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Integrated Analysis of Economic Growth and Land Prices: A Two-Sector Model Approach

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Abstract

The study presents a comprehensive analysis by constructing a two-sector growth model that incorporates endogenous wealth accumulation and land price within the framework of neoclassical growth theory and Ricardian theory. The economy under consideration comprises industrial and agricultural sectors, reflecting the dual nature of economic activity. By leveraging insights from both theories, the research aims to conduct a comparative dynamic analysis to understand the implications of changes in preferences and output elasticities of capital across the two sectors. One of the key findings of the study is the close relationship between economic growth and land prices. Through rigorous theoretical analysis and comparative dynamics, the research demonstrates that fluctuations in land prices are closely linked to the overall trajectory of economic growth. This empirical observation, often mentioned in previous studies, is elucidated within the integrated framework of neoclassical growth theory and Ricardian theory, providing a deeper understanding of the underlying mechanisms driving economic expansion. By integrating insights from neoclassical growth theory and Ricardian theory, the study offers a holistic perspective on the dynamics of economic growth and land prices. This integrated approach not only enhances our theoretical understanding but also provides valuable insights for policymakers and practitioners seeking to navigate the complex interactions between economic activity, wealth accumulation, and land markets. Overall, the research contributes to advancing our knowledge of economic growth dynamics and underscores the importance of considering multifaceted theoretical frameworks in analyzing real-world phenomena.

Keywords: Economic Growth, Land Prices, Two-Sector Model

JEL Codes: O11, O13, R14

1. INTRODUCTION

The main concern of this study is dynamic interdependence between economic growth, structural change and land price. There are different economic theories about economic structural change and economic growth. It is important to develop an economic theory based on microeconomic mechanism in which micro, intermediate and macro variables are analyzed within an integrated framework. On the Principles of Political Economy and Taxation of 1817 Ricardo studied income distribution to explain how a change in this distribution could hinder or favor accumulation. One of the hallmarks of the Ricardian system is that it links wages, interest rate, and rent together in a compact theory. Ricardo distinguished between the three production factors, labor, capital, and land. He provided a theory to explain the functional income distribution of labor share, the capital, and the land rent share of total income. Ricardo (1821: preface) pointed out: "The produce … is divided among three classes of the commodity, namely, the proprietor of land, the owners of the stock or capital necessary for its cultivation, and laborers by whose industry it is cultivated. But in different stages of the society, the proportions of the whole produce of the earth which will be allotted to each of these classes, under the names of rent, profits, and wages, will be essentially different; depending mainly on the actual fertility of the soil, on the accumulation of capital and population, and on the skill, ingenuity, and the instruments in agriculture." Since the publication of the Principles, many attempts have been done to extend or generalize the system (see Barkai, 1959, 1966; Pasinetti, 1960, 1974; Cochrane, 1970; Brems, 1970; Caravale and Tosato, 1980; Casarosa, 1985; Negish, 1989; Morishima, 1989). Nevertheless, as far as the current state of the literature is concerned, we can still apply what Ricardo (1821: preface) observed long time ago to describe the current situation: "To determine the laws which regulate this distribution, is the principal problem in Political Economy: much as the science has been improved by the writings of Turgot, Stuart, Smith, Say, Sismondi, and others, they afford very little satisfactory information respecting the natural course of rent, profit, and wages." In Ricardo's statement there is no reference to land value (price). This study makes a contribution to the literature by introducing endogenous land price into a neoclassical two-sector growth model.

