Survival, reproduction and congestion: the spaceship problem re-examined

Pierre-André Jouvet · Gregory Ponthiere

Abstract This paper re-examines the spaceship problem, i.e. the design of the optimal population under a fixed living space, by focusing on the dilemma between adding new beings and extending the life of existing beings. For that purpose, we characterize, under time-additive individual welfare depending negatively on population density, the preference ordering of a utilitarian social planner over lifetime-equal histories, i.e. histories with demographic conditions yielding an equal finite number of life-periods (imposed by resources constraints). The analysis of the spaceship problem contradicts widespread beliefs about the populationism of Classical Utilitarianism and the antipopulationism of Average Utilitarianism. We also study the invariance property exhibited by various utilitarian rankings to the total space available and to individual preferences. Finally, we compare histories for a spaceship with a stationary population, and try to accommodate intuitions about posterity and renewal of populations.

Keywords Environmental congestion · Fertility · Longevity · Population ethics · Utilitarianism · Renewal

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1 Introduction

Given that the Earth is of finite size—and, thus, can be compared, following Boulding (1966), to a ‘spaceship’—the question of the optimal population size can be formulated as the ‘spaceship problem’: are there too few or, on the contrary, too many beings living on our bounded, resources-finite, spaceship? That question, which is today at the centre of sustainable development debates, is actually an old issue, to which various answers were given over time.

While Mercantilism was, during the sixteenth and seventeenth centuries, promoting a population as large as possible by means of various policies, it should not be deduced from this that the spaceship constraint was ignored by Mercantilist thought. Actually, it is quite the opposite: a standard Mercantilist argument was that the finiteness of the living space, if coupled with a large population, would favour migrations, and, hence, the colonization of other territories.

The Italian philosopher Giovanni Botero (1588) is generally regarded as one of the first thinkers who argued against the Mercantilist populationism, and asked the question of the optimal population size. Botero argued that men have a tendency to multiply themselves as much as nature allows. However, natural resources are limited, so that, according to Botero, one cannot escape the following adjustments: either people will modify their behaviours, or there will be some adjustment in numbers through famines, diseases or wars.

Within economic thought, Richard Cantillon (1755) provided another early study of the spaceship problem, by highlighting the existence of a quantity of life versus quality of life trade-off, which restrains feasible population sizes. According to Cantillon, Man’s subsistence requires living space, whose amount depends on lifestyles, so that an arbitrage is to be made between the quantity and quality of life. While Cantillon did not solve that trade-off, he showed that, contrary to Mercantilists’ beliefs, more people is not always better.

Another contribution to the spaceship problem was made by Thomas Malthus (1798), who argued that the population size is necessarily limited within some boundaries. A population would follow a geometric progression if left unchecked (i.e. in the absence of resources constraints), but the production of means of subsistence follows, at best, an arithmetical progression (because of the finiteness of land), so that the population must, at some point, be ‘checked’, either by a positive check (deaths) or by a preventive check (fewer children).

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1 On Mercantilism and population, see Schumpeter (1954, 1, pp. 352–356).
2 See Cantillon’s comparison of peasants living modestly in the South of France with grown-up bourgeois living in abundance (1755, p. 25).
3 See Cantillon (1755, I, 15, p. 30):

It is also a question outside of my subject whether it is better to have a great multitude of inhabitants, poor and badly provided, than a small number, much more at their ease: a million who consume the produce of 6 acres per head or 4 million who live on the product of an acre and a half.

4 In later writings, Malthus (1830) will add a third type of check: the moral restraint.