Taxes, Natural Resource Endowment, and the Supply of Labor: New Evidence

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Abstract

We use the work-leisure choice model to compute equilibrium weekly hours worked for a number of Arab countries, where actual statistics are unavailable. We show that the labor supply curve is elastic in all Arab countries, and provide a new measure of labor productivity. This finding confirms previous research that workers respond to incentives, which has serious implications for tax and social security policies. We also provide some policy simulations pertinent to the effects of taxation on welfare and poverty.

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Keywords: Hours-worked, natural resource endowment, poverty, welfare.

1. Introduction

Our primary objective is to measure hours worked, which allows us to compute the Frisch elasticity of labor supply, and labor productivity in a number of Arab countries, for which no data have been published previously. The Frisch elasticity captures the elasticity of hours worked to the wage rate, given a constant marginal utility of wealth. Labor productivity is GDP per hours worked. We use the model to study the macroeconomic implications of some policy issues, such as the effect of taxes on welfare and poverty.

To measure weekly hours-worked, we calibrate a theoretical model, namely, the work-leisure choice model, which Nickell (2003), Prescott (2004) and Shimer (2009) demonstrated its goodness of fit to G7 data.[1] We use this model because the data of the main predicting factors (such as consumption, income, the tax rate and the share of capital) are available for the Arab countries.

Our sample for the Arab countries includes two groups of countries: oil-producing and non-oil-producing countries. The former do not tax income and consumption. However, the average effective marginal tax rate crucially determines the solution of the work-leisure choice model, i.e., the supply of labor. To deal with this problem, we introduce natural resource endowment in the production function of the oil-producing countries. The inclusion of natural resources in the model creates a wedge between real wages and the marginal product of labor similar to the *wedge* that taxes create. The increase in the share of natural resource reduces hours worked. It discourages work and reduces labor supply. This is because the wage rate in the oil-producing countries exceeds the equilibrium wage rate due to rent.

We make a number of contributions. First, we measure equilibrium hours worked for five Arab non-oil producers (Egypt, Jordan, Morocco, Syria, and Tunisia) and for

[1] Prescott (2004) provides evidence that – everything else being constant – significant differences in international hours worked almost disappear when tax rates are similar. Scandinavians pay relatively higher taxes; Ragan (2006) and Rogerson (2007) argued that Scandinavian governments subsidize market inputs into home production and provide more transfers (e.g. subsidized daycare) to households that supply more labor. Olovsson (2009) uses home production data to account for the differences in hours worked between Scandinavians and others.

seven oil-producers. These are, Algeria plus the Gulf Cooperation Council countries – GCC –, which include Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates (UAE) and the Kingdom of Saudi Arabia (KSA), for which the data on hours worked do not exist. Estimation of hours worked allows us to compute and analyze the Frisch elasticity of the labor supply, which has a major role in policy design. In addition, it allows us to measure productivity as GDP per hours worked in the Arab countries. Second, we are unaware of any published articles on the work-leisure model with a natural resource endowment. We modify the model and show that such endowment works just like a tax on labor supply. Third, a theory is valid if it fits different data at different times and places. So far, the bulk of the evidence for the work-leisure model relies on data from developed countries (the G7 and OECD). We confirm the validity of the work-leisure, intertemporal-intratemporal substitution model using data from the Arab countries. We show that Arab countries' labor supply curves are just like the G7 (also elastic), which has important policy implications.[2] People in non-oil-producing Arab countries work long hours, but their relative productivities are low, therefore, they are relatively poorer. People in oil-producing countries work much less, which is consistent with Noland and Pack (2007), among others, who show that fewer individuals are involved in the production and creation of wealth. Fourth, we solve the model stochastically and produce baseline projections of future labor supply for the Arab countries. Then we conduct policy scenarios. For the GCC oil-producing countries, we ask how much welfare will change if they embark on a policy to diversify their income, i.e., reduce the reliance on oil as the main source of income. We find very significant increases in the lifetime consumption equivalent, which is our measure of welfare. We also ask how much welfare will change because of the introduction of a permanent consumption tax.

Finally, we choose Morocco, which is a non-oil-producing country that has high poverty rate, and ask how long it will take to eliminate poverty if the government

[2] Lucas and Rapping (1969), Hall (1980), Andrew and Nickell (1982), Alogoskoufis (1987a, 1987b), Dutkowsky and Dunsky (1996), Nickell (2003), Prescott (2004), and Shimer (2009) among many others have provided evidence that support the model. Card (1991) cited a number of surveys at the micro level, which seem to suggest that the intertemporal substitution proposition offers little explanation to labor supply decisions. Heckman (1993) cited more supportive evidence. The literature is voluminous, but most cited work evidence against the intertemporal substitution model are Altonji (1982) and Mankiw, Rotemberg and Summers (1985).

reduces the effective marginal tax rate on households. We find that a small, permanent tax cut can reduce poverty by more than half in approximately 12 years. Section 2 summarizes the main features of the Arab economies, which have implications for the estimation of hours worked. We present the model in section 3. In section 4, we calibrate the model for the G7 countries and the Arab countries, estimate hours worked, compute the elasticity of labor supply, and labor productivity. Section 5 includes policy simulations. Section 6 is a conclusion.

2. A general description of the Arab economies

The Arab countries are heterogeneous economies, where the economic growth rates exhibit high volatility and their productivity levels are low, Makdisi *et al.* (2006). Countries such as the Sudan, Yemen and Mauritania are classified as low-income poor countries, while other such as the GCC countries are classified as high-income due to oil exports. The remaining North African and Middle Eastern countries are considered to be middle-income countries. Low- and middle-income countries are mostly labor-abundant countries with high unemployment rates, especially among the youth and educated females. Labor income transfers from abroad (remittance) have a major role in financing final private expenditure, leading to a significant increase of the consumption ratio relative to GDP. The GCC countries, on the other hand, are labor-scarce and their economies are dependent on expatriate labor, which creates a deep segmentation in labor markets. The GCC countries are also small open economies that do not impose direct income taxes because of their large natural resource endowments. Because of the rents extracted from the sale of the natural resources, the huge net operating surplus pushes the capital ratio to a high level that is significantly different from the average ratio observed in regular production functions. Almost all Arab countries are welfare states, where the government provides health care, education and unemployment benefits. The public sectors are relatively large, and in many countries, they are the main providers of job. Productivity statistics are, therefore, very difficult to measure because the public sector's output is hard to measure. Arab economies have low female participation rates.

However, in some GCC countries, the female participation ratio is high because of high wages in the public sector, and because the expatriate population is overwhelmingly active in the labor market. These structural economic features have significant impact on the average hours worked. In the GCC countries, hours are driven by the low tax rates, which tend to increase labor supply as is suggested by theory. However, large levels of rents tend to depress labor supply through inflating capital share and lowering the consumption ratio. These structural features of Arab economies seem to affect the labor supply.

Noland and Pack (2007) argue that Arab oil-producing countries are characterized by the generation of large oil rents and boom and bust cycles driven by the world price of their export. They show that the shares of rent in government revenues and in GDP are relatively high. These shares are between 70 to 85 percent of government revenues, and between 25 to 36 percent of GDP. They conclude: "fewer individuals are involved in the production of wealth, and the majority of them are involved in its distribution and consumption."

Finally, the quality of the data of the Arab countries is poor. The data do not conform to international standards. In the model, which we present here, two variables play a major part in estimating hours worked: real GDP and real consumption. The National Income Accounts in the Arab countries are problematic in the sense that they do not use household expenditures surveys to measure consumption; rather it is computed as a residual from the national income identity. Real GDP is computed from the expenditures side, and it is not a chain measure.

