Fertility, Non-Altruism and Economic Growth: Industrialization in the Nineteenth Century

Elise S. Brezis*

August 2002

Abstract

This paper presents a model of fertility, which is specific for the industrialization that took place during the nineteenth century and which was concurrent with the demographic transition that occurred over the period. While previous research on demographic transition assumed altruism as the main element explaining the increase in fertility rates, this paper does not, since altruism seems irrelevant over this period. The relationship between parents and children is part of a whole set of values and social norms that evolved over time and were affected by changes in the economic environment. In the nineteenth century, parental behavior was not compatible with altruism. I therefore present a model that suits the social norms of the nineteenth century. The value that seems to correspond to the legal system and social norms regarding the parent-child relationship of the period of industrialization is *perpetuation*. Due to a budget constraint on workers, perpetuation is displayed differently in different social classes. This paper will therefore focus on the interaction between the different social classes and show how industrialization is linked to demographic transition.

JEL classification: J13; O11; O16; O40.

Keywords: altruism; social classes; demographic transition; capital; proletariat; fertility; growth

* *Department of Economics, Bar-Ilan University, Ramat Gan, Israel* Fax: 972 (3) 535-3180; brezie@mail.biu.ac.il.

I wish to thank Mike Bordo, Daniel Cohen, Francois Crouzet, Steven Durlauf, James Foreman-Peck, Oded Galor, Edward Glaeser, Knick Harley, Samuel Hollander, Peter Temin, Thierry Verdier, Eugene White, and Warren Young, conference participants at the European Economic Historical Society Conference, and the European Economic Association meetings, as well as participants at seminars at Delta, the Hebrew University of Jerusalem, Rutgers University and the University of Wisconsin for their helpful comments.

I. Introduction

In recent models on demographic transition, altruism and human capital play a preponderant role in decisions about fertility (see Becker et al. (1990), Galor and Weil (1996, 2000), Dahan and Tsiddon (1998), and Galor and Moav (2002)). These models assume that children are a consumption good, i.e. *ceteris paribus*, the higher the income level, the higher the fertility rate, which is derived from a particular way of assuming altruism. Indeed, altruism in these models means that an individual cares about the welfare of *each* of his children, and by assuming equality between children, these models generate the result that the number of children positively affects utility. In consequence, these models assert that the increase in income that occurred in the first half of the nineteenth century led to an increase in fertility.

This way of representing the utility function of parents seems perfectly representative for the way parents behave today. Altruism towards each child is obvious in the present, and it is almost a postulate that parents love and care for their children. Therefore, the way Becker and later, Galor et al. (Galor and Weil, 2000; Galor and Moav, 2002) have modeled family economics seems adequate.

However, the postulate that it is a natural and biological tendency to want to care for children has been questioned (see Badinter, 1980 and Aries, 1973). There is increasing evidence that altruism is not a good representation of what occurred in the eighteenth-nineteenth centuries - the centuries during which fertility rates increased. The parent-children relationship is part of a whole set of values and social norms that evolve over time and are affected by changes in the economic environment. Parental love is not an intrinsic value, which is independent and invariant to economic changes. It has evolved over time, and especially in the eighteenth-nineteenth centuries, the period of industrialization.[1]

For our generation, even raising the idea that parental love is not a fundamental value might seem outrageous, and some would argue that already in the Bible it was said that Abraham loved his son Isaac (Genesis, XXII, ii). On the other hand wasn't he ready to sacrifice his son for a greater value, that is, God's will?

[1] See Zelizer, 1985.

Focusing more specifically on Europe over the period of the sixteenth to nineteenth century, parental behavior as displayed towards their children is not compatible with altruism. Indeed, during this period, most Parisian women (except the very poor) sent their children for nursing far away from Paris, when they knew that the probability of seeing the child coming back would be small. Badinter (1980, p.57) has reported that in the 1780s, of the 21,000 children born in Paris per annum, 18,000 were sent away to a wet-nurse, and more than two thirds did not return to Paris. Women knew the danger of sending their children for nursing, but still did it. There are descriptions of women who sent two or three of their children away for nursing, and although they never returned from nursing at a specific location, still sent their subsequent children to the very same place.[2]

The legal system of the time, which was an expression of social norms over the period, is clear regarding the way society was then treating children: Parents had rights over children, but children had no rights. In Greece and Rome, the father had all rights over life and death of his sons; he had the right to put them in prison (see Cicero, prodomo 3). In France of the thirteenth century, a father who killed his son was not in violation of the existing criminal law. The laws enacted by Henri II and Henri III (1556, 1579) proclaimed that children who married against parental will or permission, not only would be ineligible for an inheritance, but could be accused of abduction which was legally punishable by the death penalty (see Badinter, 1980, p.32). Moreover when parents were not satisfied with their children, the children could be sent away for deportation. (French law, 1763).

The element of altruism is adequate when modeling the family economics of the twentieth century, since nowadays, family behavior in the sixteenth to nineteenth centuries seems to us to be unacceptable, to say the least. However for describing this period, it is necessary to represent and take into account the social norms and values of the specific period. As this paper focuses on the nineteenth century, I will, therefore, present a model that is appropriate for the social norms of the eighteenth-nineteenth centuries. The model will also permit a closer fit to the data of the nineteenth century. Indeed, while there is no doubt that total income increased in the

[2] Mortality rate of children sent to wet-nurse was much higher than mortality rate of children staying at home.

first half of the nineteenth century, the income of the most important social class -- the workers -- did not increase, and for some even decreased. Thus, those models that assume altruism predict a decrease in fertility, and cannot, therefore, explain the increase in fertility that occurred during the first half of the nineteenth century.

The value that seems to correspond to both the legal system and social norms regarding the parental-child relationship of the period of industrialization is *perpetuation*. Parents wanted children in order to have a "continuation" of their line. If children were not an extension of the values of their father, they had no reason to be. This need for perpetuation is reflected in the legal system: for example, the laws that if children married against the will of parents, parents could imprison them, or if parents were not satisfied with their children, they could be sent for deportation. Indeed, it seems rational that if one cared about continuity, one cared about the marriage of children being related to specific individual values. The model I present in this paper is, therefore, based not on altruism but on perpetuation.

However perpetuation does not display itself in the same way for all individuals. Continuity was different for workers and the business elite, due to a budget constraint for the workers. Workers did not save, and workers' children had to work in order to increase the income of the family. As Marx claimed: "All family ties among the proletarians are torn asunder, and their children transformed into simple articles of commerce and instruments of labour" (Marx and Engels, 1955, p. 28). Or again, as expressed by Marx: "In order that the family may live, four people must now not only labour, but expend surplus labor for the capitalist…Previously, the workman sold his own labor power, which he disposed of nominally as a free agent. Now he sells wife and child. He has become a slave dealer" (Marx, 1967, p. 395).

In bad times, this additional income was needed even more, which led to an increase in the number of children. Indeed Marx saw this inverse correlation between wages and fertility rates: "In fact…the absolute size of the families stands in inverse proportion to the height of wages" (Marx, 1976, p. 796-7).[3] For the business elite, child labor was irrelevant, but perpetuation introduces itself in the form of a need to perpetuate the family business.

[3] See also Brezis and Young, 2003.

