Analysis and estimating the Water Demand in Qatar

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Overview

We model the water consumption in the market segment that compose the Qatari water market. We link water consumption to Population Growth. Building on the estimated model, we develop long-range forecasts of water consumption from 2018 to 2030 over different scenarios for the population driver. In addition, we proxy for water efficiency improvements by reducing the long-run elasticity of water consumption to Population. We show that the efficient use of water has a crucial role in controlling the future development of water consumption. Water conservation policies should consider this aspect and we call for the implementation of water efficiency improvement programs.[1]

The estimated model is consistent with the literature in the choice of possible variables driving water consumption. The peculiar structure of the Qatar market makes the variable selection very limited, with the water consumption dynamic and the population evolution being the only relevant elements. Therefore, to develop scenario-based water consumption forecasts, we build on population growth scenarios. These scenarios start in 2018 and end in 2030 to match the QNV2030 program horizon.[2] We match the population scenarios with the possible effects linked to the adoption of water conservation policies. However, we do not have observe variables that monitor or proxy water conservation. Therefore, we proxy for water conservation changes through the elasticity of sectoral water consumption to population. This is coherent with the assumption that an improvement in water conservation is reducing the impact of population growth on water consumption.

Methods

The evidences of stationarity in the water consumption time series around a deterministic trend, challenge the specification of a forecasting model based on scenarios developed for the two relevant drivers previously described, the population and the GDP. In fact, in this situation, a fundamental role will be taken by the deterministic component, and the introduction of conditioning variables, such as Population and GDP, might become difficult given their non-stationarity (around a deterministic component). On the one side, the possibility of using models and specifications based on common stochastic trends, i.e. on the possible cointegration between the drivers and the water consumption, is ruled out, due to the stationarity of water consumption time series. On the other side, if we exclude the drivers from the model, and specify a time series model for water consumption levels based only on water consumption data, we will not have any conditioning information on which we could draw future scenarios. In fact, the future evolution of the water consumption time

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[2] We adopt this forecast horizon to have a consistency with the national vision of sustainable development and environment protection, as defined in the program QNV2030.

series might be driven by the trend and a linear or non-linear component that drives the fluctuations around a trend. In the latter case, scenarios will be difficult to specify.

We then proceed to the estimation of a general dynamic model including economic and demographic drivers. Let y_t^i be the log-level water consumption in market segment *i*, X_t the bivariate vector containing the log-levels of GDP and population, D_t a vector of dummy variables (possibly interacted with lagged values of the dependent or with the contemporaneous or lagged values of elements included in X_t), and ε_t^i an innovation term. We consider the following general model

$$y_t^i = \alpha + \sum_{j=1}^{p} \beta_j y_{t-j}^i + \sum_{i=0}^{q} \delta_i' X_{t-i} + \gamma' D_t + \sum_{l=0}^{m} \theta_l \varepsilon_{t-l}^i$$

where we allow for an Autoregressive Distributed Lag structure, possibly augmented with dummy variables to capture either specific outliers or structural breaks, and with an error term that could follow a moving average process.

To specify the model, we follow a general-to-specific strategy, keeping the maximum lag order to 4, and evaluating the inclusion of seasonal patterns in the autoregressive component of the model by analyzing the estimated residuals serial correlation. Table 3 reports the final specification adopted for the various market segments.

Results

We have found a strong relationship between the population growth in Qatar and water demand. Additionally, water conservation program is necessary to have a control of the sustainable increase on water demand in Qatar

Conclusions

The empirical and simulation-based evidences we provide highlight that an efficient use of water is a crucial element for improving the efficient use of economic resources. The forecasting scenarios provide evidence suggesting that water conservation policies, as peroxided by a contraction of water elasticity to population, would lead to sensible decreases on water consumption levels. The most evident contraction is that of the Commercial segment, that with a drop of elasticity of 5% provides a contraction in demand of about 18%. The least reactive segment is the Industrial one, with a decrease of 4.4%, while Government, Hotel and Villa, show a water demand decrease of more than 9% with a contraction in elasticity of 5%. These results are promising and show that water conservation policies could have a crucial role in controlling the evolution of water demand in Qatar. However, these elements must be coupled with the scenarios on the population evolution.

Selected references

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