3. The Model

We begin with the model, which is found in Prescott (2004), to derive the labor supply.[3] A similar model is found in Nickell (2003) and Shimer (2009).

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[3] Prescott cites a number of papers as the basis of this theory: business cycle literature of Cooley (1995) and Cooley and Ohanian (1999); in the depression literature, he cites Kehoe and Prescott (2002); in public finance, Christaino and Eichenbaum (1992), and Baxter and King (1993); and in the stock market literature McGrattan and Prescott (2003) and Boldrin, Christian and Fisher (2001). The labor

The model's variables are lowercase. National Accounting Statistics are in uppercase. The utility function of a *stand in household* who faces a work-leisure decision is given by:

$$U = E\left\{\sum_{t=0}^{\infty}\beta^t[\log c_t + \alpha\log(100 - h_t)]\right\} \tag{1}$$

The utility function depends on the expected discounted sum of consumption c and leisure, where 100 is the number of hours available for individuals to work in a week and h is hours-worked in "market activities". The expectations operator E does not necessarily mean rational expectations, and $0 < \beta < 1$ is the discount factor and specifies the degree of patience. A high value means more patience for consumption and leisure. The parameter α is > 0 and denotes the value of the non-market productive time per household. It could be the relative value of the time spent working at home. Typically, it is the relative value of leisure. The production using this time is untaxed. The utility function includes one consumption good as in Christaino and Eichenbaum (1992).

The stock of capital evolves according to

$$k_{t+1} = (1-\delta)k_t + x_t\,, \tag{2}$$

where k is the stock of capital and x_t is gross investments. The depreciation rate is δ .

There is a *stand-in firm* with a Cobb-Douglas, constant returns to scale, technology of production:

$$y_t = A_t k_t^{\theta} h_t^{1-\theta} \geq c_t + x_t + g_t\,, \tag{3}$$

where g is government expenditure.

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supply is consistent with Lucas and Rapping (1969), Lucas (1972), Kydland and Prescott (1982), Hansen (1985) and Auerbach and Kotlikoff (1987).

Total factor productivity is *exogenous* and is given by A_t.[4] The parameter θ is the share of capital; $0<\theta<1$. For our purpose, we assume that technical progress is exogenous because it has no role in the inference being drawn.

The household's date t budget constraint is:

$$(1+\tau_c)c_t+(1+\tau_x)x_t=(1-\tau_h)w_t.h_t+(1-\tau_K)(r_t-\delta)k_t+\delta k_t+T_t, \qquad (4)$$

where w is the real wage, r is the real interest rate or rental capital, and T is transfer payment. The tax rates of consumption, investments, labor and capital are given by τ with the subscripts c, x, h, k, which denote consumption, investments, hours worked and capital, respectively.

We must emphasize the assumptions, as in Prescott (2004), that there is a government, which taxes consumption, investments, income from labor, etc., and the government budget constraint, which is unchanged in each period. All tax revenues, except those used to finance the pure public consumption good, are given back to the households either as transfer payments or in-kind. These transfers are lump sum, being independent of the household's income. Most of the public expenditures are substitutes for private consumption in the G-7 countries.

We see no reason for this not being the case in the Arab countries. In Prescott (2004), the substitution between public and private consumption is one-to-one, except for the military expenditures. The goods and services we are discussing here are typical: public education, health, etc. The assumption regarding the estimate of the pure public good g is twofold the military share's of employment times GDP.[5]

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[4] It is hard to model the evolution of technical progress A_{it} in the Arab countries because of the lack of data. The stock of R&D and patents registered in the US are very low. Saudi Arabia, Egypt, Syria, Jordan, Kuwait and the UAE combined registered 367 patents in the US during the period from 1980 to 2000. Compare that to Korea, which registered 6328 patents. In addition, human capital stock and its quality are poor; see Development Challenges for the Arab Region: A Human Development Approach, UN (2009).

[5] Prescott (2004) uses one consumption good following Christiano and Eichenbaum (1992). Rogerson (2003) finds that one consumption good is not a good assumption for explaining the aggregate labor

Clearly, this is a very simple tax system than in reality. Introducing a more realistic accelerated depreciation and investment tax credits would affect the price of the investment good relative to the consumption good, but it would not alter the inference drawn from this model. This is a simple macroeconomic model rather than a public finance model.

There are many different ways to compute the tax rate.[6] Prescott (2004) derives the tax rate in the model theoretically. He derives an aggregate effective marginal tax rate on labor income using both the tax rate on consumption τ_c and on labor τ_h. It is the fraction of additional labor income that is taken in the form of taxes, holding investments fixed.[7]

$$\tau = \frac{\tau_h + \tau_C}{1+\tau_C} \tag{5}$$

Following Prescott (2004), it is important to note that the National Income Account is adjusted to fit with economic theory, where households pay the taxes. The major adjustment is to treat "indirect taxes less subsidy" as "net taxes on final product". It means "net indirect tax" is not a cost component of GDP. Indirect taxes include value-added taxes, sales taxes, excise taxes, property taxes, etc., which are mostly levied on households.

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supply in Scandinavian countries, because Scandinavians spend more time working at home than others due to high income tax.

[6] There is a literature on the methods of estimating average marginal income tax rates in the US, where differences seem significant. Differences in the computation of income tax rates could affect the tax rate τ in model. For more on the debate, see Barro (1979), Seater (1982), Barro and Sahasakul (1983, 1986), Stephenson (1998), and Akhand and Liu (2002).

[7] Setting up the Langrange multiplier and taking the derivates with respect to c and h, we get:

$$\partial L / \partial c = (1/c) - \lambda(1+\tau_c) = 0 \Rightarrow \lambda = \frac{1}{c(1-\tau_c)};$$

$$\partial L / \partial h = \alpha/(100-h) - \lambda(1+\tau_h)w = 0 \Rightarrow \lambda = \frac{\alpha}{(1-\tau_h)(100-h)}\frac{1}{w}$$

$$\frac{\frac{\alpha}{100-h}}{\frac{1}{c}} = (\frac{1-\tau_h}{1+\tau_c})w = (1-\frac{\tau_h+\tau_c}{1+\tau_c})w = (1-\tau)w$$

Some indirect taxes such as diesel fuel taxes, property taxes on office buildings and sales taxes on equipments, etc. fall on all forms of products. It is assumed that two-thirds of the indirect taxes less subsidy fall directly on private consumption expenditures, and the remaining one-third is distributed evenly over private consumption and private investment.

Again, the National Accounting Statistics are in uppercase. The net indirect taxes on consumption, is:

$$IT_c = [2/3 + 1/3 \frac{C}{C+I}] IT, \tag{6}$$

where C is private consumption expenditures, I is private investment and IT is *net* indirect taxes. The model economy's consumption is $c = C + G - G_{mil} - IT_c$, where G is public consumption and G_{mil} is military spending. The model economy's output is given by $y = GDP - IT$.[8]

The consumption tax rate is:

$$\tau_c = \frac{IT_c}{C - IT_c}. \tag{7}$$

Taxes on labor income are two: the income tax with a marginal tax rate, and a social security tax. The social security marginal tax rate $\tau_{ss} = \dfrac{social\ security\ taxes}{(1-\theta)(GDP - IT)}$, where the denominator is labor income if labor is paid its marginal productivity.

