. This increases their wages and therefore firms have incentives to substitute them for skilled workers (secondary + VT). In this scenario, employment prospects for the latter could improve -- even if their salaries also go up as a result of lower supply reflecting a lower dropout rate at the *Baccalauréat.*

For highly skilled workers (*hsa* and *hsb*) the situation is different. Higher internal efficiency implies a rapid increase in the number of university graduates. Even if their salaries initially go down

and they can be substituted for skilled workers, downward rigidities put a limit to the demand given a level of output. Hence, without faster economic growth new highly skilled workers entering the market simply can not be absorbed.

Total factor productivity. What would happen if total factor productivity increases as a result of: (i) better quality of education and more relevant diplomas/specializations in higher education and VT; (ii) better incentives to invest in training within enterprises; and (iii) other policies that affect innovation. In the simulations, the combined effect of these policies is assumed to increase the growth rate of total factor productivity by $1/5^{th}$ of its baseline level. This increases investments and the demand for labor at a given wage. The results show important improvements both in terms of economic growth and employment creation. GDP growth could increase by 1.1 percentage point on average during the 2007-2015 period. The aggregate unemployment rate could be reduced by up to 2.8 percentage points (see Table A6). Unemployment rates by types of labor would fall for most types of labor, bringing down the aggregate unemployment rate relative to the baseline. The exceptions are highly skilled workers. With the assumed increase in TFP, the unemployment for university graduates with technical specializations could be reduced in the short term but would still be higher than in the baseline over the medium term, but much lower than in the previous scenario. The increase in unemployment for this category means that the demographic and educational effects on labor supply are stronger than the productivity and growth effect on labor demand for this category of workers. In essence, even with the higher rate of output growth generated in this scenario the economy would not be able to absorb the flow of qualified individuals. Again, this result is driven by the assumption of wages downward rigidity.

This would seem to contradict the observation in Morocco that in certain high value added sectors there are shortages of technical professionals. These shortages, however, could still exist for specific diplomas/specializations even with a high unemployment rate for the broader class of skills used here. Nonetheless, one of the policy interventions analyzed below looks at the effect of the expansion of some of these strategic sectors.

Social security reform. The simulations show that failing to reform the social security system and allowing social security contributions to increase can aggravate the unemployment

problem. The simulation discussed here focuses on the pension system. It considers a gradual increase in the contribution necessary to make the pension system solvent – around a 10 percent increase per year during 5 years. This is the contribution rate that is necessary to ensure that current liabilities are equal to expected assets (including the pay-as-you-go asset) [19] even if today it increases the surplus of the pension system. The results show that higher contribution rates could increase the aggregate unemployment rate by 1.9 percentage point over the medium term (see Table A7).

Contrary to common belief, higher pay-roll-taxes and/or workers contributions could mainly affect highly skilled workers with technical specializations and workers with secondary education or intermediate levels of vocational training. These groups would face the sharpest reductions in employment levels and therefore the highest increases in unemployment rates -- close to 4 percentage points by year 2012. On the contrary, unskilled workers would be the least affected. There are two factors that explain these results. First, a portion of the unskilled and low skilled workers is likely to enter the informal sector (see below). Second, due to the fact that unskilled workers reach their natural unemployment level in 2011 (due to demographic and educational dynamics), there is much less pressure on low skilled workers which are relatively more substitutable than skilled workers.

The higher cost of labor would also induce a mild expansion of the informal sector. Indeed, unskilled workers who do not find a job in the formal sector fill the ranks of those working in the informal sector. However, the increase in the contribution of the informal sector to total urban employment would be modest, starting with 0.1 percentage point and reaching 0.6 percentage point in 2015.

Reforming the pension system by gradually aligning benefits with contributions therefore can have a positive effect on employment creation. In the simulations, this implies that pay-roll taxes and workers contributions stay constant at current levels and that the social security surplus goes up. This increases savings and has a positive, albeit, small on economic growth (Table A8).