Therefore, during the period of increase in fertility, which corresponds to the first phase of industrialization, the model presented in this paper takes an opposite view to the model presented by Galor et al. However, during the second phase of industrialization, our models are complementary. In their models, by introducing education and human capital, they generate a substitution effect between quantity of children and quality. In consequence, fertility rates decrease. In the model presented in this paper, capital-labor ratio increases during the second phase, and therefore wages go up, which reduce the constraint on child labor. Parents can move towards their optimum level of fertility and reduce the number of children.

Briefly put, the two types of models focus on different aspects of the reduction of fertility. This paper, which focuses on the nineteenth century (the time of the demographic transition) concentrates on capital, and does not deal with human capital, because the central factor of industrialization has been attributed to capital and its accumulation through savings.[4]

This paper therefore, focuses on capital accumulation, and analyzes the interaction between the different social classes and their effects on fertility rates. Indeed, the difference in income between the social classes affects their budget constraint, and therefore their economic decisions. Our proposed model will clarify the relationship between fertility rates across different classes, since it analyzes the behavior of both the proletariat and the elite. We will show that, in fact, their economic decisions on fertility are different, and we will relate this result to the literature on fertility of the different social classes.

The literature on the difference in fertility rates in the different social classes is mainly comprised of Stevenson (1920), Notestein (1936), Innes (1938), Johnson (1960), Haines (1989), and Woods (1987). There is a debate regarding whether the social class differentials of fertility were larger during the early stages of fertility decline. Stevenson and Innes claim that they were after 1860, and that there was some diffusion of this phenomenon. Woods argues against the widening differentials and against the diffusionist view of the English fertility decline. The data seems to favor a widening of differentials, but is less clear about diffusionism (see Haines, 1989).

[4] Although there is a debate over whether accumulation of capital was due to savings or to inflows of capital from abroad (see Brezis, 1995 and Neal, 1990).

This paper enables the analysis of the relationship between the fertility rates of the workers and the business elite. The model developed below establishes that during the increase in fertility, there is a relationship between these two rates, while during the demographic transition, these two rates are not related, and therefore one cannot speak of diffusionism, as shown in the data. The model's dynamics exhibit an initial increase in the fertility rates at the onset of the Industrial Revolution in both the proletariat and the business elite. However, during the phase of the decrease in fertility of the workers, i.e., the demographic transition, there is no relationship between these two rates. The decrease in fertility of the business elite occurred independently of the dynamics of the fertility of the workers.

This paper is divided into five parts. Section II presents some historical facts related to the model. Section III presents the model, Section IV, the equilibrium and dynamics, and Section V is the conclusion.

II. Historical context of the model

2.1. Children's work

Children's work in the nineteenth century was an important element in some of the industries.[5] Children under 12 years old constituted 8% of the labor force in the cotton industry, and children aged 13-18 another 10% (see Evans, 1990, p. 250). Moreover, in certain counties in England in 1851, there was a positive correlation between fertility and the percentages of children aged 9-14 who were employed (see Birdsall, 1983, p.116).

In the nineteenth century, the costs of raising worker's children were very low. For example, in France, up to the age of 5, children were left with a nurse, for which the cost per annum was around 84 livres (see Badinter, 1980, p.65). When considering benefits, the wages received by children who started working at age 6 (and later on, due to legislation, at age 9), were around 450fs a year (around half that of adults) from which they kept for themselves around 20fs. So after one year of working they had repaid expenses, and in the other years there were net income inflows to the parents. In England, in a cotton mill survey undertaken in 1859, men were paid a weekly wage

[5] For more details, see Tuttle and Wedge (2002).

of 18s and boys were paid 7s (see Evans, 1990). So for workers, the intergenerational income flows during the nineteenth century were from children to parents.

However, there was a rise in the costs of raising children in the late nineteenth century, due to the enforcement of restrictions on child labor. During the same period, it also became more expensive to raise children due to the Poor Law of 1868 that made it an offense for parents to fail to supply their children with such necessities as food, lodging, and clothing. Moreover, in 1891, schooling was made compulsory, so that at the turn of the century, the intergenerational flows are changing directions.

2.2 Fertility and Social classes

After the proto-industrial period, there was a widening of the differences between the classes that were almost non-existent before the eighteenth century. During the Industrial Revolution, society was comprised of many classes: workers, the bourgeoisie (e.g., liberal professions such as lawyers and doctors), the "haute bourgeoisie" (i.e., the business elite), the aristocracy (who had no economic impact on industrialization), and the farmers. While workers' fertility increased, the business elite's increased even more, while the aristocracy experienced a decrease in fertility by as early as the beginning of the eighteenth century.

The differences between social classes are not only reflected in the fertility rate, but also in the nuptiality rate. In the nineteenth century, workers married early, while the bourgeois continued to marry late: "Ages at first marriage for men were the lowest in marriages which involved male factory workers marrying female factory workers" (Lynch, 1991, p. 89). We will presently examine the main elements related to fertility in the business elite and in the proletariat.

<u>The business elite</u>

In the nineteenth century, "it has to be remarked that the beginning of industrialization was related with an increase in fertility especially in the milieu bourgeois" (Bardet and Dupaquier, 1998, p.112).[6] Upon examination of the fertility rate among the business elite in England and in France, we find that it was higher than that of the other classes. The data show that the industrial elite of Manchester, Mulhouse in the

[6] In contrast to the nobility, the business elite did not show a reduction in fertility.

north of France, and Lorraine or the Ruhr area had a high fertility rate (see Daumard, 1987; Evans and Lee, 1981; and Davidoff and Hall, 1987). Some prominent industrialists had many children, such as Sir John Guest (10 children), William Crawshay (14), and Henry Overton Wills (18). In Alsace, the Koechlins had 14 children, and the average for families in northern France who were engaged in textiles was more than 10. As Crouzet (1999, p. 47) points out: "Large families were not only a guarantee against early deaths, they allowed the appointment of the most able sons."

The explanation for this behavior is that the business elite was interested in the continuation of the firm, or the familial enterprise, and this influenced the values of the time. The Victorian philosophy was to encourage women to stay home and have more children, or what was called "the Victorian role of women".

Wages and the proletariat

Since the salary of one person was not adequate for subsistence, having children brought about an increase in the family income. Table 1 presents data showing that the earnings of a worker couple were indeed not enough to survive.[7]

There is a long debate in the literature regarding the evolution of wages and more generally, the standard of living in the first half of nineteenth century England. While the optimists (Clapham, Ashton, Hartwell, and Lindert and Williamson) show that industrialization was equivalent to an increase in the standard of living of the workers, the pessimists (starting with Engels, Thompson, Toynbee, Hammond, and later Hobsbawm) disagree with this view.[8] As underlined in Taylor (1975) and Feinstein (1998), this economic debate was tainted with philosophical biases and was related to the debate on the *bienfaits* of capitalism. In Table 2, we display the latest data by Feinstein but also series by Bowley and Wood (presented in Mitchell and Deane, 1971) about the cotton industry which is one of the sectors employing the proletariat. Feinstein's data display a long plateau and subsequent slow improvement, while the other series displayed in Table 2 shows that: "If the Chartists in 1837 had called for a

7 Moreover, Basu and Van (1998, p. 416) take it for granted that "a family will send the children to the labor market only if the family's income from non-child labor sources drops very low".