The *average* income tax rate is

[8] In the Arab countries, public consumption is large, and so is the subsidy. In some Arab countries, only the *total* amount of subsidy is reported, which is the sum of production and consumption goods subsidy. Because of the large fuel subsidy, for example, the indirect tax rate is smaller than otherwise.

$$\bar{\tau}_{inc} = \frac{Direct\,Taxes}{GDP - IT - Depreciation}, \qquad (8)$$

where direct taxes are paid by households and do not include corporate income taxes. Prescott's estimate of the marginal labor income tax $\tau_h = t_{ss} + 1.6\bar{\tau}_{inc}$ and the number 1.6 reflects the fact that the marginal income tax rates are higher than the average tax rates. This particular number (1.6) delivers a marginal income tax found in Feenberg and Coutts (1993) for the "U.S.". Their calculation of the marginal income tax is based on a representative sample of tax records.

They calculate by how much the tax revenue increases if every household labor income is increased by one percent. The total change in tax receipts divided by the total change in labor income is their estimate of the marginal income tax. This assumption may not fit the Arab countries. For this reason, we use sensitivity analysis and report the figures in appendix 3. We recalibrated hours for values of 1.0, 1.6, 2.6 and 3.6. We prefer the central estimates because we believe the estimates are neither very low nor very high, and the tax rates in the Arab countries cannot be higher than 40 percent.

From the above we get the FOC, then the marginal rate of substitution equal to the price ratios:

$$\frac{\alpha/(1-h_t)}{1/c_t} = (1-\tau)w_t \qquad (9)$$

And from the production function, the marginal product of labor is equal to the real wage rate:

$$w_t = (1-\theta)k_t^{\theta}h_t^{-\theta} = (1-\theta)y_t/h_t \qquad (10)$$

The equilibrium labor supply is solved for from the two FOC above,

$$h_t = \frac{1-\theta}{(1-\theta) + \frac{c_t}{y_t}\frac{\alpha}{1-\tau_t}} \tag{11}$$

The ratio of consumption to GDP in equation (11) captures the intertemporal substitution. The tax rate in equation (11) captures the intratemporal substitution. If people expect the effective tax rate on labor income to be lower in the future, for example, they will increase their current consumption. It is important to note that our analysis of the labor supply abstracts from demographic factors, which are known to affects the supply of labor.

There is a voluminous literature of microeconomic analysis of the supply of labor, which is more difficult to incorporate into this simple macroeconomic model. Cole and Ohanian (1999, 2002), Chari, Kehoe and McGrattan (2003), and Fisher and Hornstei (2002) produced evidence of other factors that affect labor supply decisions. This paper focuses on the effect of a smaller number of variables to get a reasonable measure for hours worked in the Arab countries, which are unavailable. We also have insufficient demographic data to incorporate in our analysis.

3.1 Introducing natural resource endowment effect

For the GCC countries and Algeria, the theory predicts that a low tax rate τ increases hours worked. The GCC countries have a low tax rate. If we fit the model for the GCC, hours worked will be very high, greater than hours in the US and Japan, which is nonsensical. To ameliorate this problem, we modify the production function by introducing a natural resource (oil and gas) endowment.

The production function becomes:

$$y_t = A_t N_t^{\omega} k_t^{\theta} h_t^{1-\omega-\theta}, \tag{12}$$

where N_t could be the natural resource utilization rate, R_t. Stiglitz (1974) focuses on the ratio of resource utilization to the stock of natural resources, i.e., $\gamma = R / S$, while

Solow and Wan (1976) only use the flow.[9] The budget constraint in equation (4) will include income per capita from natural resources on the RHS.

$$(1+\tau_c)c_t + (1+\tau_x)x_t = (1-\tau_h)w_t.h_t + (1-\tau_K)(r_t - \delta)k_t + \delta k_t + T_t + (P_t^o N_t / \hat{P}_t), \quad (13)$$

where P_t^o is the international price of the natural resource, N_t is the flow of natural resources, and $\hat{P}_t$ is population.

Solving the model the same way gives:

$$h_t^N = \frac{1-\omega-\theta}{(1-\omega-\theta)+\frac{c_t}{y_t}\frac{\alpha}{1-\tau_t}}, \quad (14)$$

where the superscript N refers to natural resources. The share of hydrocarbon in output is ω. For ω>0, this formula predicts that h^N in equation (14) is smaller than h in equation (11). For ω=1, h^N <0 and for ω=0, h^N is identical to h. For $h_t^N \geq 0$, $\omega^{\max}$ must be equal to $1-\theta$.

4. Calibration

Developing countries in general and the Arab countries specifically do not report data on actual hours worked. Thus, we cannot measure the goodness of the fit of the model. To shed light on the performance of the model we will calibrate the model for the G7 first because these countries report actual hours worked. We describe the G7 data in the appendix 1 and the Arab countries data in appendix 2. Note that our data are measured in PPP term. To calibrate the model for countries, $i = 1, 2, \cdots N$, we fix the share of capital θ to the *average* of its value over the sample.

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9 In any case, it is immaterial for our case whether we have R_t or γ in the production function because the share parameter ω is what enters in the equilibrium solution of the hours worked.

The share of capital is measured from National Income Accounts, as gross operating surplus / GDP ratio. The ratio c_i / y_i is also the average over the sample.

The value of the effective marginal tax rate τ_i also varies across countries. Since we compare our estimates of hours worked to those of the G7 countries, we follow Prescott (2004) and choose the parameter α such that it maximizes the fit of the model (minimum error). However, for the Arab countries we choose α arbitrarily, because we do not have actual data. The results are reported in table 1.The upper panel of table 1 reports the calibration of the model's equilibrium hours – worked for the G7 countries, for data from 2000 to 2008.

The model fits Canada, Italy and Japan best; slightly over-predicting in the case of Canada, and slightly under-predicting in the cases of Italy and Japan. On average, however, the fit is fine with an error of 0.06. The G7's average of weekly hours worked per person is about 23.

The fit can be made tighter when we allow α to vary across countries. We do not report these results, but allowing α to vary across the G7 countries shows that for Italy, the model has a value of α equal to the average of 1.78. Three countries Canada, UK and the US have a value of α equal 1.6, which is below the G7 average. The non-English speaking countries France, Germany and Japan have a value of α higher than 2. These estimates of α indicate that the relative value of leisure is much higher in the non-English speaking G7 countries.

Now we can turn to estimating hours worked for the Arab non-oil producing. Those are also labor-abundant countries. We have data from 1991 to 2006. We compute the effective marginal tax rate. Note that there are no time series data for the marginal tax rates for Arab countries. Since our results will depend on our assumptions about certain parameters in the model, we conduct a sensitivity analysis.

From the National Income Account for each country, we calculate the share of capital as gross operating surplus to GDP.

The average value of θ is similar across Arab countries. Thus, we fix the share of capital, θ to the average, which is 0.48. Moreover, we try α of 1.78, which is the same as average G7 value.[10] Note that we do not have data or estimates for α in other non-G7 or OECD countries such as the Asian countries. We let c_i / y_i to differ across countries. We use the average of c_i / y_i over the sample. We do the same with the effective marginal tax rate. The lower panel of table 1 reports the results of h_i for the non-oil-producing Arab countries.

These estimates seem sensible relative to the G7. The average of the weekly hours worked per person is 19.87, which is lower than the G7 average of 23.4. Beginning with the most obvious, the Syrians work much more than all other countries (26.1 hours) because they have the lowest tax rate among Arabs, and their c / y ratio is less than average of the G7 countries. Egypt's estimate of hours worked is less than Jordan's despite the fact that the Jordon has a higher tax rate. This is because the consumption-output ratios are quite different. The Egyptians' c / y ratio is 0.98 while that of Jordan is 0.79. Egypt's c / y ratio significantly exceeds the G7 average.