Support to emergent sectors. The simulations consist in implementing targeted investment subsidies on some potentially dynamic sectors. The subsidies reduce the acquisition cost of capital in

[19] The pay-as-you-go asset is equal to the present value of future contributions net of the pension rights accruing from those new contributions.

these sectors and consequently increase investment .The results of the analysis indicate that each sector on its own will have little effects on economic growth and unemployment. The stimulus subsidy in the agro-industrial sector would have no impact over the short-term and very little impact over the medium term. The growth rate of GDP could increase by less than 0.1 percentage point and unemployment rates for some skills categories could be reduced by a similar amount (Table A9). No sizable effects would take place on the aggregate unemployment rate (-0.1 percentage point in 2015). The stimulus in the mechanical and electronics industrial sector could even have negative effects. Basically, the cost of the subsidy, which reduces government savings and aggregate investments, would be higher than the benefits in terms of more investment and growth in the sector (Table A10). More promising results can be observed in the financial sector. The subsidy there could increase the GDP growth rate by 0.4 percentage point in 2008 but not more than 0.1 percentage point in 2015. Reductions in the unemployment rate would be modest, between 0.2 and 0.3 percentage point (see Table A11).

The combined effect of the investment subsidy in the three sectors considered here would only add around 210,000 new jobs between 2007 and 2015. The almost totality of these jobs would be created through the stimulus in the financial sector This is due to the combination of two factors: the high intensity of the financial sector in skilled labor (more than three times higher than those of the agro-industry and mechanics sectors) and the relative complementarity between capital and skilled labor. This means that a unit of investment in the financial sector is relatively more efficient in terms of employment creation (especially for skilled workers) than in the two other sectors. The stimulus in agro-industry would generate less than 10,000 jobs and the net impact in the mechanics and electronics industrial sector would be nil. Yet, the stimulus package would increase the government deficit by 0.2 to 0.5 percent of GDP over the short term (see Table A12).

The main message here is that the Government would need to be conservative in terms of the direct impact that the Emergence Program has on employment. Clearly, there is a need to analyze the impact of the stimulus package on other sectors, but in general, it seems that reaching the target of 500,000 new jobs would require considerable public resources. As discussed in World Bank (2007), the value added of the Emergence Program could be more in terms of its impact on economic

diversification, and through this channel, innovation/self-discovery and productivity growth. These effects were not captured in the simulations. The important role of productivity growth, however, was illustrated above.

An integrated package. Not surprisingly, an integrated package that combines the various policies discussed above can have important impact on economic growth and employment creation. More specifically, this policy package would include improved internal efficiency in the education system, higher growth in total factor productivity resulting from policies that promote innovation within firms, social security reforms that keep pay-roll taxes constant and increase domestic savings, and the support to high-value added emergent sectors. Under this package, GDP growth could increase by more than 1 percentage point per year on average during the 2007-2015 period. The aggregate unemployment rate would be reduced by 2.2 percentage points per year on average during the same period (Table A13). Highly skilled unemployment will continue to increase due to the high pace of increase of the number of graduates (mainly under the scenarios A and B), but in the integrated scenario this increase is lower.

V. Conclusions

This paper has developed a dynamic general equilibrium model SELMA (Social security, Education, Labor, and Macroeconomic policies). The model was designed to help analysts to better understand how macroeconomic, education, and social protection policies interact to affect the dynamics of employment across different skill levels. The strength of the model relative to other models of its kind is the high resolution of the labor market (including the inclusion of a formal and informal sub-sector in all sector of the economy but agriculture), the inclusion of a social security module to project pension expenditures, and a human capital accumulation model that predicts the distribution of skills in the labor force.

Like any model, SELMA remains open to refinements. One of the main challenges is to validate empirically the appropriateness of selected functional forms and model parameters. Two

critical modules are those determining the dynamics of the labor force between urban and rural areas and the formal and informal sectors, as well as the demand for various skills levels.

The model was used to illustrate the impact that alternative education and social protection policies have on selected macroeconomic aggregates. The ones considered here include: GDP growth, the fiscal balance, the aggregate unemployment rate, unemployment rates by skill level, and the size of the informal sector. The results presented provide several insights.

The simulations first confirm that, even under optimistic scenarios regarding economic growth high unemployment rates in urban areas would persist, particularly among high skilled workers. The baseline scenario in the model projects GDP growth rates between 3 and 6.3 percent. These are barely enough to bring down the urban unemployment rate below the 10 percent barrier in year 2015. Setting aside the issue of skills mismatch,[20] the current economy seems unable to absorb current flows of skilled and highly skilled workers who face the highest unemployment rates.[21] The projections show that for skilled workers these are likely to increase approximating 50 percent over the medium term. For highly skilled workers unemployment rates could increase over the short term and eventually fall over the medium term, but would remain above 25 percent for non-technical specializations and 10 percent for technical specializations.