8 See Hartwell, 1972, Lindert and Williamson, 1983 and Feinstein, 1998.

comparison of their time with 1787, and had obtained a fair account of the actual social life of the working-man at the two periods, it is almost certain that they would have recorded a positive decline in the standard of life of large classes of the population" (Hobsbawm, 1957, p.61).[9]

The model presented in the next section examines the relationship between capital, wages and fertility rates. It implies a negative relationship between wages and fertility rates, and therefore is in accordance with the pessimistic view on the first half of the century, which claim a slight reduction in real wages. About the second half of the century, there is no debate that real wages and living standards went up which, according to the model, leads to a decrease in fertility rates.

The facts related to the nobility and the petit bourgeoisie are interesting but not directly linked to our model, I, therefore, present them succinctly:

The nobility and the aristocracy

In France, there is strong evidence of a decrease in the fertility rate of the nobility as early as 1650-99 (see Peller, 1965; and Hollingsworth, 1965). By the late seventeenth century, the aristocracy adopted fertility control methods, and the "European marriage pattern" became less effective. Similarly, the haute bourgeoisie of Geneva as early as the seventeenth century experienced a reduction in fertility (Henry, 1956). They began with a high fertility rate, and later it decreased in order not to experience a decline in social status.

In England, the decrease in fertility began at the beginning of the nineteenth century. There, the aristocracy moved from natural fertility to limited fertility much earlier than did other social groups. Some claim that they started out with a high fertility rate; for instance George III had 15 children and the Duke of Clarence had 10.

9 Taking the confidence interval of Feinstein, and the evidence brought by him on biological variables (height and mortality), the pessimist view for the first half of the century is based on sound ground. Moreover, on the consumption side, the decrease in income has been shown by the decrease in the consumption of meat, sugar, and tea in the first half of the century (see Taylor, 1975, p. xxxi).

The petit bourgeoisie

Among the petit bourgeoisie (i.e., the liberal professions), the fertility rate, on average, was lower than for the business elite. In this social class, children did not work. However, during the eighteenth and the first half of the nineteenth centuries, for the urban petit bourgeoisie, it was necessary for the woman to work, and the Victorian, haute bourgeoisie ideology of family had no impact. The women were working, so the burden of the care of small children was problematic, a fact that favored limitations on fertility. When the level of income increased, women ceased to work and adopted the bourgeois philosophy.

III. The model

This paper focuses only on the two classes that played a preponderant role during the Industrial Revolution: the workers and the business elite. Their utility function is the same but workers are constrained, and do not save; the business elite saves and does not need to make their children work. The model restricts itself to the period where real wages did not exceed consumption. Moreover, since the size of the elite population is negligible, the size of the population is equal to the size of the worker population.

In this model, real wages are the key element in the demographic transition; but they are not exogenous. They are endogenously determined by the capital-labor ratio, which is itself a function of the quantity of labor (determined by the workers) and the quantity of capital (determined by the business elite).[10] It is therefore the interaction between these two classes that leads to the dynamics of growth and fertility rates. In this section we present the model and the optimal decision of each class.

3.1 Output and Utility function

This paper relates to the factory system in the nineteenth century. Our focus will therefore be on the industrial sector, and not on agriculture. The two main factors of production are capital and labor (and we do not relate to land, since it is not an

[10] In this model, we assume for matters of simplicity that the economy is a closed one, i.e., that there are no immigration or capital inflows.

important factor of production for the industrial sector). The output function takes the form:

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha}. \tag{1}$$

Since we assume a constant return to scale Cobb-Douglas function, we get wages as an increasing function of the capital-labor ratio (where the second derivative is negative):

$$w_t = A(1-\alpha)(K_t / L_t)^{\alpha} \quad \text{and } r_t = A\alpha(K_t / L_t)^{\alpha-1},$$

and

$$\partial w_t / \partial(K_t / L_t) = A(1-\alpha)\alpha(K_t / L_t)^{\alpha-1} \geq 0 \tag{2}$$
$$\partial^2 w_t / \partial(K_t / L_t)^2 = -A(1-\alpha)^2\alpha(K_t / L_t)^{\alpha-2} \leq 0$$

About the utility function, it is different than in the models of Becker and Galor. As explained in the introduction, in this model I do not introduce the notion of altruism. The utility function of an individual instead of being a function of his consumption and the consumption of his heirs, is a function of his consumption and his continuity (i.e., perpetuation), CO.

$$U_t = U(C_t, CO_t). \tag{3}$$

Perpetuation is mainly influenced by two factors. The first is the harm done to children which affects negatively perpetuation; the more the total hours of children work, the less the continuity. The second element is the value of the family firm: an increase in the value of the family firm leads to more continuity. So we get:

$$U_t = U(C_t, CO_t) = U(C_t, S_t, n_t h) \tag{4}$$

where C_t, is consumption, S_t is the incremental value of the firm, h the numbers of hours children work and n_t the number of children. Despite the same utility function, the business elite behavior is different than the workers due to a different budget constraint, we therefore analyze each of these classes separately.

3.2 The Business elite

As explained above, the continuity for the business elite is related to the family business. The business elite was concerned about the family business and had an interest in the continuation of the familial enterprise. Moreover since children did not work, the utility function of the bourgeois is a function of consumption, C_t, and the

incremental value of the firm, which is a function of the savings of the entrepreneur, S_t. Assuming an additive function with the same weight on each argument, we get:

$$U_t = U(C_t, S_t) = U(C_t) + U(S_t)\,. \tag{5}$$

It is the uncertainty of survival of the firm that influenced the family's decision regarding the number of children. Mortality remained high during the nineteenth century, and the survival of the firm was a function of the number of children the business elite had; so that the higher the number of children in a family, the higher the probability of that family's firm's survival. We have shown in the previous section that fertility rate among the business elite was quite high. Indeed, familial firms belonging to families without many children usually did not survive: "Many dynasties have disappeared, because of a lack of offspring" (Crouzet, 1999, p.47). For instance, the André and the Schneider dynasties disappeared because of a small number of children (three) who died with no offspring.[11]

The value of the firm is not known with certainty, since it depends on whether the dynasty has offspring. Therefore the business elite maximizes an expected utility. When it has children who can take over the firm, the utility of the savings is $U(S_t)$. But when there are no children, savings are lost and we obtain $U(S)=0$.

Denoting p, as the probability of survival of the firm, we assume that:

$$p = p(n^b) \quad \text{where } p' > 0 \text{ and } p'' < 0\,, \tag{6}$$

where n^b is the number of children per family in the business elite.[12]

Assuming a log function, we therefore obtain that expected utility is:

$$EU = p[U(C_t) + U(S_t)] + (1-p)[U(C_t)] = U(C_t) + p(n_t^b)U(S_t) = \ln(C_t) + p(n_t^b)\ln(S_t) \tag{7}$$

We assume that each generation lives for one period. The income of the entrepreneur is the rents that he receives on inherited capital, r_tK_t. He divides his income between his own consumption, the consumption of his children, and savings, S_t:

---

11 See Crouzet (1999) and Lewis (1986).

12 This probability is also a function of the mortality rate, but since it is exogenous in our framework, we ignore it.

$$r_t K_t = \tilde{C}_t + S_t, \tag{8}$$

where $\tilde{C}_t$ includes his own consumption and that of his children.[13] A share λ of this total consumption $\tilde{C}_t$ goes toward his own consumption (and a share 1-λ goes to the children). We assume that the children's' consumption increases as a function of the number of children, i.e., the $\lambda(n_t^b)$ function is negatively sloped, so that the higher the number of children, the lower the entrepreneur's own consumption. We also assume that the function is convex. A simple form for this function is to choose an exponential form: $\lambda = e^{-n}$.