All Arab non-oil-producing countries have a high consumption to output ratio, far exceeding the developed countries in PPP terms. The North African nations, Tunisia and Morocco, work less than the Syrians and the Jordanians because they pay relatively higher taxes. Both Morocco and Tunisia have average weekly hours worked of approximately 17.

The results in table 1 confirm the literature's findings that when people are taxed the same rate they, they most probably supply the same amount of labor. Taxes affect labor supply decisions in the Arab countries.

Our estimates of the Frisch elasticity in table 1 suggest that the labor supply curves for the Arab countries are elastic, particularly in Egypt, Morocco and Tunisia. These results are consistent with the literature.

[10] One could easily allow these parameters to change across countries, but we fix them because we are comparing hours in the Arab countries to the G7 hours, which are the yardstick for the fit of the model.

Prescott (2004) argues that elastic labor supplies spares countries the trouble of facing the choice of either increasing taxes on the young, thereby reducing their welfare, or not honoring the promise made to the old to avoid making them worse off. One policy implication for large labor supply elasticity is that as the population ages, promises of payment to the current and future old people do not necessarily have to be financed by increasing taxes.

Our estimates of the labor supply can explain why the non-oil-producing Arab countries have low productivity. Table 2 reports the decomposition of income per working age population relative to the average G7. We decompose GDP per working age population into GDP per hour and hours per working age population, i.e., labor productivity multiplied by labor utilization. The Arab non-oil producing countries do not seem to have problems with labor utilization. They work long hours, but their relative productivity level is significantly lower than the G7. The Arabs work relatively long hours, produce relatively less output per hour and they are poorer than the G7 countries. These results are sensible and hardly surprising. This model predicts that any increase in the tax rate in the Arab non-oil-producing countries will make them even poorer.

Now we turn to the oil-producing Arab countries. They also have labor shortages. The majority of the labor force is imported. These countries include the GCC countries plus Algeria. We have data from 1991 to 2003. The GCC's effective marginal tax rate is relatively very low, about 5 per cent. It represents social security tax. The GCC countries do not have income and consumption taxes. Algeria differs from the GCC in taxation. Algeria's effective marginal tax rate is 34 per cent.

We estimate hours-worked over two samples. The first sample is during the periods when the price of oil was low; hence, oil revenues to GDP were low. The second sample is when the price of oil was high; hence, the revenues to GDP were high. The share of hydrocarbon in GDP ω is from each country's budgets.

It is the ratio of oil and gas revenues to GDP, $p^o q^o /(p^o q^o + p^{no} q^{no})$, where the superscript o denotes hydrocarbon (oil and gas), hence p^o is the price of the hydrocarbons and q^o is the quantity. The superscript no denotes the non-hydrocarbon revenue.

Results of the estimates of hours worked for the GCC and Algeria are shown in table 3. For sensitivity analysis, we use values of α 1.3, 1.5 and 2.0. The average predicted equilibrium weekly hours worked in the GCC is between a high of approximately 20 hours and a low of 13, during the sample when oil revenues as a share of GDP were low. This is a sensible range compared with previous estimates of the G7, and Arab non-oil-producing countries. This average is lower than the average of the non-oil-producing Arab countries. Algerians work slightly longer hours than the average GCC, but less than Bahrain. Bahrain, Oman and the UAE predicted weekly hours worked exceed the average GCC. They also work longer hours than the average Arab countries do. Bahrain and Oman in particular implement active labor market policies to reduce unemployment and to encourage their citizens to work. Kuwait, Qatar and Saudi Arabia work relatively fewer hours than all other Arab countries.

Hours worked plummet in the second sample over the period of high hydrocarbon revenues. The average of hours worked falls, between 5 and 7 hours. For Algeria, it falls between 5 and 7 hours. Among the GCC, Oman's hours-worked decline is the largest, between 8 and 12 hours. On average, GCC’s hours worked could decline to nearly 8 hours a week due to higher hydrocarbon revenues. This says a lot about the extent of the rent in these economies and reflects the manifestation of the oil curse in the labor market. In the leisure – work model, leisure is a normal good. As income increases, the income effect induces workers to buy more leisure, hence less work.

5. Two policy simulation experiments

5.1. Diversification, consumption tax, and welfare in GCC

We provide a baseline, stochastic projection for hours worked until 2050. We choose 2050 arbitrarily to indicate the long run. Then we simulate policy scenarios.

The first policy scenario is about the welfare effect of taxes. The GCC countries have been discussing ways to diversify their income source, away from oil, for some time. Here, we assume that the GCC governments pursue policies to diversify the sources of income, i.e., relies less on oil. We study the effect of a reduction in the share of oil in GDP in the.

We examine the effect of a permanent reduction in the share of hydrocarbon in GDP, ω, by an amount equal to 0.25 standard deviations. We assume that the GCC countries have successfully managed to diversify their economies away from hydrocarbon by the year 2020, leading to a permanent reduction in the share of oil and gas in GDP from the year 2021 to 2050 (the end of our simulation). The share of oil and gas revenues, as we stated earlier, is $\omega = p^o q^o /(p^o q^o + p^{no} q^{no})$. Diversification is taken to mean a reduction in the value of ω coming through an increase in $p^{no} q^{no}$ (the non-hydrocarbon output), leading to a higher share of labor in the production function and a lower share of natural resources. The increase in labor supply increases output and consumption. We measure the welfare effect of the policy by the *lifetime consumption equivalent,* which is the change in real consumption required to make the households indifferent to the policy.

We solve the model numerically over the period 2004 to 2050 using stochastic simulation with 10000 iterations.[11] We set the parameters $\alpha = 2$ and $\theta = 0.51$, which are the average values for the GCC over the sample 1991-2003.

We assume that the parameter ω evolves as a random walk over the forecasting period; the error term has a mean of zero and a standard deviation equal to the sample value.

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[11] When solving, an approximated Jacobian is used when linearizing the model. Then the approximation is updated each iteration by comparing the residuals, which result from the new trial value of the endogenous variables with the residuals of the linear equation. The method is not significantly different from Newton, but it runs faster. The innovations to stochastic equations are generated by drawing a set of random numbers from a standard normal distribution each period. These draws are scaled to match the variance-covariance system by multiplying the vector by its standard deviation because the covariance matrix is diagonal.

To simplify the solution of the model further, we appeal to the stochastic implications of the lifecycle-permanent income theory of consumption, and assume that the conditional expectations of the future marginal utility of consumption follow a random walk (Hall, 1978). Working age population grows at historical trend. We assume that the starting value of the capital stock is twice as large as real GDP in 1960. We fix the depreciation rate at 0.05. The value of the exogenous technical change A in the production function is the constant term; we calibrate it such that the value of output in 2004 is not far away from 2003 in order to ensure we have a sensible projection.

The baseline level of consumption is increasing in all GCC countries, but leveling off in the far future. The consumption to output ratio projection depends on the projected level of output from the production function. In the baseline solution, Bahrain's ratio has a negative trend suggesting that output is projected to increase by more than consumption. This ratio rises in Kuwait, Oman and Saudi Arabia. The most significant positive trend is in Saudi Arabia. The ratio is constant in the UAE.

There has been a lot of discussion about introducing consumption tax in the GCC. Thus, our second policy simulation studies the effects of introducing a 5 percent permanent value added tax (VAT). A consumption tax τ_c in the GCC on welfare, translates to a 9.5% increase in the tax rate τ (equation 5). We re-solve the model again under this assumption.

