FEDERALISM, FERTILITY AND GROWTH

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Abstract

This paper analyses the effect of federalism on fertility and growth. In a model with human capital accumulation and endogenous fertility, two regimes of education finance are compared: central and local education. Using numerical simulation, I find that local education finance yields higher growth at the price of increased inequality. Aggregate fertility may be lower or higher under federalism. Interestingly, the fertility differential is reversed: while under central finance, rich families have fewer children than poor ones (when the elasticity of substitution between children and consumption is large), the opposite may occur under local finance. The paper also tests the relationship between fertility rates and fiscal decentralisation empirically on a panel of OECD countries and finds a weak negative effect of decentralisation on total and differential (poor minus rich) fertility.

JEL Code: J13, H77.

Keywords: fertility, education, decentralisation, growth.

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1 Introduction

In most industrialised countries, fertility has been falling. While this decline, starting with the industrial revolution, has been accompanied by unprecedented levels of growth, there are now fears that further decreases in fertility will undermine social insurance systems and lead to other detrimental economic outcomes. What is more, fertility is often much lower for the skilled than the unskilled, that is, there is a fertility differential between rich and poor. If this differential were to increase, further stress would be put on social insurance systems.

Therefore, policies aimed at increasing fertility are on the agenda in most developed countries. Examples include direct support to parents or child care subsidies as well as public provision of child care and education. Since these policies also affect the incentives of parents to invest in human capital, they have implications for growth as well as fertility.

In many countries, at least some of these policies are carried out by regional governments. For instance, in Germany, education is a regional government task while child care is under the control of local governments (albeit subject to regulation from higher level governments). The federal government has recently launched initiatives to increase the availability of subsidised day care which, until now, is severely rationed. But what are the effects of assigning such policies to higher or lower levels of government? Does decentralisation increase or decrease fertility? What are the effects on growth? These seem to be important policy questions with no obvious answers.

This paper therefore attempts to analyse these questions within a growth framework with endogenous fertility. In the model, parents care for the quantity and quality (i.e. human capital) of their children. They decide on fertility levels, while the government provides public education which affects the children's future human capital. The population is heterogeneous with two groups differentiated by their initial human capital.

I then compare two regimes within this framework. Under centralised education, both groups receive the same education level per capita. As a consequence, the human capital levels of rich and poor children converge quickly. Under decentralised education finance, I assume that families sort into homogeneous jurisdictions, each providing their own public education level financed by local taxes. Rich parents then provide better education for their children, while poor parents will provide less education than under centralisation.

Using numerical simulation, I show that decentralisation results in higher average human capital but that human capital of rich and poor children diverge. Hence, there emerges an equity-efficiency trade-off: faster growth versus higher inequality.

Diverging education levels affect fertility rates, and I find that, under some parameters, decentralisation results in lower total fertility rates initially. While this is not in itself detrimental within the model considered, it may give some guidance to judge policies aimed at increasing fertility. Apart from the effect on overall fertility, there is also a composition ef-

fect. Since under decentralisation rich and poor have different public policies and diverging human capital levels, their fertility rates diverge as well. Moreover, while under centralisation richer families have fewer children (assuming the elasticity of substitution between consumption and children is large), this must no longer hold under decentralisation. In fact, I find that under decentralisation the fertility differential may be reversed so that richer parents have more children than poorer ones. This result is also partly responsible for higher growth under federalism: since richer parents have more children, more weight is put on the high human capital individuals and average human capital increases faster.

The paper also presents some empirical evidence on the link between decentralisation and fertility. Using panel data from OECD countries, I examine whether fiscal decentralisation has an effect on fertility rates. The results indicate that there is a negative effect of decentralisation on total fertility. There is also some indicative evidence of a negative effect on differential fertility, but this evidence is based on a small number of observations.

The paper is related to several recent contributions. de la Croix and Doepke (2004) study the effect of public versus private education in a model with endogenous fertility. They show that private education leads to higher balanced growth but diverging incomes; however, growth may be lower with private education when the economy is not on the balanced growth path. The same model is applied here to the distinction between central and local education policy. There are, however, a few differences to their model, which will be detailed below.