The simulations also suggest that only improving internal efficiency in the education system could make things worse. Higher internal efficiency in the education system is a pre-condition to sustain the accumulation of human capital over the medium and long term and support economic growth. But having more people graduating from university does not automatically mean higher aggregate productivity and faster growth. Over the short and medium term, the higher inflow of skilled workers would contribute to increased unemployment rates. Unskilled workers would also be affected as their number is reduced, their wages go up, and then get substituted by more skilled workers.

[20] These are not modeled within SELMA.

[21] In our application, skilled workers refer to individuals who have a diploma of Specialized Technician from the VT system. Highly skilled workers, on the other hand, refer to university graduates, which the model separates into technical and non-technical diplomas.

In the scenarios considered the model predicts that not reforming the social security could cost much more jobs than the Emergence Program could create under its best performance. Not reforming the pension system and/or not controlling the finances of the new health insurance system and letting pay-roll taxes and social security contributions increase would have a negative effect on employment levels. The aggregate unemployment rate could increase by up to 1.9 percentage point as a result of a 10 percent increase in the contribution rate over a period of 5 years. Effects are particularly important for highly skilled workers for whom unemployment rates could increase by up to 4 percentage points.

The model also warns about having high expectations regarding the effects of the Emergence Program. The stimulus package simulated in three sectors (agro-industry, financial sector, and mechanical and electronic industry) generated only 210,000 new jobs between 2007 and 2015 at a cost of 0.2 to 0.5 percent of GDP per year. If these ratios are preserved, the 500,000 target that the government has set could cost each year between 0.5 percent and 1.25 percent of GDP.

But probably the most important message from the analysis is that isolated interventions will be insufficient to reduce unemployment. Each of the policy interventions simulated here can affect unemployment rates on its own, but the effects tend to be modest. A sustained reduction in unemployment rates requires an integrated and well coordinated package of policy interventions. We argue that an integrated package that can rapidly reduce unemployment rates for all categories of workers would seek the following general objectives: (i) foster total factor productivity growth through better quality and the improved relevance of the diplomas/specialization supplied by the higher education and VT system, as well as better incentives to invest in in-service training; (ii) increase investments and promote faster growth in sectors intensive in highly-skilled workers; and (iii) reform the social security system to control labor costs. Such a package could also reduce the size of the informal sector, which implies an improvement in the average quality of the jobs created. The challenge of course is to identify the specific policies that would achieve these objectives. Several are discussed in a recent report on skills development, social protection, and employment in Morocco (see World Bank, 2007).

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Table 1: Typology of Skills in the Model SELMA

Typology of Labor Categories	Diplomas and Specializations Included
Unskilled workers (un)	No formal education or only Initial Training (i.e., VT diploma obtained where the only condition is to read and write).
Low skilled workers type A (lsa)	Primary education + VT (*specialilsation*) or 9th + VT.(*qualification*) or Secondary education only
Low skilled workers type B (lsb)	Only primary education or 9th grade
Skilled workers (sk)	Secondary education + VT (*Techniciens specialisés*)
Highly skilled workers type A (hsa)	Graduates from *Grandes Ecoles* and faculties with technical specializations.
Highly skilled workers type B (hsb)	University graduates (except physicians) without a VT diploma

Source: Authors' design. The number of workers in each skill category by economic sector was provided by the High Council for Planning on the basis of the labor force survey.

Table 2: Description of Policy Simulations

Policy	Simulation Mechanism
A. Improvement in internal efficiency of education system.	Repetition, dropouts, and enrollment rates improve by 50 percent at all levels of the education system.
B Policy A with higher total factor productivity growth.	the growth rate of TFP increases by 20 percent (e.g., from 1 percent per year to 1.2 percent per year).
C. Failure to reform social security	A 10 percent increase of the average effective contribution rate per year is assumed (e.g., from 10 percent to 11 percent)
D. A Ssustainable Social security reform[1]	It assumes that the pension system is reformed and that average replacement rates are reduced over time The contribution rate to the social security remains constant.
E. Support to emergent sectors (Agroindustry)	10 percent subsidy to the acquisition costs of capital.
F. Support to emergent sectors (Financial sector)	Same as before
G. Support to emergent sectors (Mechanical Industry and Electronics)	Same as before
H. Support to emergent sectors (D+E+F)	The subsidy is applied to the four sectors simultaneously
I. Integrated package (B+D+H)	All "shocks" are introduced simultaneously

Source: Authors' design.