The results of the two policy simulations are reported in table 4, which has 14 columns with the countries listed in the first column. We report the averages of the share of hydrocarbon in GDP ω; the standard deviation of ω; and the consumption to GDP ratio over the sample from 1991 to 2003. In the second panel, columns 5, 6 and 7 report the average projected hours worked, the value of the share of hydrocarbon, and the consumption – output ratio, c/y, respectively. In the third panel (columns 8, 9, 10 and 11), we report the results of the first policy, policy I.

In column 11, we quantify the policy of a $0.25\sigma_\omega$ reduction, in US dollars. In addition, in the last three columns we report the results of the second policy.

Note the jump in the labor supply under policy I. The reduction in the hydrocarbon revenues is very small because we intended to show the welfare impact of a small change in policy. The reduction is 0.1 on average, which is about 1.4 billion US dollars. This reduction in hydrocarbon revenues is matched by an equal reduction in government spending to keep the budget constraint unchanged. We assume that the government can reshuffle the budget in any way it chooses such that it remains fixed.[12]

Table 5 reports the lifetime consumption equivalent of the two policies. Clearly, the welfare improvement, resulting from the diversification policy and measured in lifetime consumption equivalent, is positive and sizable. In the case of Oman, it is 14 per cent, followed by Qatar (10.8 per cent) and Kuwait (9.3 percent). The Kingdom of Saudi Arabia gains relatively less from diversification because it is already the most diversified economy in the GCC. The share of manufacturing and agriculture in GDP are reasonably high. The World Bank Development Statistics reports Saudi Arabia's agriculture, manufacturing and services value added in the total GDP in 2008 to be 2.3, 8 and 27.2 percent, respectively. Bahrain is the smallest oil-producer; its main source of income is not oil. Its welfare improvement from the diversification policy is equal to that of Saudi Arabia. In the UAE, the welfare improvement measured by lifetime consumption equivalent is 5 per cent, the third lowest. The share of agriculture, manufacturing and services value added in 2006 reported by the World Bank Development Statistics are 2, 12.25 and 39.11 percent, respectively. Qatar, Kuwait and Oman benefit the most from diversification. Qatar and Kuwait rely heavily on hydrocarbon revenues.[13]An introduction of a permanent 5 per cent VAT reduces welfare by around 4.6 per cent in terms of lifetime consumption equivalent. The positive change in the labor supply, resulting from the diversification policy, is greater in magnitude than the negative change resulting from the tax policy. One can only imagine a sizable welfare effect of a policy change larger than 0.25 standard deviations in hydrocarbon share in the economy. The point is clear: diversify and benefit.

[12] The Penn table 6.2 data are only available to the year 2003 for the GCC countries.

[13] The Kuwaiti data are available from the same source for 2003 only. The shares are 0.46, 2.27 and 48.5 percent, respectively. We do not have similar data for Qatar or Bahrain.

5.2 Tax policy, labor supply and poverty reduction

Here, we discuss the policy simulation pertinent to poverty reduction in the Arab countries. The question is about the efficacy of tax policy in reducing poverty. We ask whether a decrease in the tax rate, which increases the supply of hours, productivity and GDP, reduces poverty. And, if so, by how much and how long does it take?

We choose Morocco as a case study for poverty for two reasons. Morocco's poverty level is high, 21 per cent of the population, and because we have some data on income distribution. The poverty data are based on the World Bank data found in POVNET for the year 2007 and the base year for real expenditures in 2005. For this reason, we use data for real consumption and output from the Penn Table 6.3, which has data up to 2007 for Morocco and the base year is 2005.

We solve the model over the period 1991-2006, and simulate the model stochastically with 10000 iterations over the period 2008 to 2040. In the baseline solution, τ the effective marginal tax rate, is equal 0.39. We set α to 1.78, which is the average we used earlier, and the share of capital θ equal to 0.55, which is also the average over the sample.

Here, too, we guess that the capital stock's starting value is twice the size of real GDP in 1960. We assume the depreciation rate 0.05. Consumption is a random walk, with a standard normal error term of a zero mean and standard deviation equal to that of the sample average from 1991-2007. The value of the exogenous technical change A in the production function is the constant term, and calibrated such that the value of output in 2008 is not far from the value at 2007 in order to ensure we have a sensible projection. The policy reduces the tax rate to 0.30 permanently.

The simulated values of real consumption are used to compute poverty headcount. There are three parameters in the poverty function: mean real consumption expenditures, Gini coefficient and the poverty line. We fix the poverty line at 72 US dollars per household, per month, in PPP terms. The Gini coefficient is fixed.

The only parameter that changes is mean real consumption expenditure, which is updated over the simulation period. We report the results in table 6. Figure 1 plots the poverty reduction dynamics.

Clearly, a tax reduction policy reduces poverty. As income level rises, and growth rate of real consumption rises, poverty declines by more than half in 2020, i.e., in 12 years. Everything else remains unchanged; poverty could be eliminated by 2050. One can clearly advocate more tax reduction than the one we assumed, and cut poverty even faster and by more.

6. Conclusions

The absence of data on hours worked makes policymaking very difficult. Our main contribution is to provide model-consistent estimates of hours worked, the Frisch elasticity of labor supply and labor productivity for the Arab countries, and compare them with the G7 countries. We use the work-leisure model of the labor supply, which has been tested extensively in the literature. This paper uses data from Arab countries to confirm the predictions of the model and add more supporting evidence to existing ones.

We found that supply of labor of a number of Arab countries is just as elastic as labor supply in the G7 countries, and labor productivity is relatively lower than the G7 countries.

There are two types of Arab countries: non-oil-producing countries such as Egypt, Jordan, Morocco, Syria, and Tunisia and major oil-producing countries such as the Gulf Cooperation Council (GCC) members. Algeria is a major gas producer.

Although the model explains the data of the first group of Arab countries well, where results are comparable to the G7, the second group of Arab countries (the GCC) is more interesting because there are no taxes in these countries. Without taxes, the model's performance and predictions are of limited value.

To ameliorate this deficiency, we introduce natural resource endowment effect in the work-leisure model. We define effective capital as the product of physical capital and natural resource capital. We found that natural resource endowment acts like a tax, i.e., reduce labor supply.

Oil rich GCC countries rely heavily on their natural resources as income. The government budget swells during periods of high oil and gas prices, which beget rents. The opposite happens when hydrocarbon revenues decline and the budgets shrink. People work longer hours to compensate for the loss in rent, and smooth out consumption. We show that the data support such a theory over periods of actual high and low hydrocarbon revenues. The supply of labor could decline by up to 7 hours a week per person during periods of high oil revenues.

In terms of the estimated Frisch elasticity, the Arab countries labor supplies are found to be very elastic, more so in the oil-producing countries. An elastic labor supply could imply less interventionist government policies. In addition, as populations' age, transfer payments to current and future old generations need not be financed by increasing tax rates. It can open doors to social security policies that encourage savings (Prescott, 2004). Elastic labor supplies are also good for demand policies that aim at increasing employment and hours.

We simulate the model for scenarios under a minimum number of additional assumptions. We demonstrate that a reduction in the effective marginal tax rate in the Arab countries can reduce poverty substantially, cut it in half in about 12 years in the case of Morocco. High taxes, even a 5 percent increase in the value added tax (VAT), in the oil-rich countries would reduce welfare in terms of the lifetime consumption equivalent. But, most importantly, the model suggests that welfare significantly increases as oil revenues decline in oil-producing countries. To change the natural resource curse to a blessing, it is recommended that the GCC countries diversify their income away from oil while they can. Our results indicate that a permanent reduction of hydrocarbon by the year 2020 could increase labor supply, real GDP and consumption, leading to a significant welfare improvement.

