Child Care Support Policy and Fertility in a Model Based on the Supply of Child Care Services

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Abstract

This paper shows how fertility is determined in a model that assumes the existence of child care services. When child care services exist, two stable multiple equilibria result: One is a stable, steady state that brings about low fertility with low labor participation; the other, a stable state that brings about high fertility with high labor participation. Moreover, this paper also analyzes the effects of child care policy, for example, the child allowance and expansion of child care services policies. These policies instantaneously pull up fertility. However, the high fertility equilibrium vanishes in the case of large-scale child care policy. Therefore, there is only a low fertility equilibrium. As a result, these child care policies cause fertility to decrease steeply in the long run, even though they are valid in the short run.

Keywords: Child Care Policies, Child Care Services, Fertility Rate, Labor Participation

JEL Classifications: H24, J13, J24

1   Introduction

As shown by Ahn and Mira (2002) and Sleebos (2003), the correlation between fertility and female labor participation was negative in the 1980s. However, the negative correlation has been weakening gradually, and in recent years, the correlation has changed to a positive one. One of the explanations for the change in the correlation from negative to positive is the enrichment of child care services.[1] Table 1 shows female labor participation rate and total fertility rate in developed countries. We find that the higher female labor participation rate, the higher the fertility rate is.

[Insert Table 1 around here.]

Galor and Weil (1996) and Apps and Rees (2004) showed the correlation between fertility and female labor participation, using a theoretical model. Galor and Weil showed that there was a negative correlation between fertility and labor participation; however, Apps and Rees showed that there was a positive correlation between the two. Although an opportunity cost with child care (child care prevents labor) is considered in both models, Apps and Rees assume the availability of child care services, which are a substitute for individual child care, and thus, the positive correlation, which Galor and Weil do not show, is obtained. Yakita (2007) expanded the static model of Apps and Rees and proposed a more dynamic model. Yakita showed that a positive relation is observed when the child care supply constraint relaxes (i.e., there is an increase in available child care services) under supply constraint. Apps and Rees and Yakita use the fertility function wherein the fertility is determined by the input of child care services and time spent on individual child care. It is assumed that there is some substitution between child care services and individual child care in this fertility function. That is, if the wage rate is low, households increase individual child care instead of spending on child care services.

On one hand, Martinez and Iza (2004) analyze how fertility is determined under the assumption of complete substitution between individual child care and child care services. Under such an assumption, there are two states: (1) a state wherein households do not use child care services due to a low wage rate and (2) a state wherein households use child care services due to a high wage rate. Martinez and Iza insist that an increase in skill premium decreases fertility; however, child care services not only prevent a decrease in fertility but also bring about a positive relation between fertility and skill premium (capital per capita, labor participation).[2]

This paper aims to analyze how fertility is affected by child care services and child care policy, using a model that assumes complete substitution between individual child care and child care

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[1]Yamaguchi (2005), too, asserts this reason.

[2]On the other hand, Galor and Weil show that an increase in skill premium decreases fertility due to the absence of child care services.

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services, as in Martinez and Iza (2004), and that does not consider skill premium. The following results were obtained in this paper. The existence of child care services, which are used by households that have a high wage rate, brings about two stable, steady states: (1) a state of low fertility equilibrium with low labor participation and (2) a state of high fertility equilibrium with high labor participation. Without child care services, there is only a steady state with low fertility, and thus, fertility converges to a low level. However, with child care services, the steady state with high fertility appears, and therefore, this equilibrium prevents the fertility from converging to a low level. Therefore, the existence of child care services is meaningful.

In the latter part of this paper, we analyze whether child care policies (for example, the child allowance policy, wherein households receive an allowance in proportion to the number of children they have, and the reduction in the cost of child care services policy) can pull up the fertility rate. As shown by Table 1, we find that if active child care policy brings about the high fertility rate.

