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A land market cycle in the Netherlands

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Abstract— **This paper develops a disequilibrium model of land prices in the Netherlands. It shows that the behaviour of traded quantities and prices of Dutch land have some resemblance with a disequilibrium land market model developed by Søgaard. An error correction model based on Søgaard's model generates significant results with GDP and the real interest rate as explanatory variables, but regrettably farm income nor government demand for land generate significant results. If the model is correct, bubbles are characteristic for the Dutch land market, and this suggests that there is an opportunity for Dutch government to improve on the timing of buying land for nature policy.**

Keywords— **land market cycle, land prices, nature policy.**

I. INTRODUCTION

Recently, Dutch government has changed its nature policy twice. First, in 1998 it decided to buy a lot of land for nature. Four years later, in 2002, policy changed. Government decided to buy less land and to reach the nature goals through private nature management. This 2002 change in policy was partly inspired by the necessity to reduce government expenditures because of a high government budget deficit as a consequence of the recession (figure 1). It happened that as a consequence of these changes in policy most land for nature was bought at the moment that land prices were very high (figure 2).

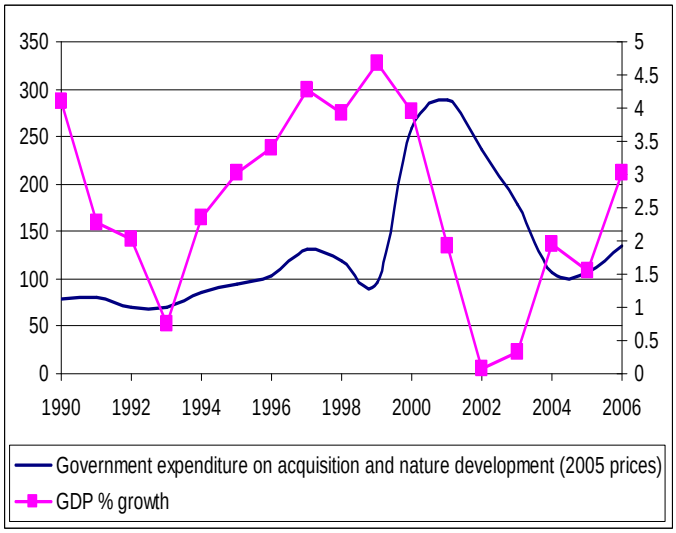

Figure 1. Government expenditures on nature and GDP growth

The development of Dutch nature policy rises two questions. The first is to what extent money could have been saved by creating a fund that only buys land when land prices are low. This requires that the management of such a fund knows when land prices are too high. The second is to what extent the fluctuations in demand for land by government has reinforced the fluctuations in land prices.

In order to be able address both policy questions this paper investigates the dynamics of the agricultural land market. We start with a disequilibrium land market model developed by Søgaard (1993) and show that this model for the Danish land market may also be applicable to the Dutch land market in the 1970s and 1990s (section 2). We integrate this analysis into an error correction model, and show that this model describes the development of Dutch agricultural land market prices between 1975 and 2005 relatively well (section 3). Effects of disequilibrium on monopoly power may reinforce the dynamics of expectations formation in this context (section 4). Then we try to extend the model with agricultural profitability and government expenditures on land. Both seem not to generate significant results, but this may be caused by incorrect specifications and problems with the data (section 5). Suggestions for improvement conclude this draft version of the paper, but will be implemented in the final paper (section 6).

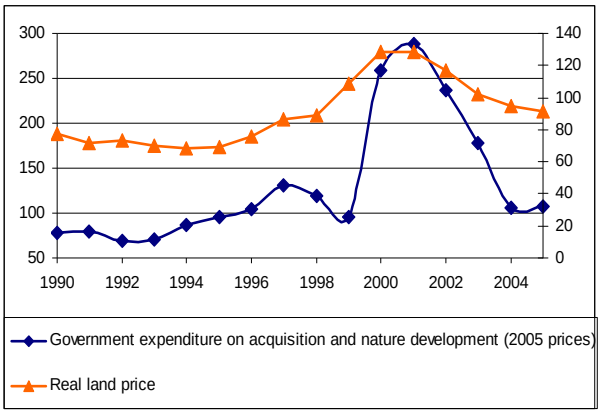

Figure 2. Government expenditure on nature and real land price

II. 2. THE LAND MARKET CYCLE

The starting point from our analyses is a model developed by Søgaard (1993). In contrast to more modern studies (Awokuse and Duke, 2006; Tegene and Kuchler, 1991; Falk and Lee, 1998; Moss and Karchova, 2005), Søgaard analyses disequilibrium behaviour in the land market explicitly. Correlated with the fluctuations in land prices are enormous fluctuations in the number of transactions, and this should be part of the understanding of land market dynamics. The logic behind both the dynamics in the land prices and the number of transactions is an adaptive expectation formation process. If the logic of this process is understood, it may be used to improve the timing of expenditures on nature.