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Table 1: Actual and Predicted Labor Supply for the G7 and Arab non-oil Producing Countries

$h = (1-\overline{\theta})/(1-\overline{\theta}) + (c/y)(\overline{\alpha}/1-\tau)$

Estimates of the Labor Supply for the G7 (2000-2008)							
Country	Actual h	Predicted	Difference	α	θ	τ	c/y
Canada	25.26	23.60	1.66	1.78	0.38	0.38	0.70
France	20.08	22.73	-2.65	1.78	0.38	0.37	0.75
Germany	19.33	21.88	-2.54	1.78	0.38	0.42	0.73
Italy	21.09	22.45	-1.36	1.78	0.38	0.40	0.72
Japan	26.98	28.40	-1.41	1.78	0.38	0.25	0.66
UK	24.05	21.30	2.75	1.78	0.38	0.38	0.80
US	26.06	23.71	2.35	1.78	0.38	0.30	0.79
Average G7	**23.26**	**23.20**	**0.06**	**1.78**	**0.38**	**0.35**	**0.73**

Estimates of the Labor Supply for the Arab Countries (1991-2006)							
	Actual	Predicted	Frisch Elasticity	α	θ	τ	c/y
Egypt	NA	18.47	4.4	1.78	0.48	0.24	0.98
Jordon	NA	21.03	3.8	1.78	0.48	0.28	0.79
Morocco	NA	16.68	5.0	1.78	0.48	0.39	0.89
Syria	NA	26.10	2.8	1.78	0.48	0.19	0.67
Tunisia	NA	17.11	4.8	1.78	0.48	0.35	0.92
Average	**NA**	**19.87**	**4.1**	**1.78**	**0.48**	**0.28**	**0.85**

1. Both $\overline{\alpha}$ and $\overline{\theta}$ are the average values across G7 countries. The individual values of α for G7 which minimizes the error are 1.6 (Canada), 2.2 (France), 2.1 (Germany), 1.7 (Italy), 2.1 (Japan), 1.6 (UK) and 1.6 (USA) respectively. Same average value of α is adopted for the Arab countries. Frisch elasticity is $h/100-1$

Table 2: Productivity Decomposition of Arab Non-Oil Producing Countries Relative to Average G7 – Sample 1991 to 2006

Hours are based on a value of $\alpha = 1.78$

Country	GDP per Person	GDP per Hour	Hours per Person
Egypt	15.80	21.48	73.55
Jordan	12.73	15.17	83.89
Morocco	15.90	23.97	66.32
Syria	6.21	5.94	104.6
Tunisia	22.06	32.43	68.03
G7	100.00	100.00	100.00

Table 3: Labor Supply with Natural Resource Endowment for Oil Producing Countries $\hat{h}^N = (1-\theta-\omega)/[(1-\theta-\omega)+(c/y)(\alpha/1-\tau)]$

($\alpha = 1.29$)

	Low Hydrocarbon Revenue Period 1991-1999						High Hydrocarbon Revenue Period 2000-2003						
	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	Difference in hours
Algeria	20.4	3.9	0.34	0.73	0.47	0.19	13.2	6.6	0.38	0.61	0.55	0.27	-12.6
Bahrain	25.8	2.9	0.05	0.73	0.49	0.19	18.8	4.3	0.05	0.72	0.53	0.26	-7.0
Kuwait	12.8	6.8	0.05	0.81	0.49	0.36	7.2	12.8	0.05	0.71	0.53	0.40	-5.6
Oman	21.7	3.6	0.05	0.83	0.49	0.22	9.8	9.2	0.05	0.73	0.53	0.37	-11.9
Qatar	15.4	5.5	0.05	0.78	0.49	0.33	13.1	6.6	0.05	0.42	0.53	0.39	-2.30
KSA	16.9	4.9	0.05	0.74	0.49	0.32	7.9	11.7	0.05	0.65	0.53	0.40	-9.0
UAE	26.0	2.8	0.05	0.63	0.49	0.23	19.6	4.1	0.05	0.65	0.53	0.27	-6.4
Average	**19.8**	**4.43**	**0.05**	**0.75**	**0.49**	**0.29**	**12.72**	**8.14**	**0.05**	**0.65**	**0.53**	**0.35**	**-7.83**

($\alpha = 1.55$)

	Low Hydrocarbon Revenue Period 1991-1999						High Hydrocarbon Revenue Period 2000-2003						
	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	Difference in hours
Algeria	16.5	5.0	0.34	0.73	0.47	0.19	10.6	8.5	0.38	0.61	0.55	0.27	-5.9
Bahrain	21.2	3.7	0.05	0.73	0.49	0.19	15.2	5.6	0.05	0.72	0.53	0.26	-6.0
Kuwait	10.2	8.8	0.05	0.81	0.49	0.36	5.7	16.5	0.05	0.71	0.53	0.40	-4.5
Oman	17.6	4.7	0.05	0.83	0.49	0.22	7.7	11.9	0.05	0.73	0.53	0.37	-9.9
Qatar	12.4	7.1	0.05	0.78	0.49	0.33	10.5	8.6	0.05	0.42	0.53	0.39	-1.9
KSA	13.6	6.4	0.05	0.74	0.49	0.32	6.2	15.2	0.05	0.65	0.53	0.40	-7.4
UAE	21.4	3.7	0.05	0.63	0.49	0.33	15.9	5.3	0.05	0.65	0.53	0.27	-5.5
Average	**16.07**	**5.72**	**0.05**	**0.75**	**0.49**	**0.29**	**10.19**	**10.51**	**0.05**	**0.65**	**0.53**	**0.35**	**-5.0**

($\alpha = 2$)

	Low Hydrocarbon Revenue Period 1991-1999						High Hydrocarbon Revenue Period 2000-2003						
	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	$\hat{h}^N$	Frisch elasticity	τ	c/y	θ	ω	Difference in hours
Algeria	13.3	6.5	0.34	0.73	0.47	0.19	8.40	10.9	0.38	0.61	0.55	0.27	-4.9
Bahrain	17.2	4.8	0.05	0.73	0.49	0.19	12.20	7.2	0.05	0.72	0.53	0.26	-5.0
Kuwait	8.1	11.4	0.05	0.81	0.49	0.36	4.50	21.4	0.05	0.71	0.53	0.40	-3.6
Oman	14.2	6.0	0.05	0.83	0.49	0.22	6.10	15.4	0.05	0.73	0.53	0.37	-8.1
Qatar	9.9	9.1	0.05	0.78	0.49	0.33	8.30	11.1	0.05	0.42	0.53	0.39	-1.6
KSA	10.9	8.2	0.05	0.74	0.49	0.32	4.90	19.5	0.05	0.65	0.53	0.40	-6.0
UAE	17.4	4.7	0.05	0.63	0.49	0.23	12.8	6.8	0.05	0.65	0.53	0.27	-4.4
Average	**12.96**	**7.38**	**0.05**	**0.75**	**0.49**	**0.29**	**8.11**	**13.56**	**0.05**	**0.65**	**0.53**	**0.35**	**-4.8**

θ is the share of capital. τ is the effective marginal tax rate; c/y is consumption to GDP ratio; $\hat{h}^N$ is equilibrium hours-worked predicted by the model; and ω is the share of hydrocarbon revenues in GDP. Frisch elasticity is $h/100-1$.