Several papers study local education policies in a dynamic context, but in contrast to the present paper all abstract from endogenous fertility. Fernandez and Rogerson (1998) show numerically that central education finance leads to higher education spending and growth. A similar approach is followed by Bearse *et al.* (2001). However, they find that centralised school finance decreases steady state per capita income. The difference is due to the existence of private alternatives to public schools in their model. de la Croix and Montfort (2000) and Tamura (2001) study growth and convergence with local education policies. They show that regions may converge if there are local human capital spillovers (de la Croix and Montfort, 2000) or if the human capital of teachers is the same in rich and poor districts (Tamura, 2001). However, in the model with knowledge spillovers of de la Croix and Montfort (2000), convergence with national education is faster than with regional education since human capital spillovers attenuate with distance. See also Benabou (1996a,b) for analyses of growth and convergence with regional education. Brueckner (2006) also studies the connection between federalism and growth. He considers a two-region model like the present one in an endogenous growth setting with constant population. He finds that by letting jurisdictions choose their preferred levels of infrastructure, federalism leads to higher growth than a unitary system.

There is a relatively large empirical literature on the connection between federalism and

growth, with somewhat controversial findings.[1] Recent studies in this line of research have found positive effects of decentralisation on growth. This paper uses similar indicators of decentralisation to assess its impact on fertility. There is no study of which I am aware that examines the effect of federalism on fertility empirically.

The paper proceeds as follows. The next section presents the model setup. Section 3 describes the decentralised equilibrium, and Section 4 presents results from numerical simulations. Section 5 presents empirical evidence from a panel of OECD countries. Finally, the last section concludes the paper.

2 The model

The basic model builds on de la Croix and Doepke (2004) but differs from their model in two respects. Whereas they analyse private versus public education with unified policy, I analyse purely public education with either central or local provision. Second, as much of the literature, de la Croix and Doepke (2004) assume Cobb-Douglas preferences. This allows for closed form solutions of all endogenous variables including tax rates and education levels. However, Cobb-Douglas utility has the counterfactual implication that with public education, all households choose the same fertility level and have the same preferred education level. Instead, I assume a general CES utility function, which implies that there will be differential fertility with public education and conflict over optimal policies. There will be some important implications for the fertility differential in particular under federalism. However, this comes at the price of reduced tractability, since the model cannot be solved analytically.

In the model, there are two groups of individuals, indexed by $i = A, B$. Time is discrete and is indexed by $t = 0, 1, ..., \infty$. The unit of analysis is the couple. In each period, couples make decisions about consumption and fertility. They also vote on public education, which benefits their children through higher human capital when they become adults. Parents differ with respect to their human capital: There are P_t^A parents of type A with human capital h_t^A, and P_t^B parents of type B with human capital h_t^B, where group A is the group with lower initial human capital, $h_0^A < h_0^B$. I assume that the poor are in the majority initially: $P_0^A > P_0^B$.

Adults of type i have preferences defined over consumption, c_t^i, and the number and human capital of their children, n_t^i and h_{t+1}^i. The utility function is assumed to be of the CES type with elasticity of substitution σ:

$$u_i = ((c_t^i)^{\frac{\sigma-1}{\sigma}} + \gamma(n_t^i h_{t+1}^i)^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}, \quad \gamma > 0.$$

[1] See, e.g., Davoodi and Zou (1998), Zhang and Zou (1998), Xie *et al.* (1999), Iimi (2005), Thießen (2003) and Stansel (2005).

With $\sigma \to 1$, the utility function becomes the Coub-Douglas function analysed by de la Croix and Doepke (2004) and many others.

Raising one child takes ϕ units of parents' time. The market wage is unity (production is assumed to be linear), and wage income is taxed at rate τ_t. Hence, the budget constraint of a couple of type i is

$$c_t^i = (1-\tau_t)(1-\phi n_t^i)h_t^i. \tag{1}$$

There is a unique consumption good produced with labour only. The production function is:

$$Y_t = L_t,$$

where aggregate labour supply is given by

$$L_t = P_t^A(1-\phi n_t^A)h_t^A + P_t^B(1-\phi n_t^B)h_t^B.$$

Children's future human capital is determined by public education spending (e_t), parental human capital, and average human capital ($\bar{h}_t$) according to the relation:

$$h_{t+1}^i = \mu e_t^\eta (h_t^i)^\beta (\bar{h}_t)^{1-\beta}, \tag{2}$$

where $\mu > 0$ and $\eta, \beta \in (0,1)$. Part of parents' human capital is transmitted to children – either through genetic inheritance or education at home. However, there are decreasing returns to parental human capital, while all children benefit from public education and from average human capital in society. An important implication is that with centralised public education human capital levels will converge over time.