This paper shows that child care policies can pull up the fertility in the short run. However, the effect in the long run is different. In the short run, the increase in fertility increases labor supply in the next period, resulting in the decrease of income in the next period. Therefore, in the long run, the fertility decreases due to the decrease in income. The large-scale child care policies destroy the equilibrium with high income and fertility; as a result, fertility decreases considerably before the implementation of child care policies. The results show that the government has to consider the effects of child care policies in the short as well as long run before implementing them.

This paper is structured as follows. Section 2 explains our model setting, and Section 3 provides the dynamic equilibrium. Section 4 analyzes the effects of child care policies, and the final section contains concluding remarks.

2　The Model

The model economy in this paper is constructed in terms of a two-period (young and old) overlapping generations model. The economy comprises three types of agents: households, firms, and the government. We explain each agent in the following subsections.

2.1　Households

Individuals in households live in two periods: young and old. Each household supplies labor and gains labor income in only the young period. In the young period, individuals raise their children. This paper assumes that it is necessary for households (parents) to input their child care time and child care goods in order to have children. Households have one unit of time, which is assumed to be allocated to labor and child care. However, this paper assumes that there are publicly provided child

care services and if households pay a fee to use child care services, then child care time per child will decrease. Each individual distributes its labor income across child care goods and consumption in the young and old periods. If households do not use child care services, we get the following budget constraint:

$$zn_t + c_{1t} + \frac{c_{2t+1}}{1 + r_{t+1}} = (1 - \phi n_t)w_t, \ 0 < \phi < 1, \tag{1}$$

where n_t represents the number of children; c_{1t} and c_{2t+1} denote consumption by the young and old generations, respectively; r_{t+1} and w_t denote interest rate and wage rate, respectively; and t represents period. It takes ϕ units of time to raise one child. In addition, the parents need to buy some child care goods z for their child. Therefore, the child care cost per child is $z + \phi w_t$. The higher the wage rate w_t, the higher is the marginal cost to have a child.

On the other hand, if households use child care services, they must pay a fee p. Therefore, necessary child care time per child decreases and changes to $\psi(< \phi)$. Households who have n_t children can supply $1 - \psi n_t$ units of labor. $1 - \psi n_t$ means labor participation rate. We consider $1 - \psi n_t$ as couple's or female labor participation rate. In this case, we get the following budget constraint:

$$(z + p)n_t + c_{1t} + \frac{c_{2t+1}}{1 + r_{t+1}} = (1 - \psi n_t)w_t. \tag{2}$$

Having n_t children, the child care cost is $(z + p + \psi w_t)n_t$. If the child care cost per child in the case that households use child care services is less than that in the case that they do not, then they use child care services. This condition can be represented as follows:

$$z + \phi w_t > z + p + \psi w_t \rightarrow w_t > \frac{p}{\phi - \psi}. \tag{3}$$

If this condition is satisfied, households use child care services.

Households' utility function u_t is assumed as follows:

$$u_t = \alpha \ln c_{1t} + \beta \ln c_{2t+1} + (1 - \alpha - \beta) \ln n_t, \ 0 < \alpha, \beta < 1. \tag{4}$$

It is assumed that households gain utility not from their children's lifetime utility but simply by having children. This assumption is the same as that in Eckstein and Wolpin (1985), Galor and Weil (1996), van Groezen, Leers, and Meijdam (2003), and so on.

Next, we consider the optimization problem in two cases: (1) the case where households use child care services and (2) the case where they do not use these services.

The Case that Households Do Not Use Child Care Services Each household maximizes its utility (4) under the budget constraint (1). We get the following optimum equation:

$$c_{1t} = \alpha w_t, \tag{5}$$

$$c_{2t+1} = (1 + r_{t+1})\beta w_t, \tag{6}$$

$$n_t^0 = \frac{(1 - \alpha - \beta)w_t}{z + \phi w_t}, \tag{7}$$

where n_t^0 denotes the number of children in the case that each household does not use child care services.