[1] The reform is composed of the following elements: review benefit formulas and eligibility conditions in order to ensure financial sustainability; and eliminate incentives for evasion and early retirement; make redistribution transparent and progressive; and ensure the full portability of benefits across pension funds and, to the extent possible, identical provisions.

Appendix

Table A1: main elasticities of the model

Elasticity of substitution between imports and local products	**1.5**
Elasticity of transformation between local products and exports	**1.5**
Elasticities of substitution	
-between a capital-highly skilled labor bundle (KHS) and a low skilled labor-unskilled labor bundle (ULS).	**0.5**
-between capital (*K*) and a skilled-highly skilled labor demand bundle (HSK)	**0.4**
- between unskilled labor (*un*) and a low skilled labor demand bundle (LS)	**0.7**
- between a composite highly skilled labor bundle (HS) and skilled labor (*sk*)	**0.8**
-between two highly skilled workers categories, namely *hsa* and *hsb*.	**0.85**
-between two low skilled categories *lsa* and *lsb*.	**0.9**
-between temporary and permanent labor	**1.5**

Table A2: The Baseline Scenario

Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP Billion Dh	528.3	557.7	586.9	604.2	630.3	665.8	704.3	746.9	793.9
GDP Growth	2.8%	5.6%	5.2%	3.0%	4.3%	5.6%	5.8%	6.1%	6.3%
Government Balance Billion Dh	0.02	0.9	1.7	1.9	2.3	3.1	4.1	5.2	6.3
Social Security Balance Billion Dh	7.9	7.7	7.4	7.0	6.3	5.6	4.6	3.4	2.0
Total investment Billion Dh	155.3	170.4	185.7	193.4	205.5	223.9	244.6	267.7	293.1
Total Unemployment	12.3%	12.0%	11.7%	11.9%	11.8%	11.5%	11.1%	10.5%	9.8%
Share informal labor supply	23.5%	23.5%	23.3%	23.3%	23.2%	23.2%	23.2%	23.3%	23.4%
Total Urban labor supply (Million)	9.7	10.1	10.4	10.7	10.9	11.2	11.4	11.6	11.8
Unemployment									
un	5.1%	4.4%	3.6%	3.4%	3.0%	3.0%	3.0%	3.0%	3.0%
lsb	12.4%	11.5%	11.0%	11.1%	10.5%	9.4%	7.9%	6.0%	3.7%
lsa	12.1%	11.0%	10.5%	10.6%	9.9%	8.3%	6.3%	3.9%	3.0%
sk	41.5%	43.4%	45.1%	46.6%	47.5%	48.0%	48.3%	48.3%	48.2%
hsb	33.0%	32.7%	32.6%	32.8%	32.7%	32.0%	30.9%	29.3%	27.4%
hsa	16.5%	17.7%	17.6%	17.8%	17.6%	16.6%	15.4%	13.6%	11.1%

Table A3: Sensitivity analysis (trade elasticities)

Elasticities	Macro variable	2007	2008	2009	2010	2011	2012	2013	2014	2015
Lower value	GDP growth	2.4%	5.9%	5.2%	3.0%	4.3%	5.6%	5.7%	6.0%	6.2%
	Total unemployment	**12.6%**	**12.0%**	**11.9%**	**12.0%**	**11.9%**	**11.6%**	**11.2%**	**10.7%**	**10.0%**
Actual value	GDP growth	2.8%	5.6%	5.2%	3.0%	4.3%	5.6%	5.8%	6.1%	6.3%
	Total unemployment	**12.3%**	**12.0%**	**11.7%**	**11.9%**	**11.8%**	**11.5%**	**11.1%**	**10.5%**	**9.8%**
Upper value	GDP growth	3.2%	5.4%	5.3%	3.0%	4.3%	5.7%	5.8%	6.1%	6.4%
	Total unemployment	**12.0%**	**11.8%**	**11.5%**	**11.7%**	**11.6%**	**11.3%**	**10.9%**	**10.3%**	**9.6%**

