Impact of world demand shock
an illustration using a macro model of Morocco

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This paper describes the impact of world demand shock on Moroccan economy using the macro econometric model. The model has been built using annual data and is aimed at improving the current analysis in many ways: it can provide short run forecast of the economy, it can provide analytical exercises and it can explore the effect of unanticipated shocks or of policy change.
The model mingles short run Keynesian dynamics with a consistent neo-classical supply side. In the current version, potential output is given by a constant-returns-to- scale Cobb-Douglas production function. In the long run, potential output is determined by the working age population, total factor productivity and the real cost of capital.
The short run dynamics is determined by an error-correction model, which implicitly assumes the presence of adjustment costs that smooth the convergence towards the long run equilibrium.
The model allows understanding the evolution of a range of macroeconomic variables. Moreover, the model demonstrates good potential for policy simulations. It's responses to standard shocks are in line with usual analytical exercises and with the economic observations.
The policy simulation of the model is illustrated by the simulation of foreign demand shock. The increase of world demand influence heavily Moroccan economy, considered as a relatively liberal economy with a higher diversification of the external trade. The simulation shows the importance of foreign demand in terms of their global positive effect on aggregate demand, employment and growth.

Keywords: Macro econometric model, Forecasting, policy simulation, simulation of world demand shock.

The present model is a medium, compact, and aggregate macro model. It can be divided into five blocks: Production, Prices, Wages, Households and External trade. There are 140 equations in the model, among which 120 accounting identities or technical relationships and 20 econometric equations. These econometric equations are usually in error correction form and estimated by one stage ordinary least squares. We use annually data and estimation period is from 1990 to 2012. The model is run with the software Eviews and T-Student is shown in parenthesis. (Desegregated version of this model exists and is more developed with 270 equations)

The remainder of the paper is structured as follows. Section 1 presents the database used and how missing data were constructed. Section 2 develops the theoretical framework of the model and reviews the main equations of the model. Section 3 presents an analytical simulation to describe the response of Moroccan economy to an external shock (increase of the world demand).

I - The Database and the Accounting Framework

The aim of the model is to provide an instrument to analyze the evolution of the GDP and its principal components, as well as that of prices, employment, etc. It might also be useful to forecast over a short-term horizon the evolution of Moroccan economy.

The primary source of data is the annually national accounts published by the National Account Office, High Commission of Planning (HCP) in SEC 98 basis. Other sources are:
-Statistics Office (HCP) : prices, employment and unemployment;
-Demographic Research and Study Centre (HCP): Urban and rural population by age group.
-Exchange Office: foreign trade and exchange rates;
-Ministry of Finance and Economics: public finance statistics and other statistics;
-Central Bank: monetary and financial statistics of Morocco;
-International Monetary Fund: (international financial statistics), international trade, foreign prices, exchange rates and other statistics.
In addition, certain crucial data for economic analysis are lacking. This means that data have been reconstructed for productive capital and employment.

Data from National Accounting provide investment series, in value and in volume. It therefore includes information that is useful for the calculation of a series for the capital stock. To calculate the stock of capital in volume (K), the following accumulation model is used:

$$K_t = (1-\delta_t).K_{t-1} + I_t$$

With information on investment (I) and the depreciation of capital (δ), this equation makes it possible to compile the series for capital once a point in the series is chosen.
The capital in initial year K_{t0} is estimated by I_{t0} /(δ+Average growth rate real GDP)
The average rate of depreciation is estimated to be 5% for developing countries.

The gross data used for the employment series emanate from Moroccan Statistics Office. Employment and unemployment rate in rural area, database is available since 1998. For the period between 1990 and 2O12, the series were back-calculated using census national data of 1994.

II Theoretical framework and the main equations of the model

To formulate econometric equations we will look for a satisfying description of the behavior of agents, by checking economic theory against available data. We shall define alternate formulations with unknown parameters, compute for each formulation the values which give the best explanation of past evolutions, and make our selection, using as criteria both statistical tests and compliance to economic theory. This process can lead us to introduce new variables, or to change some definitions, which could mean reformulating some identities.