The Case that Households Use Child Care Services   Each household maximizes its utility (4) under the budget constraint (2). However, optimal consumption allocations c_{1t}, c_{2t+1} is the same as the allocation in the case that households do not use child care services, and n_t, too, is different from this case. The number of children (fertility rate) in this case n_t^1 is shown as follows:

$$n_t^1 = \frac{(1 - \alpha - \beta)w_t}{z + p + \psi w_t} \tag{8}$$

Unless the condition (3) is satisfied, $n_t = n_t^0$. If the condition (3) is satisfied, $n_t = n_t^1$.

2.2   Firms

We assume that the representative firms that have a constant return to scale product function can be shown as follows:

$$Y_t^i = F(K_t^i, B_t L_t^i), \tag{9}$$

where Y_t^i denotes the firm i's output and K_t^i and L_t^i are the firm i's capital stock and labor, respectively. B_t represents labor productivity, which is the same among firms and which is assumed as follows:

$$B_t = \frac{K_t}{L_t}\frac{1}{b}, \ b > 0. \tag{10}$$

Labor productivity B_t is dependent on capital per labor input, which is also assumed in Grossman and Yanagawa (1993).[3] In a perfectly competitive market, considering the symmetry of firms, wage w_t and capital rent r_t are equal to the marginal product of each factor input.

$$w_t = B(f(b) - f'(b)b), \tag{11}$$

$$1 + r_t = f'(b). \tag{12}$$

We assume that the capital stock fully depreciates within a period. If we define $\omega \equiv f(b) - f'(b)b$, the wage rate shown by (11) is shown as follows:

$$w_t = \frac{\omega}{b}\frac{K_t}{L_t} \tag{13}$$

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[3]This product function contains externality as Romer (1986).

2.3 Government

The government in this model supplies child care services. The government receives a fee of p per child, which is paid by the parents, and sets up child care facilities to provide child care services. Originally, in considering the provision of child care services, we assume that it costs c units of final goods to provide child care service for per child. Then, total revenue is $pn_t N_t$ and total expenditure is $cn_t N_t$. Assuming balanced budget, we obtain $p = c$.

3 The Equilibrium

Having considered the behavior of the agents, we proceed to the analysis of the equilibrium. The equilibrium of this economy depends on the capital per capita $k_t \left(\equiv \frac{K_t}{N_t} \right)$. Representing the savings per household as s_t, the capital market clearing condition is given by $K_{t+1} = N_t s_t$. In the following subsections, we derive equilibria in the case where child care services are available and the case where these services are not available.

3.1 The Case of No Child Care Services

In the case of the absence of child care services, labor supply L_t is given by $L_t = (1 - \phi n_t)N_t$. In this case, we obtain the following difference equation for k_t:

$$k_{t+1} = \frac{\beta}{1 - \alpha - \beta} \left(z + \frac{\phi \omega}{b} \frac{k_t}{1 - \phi n(k_t)} \right). \tag{14}$$

The capital per capita in steady states $k^*(= k_t = k_{t+1})$ is not always unique. Under some parameters, the capital per capita in steady states is unique or two or neither, as the following figure shows.

[Insert Fig.1 around here.]

In $Case1$, there is no steady state that satisfies $k^*(= k_t = k_{t+1})$, resulting in the generation of endogenous growth. In this case, the fertility rate (that is, the number of children that households have) increases due to the increase in income. $Case2$ brings about two multiple steady states with high and low capital per capita, respectively. However, the steady state with low capital per capita $k^{2,low}$ is stable; therefore, the fertility rate falls to a low level with the low level income. In $Case2$, if the initial capital per capita k_0 is larger than $k^{2,high}$, the fertility rate continues to increase due to the increase in income, such as in $Case1$. In $Case3$, there is a unique and stable steady state; therefore, endogenous growth is not generated such as in $Case1$ and $Case2$. Therefore, in $Case3$, there is no tendency for the fertility rate to continue increasing with income. In fact, the fertility

rate n_t increases with an increase in k_t, and converges to a constant value as follows:

$$\lim_{k_t \to \infty} n_t = \frac{1 - \alpha - \beta}{\phi}. \tag{15}$$

Therefore, the slope of the dynamic equation (14) also converges to $\frac{\beta}{1-\alpha-\beta}\frac{\phi\omega}{b}\frac{1}{\alpha+\beta}$. If this slope is less than one, it results in $Case3$. Being above one, it brings about $Case2$. Under the condition that $Case2$ is brought about, with a large z, that is, the cost of child care goods is low, $Case1$ results. Then, the following proposition is obtained.