Substituting in equation (7), we get that the entrepreneur chooses his savings and the number of his children so as to maximize:

$$\ln[(r_t K_t - S_t)\lambda(n_t^b)] + p(n_t^b)\ln(S_t). \tag{9}$$

Let us note that this utility function has some similarity to the one presented in models that assume altruism; we obtain an equivalent equation, but from different assumptions regarding the economy.

The first-order conditions are shown in equations (10) and (11), that determine the quantity of savings, consumption, and children chosen by the entrepreneur:

$$S_t = p(n_t^b)/(1+p(n_t^b))]r_t K_t = P(n_t^b) r_t K_t \quad P = p/(1+p) \quad P' \geq 0 \;\; P'' < 0. \tag{10}$$

$$-\lambda'(n_t^b)/\lambda(n_t^b) = p'(n_t^b)\ln(Pr_t K_t) \qquad . \tag{11}$$

Equation (10) indicates that savings are a linear function of rents ($r_t K_t$). The right-hand side of equation (11) is downward-sloping[14], while the left-hand side is upward-sloping (and in the case where the λ function takes an exponential form, it is linear).[15] In consequence, there is a unique solution of the number of children, shown in

---

[13] The spouse's consumption is included in his own consumption.

[14] The RHS might be upward-sloping for small n, then downward-sloping. If we assume that K is large enough or p is very concave, then the RHS always has a negative slope.

[15] For the SOC to be negative, we have to assume that λ is such that $\lambda'^2 \geq \lambda''\lambda$. Under this condition, we obtain that the left-hand side is upward-sloping.

Figure 1. An increase in the capital stock (K_t) implies that the upward-sloping curve moves to the right, which leads to an increase in the optimal number of children, we therefore get that the number of children is a positive function of the capital stock (K_t).

3.3 The Workers

Given the utility function presented in equation (4), workers did not have capital to bequest to their heirs. Moreover in the nineteenth century, for workers child labor was a necessity as shown in section 2; intergenerational income flows were from children to parents.[16]

Usually, children began working at the age of eight or nine, (and sometimes at age of six) and the incomes of all members of the family were pooled. After the age of 13, children were allowed to retain some of their income in order to build a small capital prior to marriage. The children's' income was a necessity in the proletariat: "At no stage in this family history, had they been able to manage only on the husband's wage" (Meyering, 1990, p.141).

So despite the fact that utility of the worker would be greater if his children did not work, he was constrained to let his children work. Since the salary of one person was not adequate for subsistence, (We analyze a period where wages were lower than the subsistence level, i.e., $\overline{C} > w$), having children brought about an increase in the family income.[17]

So, in each period, workers choose to maximize a utility function:

$$U_t = U(C_t, CO_t) = U(C_t, n_t h) \quad \text{and} \quad U_1 \geq 0, U_2 \leq 0 \tag{12}$$

[16] Hazan and Berdugo (2002) present a model where child labor is introduced in a Galor et al. type of framework, which assume that intergenerational flows are from parents to children.

[17] Dasgupta (1995) shows that this need for child labor exists in developing countries nowadays. He also emphasizes that in developing countries, where children are in effect "working hands", a reduction in productivity leads to an increase in fertility since more hands are needed. Moreover, based on data from the Population Institute's value of children (VOC) project, Caldwell (1983, p.474) wrote that: "The findings indicate that fertility decline is associated with declining economic roles for children."

We also assume that $U_{11} \leq 0$, $U_{22} \leq 0$, $U_{12} \leq 0$, and that h, the number of hours worked by children is constant and equal to 1, despite the fact that over the years, it has been legally reduced.

The budget constraint of the family in each period is:

$$C + l(n^w) = w + wn^w \tag{13}$$

$$\text{and } C \geq \bar{C}. \tag{14}$$

$\bar{C}$ is the subsistence level of consumption for an adult, n^w is the number of children that the worker has, and $l(n^w)$ is the consumption of children. We assume that $l(n^w)$ is upward-sloping and concave ($l'>0$ and $l''<0$).

On the right hand side of equation (13), we have family income. This includes the worker's wages as well as children's wages. Children's wages were, in reality, lower than wages of adults (about half in the textile industry), but in order to simplify the model, we take all wages as equal. On the left-hand side, we have the outlays, i.e., the worker's consumption, as well as his children's consumption. The inequality in equation (14) means that consumption cannot be lower than the subsistence level of consumption.

The top part of Figure 2 represents the utility function as a function of the number of children n, by substituting consumption from the budget constraint (13).[18] However, the wage rate is so low that at the maximum of the utility function, consumption is lower than the subsistence level. Therefore, equation (14) is binding, and the number of children is higher than the optimum and is such that:

$$w + wn^{w}* - l(n^{w}*) = \bar{C} \quad , \tag{15}$$

as shown in the lower part of Figure 2. The optimum number of children is therefore higher than the non-binding maximum.

[18] It is easy to show that U(n) has an optimum where $dU/dn=0$, and that $d^2U/dn^2<0$. Indeed, since U(n) = U(w+wn-l(n), n), its derivative takes when n is small, a positive sign and a negative one when n tends to infinity. Moreover since $d^2U/dn^2<0$ then there exists an n such that the FOC is zero.

Lemma 1.

The optimal number of children of the proletariat is a negative function of wages.

Proof. When wages increase (a shift to the left of the straight line in Figure 2), the constraint is reduced, and therefore the fertility rate decreases. The optimal number of children is therefore a negative function of wages as shown by differentiating equation (15):

$$dn^{w}*/dw = (1+n)/(l'-w) < 0. \tag{16}$$

An assumption that is necessary for this model is that $l' \leq w$, that is, the net wages of children at the margin is greater than zero, i.e., the intergenerational transfer goes from children to parents, an assumption that holds for the proletariat during the nineteenth century, as we have shown above. We also assume that the second derivative of the l function is such that $(1+n)l''/(l'-w) \geq 2$. Under this assumption, we obtain that $d^2n^{w}*/dw^2 \leq 0$.

The interpretation of equation (16) is that when wages slightly decreased, as occurred during the first half of the nineteenth century (see Table 2), families needed more children to survive, and the fertility rate went up slightly. During the second half of the century, wages went up, and therefore workers reduced their fertility rate. The interaction between the decisions of workers and the output function leads to a relationship between the fertility rate of the workers and the capital-labor ratio as in Lemma 2.

Lemma 2.

In each period, the fertility rate of the workers is a negative function of the capital-labor ratio as expressed in equation (17):

$$n_t^{w} = \Delta(K_t/L_t) \quad \text{where } \Delta' \leq 0 \text{ and } \Delta'' \leq 0. \tag{17}$$

Proof. Since the fertility rate is a decreasing function of wages, and wages are an increasing function of the capital-labor ratio, we obtain that the fertility rate is a decreasing function of the capital-labor ratio. Assuming that $(dn_t^{w}/dw)/(d^2n_t^{w}/dw^2) \leq A\alpha(K/L)^{\alpha}$, we get that $\Delta'' \leq 0$. ð

This relationship between the fertility rate and the capital-labor ratio permits to analyze the dynamics of the capital-labor ratio.

