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# An analysis of the relevance of off-balance sheet items in explaining productivity change in European banking

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# Notes

<sup>1</sup>Important developments in this field have been introduced, among others, by the work of Diewert ([1976](#), [1978](#), [1981](#)), Caves et al. ([1982a](#) and [1982b](#)) and Färe et al. ([1985](#), [1994](#)).

<sup>2</sup>Shephard's ([1970](#)) distance functions have guided much of the development in efficiency and productivity analysis. In a multi-input multi-output framework, an output distance function is defined as the reciprocal of the maximum proportional expansion of the output vector, given inputs. An input distance function is defined as the reciprocal of the maximum proportional contraction of the input vector, given outputs.

<sup>3</sup>In his empirical work, Farrell ([1957](#)) defines technical efficiency as the maximum proportional contraction of inputs. He also indicated that, under constant returns to scale, this may be interpreted as the percentage by which output could be increased using the same inputs. The interpretation of Farrell's measures of technical efficiency as reciprocals of distance functions can be found in Färe et al. ([1985](#), [1994](#)).

<sup>4</sup>For a literature survey on the subject, see Grosskopf ([1993](#)) and Färe et al. ([1997](#)). Also, Ray and Desli ([1997](#)) discuss the conceptual framework and Mukherjee et al. ([2001](#)) derive the geometric decomposition for a generalized Malmquist index.

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