Proposition 1 Without child care services, it is possible not to have a steady state. Moreover, the steady state is not always unique even though the steady state equilibrium exists.

If child care time per child ϕ or the effective wage rate ω is small, $\frac{\beta}{1-\alpha-\beta}\frac{\phi\omega}{b}\frac{1}{\alpha+\beta} < 1$ is satisfied. The smaller the value of ϕ, the higher is the fertility rate for any capital per capita k_t; therefore, the wage rate decreases due to the increase in labor supply. On one hand, the smaller the value of ω, the smaller is the wage rate w_t, too. In the case of a small ϕ or ω, w_t is small; therefore, multiple equilibria are not generated because the savings do not rise sufficiently.

3.2 The Case that Child Care Services Are Available

If each household uses the child care services, labor supply L_t is given by $L_t = (1 - \psi n_t)N_t$. In this case, we obtain the following difference equation for k_t:

$$k_{t+1} = \frac{\beta}{1 - \alpha - \beta}\left(z + p + \frac{\psi\omega}{b}\frac{k_t}{1 - \psi n(k_t)}\right). \tag{16}$$

The form of the dynamic equation shown by (16) is shown in Fig.2.

[Insert Fig.2 around here.]

$None$ denotes the dynamic equation (14) representing the case without child care services, and $Available$ denotes the dynamic equation (16) representing the case with child care services. For $p > 0$, the curve of $Available$ is above that of $None$ at $k_t = 0$. In fact, the fertility rate n_t increases with an increase in k_t, and converges to a constant value as follows:

$$\lim_{k_t \to \infty} n_t = \frac{1 - \alpha - \beta}{\psi}. \tag{17}$$

The fertility rate of the $None$ or $Available$ cases increases with an increase in k_t. For $\phi > \psi$, the fertility rate of $Available$ converges to a higher value than it does in the case of $None$. Therefore, five cases exist as follows:

1. Both *None* and *Available* have two multiple equilibria.

2. *None* has two multiple equilibria, and *Available* has unique equilibria.

3. Both *None* and *Available* have a unique equilibrium.

4. *None* has no equilibrium (endogenous growth), and *Available* has a unique equilibrium.

5. Neither *None* nor *Available* has an equilibrium (endogenous growth).

However, it is not the case that *None* has a unique equilibrium and *Available* has two multiple equilibria. Actually, each household uses the child care services if the child care cost decreases upon doing so. This condition is shown as (3). Moreover, this condition (3) can be represented as follows:

$$z + \phi w_t > z + p + \psi w_t \rightarrow k_t > \frac{b}{\omega} \frac{p}{\phi - \psi} (1 - \psi n_t(k_t)). \tag{18}$$

The left side of this equation is the increasing function of k_t, and the right side is the decreasing function of k_t; therefore, the range of k_t that satisfies the condition (18) exists. We define k_t that satisfies $k_t = \frac{b}{\omega} \frac{p}{\phi - \psi} (1 - \psi n_t(k_t))$ as $\hat{k}_t$.[4] If $k_t < \hat{k}_t$, the dynamic equation of k_t is represented as (14)(*None*). If $k_t \geq \hat{k}_t$, it is represented as (16)(*Available*). Fig.3 shows two cases of some possible dynamics.

[Insert Fig.3 around here.]