IV. Equilibrium and the dynamics of capital, wages, and fertility rates

On the side of the business elite, at the beginning of each period, capital and interest rate determine their savings and their fertility rate. For the workers, capital and labor given at the beginning of each period determines the wages received by the workers and their fertility rate (see equations 2 and 15). In order to examine, over time, the behavior of these two fertility rates, one has to analyze the dynamics of the system.

The number of children in each family of workers determines the population in the next period (since the elite population is negligible), while the savings of the elite determines the stock of capital):

$$K_{t+1} = K_t + S_t; \quad L_{t+1} = L_t(1 + n_t^w). \tag{18}$$

If the increase in the capital stock is lower than the increase in population, then the capital-labor ratio will decline, and wages in the next period will be lower than in the first period. As a result, the fertility rate of the workers will increase, and the labor supply will increase. When the situation is reversed, there is a decrease in the fertility rate. Therefore, the increase or decrease of the capital-labor ratio over time determine the dynamics of the economy. From equation (18) we get that:

$$K_{t+1}/L_{t+1} \leq K_t/L_t \Leftrightarrow S_t/K_t \leq n_t^w. \tag{19}$$

i.e., there is an increase in the capital-labor ratio if and only if the savings-capital ratio (S/K) is greater than the increase in population, n^w.

The two elements of equation (19) can be compared since the savings-capital ratio and the fertility rate of the workers are a function of the capital-labor ratio, as shown in Figure 3. The relationship between the capital-labor ratio and the fertility rate of the workers, i.e., equation (17) is represented by the NN curve, which is concave. Substituting the interest rate from equation (2) into equation (10), we get the saving-capital ratio shown in equation (20) and represented by the curve SS of which the first derivative is negative, and the second is positive.[19]

$$S_t/K_t = P(n_t^b)A\alpha(K_t/L_t)^{\alpha-1}. \tag{20}$$

The interaction between capital and labor leads to the dynamics of the model as summarized in the following Proposition.

[19] However, n^b is also a function of rK, but the effect of k on n^b is negligible.

Proposition

(i) After the proto-industrialization and during the first phase of industrialization, the capital-labor ratio decreases, wages go down, and the fertility rate of both workers and the business elite goes up. However, these fertility rates are independent of each other.

(ii) During the second phase of industrialization, the capital-labor ratio increases and the fertility rate of the workers decreases. This is the period of the demographic transition.

(iii) The dynamics of the fertility rate of the business elite are independent of the fertility rate of the workers. A decrease in this fertility rate can be explained by a decrease in the mortality rate in this social class.

Proof. Figure 3 depicts the NN curve that describes the fertility rate, n^w, and the SS curve that describes the S/K function. K/L* is the steady state where capital increases at the same rate as population. During the eighteenth century, the dynamics was of an increase in capital-labor ratio, fertility rates and population towards the steady state as shown by arrow (1). However, a shock that leads to an increase in capital-labor ration as were the wars at the end of the eighteenth century leads that the capital-labor ratio, n^w is greater than S/K, so that the capital-labor ratio is decreasing (as shown by arrow (2)). This situation continues until the system reaches again the steady state at K/L*, where n^w is equal to S/K. This is a steady state, *a priori*, and there are no changes in the capital-labor ratio or in wages. At this point, the variable that drives the system to continue to move is the fertility rate of the entrepreneurs (n^b), since it is a function of capital that is still continuing to increase. The exogenous variable that also drives the system is A (technological progress). Since A and n^b increase, the SS curve shifts continuously to the right. So from then on, the trajectory is a movement along the NN curve described by equation (17). Over time, the capital-labor ratio increases, and as a result, the fertility rate n^w decreases. ð

The era of industrialization cannot be described as a long and steady increase in real income of all classes. During the whole firs half of the nineteenth century, standard of living decrease for the workers and yet fertility rates slightly increase. Indeed, during the nineteenth century, there was a negative correlation between wages

(and the capital-labor ratio) and the fertility rate. The fertility rate of the business elite increased as a consequence of the increase in capital. During the first phase of industrialization, both these fertility rates increase, but for different reasons: that of the workers because of a reduction of their wages, and that of the elite because of an increase in the value of their firms. It should be emphasized that the increase in fertility rates of the proletariat in the first half of the nineteenth century was small, as was the decrease in wages.

During the second phase, the fertility rate of the workers decreases, and this is the period of the demographic transition. The dynamics as presented do not lead to a decrease in the elite's fertility rate. However, when one incorporates the decrease in the mortality rate, it leads to a decrease in the fertility rate. In other words, there is no causality effect in the behavior of these two fertility rates, as stated by Stevenson (1920).

V. Conclusion

Altruism has become a concept that is taken for granted in family economics. It is an assumption that does not need explaining for those of us living at the turn of the twenty first century, and it was certainly true for those living in the developed world in the twentieth century. But to take this modeling approach and apply it through all of the centuries can be problematic.

This paper proposes a framework more specific to the nineteenth century, while it tries to paint a more concentrated picture that fits the details of this specific period regarding demography, industrialization, and the behavior of the various social classes. The model not only offers an explanation for the demographic transition, but it also explains the possible correlation between the fertility rates of both the proletariat and the business elite.

It shows that both fertility rates increase concurrently, yet during the demographic transition, these fertility rates are not correlated and are independent. Indeed, when income increases (*ceteris paribus*), it has a positive influence on the number of children given birth to by the business elite. However, an income increase has the opposite effect on the proletariat: higher wages lead to a reduction in the number of children. The dynamics shown by the model corroborate the findings of Stevenson (1920, p. 431) that "The difference in fertility between the social classes is

small for marriage contracted before 1861, and rapidly increases to a maximum for those of 1891-96".

In conclusion, this model, which departs from the Malthusian view, can be an alternative that is better suited for explaining phenomena that occurred in the nineteenth century with regard to industrialization and demography. It is based on the fact that laws governing population decisions are not unrelated to historical processes, and models suitable for the twentieth century cannot always be adapted to the nineteenth century, since: "In fact every special historic mode of production has its own special laws of population, historically valid within its limits alone". (Marx, 1976, p. 784).

Bibliography

Andorka, R. 1978. *Determinants of Fertility in Advanced Societies*. London: Methuen and Co.

Aries, P. 1973. *L'enfant et la vie familiale sous l'Ancien Regime*. Paris: Editions du Seuil.

Badinter, E. 1980. *L'amour en plus*. Paris : Flammarion.

Bairoch, P. 1998. *Victoires et Deboires*. Paris: Gallimard.

Bardet, J-P. and J. Dupaquier. 1998. *Histoire des Populations de l'Europe-II- La revolution demographique 1750-1914*. Paris: Fayard.

Basu, K. and P.H. Van. 1998. "The Economics of Child Labor," *American Economic Review*, 88(3): 412-27.

Becker, G.S. 1960. "An Economic Analysis of Fertility in European Countries," in *Demographic and Economic Change in Developed Countries*, NBER Princeton University Press, pp. 209-31.

Becker, G.S. and R. Barro. 1988. "A Reformulation of the Economic Theory of Fertility," *The Quarterly Journal of Economics*, February: 1-25.

Becker, G.S., Murphy K.M., and R. Tamura. 1990. "Human Capital Fertility and Economic Growth" *Journal of Political Economy*, 98,5: S12-S37.

Birdsall, N. 1983. “Fertility and Economic Change in Eighteenth and Nineteenth Century Europe: A Comment,” *Population and Development Review*, 9(1): 111-123.