The Ricardian theory does not provide a profound microeconomic mechanism of wealth accumulation. On the other hand, neoclassical growth theory models endogenous wealth accumulation with microeconomic foundation. We will integrate the neoclassical growth theory with the Ricardian theory of distribution for studying dynamic interactions among growth, wealth and income distribution, and economic structures. The traditional Ricardian theory does not determine land price dynamics. Nevertheless, price dynamics are important variables of modern economies. As Cho (1996: 145) stated long time ago, "During the past decade, the number of studies on intertemporal changes in house prices has increased rapidly because of wider availability of extensive micro-level data sets, improvements in modeling techniques, and expanded business applications." The literature on house and land prices has been increasingly expanding since then

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(e.g., Bryan and Colwell, 1982; Case and Quigley, 1991; Chinloy, 1992; Clapp and Giaccotto, 1994; Calhoun, 1995; Quigley, 1995; Capozza and Seguin, 1996; Alpanda, 2012; Du and Peiser, 2014; Kok *et al*. 2014). Most of these studies are empirical. There are only a few formal growth models with endogenous land values. As recently reviewed by Liu *et al*. (2011: 1), "Although it is widely accepted that house prices could have an important influence on macroeconomic fluctuations, quantitative studies in a general equilibrium framework have been scant." This study examines land prices in a general equilibrium framework with homogeneous population and heterogeneous goods. The model in this study is based on the growth model with land and economic structure by Zhang (1996, 2014). The main difference of this study from the previous models by Zhang is that this study assumes private landownership while Zhang's previous studies assume public landownership.

2. THE MODEL

The economy consists of industrial and agricultural sectors. The industrial sector produces goods, which are freely traded in market. The industrial production is the same as that in Solow's one-sector neoclassical growth model. It is a commodity used both for investment and consumption. The agricultural sector produces agricultural goods, which is used for consumption. The population N is homogenous and constant. We neglect effects of changing population on economic structure and land values. We neglect effects of changing population on economic structure and land values. The total land L is homogenous and constant. The land is owned by households and is distributed between housing and agricultural production in free land market. The assumption of fixed land is also a strict requirement. As observed by Glaeser, *et al.* (2005), land supply elasticity varies substantially over space in the USA (see also, Davis and Heathcote, 2007). This study neglects possible changes in land supply. Households achieve the same utility level regardless of what profession they choose. All the markets are perfectly competitive. We select industrial goods to serve as numeraire.

2.1. THE INDUSTRIAL SECTOR

We assume that production is to combine labor force, $N_i(t)$, and physical capital, $K_i(t)$. We use the conventional production function to describe a relationship between inputs and output. The production function $F_i(t)$ is specified as follows

$$F_i(t) = A_i K_i^{\alpha_i}(t) N_i^{\beta_i}(t), \quad A_i, \alpha_i, \beta_i > 0, \quad \alpha_i + \beta_i = 1, \tag{1}$$

where A_i, α_i and β_i are positive parameters. The production function is a neoclassical one and homogeneous of degree one with the inputs. Markets are competitive; thus labor and capital earn their marginal products. The rate of interest $r(t)$ and wage rate $w(t)$ are determined by markets. The marginal conditions are given by

$$r(t) + \delta_k = \frac{\alpha_i F_i(t)}{K_i(t)}, \quad w(t) = \frac{\beta_i F_i(t)}{N_i(t)}, \tag{2}$$

where δ_k is the given depreciation rate of physical capital.

2.2. THE AGRICULTURAL SECTOR

We assume that agricultural production is carried out by combination of capital $K_a(t)$, labor force $N_a(t)$, and land $L_a(t)$ as follows

$$F_a(t) = A_a K_a^{\alpha_a}(t) N_a^{\beta_a}(t) L_a^{\varsigma}(t), \quad A_a, \alpha_a, \beta_a, \varsigma > 0, \quad \alpha_a + \beta_a + \varsigma = 1, \tag{3}$$

where $L_a(t)$ is the land employed by the agricultural sector and A_a, α_a, β_a, and ς are parameters. The marginal conditions are given by

$$r(t) + \delta_k = \frac{\alpha_a p_a(t) F_a(t)}{K_a(t)}, \quad w(t) = \frac{\beta_a p_a(t) F_a(t)}{N_a(t)}, \quad R(t) = \frac{\varsigma p_a(t) F_a(t)}{L_a(t)}. \tag{4}$$

where $p_a(t)$ is the price of agricultural goods and $R(t)$ is the land rent.