Fig.3-1 shows the case of a unique equilibrium, and households do not use the child care services in the steady state. If an initial capital per capita k_0 is more than $\hat{k}_t$, households use the child care services. However, the child care services increase fertility (labor supply in the next period); therefore, the wage rate decreases due to the increase in labor supply. The decrease in wage rate brings about a decrease in savings, which further decreases the wage rate. These decreases occur repeatedly. Finally, households do not use child care services because of their low wage rates. (A low wage rate implies a low opportunity cost of child care.) On the other hand, Fig.3-2 shows the case with two multiple equilibria, which are the equilibria wherein households use and do not use the child care services, respectively. If an initial capital per capita k_0 is in the range $\hat{k}_t < k_0 < \bar{k}_t$ and if there are no child care services, k_t converges to k^{low}, that is, both income and fertility converge to a low level. This transition can be explained as follows. Although households have the desire to have children, they do not have a sufficient income to do so; therefore, they supply labor to a greater extent. This labor supply considerably decreases the wage rate, resulting in the capital per capita k_t decreasing to a greater and greater extent. The fertility rate also decreases with the decrease in k_t. However, if the initial capital per capita k_0 is in the range $\hat{k}_t < k_0 < \bar{k}_t$ and if there are child

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[4]Decrease in z or p lowers $\hat{k}_t$.

care services, k_t converges not to k^{low} but k^{high}. This equilibrium results in an adequate income for having children as well as in a high fertility rate. Then, the following proposition is obtained.

Proposition 2 Even though both income and fertility continue to decrease in an economy without child care services, both income and fertility can be pulled up by child care services, so that we can make both income and fertility converge to a high level.

In Fig.3-2, we define the fertility with k^{low} as n^0, and that with k^{high} as n^1, and we obtain $n^0 < n^1$. For $\phi > \psi$, with a small ψ, we obtain $\phi n^0 > \psi n^1$. In this case, the labor participation of k^{high} is greater than that of k^{low}; therefore, there are two steady state equilibria: (1) the equilibrium with both a low fertility rate and low labor participation and (2) the equilibrium with both a high fertility rate and high labor participation.

We find that the existence of child care services prevents the decrease in fertility rate and maintains the fertility rate to some extent. The purpose of child care policy by the government is considered to be the maintenance or increase in fertility. We consider the child allowance policy (wherein the government gives an allowance to households in proportion to the number of children they have) and reduction in the cost of child care service policy as examples of child care policies. We are apt to think that these child care policies are valid. However, the next section shows that if the government engages in the large-scale implementation of these child care policies, there will be a decrease in the fertility rate.

4   The Analysis of Child Care Policy

This section analyzes the effects of two child care policies: (1) the child allowance policy and (2) the reduction in the cost of child care services policy. We analyze how these policies affect the fertility rate and income, and whether these policies can pull up the fertility rate.

4.1   Child Allowance Policy

First, we consider the child allowance policy wherein an allowance is given to households in proportion to the number of children they have. The allowance decreases the child care cost per child, and concretely, we consider a decrease in z. The decrease in z causes the curve shown by the dynamic equations (14) and (16) to decline. The reason for this is that the decrease in z pulls up the fertility rate for any k_t; therefore, this increase in n_t decreases the capital per capita in the $t+1$ period k_{t+1}. In the following analysis, we show the effect of child care policy in the only case that satisfies the condition $\frac{\beta}{1-\alpha-\beta}\frac{\phi\omega}{b}\frac{1}{\alpha+\beta} < 1$.

As a result of the implementation of the child allowance policy, we find the change shown by the following two figures.[5]

[Insert Fig.4 around here.]

Child allowance policy has two effects-a positive effect and a negative effect-on fertility rate. The positive effect is that the allowance decreases child care cost z; therefore, the fertility rate increases in the short run. However, the negative effect is that the increase in fertility rate n_t in the short run decreases capital per capita in the next period k_{t+1} due to the increase in labor supply. The decrease in k_{t+1} brings about a decrease in income y_{t+1}; therefore, the fertility rate n_{t+1} decreases. If the negative effect is larger than the positive effect, in the long run, the fertility rate decreases on account of the allowance.[6]

Fig.4-1 shows the case of a small z. In this case, even though the steady state equilibrium with high income k^{high} moves leftwards, the decrease in income is small. On the other hand, if too much allowance is given, as shown in Fig.4-2, k^{high}, which brings about a high fertility rate, vanishes; therefore, the capital per capita decreases to k^{low}. Therefore, the allowance decreases the fertility rate considerably because the decrease in income is larger.

