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EFFICIENT ELECTRICITY PORTFOLIOS FOR SWITZERLAND AND THE UNITED STATES

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Overview
This study applies financial portfolio theory to determine efficient electricity-generating technology mixes for Switzerland and the United States. These efficient allocations satisfy at least two objectives that are enshrined both in the Swiss constitution and mission statement of the US National Energy Policy Development Group, viz. “secure provision” and “low cost to the economy”. Expected returns are given by the (negative of the) rate of increase of power generation cost. Volatility of returns relates to the standard deviation of the cost increase associated with the portfolio, which contains technologies such as Nuclear, Run of river, Storage hydro, and Solar in the case of Switzerland, and Coal, Nuclear, Gas, Oil, and Wind in the case of the United States.

Methods
Since shocks in generation costs are found to be correlated, we use the seemingly unrelated regression estimation (SURE) method for filtering out the systematic components of the covariance matrix of the cost changes.

Results
When introducing constraints with regard to the acceptable share of a technology included in the portfolio and taking account of external costs such as those due to global warming and health losses, the results suggest that at observed generation costs in 2003, the maximum expected return (MER) portfolio for Switzerland would call for a shift towards Nuclear power and Solar, and therefore away from Run of river and Storage hydro generated electricity (see Figure 1 below). By way of contrast, the minimum variance (MV) portfolio mainly contains Nuclear power, Storage hydro, Run of river and Solar. The 2003 MER portfolio for the United States contains Coal generated electricity and Wind, while the MV alternative combines Coal, Oil, Nuclear and Wind (See Figure 2 below). Interestingly, Gas does not play any role in the determination of efficient electricity portfolios in the United States.

Conclusions
One could argue that for a population as risk-averse as the Swiss, the minimum variance portfolio is appropriate. Under this standard and with a “realistic” restriction on the shares of Run of river, Storage hydro and Solar, Nuclear accounts for 51 percent (neglecting external costs) or 60 percent (high external costs, see Frontier 1) of the 2003 efficient portfolio. If one compares these efficient portfolios with the actual 2003 portfolio, one is led to conclude that the current mix of technologies is clearly inefficient. A move towards Nuclear and away from Run of river electricity seems to be advisable in terms of reducing risk and maximizing expected returns. For the United States, a similar discrepancy emerges in terms of Coal and Gas generated electricity. With a “realistic” restriction on the share of Wind power, Coal accounts for 66 percent in the minimum variance portfolio (neglecting external costs) or 81 percent (high external costs, see Figure 2). Interestingly, Gas does not show up in any efficient portfo-
lio. The United States thus may reap an efficiency gain by investing in more Coal generated electricity and staying away from Gas.

![Figure 1 Swiss Efficient Electricity Portfolios (2003, SURE-based, with constraint, with high external costs)](image1)

Figure 1 Swiss Efficient Electricity Portfolios (2003, SURE-based, with constraint, with high external costs)

![Figure 2 U.S. Efficient Electricity Portfolios (2003, SURE-based, with constraint, with high external costs)](image2)

Figure 2 U.S. Efficient Electricity Portfolios (2003, SURE-based, with constraint, with high external costs)

**References**


