



# Indeterminacy with no-income-effect preferences and sector-specific externalities <sup>☆</sup>

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## Abstract

We examine a two-sector real business cycle (RBC) model with sector-specific externalities in which household utility exhibits no income effect on the demand for leisure. Unlike in the one-sector counterpart, indeterminacy can result with sufficiently high returns-to-scale in the investment sector. Moreover, the smaller the labor supply elasticity, the lower the level of externalities needed for indeterminacy. This finding is the opposite of that in all existing RBC-based indeterminacy studies. Finally, in contrast to previous sunspot-driven two-sector RBC models, our economy is able to match the stylized facts that sectoral labor inputs are positively correlated and consumption is procyclical.

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## 1. Introduction

Starting with the work of Benhabib and Farmer [4] and Farmer and Guo [11], there is now an extensive macroeconomic literature that explores indeterminacy and sunspots in the

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real business cycle (RBC) model.<sup>1</sup> The original Benhabib–Farmer–Guo one-sector economy, with a Cobb–Douglas production function and sufficiently strong increasing returns, displays multiple equilibria and belief-driven business cycle fluctuations when the separable household utility is logarithmic in consumption and convex in hours worked. More recently, Meng and Yip [18] and Jaimovich [14] (hereafter MYJ) have shown that a one-sector RBC model, instead with non-separable preferences, always exhibits saddle-path stability and equilibrium uniqueness when there is no income effect on the demand for leisure, regardless of the degree of aggregate returns-to-scale in production. MYJ’s result illustrates the critical importance of the income effect associated with the household’s labor supply decision in generating indeterminacy and sunspots within one-sector RBC models.

In this paper, we build upon MYJ’s analyses and examine the quantitative interrelations between equilibrium indeterminacy and the no-income-effect utility function in a two-sector RBC model. Distinct consumption and investment goods are produced with sector-specific productive externalities *à la* Benhabib and Farmer [5] and Harrison [13]. Our main theoretical findings are summarized as follows. First, unlike in MYJ’s one-sector model, our two-sector economy may exhibit an indeterminate steady state, and thus a continuum of stationary perfect-foresight equilibria, when sufficiently strong externalities are present. Intuitively, in order for equilibrium indeterminacy to occur in any dynamic general equilibrium macroeconomic model, the associated first-order conditions must continue to hold when there is a change in non-fundamental expectations. In particular, the household’s intertemporal Euler equation equates the shadow value of capital sacrificed this period in order to consume – this period’s marginal utility of consumption – to the discounted utility value of capital gained next period – its gross rate of return weighted by the marginal utility of next period’s consumption. Therefore, upon the expectation of a higher return on capital in the future, agents will consume and work more next period. In the MYJ economy, this expectation cannot be self-fulfilled because an increase in labor hours large enough to raise the gross rate of return on capital will generate an unsustainable rise in its net return, through a higher marginal utility of consumption. In our two-sector model, however, next period’s net return on capital also depends positively on its relative price, which increases when future consumption rises. Therefore, a very small increase in hours worked can in fact lead to the anticipated hike in the return on capital.

Second, we find that a necessary and sufficient condition for indeterminacy and sunspots in our model is sufficiently strong increasing returns-to-scale in the investment sector. The intuition for this result is the same as in the separable preference set-up of Harrison [13]: when agents anticipate that the return on capital will increase tomorrow, they need incentive to give up consumption today for more capital accumulation. As long as they will be rewarded with productive investment, in the form of sufficient increasing returns in that sector, it will be worthwhile for them to do so.

Third, and perhaps most surprising, the degree of increasing returns-to-scale required for our model to exhibit multiple equilibria increases with the household’s labor supply elasticity. In other words, the smaller the labor supply elasticity, the lower the threshold level of investment externalities needed to produce equilibrium indeterminacy. This finding is exactly the opposite of that in all existing RBC-based indeterminacy studies, where an infinitely elastic labor supply is often adopted. The reason is that, to fulfill agents’ optimistic expectations and satisfy the

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<sup>1</sup> See Benhabib and Farmer [6] for an excellent survey. With the noted exceptions of Benhabib and Nishimura [8], and Benhabib, Meng and Nishimura [7], most studies in this literature postulate constant returns-to-scale at the individual firm level. We also maintain this assumption throughout our analysis.

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