4.2   Reduction in the Cost of Child Care Service Policy

In this subsection, we analyze whether the fertility rate can be increased when the government reduces the cost of child care services p so that the child care services become cheap for households.[7] As shown in Fig.5, a decrease in the fee p brings about a decrease $\hat{k}_t$ and makes the curve shown by the dynamic equation (16) move downwards.

[Insert Fig.5 around here.]

As shown in Fig.5, a decrease in p does not result in the curve shown by equation (14) moving downwards but in (16) and $\hat{k}$ moving leftwards. The case of Fig.5-1 shows the case wherein the decrease in p is small. In this case, the decrease in $\hat{k}_t$ is small. k^{high} with high fertility moves leftwards, resulting in this change decreasing the fertility rate in k^{high}. On the other hand, Fig.5-2 shows the case wherein k^{high} vanishes, resulting in a unique equilibrium k^{low}. In this case, the fertility rate decreases considerably in the long run because the capital per capita k_t decreases down to k^{low}. Then, the following proposition is obtained.

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[5]If $\frac{b}{\omega(\phi-\psi)}$ is large, $\hat{k}_t$ moves largely in decrease in z or p

[6]This paper does not consider taxation for the financing of child care policies. Even if we consider taxation in this paper, the results do not change greatly. Considering labor income taxation, we surmise that the child care policies are valid in the short run if the tax burden is light. In the long run, in addition to there being a decrease in capital per capita, the tax burden leads to a decrease in income, that is, the decrease in income is larger than that in the case of no tax burden.

[7]We consider that the government reduces child care service cost c with the policy, thus the fee p reduces.

Proposition 3 The two child care policies (child allowance policy and the reduction in the cost of child care service policy) have two effects on fertility: (1) a decrease in child care cost z or p increases the fertility rate and (2) a decrease in income decreases the fertility rate. Too many child care policies destroy the equilibrium with high fertility.

The small-scale child care policies (k^{high} does not vanish) decrease z, p, and k^{high}. However, the decrease in k^{high} is larger than that in z or p.[8] That is, this result shows that fertility increases in the short run; however, in the long run, the fertility decreases due to child care policies on account of the decrease in income.

If the government implements large-scale child care policies (k^{high} vanishes), the fertility increases in the short run. However, in the long run, the fertility decreases considerably due to the considerable decrease in income. The government should pay attention to what positive child care policies that decrease z or p considerably are valid in the short run but invalid in the long run.

5 Conclusions

This paper analyzes how fertility is affected by child care services in a dynamic model under the assumption that there is complete substitution between individual child care time and child care services. Among the results that we have presented in this paper, the following are noteworthy.

Even if the case wherein there are no child care services has a stable and unique steady state, owing to child care services, the two stable steady states appear. Without child care services, there is only the equilibrium with low fertility. On the other hand, the existence of child care services brings about the equilibrium with high fertility. This result shows that the existence of child care services can maintain a high fertility rate.

In the latter part of this paper, we analyzed whether child care policies, (for example, the child allowance policy, wherein households receive an allowance in proportion to the number of children they have, and the reduction in the cost of child care services policy) can pull up the fertility rate. These policies can pull up the fertility rate in the short run. However, the effect in the long run is different. The increase in fertility in the short run increases the labor supply in the next period; therefore, the income decreases in the next period. Therefore, the fertility decreases in the long run due to the decrease in income. The large-scale child care policies destroy the equilibrium with high income and fertility; as a result, the fertility decreases considerably before the implementation of

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[8]The reason for this is that the slope of the curve in the case of *Available* with k^{high} is less than one. The fertility in steady state is shown $n = \frac{1-\alpha-\beta}{\frac{b}{\omega}(1-\phi n)\frac{z+p}{k}+\psi}$. Decrease in z or p decreases the fertility in the steady state because slope that is less than one brings about increases $\frac{z+p}{k}$.

child care policies.