Brezis, E.S.1995. “Foreign Capital Flows in the Century of Britain’s Industrial Revolution: New Estimates, Controlled Conjectures” *Economic History Review*, XLVIII 1: 46-67.

Brezis, E.S. and W. Young. 2002. “The New Views on Demographic transition: A Reassessment of Malthus’s and Marx’s Approach to Population .” *European Journal of History of Economic Thought*, forthcoming.

Caldwell, J.C. 1981. “The Mechanism of Demographic Change in Historical Perspective,” *Population Studies* 35-1: 553-577.

Caldwell, J.C. 1983. “Direct Economic Costs and Benefits of Children” in *Determinants of Fertility in Developing Countries*. Academic Press

Coale, A.J. and S.C. Watkins, eds. 1986. *The Decline of Fertility in Europe*. Princeton.

Crafts, N.R.F. 1989. “Duration of Marriage, Fertility and Women’s Employment Opportunities in England and Wales in 1911,” *Population Studies*, 43: 325-35.

Crafts, N.R.F. and C.K. Harley. 1992. “Output Growth and the British Industrial Revolution: a Restatment of the Crafts-Harley View”, *Economic History Review*, 4: 703-30.

Crouzet, F. 1982. *The Victorian Economy*. New York: Columbia University Press.

Crouzet, F. 1999. “Business Dynasties in Britain and France,” in Brezis E.S. and P. Temin (eds), *Elites, Minorities and Economic Growth*. New York: Elsevier, North-Holland, pp.41-54.

Dahan, M. and D. Tsiddon. 1998. “Demographic Transition, Income Distribution, and Economic Growth,” *Journal of Economic Growth* 3(1): 29-52.

Dasgupta, P. 1995. “The Population Problem: Theory and Evidence”, *Journal of Economic Literature*, 33:1879-1902.

Daumard, A. 1987. *Les bourgeois et la bourgeoisie en France depuis 1815*. Paris.

Davidoff, L. and C. Hall. 1987. *Family Fortunes: Men and Women of the English Middle Class, 1750-1850*. Chicago.

Evans, R.J. and W.R. Lee. 1981. eds. *The German family: Essays on the Social History of the family in nineteenth and twentieth century Germany*. London.

Evans, C. 1990. "Unemployment and the Making of the Feminine during the Lancashire Cotton Famine" in Hudson P. and W.R. Lee eds. *Women's Work and the Family Economy in Historical Perspective*. Manchester: Manchester University Press.

Feinstein, C.1981. "Capital Accumulation and the Industrial Revolution" in R.C. Floud and D.N. McCloskey (eds.), *The Economic History of Britain Since 1700,* Cambridge: Cambridge University Press.

Feinstein, C.1998. "Pessimism Perpetuated: Real Wages and the Standard of Living in Britain during and after the Industrial Revolution" *Journal of Economic History*, 58(3):625-58.

Galor, O. and D.N. Weil. 1996. "The Gender Gap, Fertility, and Growth," *American Economic Review*, 86, 374-387.

Galor, O and D.N. Weil. 2000. "Population, Technology and Growth: From the Malthusian Regime to the Demographic Transition," *American Economic Review*, 90: 806-828.

Galor, O. and O. Moav. 2000. "Das Human Kapital," Working Paper No. 00-17, Brown University.

Galor, O. and O. Moav. 2002. "Natural Selection and the Origin of Economic Growth" *Quarterly Journal of Economics*, Forthcoming

Glass, D.V. and D.E.C. Eversley, eds. 1965. *Population in History*. London.

Haines, M.R. 1989. "Social Class Differentials during Fertility Decline: England and Wales Revisited," *Population Studies* 43:305-23.

Hartwell, R.M. 1961. "The Rising Standard of Living in England 1800-1850" *Economic History Review*, 13.

Hartwell, R.M. 1972. *The Long Debate on Poverty*.

Hazan, M. and B. Berdugo. 2002. “Child Labor, Fertility, and Economic Growth.” *Economic Journal*, Forthcoming.

Henry, L. 1956. *Anciennes familles genevoises, études démographiques, xvi-xix siecles*. Paris.

Hilden, P. 1984. “Class and Gender: Conflicting Components of Women’s Behaviour in the Textile Mills of Lille, Roubaix and Tourcoing, 1880-1914,” *The Historical Journal* 27,2:361-85.

Hobsbawm, E.J 1957. “The British Standard of Living 1790-1850.” *Economic History Review* 10: 46-68.

Hollingsworth, T.H. 1965. “A Demographic Study of the British Ducal Families,” in Glass, D.V. and Eversley D.E.C. eds. 1965. *Population in History*. London.

Innes, W. 1938. *Class Fertility Trends in England and Wales, 1876-1934*. Princeton: New Jersey.

Johnson, G.Z. 1960. Differential Fertility in European Countries in *Demographic and Economic Change in Developed Countries*, NBER Princeton University Press, pp. 36-72.

Lewis, J.S. 1986. *In the Family Way: Childbearing in the British Aristocracy, 1760-1860*, New Jersey: Rutgers University Press.

Lindert, P.H. and J.G. Williamson. 1983. “English Workers’ Living Standards during the Industrial Revolution: A New Look”, *Economic History Review*, 36(1): 1-25.

Lynch, K.A. 1991. “The European Marriage Pattern in the Cities,” *Journal of Family History* 16(1): 79-96.

Maddison, A. 1995. *Monitoring the World Economy, 1820-1992*, Paris:OECD.

Marx, K. 1976. *Capital*, Vol. I. England: Penguin Books.

Meyering, A. 1990. “La Petite Ouvrière Surmenée: Family Structure, Family Income and Women’s Work in Nineteenth Century France” in Hudson P. and W.R. Lee ed. *Women’s Work and the Family Economy in Historical Perspective*. Manchester: Manchester University Press.

Mitchell, B.R. and P. Deane. 1971. *Abstract of the British Historical Statistics*, Cambridge: Cambridge University Press.

Morand, O. 1999. “Endogenous Fertility, Income Distribution and Growth,” *Journal of Economic Growth*, 4:331-349.

Neal, L. 1990. *The Rise of Financial Capitalism*, Cambridge.

Neale, R.S. 1975. “The Standard of Living 1780-1844: A Regional and Class Study”. In A.J. Taylor ed *The Standard of Living in Britain in the Industrial Revolution*. Methuen: England pp. 154-79.

Notestein, F.W. 1936. “Class Differences in Fertility” *Annals of the American Academy of Political and Social Science*, 188, November: 2-36.

Peller, S. 1965. “Births and Deaths Among Europe’s Ruling Families since 1500,” in Glass, D.V. and Eversley D.E.C. eds. 1965. *Population in History*. London.

Stevenson, T.H.C. 1920. “The Fertility of Social Classes in England and Wales from the Middle of the Nineteenth Century to 1911,” *Journal of the Royal Statistics Society* May(3): 401-32.

Taylor, A.J. 1975. *The Standard of Living in Britain in the Industrial Revolution*. London.

Tilly, L.A. and J. Scott. 1989. *Women, Work and Family*. London: Routledge.

Turttle, C.and S. Wegge. 2002. “The Role of Child Labor in Industrialization”, mimeo.

Williamson, J. 1985. *Did British Capitalism Breed Inequality?* London: Allen and Unwin.

Woods, R.I. 1987. “Approaches to the Fertility Transition in Victorian England,” *Population Studies* 41(2): 283-311.