In order to define incomes, it is necessary to determine land ownership structure. Land may be owned by different agents under various institutions. We assume that land is privately owned by households. There are different approaches with regard to determination of land prices and rents. For instance, Zhang (1996) assumes public ownership of land. In some approaches (Iacoviello, 2005; Iacoviello and Neri, 2010) households are assumed to be credit constrained and these households use land or houses as collateral to finance consumption expenditures. These models with credit-constrained households are used to explain positive co-movements between house prices and consumption expenditures (see also, Campbell and Mankiw, 1989; Zeldes, 1989; Case, *et al.*, 2005; Mian and Sufi, 2010; Oikarinen, 2014), even though they are not effective in explaining well-observed positive co-movements between land prices and business investment. In Liu *et al.* (2011), instead of households, firms are assumed to be credit constrained. Firms finance investment spending by using land as a collateral asset. Land can be sold and bought in free markets without any friction and transaction costs. Land use will not waste land and land cannot regenerate itself. Households own land and physical wealth. We use $p_L(t)$ to denote the price of land. Consider now an investor with one unity of money. He can either

invest in capital good thereby earning a profit equal to the net own-rate of return $r(t)$ or invest in land thereby earning a profit equal to the net own-rate of return $R(t)/p_L(t)$.

For simplicity, we use lot size to stand for housing. As argued, for instance, by Davis and Heathcote (2007), most of the fluctuations in house prices are driven by land price rather than by the cost of structures. Consumers decide consumption levels of industrial and agricultural goods and lot size, as well as on how much to save. This study uses the approach to consumers' behavior proposed by Zhang (1993). We denote respectively physical wealth by $\bar{k}(t)$ and land $\bar{l}(t)$ owned by the representative household.

The GDP and national capital stock rise over time till they become stationary. The wage rate, the price of land, price of agricultural goods, and land rent are increased, and the rate of interest is reduced. The output level of the agricultural sector is increased and the output level of the industrial sector is reduced. Some of the force is shifted from the industrial sector to the agricultural sector. The capital inputs of the two sectors are increased. The physical wealth, total wealth, and consumption levels of the two goods are increased. It should be noted that the dynamic relationship between the GDP and the land price plotted in Figure 1 is similar to the phenomenon described by Liu *et al*. (2011: 1): "The recent financial crisis caused by a collapse of the housing market propelled the U.S. economy into the Great Recession. A notable development during the crisis period was a slump in business investment in tandem with a sharp decline in land prices." The conclusions made by Liu *et al*. are based on the data for the Great Recession period as well as for the entire sample period from 1975 to 2010.

We now examine effects of changes in some parameters on the motion of the economic system. As the lemma gives a computational procedure to calibrate the motion of all the variables and the equilibrium point is locally stable, it is straightforward to conduct comparative dynamic analysis. In the rest of this study we use $\overline{\Delta} x_j(t)$ to stand for the change rate of the variable, $x_j(t)$, in percentage due to changes in a parameter value.

3. CONCLUSIONS

This study examined dynamic interactions among land, capital and economic structure. The main framework is neoclassical and the household's decision is based on an alternative approach. We integrated some ideas in the neoclassical growth theory and land economics in a compact framework. By simulation, we demonstrated that the economic system has a unique steady state. We also conducted comparative dynamic analysis with regard to changes in the preference and the two sectors' output elasticities of capital. Our results on relations between economic growth and land price are similar to the phenomenon that is described by Liu *et al*. (2011: 1), "The recent financial crisis caused by a collapse of the housing market propelled the U.S. economy into the Great Recession. A notable development during the crisis period was a slump in business investment in tandem with a sharp decline in land prices." The similarity is concluded in the sense that a rising period in the GDP is in tandem with an increasing period in the land price. Indeed, our conclusion is obtained under the strict conditions without taking account of many possible important determinants of land prices. It should be noted that many limitations of this model become apparent in the light of the sophistication of the literature of growth theory and land economics. For instance, we may generalize the model by using more general function forms of the two sectors and the utility function. It is also possible to extend the model by taking account of heterogeneity of households.

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