This paper shows that prior to implementing child care policies, the government should consider their short- and long-run effects.

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Total fertility rate (2005)

Japan	Germany	Sweden	England	France
1.26	1.34	1.77	1.78	1.94

(Data: White paper on society with fewer children 2007)

Female labor participation rate (15〜64 years old) (2004)

Japan	France	Germany	England	Sweden
60.2%	63.8%	65.2%	66.8%	75.7%

(Data: White paper on gender equality 2006
(England is the data at 1993))

Government expenditure related family policy (the share to GDP (2003))

Japan	Germany	England	France	Sweden
0.75%	2.01%	2.93%	3.02%	3.54%

(Data: OECD "Social Expenditure Database 2007")

Table 1: Total fertility rate, female labor participation and government expenditure related family policy in developed countries
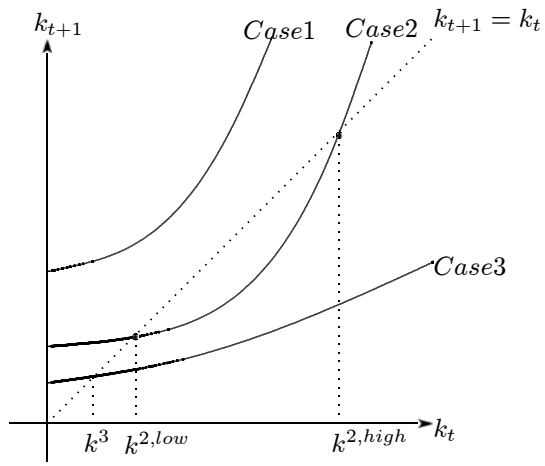
Fig.1: Dynamics of k_t in the case of no nursery schools
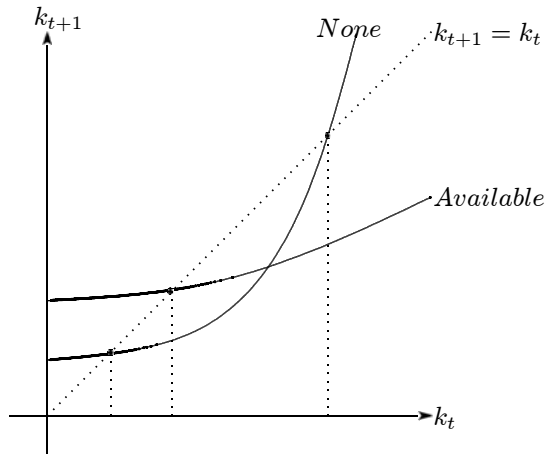
Fig.2: Dynamics of k_t in the case of the existence of nursery schools
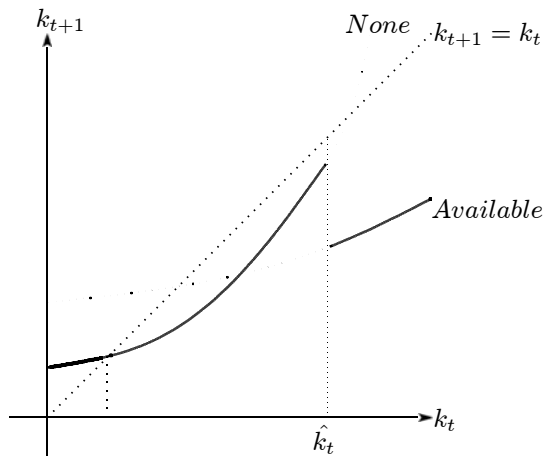
15

