Revised survival analysis-based models in medical device innovation field

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Scholars have shown that innovation and R&D affect both the business cycle and long-run economic growth (Basu et al. [1]; Comin and Gertle [2]). A statistical analysis of cross-country adoption of medical technology data, whose focus is on linear particle accelerators used as radiation treatment devices for patients with cancer, is presented. We exploit a unique database collecting information on some worldwide radiotherapy centres and concerning the exact year of medical device adoption, in order to compare the late-innovation functions of different groups of countries and to detect the basic economic, social and geographical features impacting on the early technological innovation opportunity. From a statistical point of view, a contribution to the study of technological medical innovations can be provided through the survival analysis-based models. Survival analysis resorts to both non-parametric and semi-parametric tools, such as the survival function (e.g. Kaplan and Meier [5]), which gives the probability of surviving beyond a certain event time t, and the Cox regression model (Cox [3]; Cox and Oakes [4]), which fulfills predictive purposes by detecting both the individual baseline hazard and that associated with the presence of specific factors impacting on the event occurrence. Typically, the event of interest takes a negative connotation since denoting a failure (e.g., length of time before a patient die after a disease). The fact that the survival and the cumulative distribution of a random variable are intertwined proves useful to interpret survival analysis results from an economic standpoint. Our proposal is to extend the survival analysis approach to the context of the innovative medical device adoption and its eventual diffusion within the worldwide countries, here representing the statistical units of interest. In such a perspective, a new perception of the main survival analysis tools is then provided. The event of interest is recognized in the initial adoption of a specific technology, becoming an indicator of medical technology innovation. On the contrary, the survival function is interpreted as an indicator of the delay in the technological innovation adoption since measuring the probability of introducing a novel medical device beyond a specific event time t. Given these features, the survival function is named late-innovation function. In the same manner, also the Cox regression model is framed into an opposite scenario where the baseline hazard has no longer the meaning of risk but rather the meaning of early technological innovation opportunity, if no factors impacting on the initial technology adoption are taken into account. Analogously, the hazard function built on specific economic, social or geographical variables allows to detect their effects on the early technological innovation opportunity.

Keywords: medical device innovations, survival analysis, late-innovation function, early technological innovation opportunity

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Pre-emergence thermal and hydrothermal time model in crop

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Pre-emergence stage (germination to emergence) to determine the seedling emergence and its ecology plays an important role. So, calculating and verifying this critical stage of plant life is necessary for seedling emergence modeling. To calculate the length growth of seedlings in each day, first, the Hunt equation was used for calculating the relative growth rate of seedlings (RGRL). $RGR_L=(\ln L_f-\ln L_0)/t_{GE}$. Where RGRL is relative growth rate, Lf the final length of shoot in mm, L0 the length at the onset of growth and tGE the time spent from germination to emergence in h. RGRL unit was expressed as mm mm-1 h-1. Assuming