II.1 The demand side

II-1.1-houshod's income and consumption

In the model, household's disposable income is endogenously determined by an aggregation of its different components: gross operating surplus, compensations, financial income, income taxes, social contributions, social benefits and transfers. Household revenue separates wages (employment x wage rate) and non-wage revenue, both from production and from government transfers.

Household consumption depends on revenue, inflation, interest rate and unemployment. Consumption is reduced by an increase of the real short run interest rate or by an increase of the inflation rate. A rise of unemployment reduces the expected future income of households and leads them to increase their precautionary savings. The econometric properties of the equation are satisfying and consumption converges rapidly towards its long-term level.

```
dlog(co)=0,73*dlog(rdr)+0,87*log(rdr(-1)/co(-1))-0,84*d(cho_u/(l+cho_u))-0,82*@pch(pco)
          (3,47)          (3,17)                  (-0,95)                  (-0,85)
        -0,01*(tic-100*@pch(pco))- 0,02*(t-2008)*(t<=2008) - 0,23
        (-1,04)                    (-2,44)                  (-3,09)
R² =0,84                DW =1,88
```

Co :household consumption — Rdr: real disposable income
Cho: unemployment — L: employment
Pco: consumer prices — Tic: short-term interest rate

II-1.2- Inventories

Inventory behavior comes from a number of motives, including the desire to smooth the fluctuations of production, to constitute a buffer against unanticipated changes of demand or to avoid a stock out. The desired level of stock is assumed depends on added value . The equation thus reads:

```
ds/q_m(-1)= 0,19*@pch(Q_m)
            (3,18)
R² = 0,60               DW = 1,32
```

Ds : inventorie
Q_m : market added value

II-1.3-Trade

II-1.3.1-Exports

Exports depend, in addition to price competitiveness, on the world demand for Moroccan products. However, local production capacity has no effect on Moroccan exports, as exports limits are due (in addition to the world demand and competitiveness) to the adaptation of Moroccan offer to the world demand.

```
dlog(x)= 0,41*dlog(dm)-0,42*dlog(compx)-0,14*(log(x(-1)/dm(-1))- 0,07*(t-2008)*(t<=2008)
          ( c )          ( c )           ( c )                    ( c )
        -0,6*log(compx(-1))+2,37
         ( c )              (24,25)
R² = 0,63                       DW = 2,19
```

X: Export — Dm: world demand
Compx: competitive export prices — C: forced parameter

This equation is essentially calibrated because the estimated results are not acceptable.

II-1.3.2-Imports

For imports, in addition to competitiveness, they are determined by local demand. This demand is expressed in final and intermediate goods to satisfy not only local demand but also exports.

dlog(m)= 1*DLOG(DF+ct*Q_m)-0,4 p_m(2)*LOG(COMPM)+ 0,8*log(ut)- 0,31-
(c) (c) (c) (-13,68)
0,3*log(m(-1)/(df(-1)+ct(-1)*Q_m(-1)))
(c)
R^2 = 0,99 DW = 2,27

df: domestic final demand
ct: technical coefficient
Ut: capacity utilization rate
Q_m: market value added
Compm: Competitiveness import prices

II.2 The supply side

II-2.1- Production function

As a theoretical underpinning, we assume that the potential output is given by a Cobb- Douglas production function. This assumption which leads to a constant elasticity of substitution between labor and capital, is not rejected by the data when tested. This theoretical functional form is used in the model to derive the specification of the equations of factors demand, the rate of capacity utilization and the wage-setting curve.