Table 4: Taxes, Natural Resources and Labor Supply Projections for GCC

Average values

Country	Average Sample Data (1991-2003)			Base Run (2004-2050)			Policy I (2020 – 2050)				Policy II (2004 – 2050)		
	ω	σ_{ω}	c/y	h^N	ω	c/y	h^N	ω	$0.25\sigma_{\omega}$ in million USD	τ	h^N	ω	τ
Bahrain	0.22	0.04	72.5	16.4	0.25	71.0	17.1	0.24	153.3	0.05	15.7	0.25	0.095
Kuwait	0.38	0.07	83.7	11.4	0.35	64.3	12.5	0.33	1017.2	0.05	10.9	0.35	0.095
Oman	0.26	0.07	79.5	7.4	0.39	73.3	8.8	0.37	839.8	0.05	7.0	0.39	0.095
Qatar	0.37	0.07	65.7	13.4	0.36	39.2	14.8	0.35	351.7	0.05	12.8	0.36	0.095
KSA	0.32	0.04	70.7	16.2	0.29	60.4	17.0	0.28	3812.9	0.05	15.6	0.29	0.095
UAE	0.30	0.07	63.5	18.7	0.23	66.1	19.9	0.21	2187.5	0.05	18.0	0.23	0.095
GCC	**0.31**	**0.06**	**72.6**	**13.9**	**0.31**	**62.38**	**15.0**	**0.30**	**1393.7**	**0.05**	**13.6**	**0.31**	**0.095**

h_t^N is hours-worked (equation 10).

ω is the share of oil and gas (gas is converted into oil using the standard scale of 6.6).

σ_{ω} is the standard deviation of the natural resource revenues in GDP.

c/y is the consumption to GDP ratio.

τ is the tax rate.

Consumption and ω follow a random walk process over the simulation horizon from 2004 to 2050.

Policy I is the diversification policy, where the GCC manages to diversify by 2020, and reduce the share of hydrocarbon by $0.25\sigma_{\omega}$.

Policy II is the tax rate increases policy, where a 5% permanent increase in VAT (9.5 percent in the tax rate in equation 5).

Table 5: Lifetime Consumption Equivalent

Country	Policy I	Policy II
Bahrain	3.87	- 4.79
Kuwait	9.29	- 4.80
Oman	13.99	- 3.77
Qatar	10.88	- 4.78
KSA	4.21	- 4.81
UAE	5.07	- 4.82

- Policy I is the diversification policy, where the share of hydrocarbon in GDP falls by 0.25 standard deviation from 2021 to 2050.
- Policy II is an introduction of a 5 percent permanent increase in VAT, which amounts to a 9.5 percent increase in the tax rate.

Table 6: Morocco's Poverty Reduction Policy Simulation

	Hours		GDP Per Capita		$\partial y / d\tau$	Income Multiplier	Δc_t^s	Poverty %
2007	Baseline	Policy	Baseline	Policy				21.59 [i]
2008	15.99	17.97	5682.52	6014.69	-1.27	5.85	2.26	20.48
2010	15.96	17.94	5905.58	6280.19	-1.15	6.34	2.58	18.27
2015	15.97	17.95	6487.00	6967.58	-0.94	7.41	1.69	14.72
2020	15.92	17.90	7076.94	7662.59	-0.81	8.28	1.20	10.50
2025	15.93	17.91	7703.77	8395.41	-0.72	8.98	2.68	7.57
2030	15.92	17.90	8356.12	9154.61	-0.66	9.56	1.51	5.61
2035	15.93	17.91	9042.68	9949.86	-0.62	10.03	1.74	4.01
2040	15.94	17.92	9767.29	10785.58	-0.58	10.43	1.37	2.92
2045	15.93	17.91	10527.96	11659.88	-0.56	10.75	1.31	2.11
2050	15.92	17.90	11328.41	12577.27	-0.53	11.02	1.46	1.54

i Actual data

-Data are in PPP 2005 base year. Real PPP GDP.

- $\partial y / d\tau$ is the tax multiplier, where an increase in the tax rate reduces income.

- $(y^s - y^b / y^b)100$ is the GDP multiplier, where the superscript s denotes simulation solution value and b denotes the baseline simulation value.

- Δc_t^s is the consumption growth after policy.

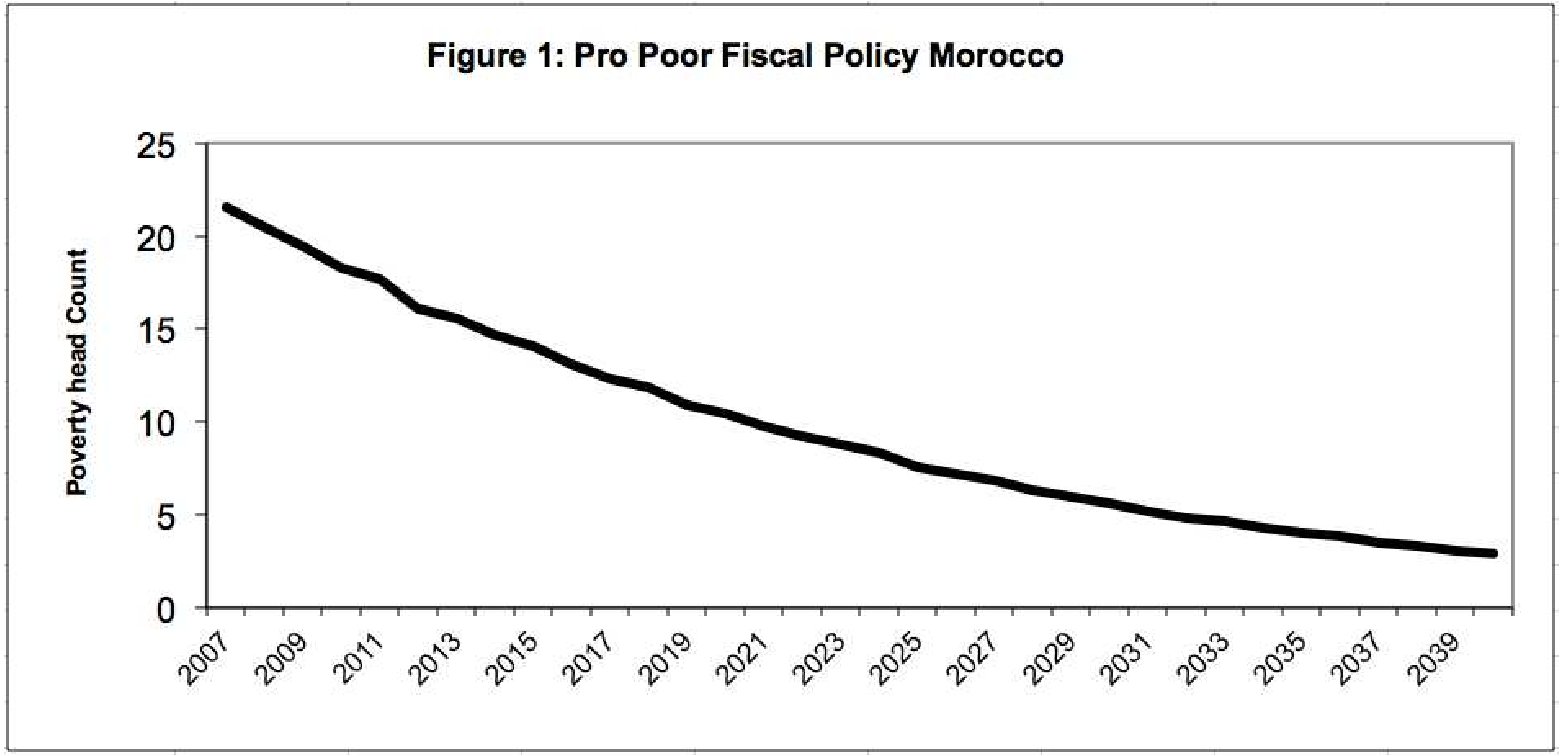
Figure 1: Pro Poor Fiscal Policy Morocco
Poverty head Count
25
20
15
10
5
0
2007
2009
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039