Wrigley, E.A. and R.S. Schofield. 1981. *The Population History of England, 1541-1871*. Cambridge.

Zelizer, V. 1985. *Pricing the Priceless Child, The Changing Social Value of Children*. Princeton: Princeton University Press.

Table 1

Earnings and cost of living for one worker couple in Bath for the years 1832–1850.

	Earnings	Cost of living
Bath (England)	(shillings per week)	
1832	9s 6d	13s 1d
1840	13s 2d	13s 10d
1850	14s 1d	14s 2d

Sources: Neale, 1975.

Notes: For Bath it is assumed that subsistence for one worker couple includes 28.5lb of bread, 1.5 lb of meat, 1lb of bacon, 3lb of cheese, and 4lb of potatoes. The cost of this basket for 1832 was 9s6d. We add to it 1s4d for clothing and shoes, 3d for candles and soap, 6d for fuel, and 1s6d for rent, for a total cost of 13s1d.

Table 2

Fertility rate, wages, and the ratio of capital to labor in England during the nineteenth century

	(1) **Index of Fertility rate**	**(2)** **Real Wages**	**(3)**	**(4) K/L in the industrial sector**
		average	**in the cotton industry**	
1800	65	84.9	98	396
1810	65	105.4	81	383
1820	65	110.9	67	375
1830	65	114.3	64	335
1840	66	115.9	66	340
1850	67	138.6	84	346
1860	67	135.1	90	378
1870	68	151.3	109	400
1880	65	173.8	122	420
1890	62	234.2	157	434

Sources: column (1): the index of legitimate fertility rate (Ig), Bardet and Dupaquier, 1998; column (2): Feinstein, 1998, p. 653; column (3): nominal wages, Mitchell and Deane, 1971, p.349 divided by cost of living index, Feinstein, 1998, p.653; column (4): for capital: Feinstein 1981; and for labor: Maddison, 1995.

Figure 1

The Optimal Fertility Rates of the Elite

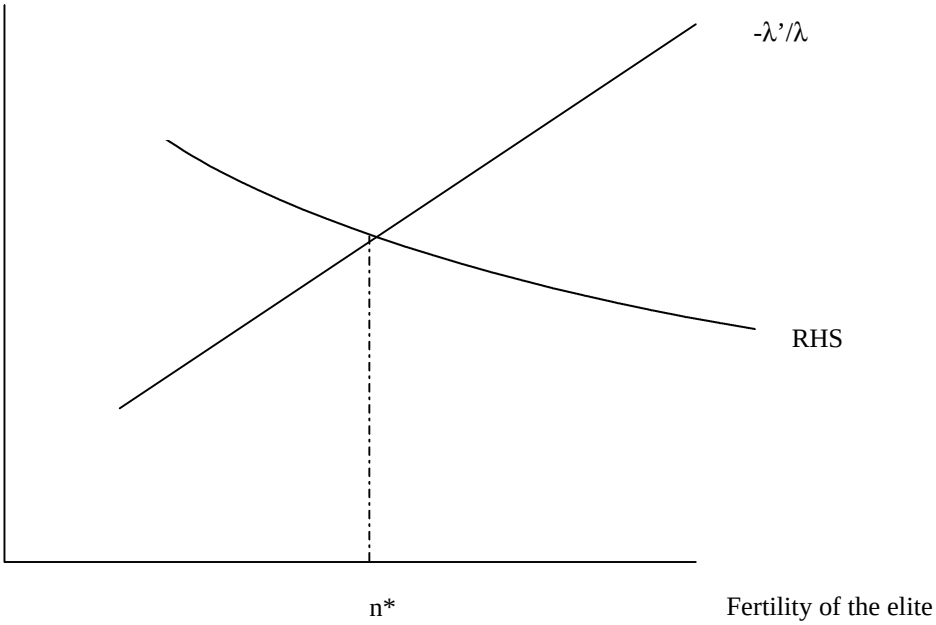


Figure 2

The Optimal Fertility Rates of the Proletariat

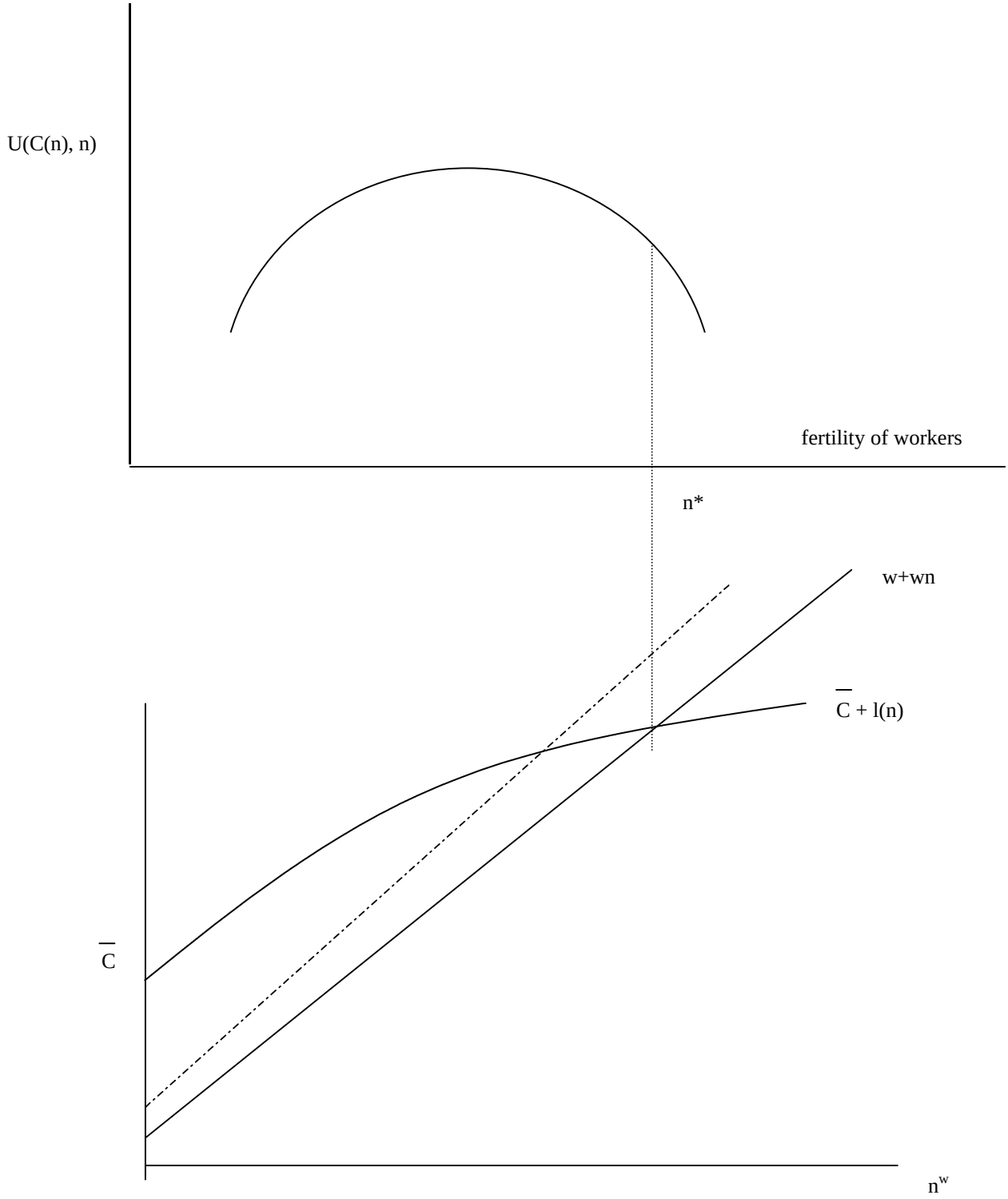
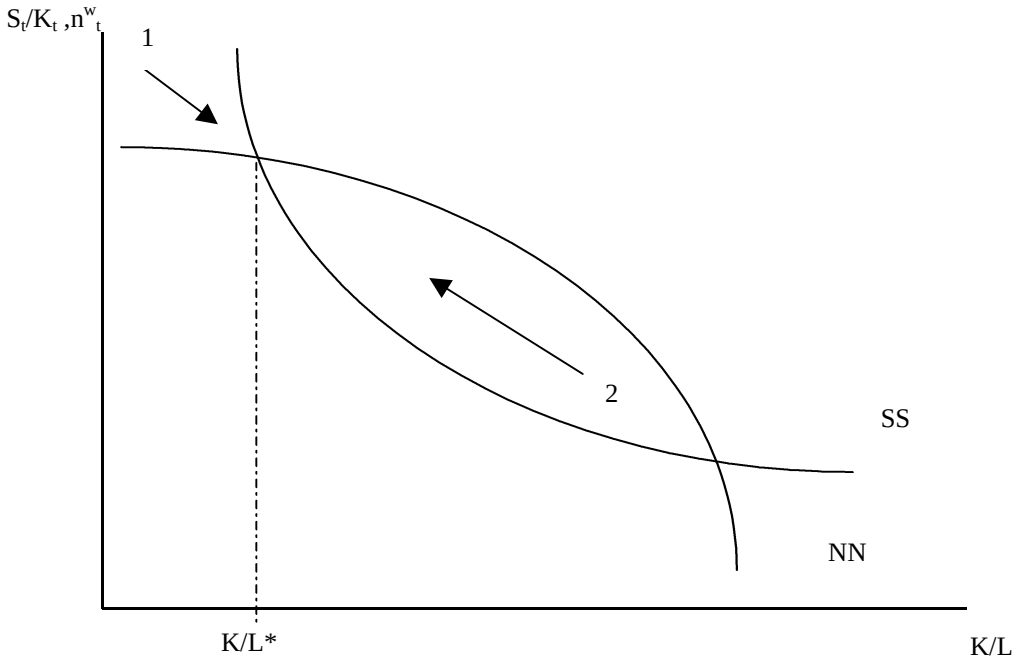