The production function is a constant-returns to scale Cobb-Douglas function with neutral technological progress:

$\log(cap) = \alpha*\log(l) + (1-\alpha)*\log(k_{(-1)}) - b*t - cte$

Cap : production capacity
L : employment
K(-1): capital stock of the last year
T : a deterministic linear trend

II-2.2- The wage-price loop

II-2.2.1- Wages

Wages are indexed to prices and labor productivity and negatively dependent on unemployment

dlog(we)=0,63*dlog(pco)- 0,56*(log(csup(-1))-0.5*log(pco(-1))-(1-0.5)* log(pq(-1)
(7,16) (-3,31) (c) (c)
/(1-tsub(-1)))- 0,92+(1-1,63)*dlog(pco(-1))+ 0,73*dlog(q/le) -0,38*cho/(le+cho)
(-2,84) (7,16) (3,35) (-2,30)
R^2 = 0,88 DW = 1,81

We: wage rate
Pq: Price added value
Le: business employment
Csup: labor costs per unit of output in the non-agricultural sector
Pco: index of the cost of living
Tsub: subsidy rate to businesses
Cho unemployment levels

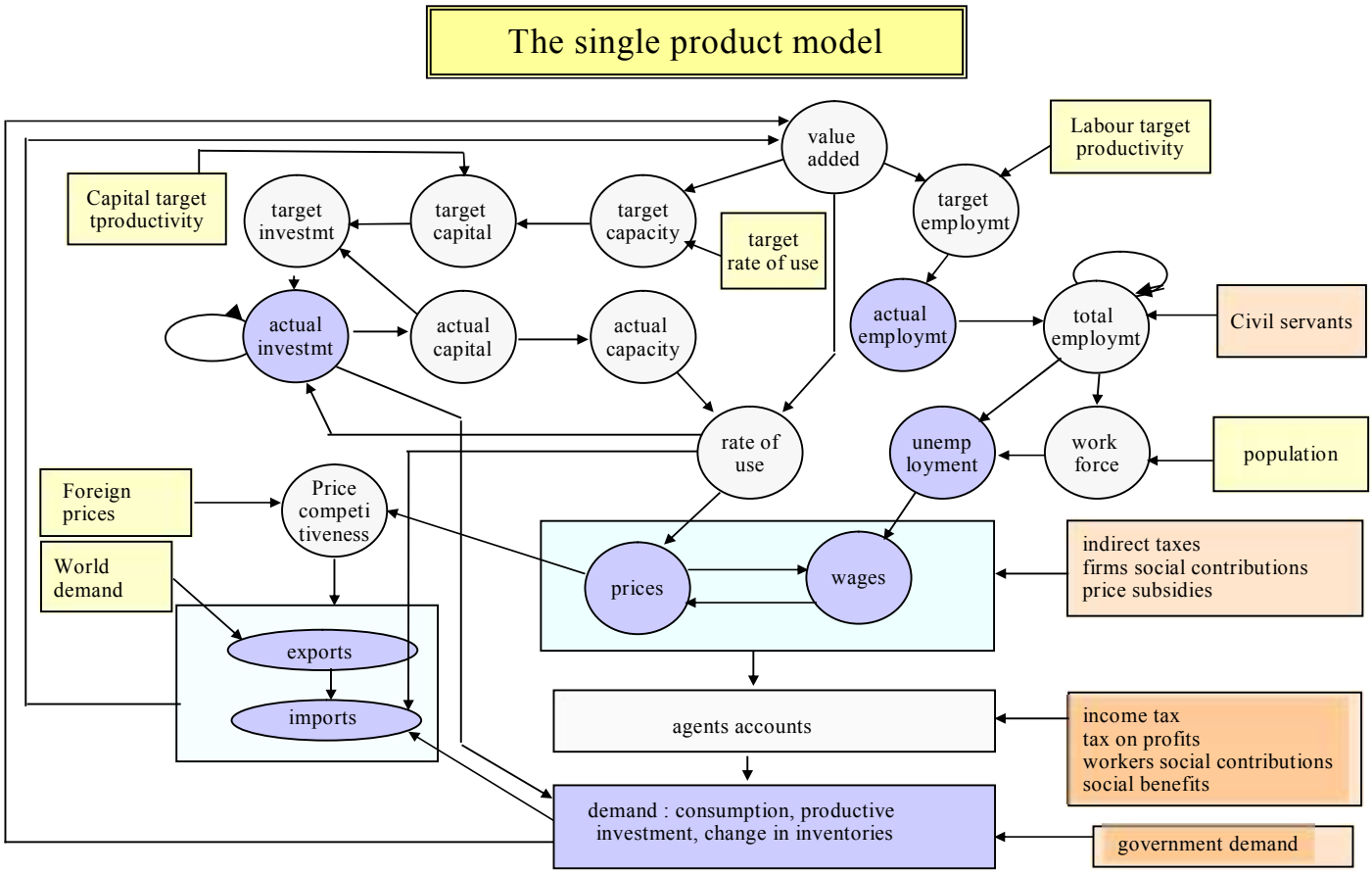
II-2.2.2- Prices

1 The added value price

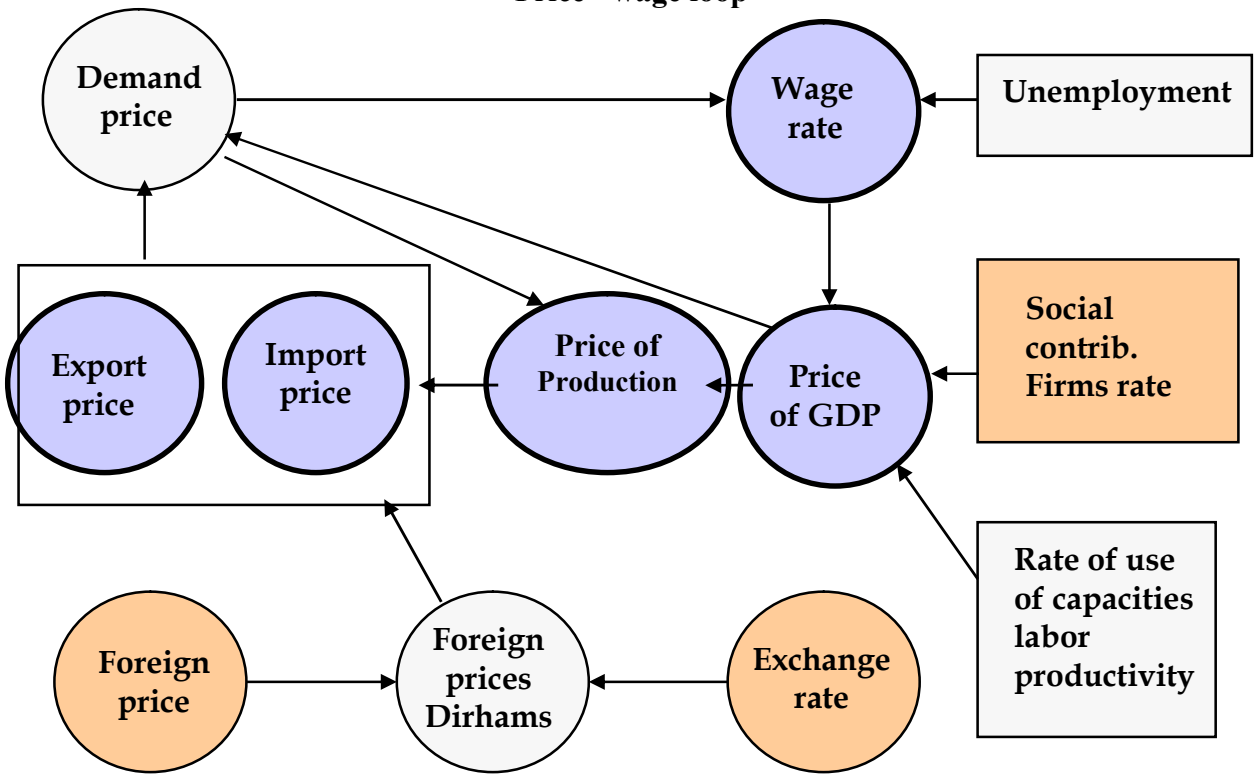
The added value price is estimated by product for goods offred in the local market and exported to other countries. Thus, we assume that firms define an overall target for their rate margins, without separating by goods destination.