Table A4: Sensitivity analysis (production function elasticities)

Elasticities	Macro variable	2007	2008	2009	2010	2011	2012	2013	2014	2015
Lower value	GDP growth	3.0%	5.4%	5.3%	2.9%	4.6%	5.7%	5.8%	6.0%	6.3%
	Total unemployment	**13.4%**	**13.0%**	**13.0%**	**12.8%**	**12.4%**	**11.7%**	**11.5%**	**10.6%**	**10.2%**
Actual value	GDP growth	2.8%	5.6%	5.2%	3.0%	4.3%	5.6%	5.8%	6.1%	6.3%
	Total unemployment	**12.3%**	**12.0%**	**11.7%**	**11.9%**	**11.8%**	**11.5%**	**11.1%**	**10.5%**	**9.8%**
Upper value	GDP growth	2.8%	5.5%	5.1%	2.9%	4.2%	5.6%	5.8%	6.0%	6.3%
	Total unemployment	**11.4%**	**11.1%**	**11.1%**	**11.5%**	**11.5%**	**11.2%**	**10.8%**	**10.2%**	**9.5%**

Table A5: Improving Internal Efficiency in the Education System (Policy A)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.0%
GDP Growth (percentage points)	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	-0.2%
Government Balance	101%	3%	2%	2%	5%	6%	4%	3%	-1%
Social Security Balance	0.2%	0.2%	0.2%	0.2%	-0.1%	-0.4%	-0.3%	-0.1%	1.7%
Total investment	0.2%	0.2%	0.2%	0.3%	0.5%	0.6%	0.6%	0.4%	-0.1%
Total Unemployment (percentage points)	0.0%	0.0%	0.0%	0.0%	-0.3%	-0.5%	-0.4%	-0.1%	0.9%
Share informal labor supply (percentage points)	0.2%	0.2%	0.1%	0.1%	0.0%	-0.1%	-0.2%	-0.3%	-0.4%
Unemployment (percentage points)									
un	1.6%	1.7%	1.8%	1.6%	0.8%	0.0%	0.0%	0.0%	0.0%
lsb	0.1%	-0.2%	-0.5%	-1.0%	-1.5%	-2.1%	-2.7%	-3.0%	-0.7%
lsa	2.2%	3.1%	4.0%	4.9%	5.8%	6.7%	7.8%	8.9%	7.7%
sk	-8.1%	-8.7%	-9.0%	-9.0%	-9.2%	-9.4%	-9.4%	-9.4%	-9.0%
hsb	2.6%	4.0%	5.9%	9.3%	12.4%	15.4%	18.1%	20.6%	23.3%
hsa	1.8%	2.2%	2.6%	3.0%	4.0%	5.0%	6.8%	8.5%	10.5%

Table A6: Internal Efficiency and Faster Total Productivity Growth (Policy B)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	4.2%	5.4%	6.6%	7.3%	8.4%	9.7%	10.9%	12.0%	13.0%
GDP Growth (percentage points)	1.1%	1.2%	1.1%	0.7%	1.1%	1.2%	1.1%	1.1%	1.0%
Government Balance	6188%	210%	138%	145%	134%	116%	98%	84%	72%
Social Security Balance	1.4%	1.7%	2.4%	2.7%	2.9%	2.6%	1.9%	-0.8%	-11.0%
Total investment	10.8%	13.1%	15.2%	16.9%	18.5%	20.6%	22.0%	23.2%	23.9%
Total Unemployment (percentage points)	-1.8%	-2.6%	-2.7%	-2.8%	-2.7%	-2.7%	-2.1%	-1.4%	-0.4%
Share informal labor supply (percentage points)	0.0%	0.0%	-0.1%	-0.1%	-0.3%	-0.3%	-0.3%	-0.2%	0.0%
Unemployment (percentage points)									
un	-0.4%	-1.0%	-0.6%	-0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	-1.5%	-2.5%	-3.3%	-4.6%	-5.7%	-6.4%	-4.9%	-3.0%	-0.7%
lsa	-0.2%	-0.3%	0.0%	-0.2%	0.1%	-0.4%	-0.9%	-0.9%	0.0%
sk	-9.7%	-11.1%	-11.6%	-12.2%	-12.7%	-13.4%	-13.7%	-14.1%	-14.0%
hsb	1.0%	1.8%	3.5%	6.4%	9.5%	12.1%	14.6%	16.9%	19.5%
hsa	-0.2%	-0.7%	-0.8%	-1.3%	-0.4%	-0.3%	1.2%	2.4%	4.1%