Average human capital is defined as

$$\bar{h}_t = \frac{P_t^A h_t^A + P_t^B h_t^B}{P_t^A + P_t^B}, \tag{3}$$

and relative human capital of the poor will be denoted $x_t^A \equiv h_t^A/h_t^B$.

The following sequence of events is assumed within each period. At the first stage, all parents vote on the tax rate and public education level. The decision is taken by simple majority so the preferences of the more numerous group prevail. As long the poor have more children than the rich, the poor will be in the majority. At the second stage, parents take decisions on consumption and fertility. As usual, the game is solved by backward induction.

At stage two, parents maximise utility subject to the budget constraint (1) and the human capital technology (2). The resulting fertility level is given by

$$n_t^i = \frac{\gamma^\sigma (1-\tau_t)\left(\mu e_t^\eta (h_t^i)^\beta (\bar{h}_t)^{1-\beta}\right)^\sigma h_t^i}{\gamma^\sigma (1-\tau_t)\phi\left(\mu e_t^\eta (h_t^i)^\beta (\bar{h}_t)^{1-\beta}\right)^\sigma h_t^i + (1-\tau_t)^\sigma (h_t^i)^\sigma \mu e_t^\eta (h_t^i)^\beta (\bar{h}_t)^{1-\beta}}. \tag{4}$$

Table 1: Comparative statics of fertility and optimal tax rates

	$\sigma > 1$	$\sigma < 1$
Fertility		
h_t^i	$-$	$+$
τ_t	$+$	$-$
g_t	$+$	$-$
Optimal tax rate		
h_t^i	$-$	$+$

Equation (4) shows how human capital determines fertility, for given public education. Differentiation shows that fertility increases with income when $\sigma < 1$ and decreases with income when $\sigma > 1$.[2] On the one hand, richer parents will want more children, since the demand for children increases with income. On the other hand, raising children takes time; therefore, since richer parents have a higher opportunity cost of time, the cost of children is higher the higher parents' human capital. Since the income elasticity of demand is one with CES utility, the first effect will dominate if σ is lower than one, and richer parents will have more children. Conversely, when $\sigma > 1$, the price effect dominates and richer parents will have fewer children.

Fertility is also shaped by the tax rate and public education level. A higher tax rate, has income and price effects opposite to those of an increase in income: While a higher tax rate decreases the opportunity cost of raising children, which tends to increase fertility, it also reduces net income which works towards lower fertility. The price effect will dominate and, hence, a higher tax rate will increase fertility if the elasticity of substitution is larger than one. Conversely, when $\sigma < 1$ a higher tax rate decreases fertility. The comparative statics of fertility are summarised in Table 1.

Better public education increases children's human capital. For given fertility rate, the utility of a given number of children increases. When consumption and children (or better, children of a certain human capital level) are close substitutes ($\sigma > 1$), the household will decrease consumption, which for given net income means fertility must increase. Conversely, when consumption and children are complementary (in the sense that $\sigma < 1$), the household will want to increase consumption which can be accomplished only by decreasing fertility.

Consider now the choice of education spending. The government budget constraint must balance in each period, that is, expenditures on education must equal tax revenue:

$$(P_t^A n_t^A + P_t^B n_t^B)e_t = \tau_t(P_t^A h_t^A(1 - \phi n_t^A) + P_t^B h_t^B(1 - \phi n_t^B)). \tag{5}$$

[2]This holds under the assumption that children's human capital increases less than one-for-one with parental human capital, i.e. $\beta < 1$.

Each couple then votes for the tax rate and spending level to maximise indirect utility, subject to (2) and (5).