Appendix 1 – Data

Average 2000-2008	Canada	France	Germany	Italy	Japan	UK	USA
General government final consumption expenditure, %GDP	19.24	23.31	18.70	19.62	17.86	20.54	15.58
Consumption of fixed capital, % GDP	13.01	13.00	14.89	15.28	20.62	11.26	11.85
Household final consumption expenditure, % GDP	55.84	56.46	58.47	59.04	57.08	64.88	70.03
Working Age Population to Total Population	0.69	0.63	0.67	0.67	0.66	0.66	0.67
Employment to Age working population	0.72	0.65	0.67	0.58	0.75	0.71	0.72
Taxes individuals, % GDP	12.23	7.64	8.91	10.72	5.19	10.48	10.38
Social Security Contributions, Employees % GDP	2.01	4.02	6.11	2.30	4.28	2.64	3.00
Taxes on goods and services, % GDP	8.42	11.00	10.35	11.01	5.22	10.97	4.73
Military Expenditure, % GDP	1.20	2.46	1.38	1.92	0.97	2.46	3.76
τ_c	0.16	0.22	0.20	0.20	0.09	0.19	0.07
τ_{ss}	0.04	0.07	0.11	0.05	0.07	0.04	0.05
Capital Share	0.38	0.35	0.38	0.46	0.35	0.34	0.37
τ_{inc}	0.16	0.10	0.12	0.15	0.07	0.13	0.12
τ_h	0.28	0.23	0.30	0.28	0.18	0.26	0.25
τ	0.38	0.37	0.42	0.40	0.25	0.38	0.30
c / y	0.70	0.75	0.73	0.72	0.66	0.80	0.79
GDP Per Person, GDP Less IT in PPP 2005 divided By Population aged 15-64	42510.72	38698.09	37867.03	35733.27	40045.97	39364.55	57049.32

Source:OECD

Data Appendix 2

(average 1991-2006)

Country	Actual Weekly Worked Hours	Capital Share	Consumption Output Ratio, PWT 6.2 (1991-2003/04)	Investment Ratio, PWT 6.2 (1991/03/04)	Population (Millions)	Labor force (Millions)	Employment (Millions)	Population Aged 15-64 % Total Population	Employment to Population Aged 15-64
Algeria		0.51	0.69	12.67	29.79	10.46	8.01	60.14	0.44
Bahrain		0.35	0.73	9.89	0.63	0.29	0.27	68.50	0.64
Egypt		0.45	0.96	5.41	64.91	19.24	17.35	58.89	0.45
Kuwait		0.57	0.84	10.67	2.05	1.08	1.09	70.99	0.74
Jordan		0.36	0.77	14.39	4.60	1.23	1.21	68.35	0.38
Morocco		0.56	0.90	11.52	27.76	9.56	8.55	60.67	0.51
Oman		0.53	0.80	9.30	2.29	0.82	0.76	59.81	0.55
Qatar		0.50	0.66	18.70	0.61	0.34	0.33	73.49	0.72
KSA		0.51	0.71	9.96	20.06	6.64	6.34	58.67	0.54
Syria		0.33	0.73	7.79	16.06	4.73	5.09	55.11	0.57
Tunisia		0.24	0.92	13.35	9.33	3.09	2.71	62.78	0.46
UAE		0.61	0.63	23.12	3.04	1.75	1.72	73.98	0.75
Source	ILO	UN	WDI-PWT	PWT	WDI	WDI	ILO	WDI	ILO

country	Employment to total population Ratio	Oil and Gas Reserves, Billions Barrels of Equivalent Oil	GDP Per Capita PPP PWT 6.2 (1991/03/04)	τ_c	τ_{ss}	τ_{inc}	$\tau_{inc} + \tau_{ss}$	τ	ω Share of Hydrocarbon Revenues
Algeria	0.27	38.0	4826.0	0.18	0.05	0.10	0.21	0.33	0.23
Bahrain	0.44	0.8	15562.4	0.00	0.04	0.01	0.05	0.05	0.22
Egypt	0.27		3955.0	0.09	0.05	0.08	0.17	0.24	
Kuwait	0.53	107.7	21698.5	0.00	0.04	0.00	0.04	0.04	0.32
Jordan	0.26		3835.6	0.16	0.04	0.08	0.16	0.28	
Morocco	0.31		3630.0	0.19	0.10	0.11	0.28	0.39	
Oman	0.33	9.7	13127.0	0.00	0.04	0.01	0.05	0.05	0.20
Qatar	0.53	113.6	23284.6	0.00	0.03	0.00	0.03	0.03	0.35
KSA	0.31	302.4	14086.7	0.00	0.06	0.00	0.04	0.04	0.25
Syria	0.31		1799.0	0.00	0.00	0.12	0.20	0.19	
Tunisia	0.29		6296.2	0.22	0.05	0.08	0.16	0.31	
UAE	0.56	137.8	24455.5	0.00	0.04	0.00	0.02	0.01	0.26
Source	ILO	BP	PWT	WDI, IFS	SS	WDI, IFS	Computed	Computed	WDI, IFS

ILO is the International Labor Organization
BP is British Petroleum
PWT is Penn World Table 6.3
WDI is World Bank
IFS is International Financial Stats, the IMF

Appendix 3

Sensitivity Analysis of the Effective Marginal Tax Rate Calculations

	Lower Bound Estimate		Central Estimate		Upper Bound Estimate			
Country	τ_1	h	τ_2	h	τ_3	h	τ_4	h
Algeria	0.28	17.8	0.33	16.8	0.41	15.1	0.50	13.1
Egypt	0.20	21.5	0.24	20.6	0.31	19.1	0.38	17.5
Jordan	0.24	24.4	0.28	23.4	0.34	21.9	0.41	20.0
Morocco	0.34	19.9	0.39	18.6	0.49	16.1	0.58	13.7
Syria	0.12	30.6	0.19	28.8	0.32	25.4	0.44	21.9
Tunisia	0.30	20.3	0.35	19.2	0.43	17.2	0.51	15.1
Average	**0.24**	**22.4**	**0.28**	**21.3**	**0.44**	**19.1**	**0.45**	**16.8**

τ_1 corresponds to a tax rate with $\tau_h = t_{ss} + 1\overline{\tau}_{inc}$

τ_2 corresponds to a tax rate with $\tau_h = t_{ss} + 1.6\overline{\tau}_{inc}$

τ_3 corresponds to a tax rate with $\tau_h = t_{ss} + 2.6\overline{\tau}_{inc}$

τ_4 corresponds to a tax rate with $\tau_h = t_{ss} + 3.6\overline{\tau}_{inc}$

See definitions of the social security tax and tax on income in the appendix. τ_{ss} τ_{inc}

$h = (1-\theta)/[(1-\theta)+(c/y)*(\alpha/1-\tau)]$ are hours-worked using predicting factors $\theta = 0.48$; average Arab countries c/y and $\alpha = 1.55$