Table A7: Failure to Reform the Social Security (Policy C)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.1%	0.1%	0.2%	0.4%	2.0%	0.9%	1.7%	2.4%	3.1%
GDP Growth (percentage points)	-0.2%	0.0%	0.1%	0.1%	1.7%	-1.1%	0.8%	0.7%	0.8%
Government Balance	-113%	-3%	-2%	0%	-32%	8%	2%	4%	6%
Social Security Balance	32%	34%	38%	42%	284%	340%	444%	639%	1166%
Total investment	2.5%	2.3%	2.3%	2.5%	12.8%	13.7%	13.5%	14.2%	15.1%
Total Unemployment (percentage points)	0.5%	0.5%	0.4%	0.4%	1.9%	1.4%	1.2%	1.1%	0.9%
Share informal labor supply (percentage points)	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.4%	0.5%	0.6%
Unemployment (percentage points)									
un	0.5%	0.5%	0.4%	0.4%	1.5%	0.2%	0.0%	0.0%	0.0%
lsb	0.4%	0.4%	0.4%	0.3%	2.1%	2.4%	2.2%	1.9%	1.8%
lsa	0.7%	0.7%	0.7%	0.7%	3.6%	4.2%	4.0%	3.7%	1.8%
sk	0.5%	0.4%	0.4%	0.4%	1.9%	2.0%	1.8%	1.6%	1.5%
hsb	0.6%	0.5%	0.5%	0.5%	2.6%	2.8%	2.7%	2.5%	2.4%
hsa	0.8%	0.7%	0.7%	0.7%	3.5%	3.7%	3.6%	3.4%	3.3%

Table A8: Reforming the Social Security (Policy D)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
GDP Growth (percentage points)	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Government Balance	-121%	-3%	-2%	-2%	-1%	-1%	-1%	-1%	0%
Social Security Balance	3.9%	3.5%	4.7%	5.3%	5.6%	5.8%	6.0%	5.8%	3.1%
Total investment	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.2%
Total Unemployment (percentage points)	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Share informal labor supply (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Unemployment (percentage points)									
un	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
lsa	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
sk	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
hsb	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
hsa	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Table A9: Stimulus to the Agro-Industrial Sector (Policy E)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%
GDP Growth (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Government Balance	-963%	-30%	-19%	-20%	-18%	-14%	-11%	-10%	-8%
Social Security Balance	0.0%	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
Total investment	0.0%	0.1%	0.1%	0.2%	0.3%	0.4%	0.4%	0.4%	0.4%
Total Unemployment (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Share informal labor supply (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Unemployment (percentage points)									
un	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%
lsa	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.2%	0.0%
sk	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%
hsb	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%
hsa	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%

Table A10: Stimulus to the Financial Sector (Policy F)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.0%	0.3%	0.4%	0.5%	0.5%	0.6%	0.7%	0.7%	0.8%
GDP Growth (percentage points)	0.0%	0.4%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%
Government Balance	-3354%	-77%	-42%	-39%	-35%	-27%	-22%	-18%	-16%
Social Security Balance	0.0%	0.0%	0.1%	0.1%	0.3%	0.3%	0.2%	0.1%	-0.4%
Total investment	0.0%	1.1%	1.4%	1.6%	1.6%	1.7%	1.8%	1.9%	1.9%
Total Unemployment (percentage points)	0.0%	-0.2%	-0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.3%	-0.3%
Share informal labor supply (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%
Unemployment (percentage points)									
un	0.0%	-0.2%	-0.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	0.0%	-0.2%	-0.2%	-0.3%	-0.3%	-0.4%	-0.4%	-0.5%	-0.6%
lsa	0.0%	-0.2%	-0.3%	-0.4%	-0.5%	-0.6%	-0.7%	-0.8%	0.0%
sk	0.0%	-0.1%	-0.2%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%	-0.4%
hsb	0.0%	-0.1%	-0.2%	-0.3%	-0.3%	-0.3%	-0.4%	-0.5%	-0.5%
hsa	0.0%	-0.2%	-0.3%	-0.3%	-0.4%	-0.4%	-0.5%	-0.6%	-0.6%