Figure 3

Dynamics of the Model



Bar-Ilan University
Department of Economics
WORKING PAPERS

1-01 **The Optimal Size for a Minority**
Hillel Rapoport and Avi Weiss, January 2001.

2-01 **An Application of a Switching Regimes Regression to the Study of Urban Structure**
Gershon Alperovich and Joseph Deutsch, January 2001.

3-01 **The Kuznets Curve and the Impact of Various Income Sources on the Link Between Inequality and Development**
Joseph Deutsch and Jacques Silber, February 2001.

4-01 **International Asset Allocation: A New Perspective**
Abraham Lioui and Patrice Poncet**,** February 2001.

5-01 **מודל המועדון והקהילה החרדית**
יעקב רוזנברג, פברואר 2001.

6-01 **Multi-Generation Model of Immigrant Earnings: Theory and Application**
Gil S. Epstein and Tikva Lecker, February 2001.

7-01 **Shattered Rails, Ruined Credit: Financial Fragility and Railroad Operations in the Great Depression**
Daniel A.Schiffman, February 2001.

8-01 **Cooperation and Competition in a Duopoly R&D Market**
Damiano Bruno Silipo and Avi Weiss, March 2001.

9-01 **A Theory of Immigration Amnesties**
Gil S. Epstein and Avi Weiss, April 2001.

10-01 **Dynamic Asset Pricing With Non-Redundant Forwards**
Abraham Lioui and Patrice Poncet, May 2001.

Electronic versions of the papers are available at
http://www.biu.ac.il/soc/ec/working_papers.html

11-01 **Macroeconomic and Labor Market Impact of Russian Immigration in Israel**

Sarit Cohen and Chang-Tai Hsieh, May 2001.

12-01 **Network Topology and the Efficiency of Equilibrium**

Igal Milchtaich, June 2001.

13-01 **General Equilibrium Pricing of Trading Strategy Risk**

Abraham Lioui and Patrice Poncet, July 2001.

14-01 **Social Conformity and Child Labor**

Shirit Katav-Herz, July 2001.

15-01 **Determinants of Railroad Capital Structure, 1830–1885**

Daniel A. Schiffman, July 2001.

16-01 **Political-Legal Institutions and the Railroad Financing Mix, 1885–1929**

Daniel A. Schiffman, September 2001.

17-01 **Macroeconomic Instability, Migration, and the Option Value of Education**

Eliakim Katz and Hillel Rapoport, October 2001.

18-01 **Property Rights, Theft, and Efficiency: The Biblical Waiver of Fines in the Case of Confessed Theft**

Eliakim Katz and Jacob Rosenberg, November 2001.

19-01 **Ethnic Discrimination and the Migration of Skilled Labor**

Frédéric Docquier and Hillel Rapoport, December 2001.

1-02 **Can Vocational Education Improve the Wages of Minorities and Disadvantaged Groups? The Case of Israel**

Shoshana Neuman and Adrian Ziderman, February 2002.

2-02 **What Can the Price Gap between Branded and Private Label Products Tell Us about Markups?**

Robert Barsky, Mark Bergen, Shantanu Dutta, and Daniel Levy, March 2002.

3-02 **Holiday Price Rigidity and Cost of Price Adjustment**

Daniel Levy, Georg Müller, Shantanu Dutta, and Mark Bergen, March 2002.

4-02 **Computation of Completely Mixed Equilibrium Payoffs**

Igal Milchtaich, March 2002.

5-02 **Coordination and Critical Mass in a Network Market – An Experimental Evaluation**

Amir Etziony and Avi Weiss, March 2002.

6-02 **Inviting Competition to Achieve Critical Mass**

Amir Etziony and Avi Weiss, April 2002.

7-02 **Credibility, Pre-Production and Inviting Competition in a Network Market**

Amir Etziony and Avi Weiss, April 2002.

8-02 **Brain Drain and LDCs' Growth: Winners and Losers**

Michel Beine, Fréderic Docquier, and Hillel Rapoport, April 2002.

9-02 **Heterogeneity in Price Rigidity: Evidence from a Case Study Using Micro-Level Data**

Daniel Levy, Shantanu Dutta, and Mark Bergen, April 2002.

10-02 **Price Flexibility in Channels of Distribution: Evidence from Scanner Data**

Shantanu Dutta, Mark Bergen, and Daniel Levy, April 2002.

11-02 **Acquired Cooperation in Finite-Horizon Dynamic Games**

Igal Milchtaich and Avi Weiss, April 2002.

12-02 **Cointegration in Frequency Domain**

Daniel Levy, May 2002.

13-02 **Which Voting Rules Elicit Informative Voting?**

Ruth Ben-Yashar and Igal Milchtaich, May 2002.

14-02 **Fertility, Non-Altruism and Economic Growth: Industrialization in the Nineteenth Century**

Elise S. Brezis, October 2002.