How does initial human capital affect a family's optimal tax rate? First, higher income means that parents will want a better education for their children since they care about quantity and quality of children and children's human capital is normal in the utility function. Second, however, higher income means that the tax price of public education rises because of the proportional income tax. Again, when the elasticity of substitution is less than one, the income effect dominates and richer parents prefer higher tax rates. Conversely, with $\sigma > 1$ the price effect dominates and richer parents prefer lower taxes.

The decisive voter is always a poor voter, at least when $\sigma > 1$, since then fertility for the poor is higher than for the rich, so the poor will always be in the majority. When $\sigma < 1$, the rich have more children, which opens up the possibility that they may at some point outnumber the poor. In the numerical simulation below, I check by hand that the poor stay in the majority even when rich fertility rates are higher.

An intertemporal equilibrium is defined as follows.

Definition 1 *An equilibrium under central education finance consists of a sequence of aggregate quantities* $\{\bar{h}_t, L_t\}$*, group sizes* $\{P_t^i\}_{i=A,B}$*, private decision rules* $\{c_t^i, n_t^i\}_{i=A,B}$*, and policy variables* $\{\tau_t, e_t\}$*, such that*

(i) households maximise utility subject to their budget constraint and the human capital technology,

(ii) the government budget is balanced, and

(iii) the policy variables maximise the utility of the decisive voter, given the government budget constraint.

It can now be shown how human capital levels evolve over time. The following result, based on de la Croix and Doepke (2004), is proved in Appendix A:

Proposition 1 *Under central education finance, there is a balanced growth path where* $x_t^A = x_t^B = 1$ *and* $n_t^A = n_t^B$*, i.e. inequality in human capital and fertility has vanished.*

The intuition is straightforward. All individuals receive the same education and benefit from average national human capital. Since children's human capital increases less than proportionately with parental human capital, this implies that human capital levels – and, therefore also fertility levels – must converge.

3 Decentralised equilibrium

Consider now what happens when the provision of education is decentralised to local governments, and individuals are mobile so they can choose their place of residence. Assume

that the country is made up of two regions. Since individuals are heterogeneous, an immediate conjecture is that they will sort into homogeneous jurisdictions, one inhabited by the rich and the other by the poor, and indeed, I will assume this to be the case. Note, however, that this outcome may necessitate that jurisdictions can control migration, either directly or indirectly (for instance through zoning). If this were not the case, the poor might prefer to live in the rich jurisdiction where average human capital is high. The determination of equilibrium would become much more involved, since a stratified equilibrium would exist only if it is incentive compatible. Another interpretation might of course be to look at two regions which differ by their human capital endowments where there is no migration between regions.

There are two other features worthy to note. First, the assumption that central education implies identical education quality per capita is obviously unrealistic. For instance, even though spending per capita might be identical, the quality of education would differ between groups if the rich and poor do not live in the same areas and use different public schools, due for instance to the existence of peer effects. Therefore, even with identical spending levels per capita, able or rich students generally receive a better quality education than poor or less able students. Second, the assumption of perfect sorting under local school finance is obviously just as unrealistic for many reasons, for instance, because parents differ by income, abilities, preferences for having children, and so on. However, the important point is that central finance leads to a more equal distribution of education quality than local finance, which is easy to reconcile with empirical evidence.

An equilibrium under local education will be defined as follows:

Definition 2 *An equilibrium under local education finance consists of two regions populated by homogeneous individuals of type $i \in \{A, B\}$ such that within each jurisdiction an intertemporal equilibrium as defined in Definition 1 obtains.*

Within each jurisdiction, the determination of the equilibrium then proceeds just like described in the previous section. The only difference is that there is no more heterogeneity within each jurisdiction, i.e. within jurisdiction i, $\bar{h}_t^i = h_t^i$. This implies that the individual problem in jurisdiction i can be stated as

$$\max((c_t^i)^{\frac{\sigma-1}{\sigma}} + \gamma(n_t^i h_{t+1}^i)^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \quad \text{s.t. } c_t^i = (1 - n_t^i\phi)h_t^i - n_t^i e_t^i \text{ and } h_{t+1}^i = \mu e_t^\eta h_t^i, \qquad (6)$$

where n_t^i is given by (4). To some extent, each group then behaves as if they provided private education to themselves.[3,4]

[3]There is a subtle difference to perfectly private education. With private education as modeled by de la Croix and Doepke (2004), parents decide on fertility and education simultaneously, while with public education, parents decide on fertility once education is fixed. Therefore, the quantity-quality tradeoff which parents face under private education when deciding on fertility does not exist at this stage under public education.