Table A11: Stimulus to the Mechanical and Electronic Industrial Sector (Policy G)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.0%	-0.2%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
GDP Growth (percentage points)	0.0%	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Government Balance	-4760%	-80%	-56%	-48%	-44%	-34%	-28%	-24%	-21%
Social Security Balance	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.4%	1.0%
Total investment	0.0%	-0.6%	-0.8%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%
Total Unemployment (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Share informal labor supply (percentage points)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Unemployment (percentage points)									
un	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
lsa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sk	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
hsb	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
hsa	0.0%	-0.1%	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%	0.0%

Table A12: Stimulus to Agro-Industrial Sector. Financial Sector. and Mechanical and Electronic Industrial Sector (Policy H)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	0.0%	0.2%	0.2%	0.3%	0.3%	0.4%	0.5%	0.5%	0.6%
GDP Growth (percentage points)	0.0%	0.2%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%
Government Balance	-8859%	-186%	-118%	-107%	-98%	-75%	-62%	-53%	-46%
Social Security Balance	0.0%	0.0%	0.1%	0.1%	0.3%	0.4%	0.5%	0.5%	0.7%
Total investment	0.0%	0.5%	0.8%	1.0%	1.0%	1.2%	1.3%	1.4%	1.4%
Total Unemployment (percentage points)	0.0%	-0.2%	-0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.3%	-0.3%
Share informal labor supply (percentage points)	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.2%
Unemployment (percentage points)									
un	0.0%	-0.2%	-0.2%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	0.0%	-0.2%	-0.2%	-0.3%	-0.3%	-0.4%	-0.4%	-0.5%	-0.6%
lsa	0.0%	-0.3%	-0.3%	-0.5%	-0.5%	-0.7%	-0.8%	-0.9%	0.0%
sk	0.0%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	-0.4%	-0.4%
hsb	0.0%	-0.2%	-0.2%	-0.3%	-0.3%	-0.4%	-0.5%	-0.6%	-0.6%
hsa	0.0%	-0.3%	-0.3%	-0.5%	-0.5%	-0.6%	-0.6%	-0.8%	-0.8%

Table A13: An Integrated Policy Package (Policy I)

Variation in % compared to the reference scenario									
Macro Results	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
GDP	4.2%	5.4%	6.6%	7.4%	8.6%	10.0%	11.2%	12.4%	13.5%
GDP Growth (percentage points)	1.1%	1.3%	1.2%	0.8%	1.2%	1.3%	1.2%	1.1%	1.0%
Government Balance	-4508%	7%	-17%	20%	7%	26%	18%	20%	15%
Social Security Balance	5.4%	5.4%	7.6%	8.7%	9.4%	9.8%	9.5%	7.3%	-5.5%
Total investment	11.0%	13.5%	15.8%	17.7%	19.5%	21.7%	23.2%	24.3%	25.0%
Total Unemployment (percentage points)	-1.7%	-2.7%	-2.7%	-2.9%	-2.8%	-2.8%	-2.2%	-1.5%	-0.5%
Share informal labor supply (percentage points)	0.0%	0.0%	-0.2%	-0.2%	-0.4%	-0.4%	-0.4%	-0.3%	-0.2%
Unemployment (percentage points)									
un	-0.3%	-1.0%	-0.6%	-0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
lsb	-1.5%	-2.6%	-3.4%	-4.9%	-5.9%	-6.4%	-4.9%	-3.0%	-0.7%
lsa	-0.1%	-0.5%	-0.1%	-0.6%	-0.3%	-1.2%	-1.6%	-0.9%	0.0%
sk	-9.6%	-11.2%	-11.6%	-12.5%	-12.9%	-13.8%	-14.1%	-14.5%	-14.4%
hsb	1.1%	1.6%	3.4%	6.1%	9.3%	11.7%	14.3%	16.5%	19.1%
hsa	-0.2%	-0.9%	-0.8%	-1.7%	-0.7%	-0.8%	0.7%	1.7%	3.4%