The Søgaard model can be summarized as follows[1]. The quantity of land demanded Q^d is determined by the difference between the current price P and the equilibrium price P^e, the equilibrium price, and the expected price increase that is assumed to depend on the recent price increase ΔP:

(1) $$Q^d = \alpha_0 - \alpha_1(P - P^e) + \alpha_2 P^e + \alpha_3 \Delta P$$

The same variables, but with the opposite signs for the coefficients, hold for the quantity of land supplied Q^s:

(2) $$Q^s = \beta_0 + \beta_1(P - P^e) - \beta_2 P^e - \beta_3 \Delta P$$

By definition, when the market is in equilibrium, i.e. $P = P_{-1} = P^e$, the quantity demanded and the quantity supplied are equal. The dynamics starts when for some reason, for example an expected increase in agricultural prices, the equilibrium price changes. If the equilibrium price rises, by definition the current market price is too low, and therefore there is excess demand. At disequilibrium prices the shortest side of the market determines the quantity of land traded:

(3) $$Q = \min(Q^d, Q^s)$$

This implies that the quantity of land traded is lower than in equilibrium as long as the market is out of equilibrium.

Based on the perceived excess demand, demanders will adjust the price at which they are willing to buy:

(4) $$\Delta P_{+1} = \varepsilon(Q^d - Q^s)$$

Because market participants expect increasing prices to continue, land suppliers will wait till the expected price increase is realized. During the process of price adjustment, because of speculative expectations of further price increases, there may be also excess demand if the price is above the equilibrium price. The further the price is above the equilibrium price, the more land suppliers start to take their profits, increasing the number of transactions and reducing the rise in land prices. The highest number of transactions will take place when the price is at its maximum. The decrease in the rise in land prices in combination with the awareness that land prices are too high compared with the equilibrium price, generates a decrease in the quantity of land demanded. The market is in excess supply and the price decrease will stimulate potential buyers to wait till the price decrease is realized. According the same mechanism as when the price was rising towards the equilibrium price, the adjustment process will overshoot, and a new, cycle may start. When participants on the market behave according to rational expectations (i.e. at a α_1 and β_1 around 1 and a low α_3 and β_3) the price fluctuations outside the equilibrium price will be very small. In the real world there is imperfect information on the land market, and therefore price fluctuations can be much larger.

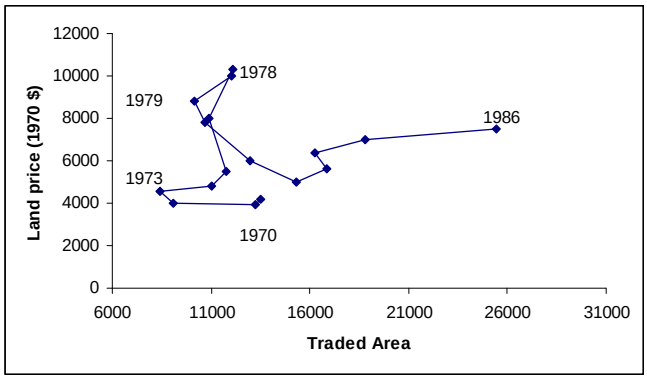

Figure 3. A land market cycle for 1970-1986?

1. [1] All variables are logarithmic.