[4]de la Croix and Doepke (2004) model the choice of public versus private education in the same model

While the problem in (6) cannot be solved analytically, it is easy to see that the rich jurisdiction will spend more on education than the poor jurisdiction, since education is a normal good. But this implies $x_{t+1}^A < x_t^A$ for all t. Hence, we have the following result.

Proposition 2 *Under local education finance, there is no convergence of income across regions. In fact, x_t^A converges to zero.*

The fact that income levels do not converge is due to the absence of human capital spillovers between regions. When such spillovers are present, human capital levels would still converge under local finance, albeit a slower pace than under central finance (de la Croix and Montfort, 2000). It would then also be possible to obtain faster growth under central finance.[5]

Before looking at the results of numerical simulations, it may be useful to present some general thoughts on the effect of decentralisation on fertility and growth. The central question is how taxes and spending evolve under local compared to central education. The result that the rich choose higher education than the poor under local finance is independent of the magnitude of the elasticity of substitution. The effect of decentralisation on the tax rate, on the other hand, depends on whether σ is smaller or larger than one.

Suppose $\sigma > 1$. For the poor, decentralisation reduces the average tax base (the rich have left), which means that the tax price of public education rises. This implies that the optimal tax rate falls and with it, the public education level. Conversely, for the rich, the tax base increases which implies a higher optimal tax rate and more education spending.

What are the effects on fertility and human capital? For the poor, since the tax rate and public education level fall, fertility decreases relative to central education. Conversely, for the rich, fertility increases. In fact, the simulation in the next section shows that the ranking of fertility levels may be reversed: Whereas under centralisation rich parents have fewer children, under decentralisation they may have more children than poor parents. As for human capital, since the poor will receive less education under decentralisation and the rich more, human capital levels will not converge (see Prop. 2).

When $\sigma < 1$, the effects go partly in the opposite direction. Under decentralisation, the poor will want a higher tax rate, while the education level will still decrease. The effect on fertility is thus a priori unclear. For the rich, the optimal tax level falls under decentralisation and the public education level rises. Again, the effect on rich fertility is ambiguous. However, in this case as well, the human capital levels of rich and poor will

with only one national education policy. However, in their model, individuals' human capital is affected by average national human capital $\bar{h}_t$, whereas here it is assumed to depend on average regional human capital $\bar{h}_t^i$. Their assumption would correspond to a model with human capital spillovers between regions as in de la Croix and Montfort (2000).

[5]de la Croix and Doepke (2004) show that public education may lead to faster growth than private education (off the balanced growth path) depending on income inequality.

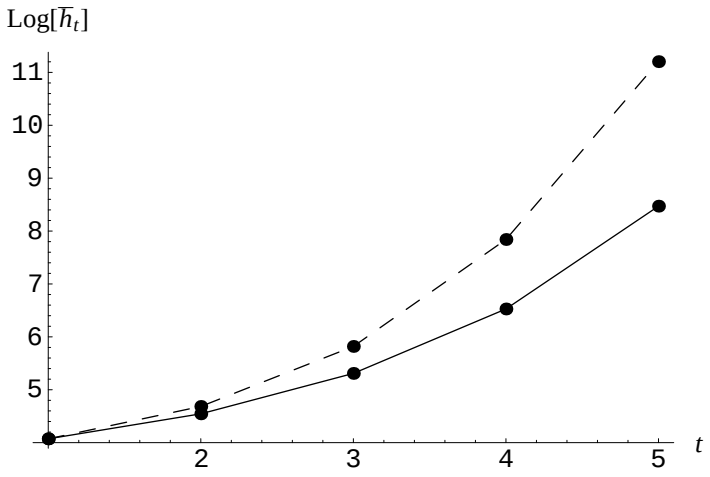

Figure 1: Average human capital under central (solid lines) and local (dashed lines) education

not converge under decentralisation, as shown in Prop. 2.