dlog(pq/(1-tsub)/(1+taii))= 0,29*dlog(csup) + 0,40*log(ut) + 0,36*log(csup(-1)/(pq(-1)/
(2,83) (3,04) (2,49)
((1-tsub(-1))/(1- tsub0))/((1+ taii(-1))/(1+taii0))))-0,01*(t-2001)*(t<=2001)+0,77
(-2,81) (2,67)
R^2 = 0,54 DW = 1,94

Pq: added value price
Taii: rate of domestic consumption tax
Ut: capacity utilization rate
Tsub: subsidy rate to businesses
Csup: labor costs per unit of output



Price - wage loop



III Analytical simulation of external shock on Moroccan economy

After presenting the macro econometric model of Moroccan economy, we present an analytical simulation to describe the response of the economy to an increase of world demand by 10%.

This simulation consists in a pure demand shock. In the short run, the increase of world demand leads to an increase of Moroccan exports. This triggers a rise in GDP, internal demand and employment. In the first year, the shock leads to a rise of 1,54 point of GDP.

The decline of unemployment and pressures on capacity utilizations rapidly lead to a rise of wages and production prices. An inflationary spiral occurs and triggers a crowding out of demand. Competitiveness declines, which boosts imports and dampens exports.

In the long run, the expansionary effect disappears and the unemployment rate goes back to its equilibrium rate.

Macroeconomic effects of the increase of world demand by 10%

Growth rate	2015	2016	2017	2018	2019	2020
Consumption	0,70	0,53	0,54	0,59	0,62	0,64
Investment	2,46	1,95	1,54	1,45	1,47	1,48
GDP	1,54	1,07	0,80	0,72	0,68	0,65
Exports	4,24	3,83	3,47	3,18	2,97	2,82
Imports	3,07	2,76	2,67	2,73	2,74	2,72
Consumption price	1,48	1,72	1,75	1,77	1,78	1,78
Réel disponible Revenu H	1,11	0,94	0,83	0,79	0,75	0,73
Différences						
Employement	64820	49120	37160	31410	27200	24180
Unemployement	-27768	-22757	-17492	-14722	-12754	-11357
Gap in % of GDP						
Fiscal balance	0,61	0,86	0,84	0,85	0,86	0,86
Trade balance	0,37	0,68	0,72	0,63	0,56	0,51

The reforms undertaken by Moroccan economy during the last decade implied lower trade barriers and a higher diversification of the external trade. Analyzing the contribution of aggregate demand to growth, it is important to acknowledge that the country's growth rate has been heavily influenced by the increase of world demand. The implications are those expected.

Conclusion

This paper describes an annual macro econometric model of Morocco. The principal goal was to provide a representation of Moroccan economy in order to simulate the consequences of several economic policies considered as essential. The modeling process follows the empirical-based approach by estimating error-correction equations. To ensure coefficient invariance, we used parameter constancy tests. The resulting model demonstrates good potential for policy simulations and the results we obtain are in line with the economic observations.

The model thus provides a useful basis, for both forecasting and analysis, to study the economy of Morocco in a number of practical contexts:

- Relatively good performances in forecasting enable the model to be used for short- term forecasting, along with other tools already used for forecasting.
- Besides, good analytical properties of the model enable to use it to study the impact of change of economic policy.

The model has already been used in this effect at High Commission of Planning and, as shown, the analytical simulation describing the response of the economy to world demand shock is a good illustration.