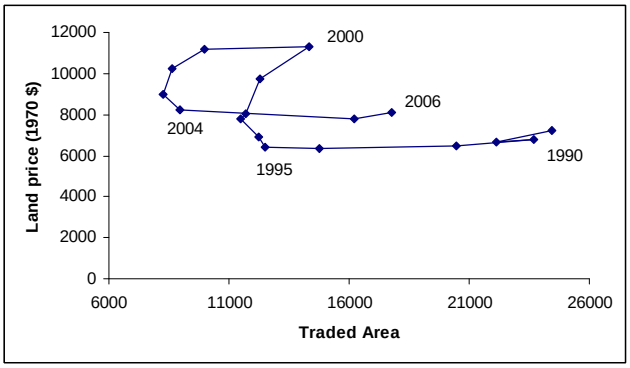

Figure 4. A land market cycle for 1990-2006?

Figures 3 and 4[2] show Dutch land prices and quantities. These figures suggest that there may be something like a land cycle in the Netherlands. The traded area is only the land traded between farmers[3] and the real land prices are the average prices per ha of these transactions, deflated by the GDP price index. Something like a cycle is suggested in figure 3, where for example after 1978 a decrease in price starting from the top is accompanied with a decreases in the traded area, while after a decrease in price the number of transactions increases. Both facts are consistent with Søgaard's theory. Nevertheless, also a lot of elements of the price-trade area relationship are not immediately consistent with the theory. This may be explained by the large number of shocks during both periods (two oil crises, two recessions, inflation) that may have changed the conditions on the land market enormously. Therefore, the challenge is to model the external conditions relevant for the land market and to test for the dynamics involved in the Søgaard model.

III. 3. AN ERROR CORRECTION MODEL OF THE LAND MARKET

The reduced form of the Søgaard model can be determined by substituting equations (1) and (2) in equation (4):

$$\Delta P_{+1} = \varepsilon(\alpha_0 - \beta_0 + (\alpha_1 - \beta_1)(P - P^e) - (\alpha_2 - \beta_2)P^e - (\alpha_3 - \beta_3)\Delta P) \quad (5)$$

Søgaard assumes that α_2 equals β_2, and we may assume that also some changes in exogenous variables may influence expectations and have a direct influence on temporary supply and demand conditions. In first instance we will focus on two explanatory variables, i.e. the real interest rate and the real gdp. The long-term real interest rate obviously influences land prices as it is an asset where its value is determined by the net present value. It may also have a short-term effect, because it influences the amount of money people can borrow. Gross domestic income may influence land demand in two ways. First, demand for land for non-agricultural use may rise, increasing land demand and stimulating speculation. Second, local demand for agricultural products rises, and therefore agriculture may become more profitable. This is a long-term effect.

If we include the two variables in an error correction model of the land market, then the following equation emerges[4]:

$$\Delta P_{+1} = \gamma_0 - \gamma_1(P - \gamma_2 Y - \gamma_3 r) + \gamma_4 \Delta P + \gamma_5 \Delta Y_{+1} + \gamma_6 \Delta r_{+1} \quad (6)$$

where Y is real GDP and r is the real long-term interest rate.[5] Because the long-term real interest rate may fluctuate a lot a weighted average of five years is used for the equilibrium part of the formula. The estimation results of this equation for 1975-2005 (table 1) show that all coefficients are significant and with the correct sign. Figure 5 shows that the dynamics of the land market price is captured relatively well by the model, where the equilibrium price is much more stable than the predicted price.

Table 1. Estimation results

	Log(Real Land price)	
Variable	Coefficient	T-ratio
γ_0: Constant	0.27	0.4
γ_1: Adjustment coefficient	-0.39	-5.9
γ_2: Long-term GDP coefficient	0.29	2.2
γ_3: Long-term real interest rate coefficient	-0.07	-4.9
γ_4: Lagged change in real land price	0.39	4.1
γ_5: Short-term change in GDP coefficient	4.32	5.2
γ_6: Short-term change in real interest rate coefficient	-0.02	-2.4
Adjusted R^2	0.84	
D-W	2.3	

2. [2] Data are from Luijt, 2007.
3. [3] For figure 3 included complete farms, in figure 4 only land.
4. [4] After simplifying all combined coefficients, and using the Søgaard assumption.
5. [5] The only variable that is not a logarithm.

