The Many Life Cycle Models

- Few models have received the attention of the Life Cycle Model. And few remain so useful and up to date after five decades of active research.
- The basic idea of the Life-Cycle Model is to apply the insights from intertemporal allocation to explain the way in which consumption evolves with age over the life-span of individuals and households.
- Even in its simplest form, this model allows us to emphasize important economics concepts like intertemporal substitution and attitudes toward risk.
- In general we assume a utility function that is intertemporally additive. This means that the marginal rate of substitution between any two periods is independent of the level of consumption in any other period.
- This means we are ruling out habit formation, goods which effects persist beyond the act of consumption (vacations), and also durable goods.
- In a world of certainty the theory has plenty of bite but very little realism. Lifetime allocation of consumption has been shown not to be independent of the timing of income realization.
- Even the pioneers emphasize how important uncertainty was, but they did not have the machinery to formalize it. Once we introduce uncertainty the individual starts maximizing expected utility. By using felicity functions consistent with the expected utility, we are assuming the simultaneous additivity induced by intertemporal additivity and expected utility. This implies that the degree of intertemporal substitutability is inversely related to the degree of risk-aversion.
- More realistic treatments of uncertainty have maintained researchers busy, both in the theoretical side and the empirical side. Nobody thinks the Life Cycle model really predicts that consumption is constant and that is equal to some measure of permanent income (once uncertainty and more realistic utility functions are considered). However, generalizations of the insights of those early models are still the main features of today's models.

- Capital Uncertainty, Income Uncertainty, Borrowing Constraints, Labor Supply, Precautionary Savings, Bequests, Social Insurance, Portfolio Choice, Human Capital, Fertility and Demographics, Annuitization, etc.. Are just some of the topics analyzed by the literature that has evolved from the early Life-Cycle models.
- Very often in order to solve these types of models analytical solutions fall short, and resorting to some kind of numerical calculations is becoming more accepted.
- We still have some methodology to cover, but you should be ready to understand any research using dynamic models, especially if based in the life-cycle model.
- Capital Uncertainty is the main concern of the work of Phelps (1962), Levhari and Srinivasan (1969), and Hakansson (1970). They introduce other sources of income, but they assume they are exogenously given. In our analysis of their research we have ignored these other sources, we will analyze them in the future. On the other hand, we have introduced bequests, finite lifetimes, and lifetime uncertainty.
- Their work, even several decades later, is one of the prime examples of elegant and appropriate use of Dynamic Programming techniques in economics. Their models depart from fairly stylized models of the pioneers of the life cycle model, and set a standard for appropriate matching of models with methodology.
- With the work of Samuelson (1969) and Merton (1969) these models set the stage for the development of Finance as a field.

- Income Uncertainty dates back to even earlier years, with the seminal work of Beckmann (1959). His is one of the first examples of use of Dynamic Programming in economics. He only deals with simple characterizations of the model, but sets the stage for further work.
- Nagatani (1972) also relaxes the income certainty assumption, and using Isoelastic utilities (which implies precautionary savings, with its risk aversion parameter also controlling the degree of precautionary savings) shows that the allocation of consumption is not independent of the income realizations, even without having to resort to borrowing constraints. Basically, he shows that the consumer is revising his income prospects as the life cycle proceeds, resulting in the positive relationship between consumption and income.
- Miller (1974) provides an infinite horizon model with stochastic income stream, and is a closer counterpart with this type of uncertainty to the work of Phelps, and Hakansson. He finds that this source of uncertainty leads to a lower consumption stream than in the certainty case.
- Skinner (1988) uses an approximation to the optimal decision rules to show how important precautionary savings are in the presence of uncertain income streams. With convex marginal utility of consumption we will see precautionary savings, to insure against the uncertain future path of income.
- Precautionary savings models will predict that people save a lot more when young than what a simple life cycle model would predict. Also some work shows that lack of borrowing can be the result of a rational response to the uncertainty of the income stream that could lead to zero consumption.
- Successful empirical work builds upon the precautionary savings intuition. Guiso, Jappeli, and Terlizzese (1992), Gourinchas and Parker (1999), and Cagetti (1999).
- Engen, Gale, and Uccello (1999), use a very similar model, based on simulation and calibration to emphasize that individuals might be rational saving less for retirement than simpler life cycle models would predict.
- Zeldes (1989) builds upon this tradition and shows, that without resorting to borrowing constraints, and resorting to numerical solutions with Isoelastic utility, consumption tracks income. He emphasizes the need to move away from quadratic utility functions, which less ambitious literatures have been relying on.