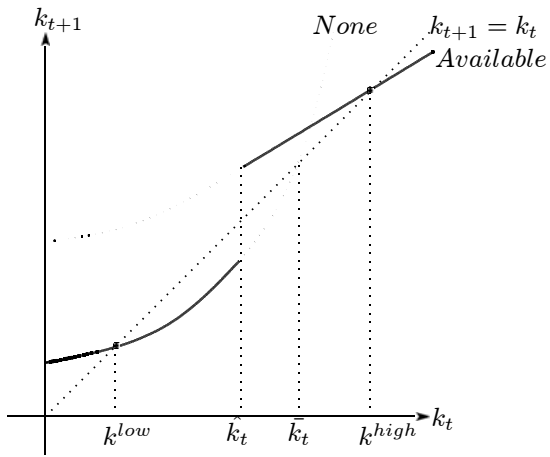Fig.3-1: Dynamics of k_t (unique steady state equilibria)

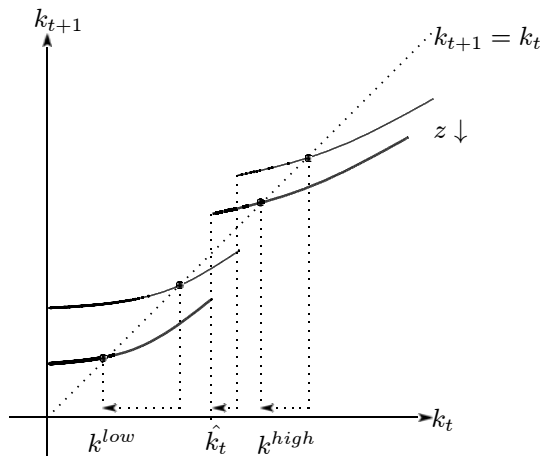Fig.3-2: Dynamics of k_t (two steady state equilibria)
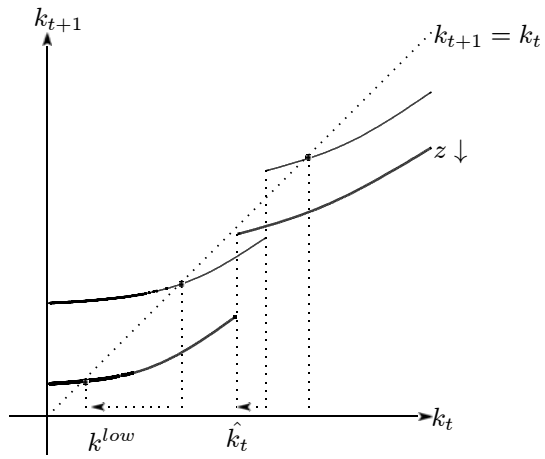
Fig.4-1: Child allowance (valid case)
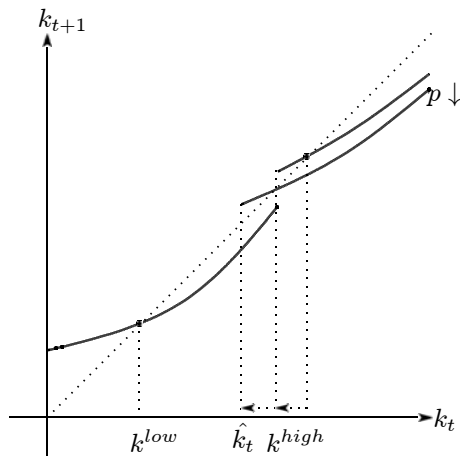

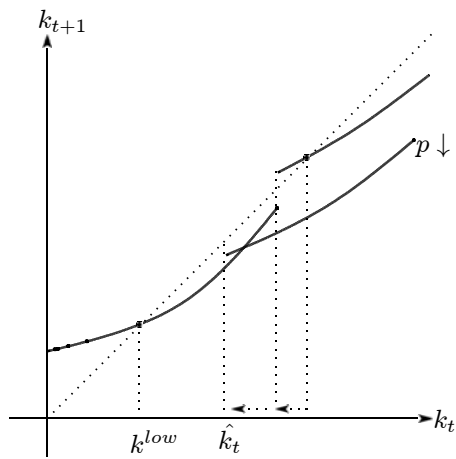Fig.4-2: Child allowance (invalid case)

Fig.5-1: Decrease in fee (valid case)

Fig.5-2: Decrease in fee (invalid case)