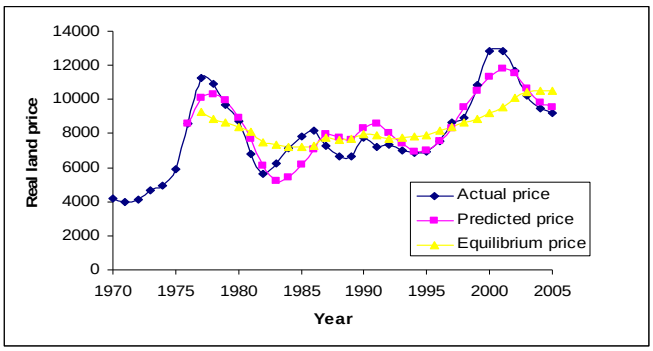

Figure 5. Actual and predicted land prices

If the estimation of the land market dynamics is correct, then about 40% of the change in land price is taken into the next period. This suggests that there bubbles, consistent with other research (Engsted, 1998; Featherstone and Baker, 1987; Roch and McQuinn, 2001). The difference between the real price and the equilibrium price may provide a good indication of the probable development of the land price, and a fund for buying land can profit from these fluctuations.

IV. 4. THE LAND MARKET CYCLE AND MONOPOLY POWER

A land market is characterized by imperfect competition. It is difficult to buy the land of your neighbour, and that is what you need if you want to increase the size of your farm. Cotteleer *et al*. (2007) explain local land prices by urbanization effects and monopoly power, defined as the difference between the number of buyers and sellers divided the sum of sellers and buyers. The effect is significant and relatively high for land in the countryside. This could have consequences in the context of the Søgaard model, because this model explains large fluctuations in total land demand and supply. If the effect of monopoly power of buyers and suppliers would work out over time in the same way as over space, the monopoly power variable could fluctuate between about 0.5 and 1, implying that when prices are rising and suppliers are waiting to sell, they have the ability to set prices about 25% higher than normal prices. If prices are declining, prices may be 25% lower than in equilibrium. This effect may be part of the mechanism in the error correction model next to expectation formation that is assumed in the Søgaard model.

V. 5. FARM INCOME AND GOVERNMENT EXPENDITURES ON LAND

The error correction model of section 3 is not completely satisfactory in the sense that you would expect that agricultural dynamics influences the land market, not only GDP, while you would expect also that government demand for land influences the land market. Both hypotheses have an important policy relevance. The first has implications for the effectiveness of farm income policy, while the second is important in the discussion to what extent government expenditures on the land market destabilizes the land market. An investigation of both hypotheses is discussed in this section.

First, demand for agricultural land will be determined by the rent on marginal rent. At least since the 1970s it is exceptional that complete farms are sold; most transactions consider land, and land is demanded to realize economies of scale. Therefore the value of the extra land is important, and this implies that average farm income is not relevant as an explanatory variable. The problem with the concept of the rent of marginal land is that it is not easy to measure. We tried several estimates of marginal land rend based on the estimation of production functions, but neither worked out. This is consistent with some literature (Falk and Lee, 1998; Moss and Katchova, 2005), but others find significant effects of land rents on prices (for example, Burt, 1986; Weersink *et al*, 1999; Gutierrez et. al., 2007).[6] An important reason behind these problems is that both for capital and labour imputed costs are relevant that are lower than the market value, but we don't know how much lower.

Demand by government of land is also not easy to find out. Part is organized well through an organisation specialized on buying land, but also municipalities and other agents buy land. Furthermore, not all land demand by the specialized organization is a net demand; sometimes this organization buys land in order to sell it later in the context of an increase in efficiency of land use. Therefore, the real pressure on the land market by this organization is not easy to measure.

We have tried to incorporate both different measures of the profitability of marginal land and government demand for land in the equation, but did not find significant effects. The lack of correlation between farm income and land prices is a fact that is also found elsewhere, but it remains relatively unsatisfactory. Therefore, an attempt will be made later to improve the indicators of the marginal land rent.

6. [6] Søgaard even found an incorrect sign for land rent.

VI. CONCLUSIONS

GDP and the real interest rate in combination with an error correction mechanism that may be related with imperfect information but also with monopoly power, seems to explain land price behaviour in the Netherlands between 1975 and 2005 relatively well. If the model is correct, there are opportunities to save money on nature policy through a better timing of government land demand, and such a policy may stabilize the land market.

This last effect has not been shown, but this may be caused by incorrect specification of the model. Therefore, in the final paper explicit tests on exogeneity will be performed and possibly a vector autoregression estimation formulation will improve results. Also improved data may improve results. Till we have solved this problem, we have to be careful with respect to conclusions about the effect of government land demand behaviour on the land market.

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