- Thurow (1969) was one of the first researchers to emphasize the fact that empirically, consumption tracks income. He explains this by resorting to credit constraints. Credit market restrictions prevent consumers from borrowing as much against future income as they desire at the going rates. As long as income tends to increase with age, and discounted future income cannot be fully transferred at the borrowing rate, a consumer's effective net worth increases with age, which causes increasing consumption with age.
- The very often cited work of Zeldes (1989), and especially Deaton (1991) elaborate further on the importance of considering liquidity constraints. Expanding on findings of Thurow. If consumers are impatience the implications are very similar to that of precautionary savings. Their work also gave rise to the literature on buffer stock of savings.
- Other authors, Attanasio, Banks, and Meghir (1997), and many other studies have opted for focusing on demographic characteristics to explain the shape of the consumption profile. Still they assume exogeneity of the income profile.
- Hubbard, Skinner, and Zeldes (1994, and 1995) have looked at the effects on wealth accumulation of the existence of social security porgrams (such as welfare) that incorporate asset limitations. For poor people, who are never going to accumulate much wealth, and who face health and earnings uncertainty, it can be optimal to make no attempt to accumulate. They find that only above some critical wealth level does it make sense to try to accumulate savings for retirement or health expenditures.

- Heckman (1974) and in more recent work, Low (1998, and 1999), French (2000), Benítez-Silva (2000), Rust, Buchinsky, and Benítez-Silva (2001), endogenize labor supply and the income stream to show that this provides very realistic simulations, and in some cases estimates of the most important variables of the life cycle model. With the life cycle model modified to take into account retirement and disability programs.
- Here the key is rather than treating income as exogenous, we view earnings as resulting from a life cycle labor supply decision. If individuals are free to set their hours of work, and if wage rates change systematically over the life cycle, the path of consumption of market goods will depend on the wage rate at each age unless goods and leisure are independent of each other in utility.
- If we assume substitutability in the utility function, in the sense that a reduction in the consumption of leisure raises the marginal utility from consuming goods, at ages where the price of leisure is high relative to other ages, the consumer has an incentive to economize on his leisure but spend more on goods. In this case, at ages where wage rates are high, consumers work more, earn more, and consume more than at ages where wages are lower.
- The work of Rust (1989, 1990, 1997–with Phelan) is an excellent example of dynamic modeling and estimation using the life cycle model. Still they assume that consumption is equal to income, something defended by Deaton (1991) bur hardly realistic looking at the data.
- Heckman (1975, and 1976), introduces human capital in a model with consumption and labor supply. Seater (1977) introduces search behavior in such a model, and so does Benítez-Silva (2001) in a dynamic setting under uncertainty , which can also be interpreted as human capital formation.
- Samuelson (1969) and also Merton (1969) were concern on the portfolio choice decision. Bodie, Merton, and Samuelson (1992) extend that type of model with endogenous labor supply, and Benítez-Silva (2001) provides an empirical test of that model.
- The life cycle model has also been used to emphasize the uncertainty over finite lifetimes, like in Yaari (1965), and Davies (1981), and the rational responses to this type of uncertainty, like annuitization. Benítez-Silva (2000) builds upon that literature to emphasize the importance of endogenous labor supply when considering the demand for certain financial instruments.