In the next section, I present numerical simulation results to illustrate the effects of decentralisation on fertility and growth. The simulation also allows to analyse the dynamics of fertility and human capital accumulation under different regimes.

4 Simulation

4.1 Benchmark results

This section presents results from numerical simulations. I use the following benchmark parameter values: $\mu = 0.75, \eta = 0.6, \gamma = 0.15, \phi = 0.12, \beta = 0.22$, and $\sigma = 1.11$. Initial population sizes are $P_1^A = 90, P_1^B = 45$ and human capital levels $h_1^A = 38, h_1^B = 100$. While this section is not intended to replicate specific values of fertility or growth for any specific time and country, the values chosen correspond roughly to those used in de la Croix and Doepke (2004).

In the first period, fertility levels under central education are $n_1^A = 1.21$ and $n_1^B = 1.13$, so a poor family has 2.42 children on average and a rich family 2.26. The equilibrium tax rate is $\tau_1 = 0.0866$ or 8.7%, and education spending per capita $e_1 = 3.69$. Under local finance, fertility rates in the first period are $n_1^A = 1.15$ and $n_1^B = 1.21$, tax rates $\tau_1^A = 0.0822, \tau_1^B = 0.0871$ and education spending $g_1^A = 2.35$ and $g_1^B = 6.15$. Next, I describe the evolution of key variables over the first five periods.

Figure 1 shows the evolution of average human capital under the central and local regimes. As the figure shows, decentralisation yields higher growth of average human

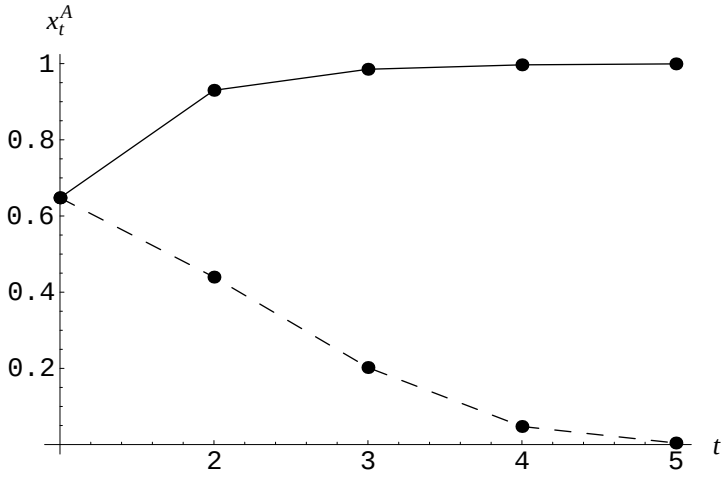

Figure 2: Relative human capital of the poor under central (solid lines) and local (dashed lines) education

capital. This mirrors the findings of Brueckner (2006). The finding can also be contrasted to de la Croix and Doepke (2004) who find that – off the balanced growth path – growth may be higher with public than private education (when income inequality is large), the reason being that private education implies that the poor substitute out of child quality into child quantity. This implies that more weight gets put on low human capital individuals in the determination of average human capital. In the present setting, decentralisation has somewhat different effects than private education in de la Croix and Doepke (2004). In particular, the rich will have more children than the poor and, consequently, average human capital rises much faster than under centralisation. The main difference is that with private education, the rich substitute out of child quantity into quality.

As Figure 2 shows, the higher growth under local education comes at the price of dramatically increased inequality. The figure displays the relative human capital of the poor, x_t^A. Under centralisation, human capital levels for rich and poor converge rather quickly, while under local education, relative human capital of the poor falls towards zero.

Finally, Figure 3 displays fertility levels under centralisation and decentralisation. Here dark lines refer to fertility levels of the poor and gray lines to the rich (both solid under centralisation, dashed under decentralisation). Note that decentralisation reverses the ranking of fertility levels: Under decentralisation, the rich have more and the poor fewer children than under centralisation – at least after the second period. Total fertility is, however, rather similar under both regimes. Figure 4 displays total fertility rates under centralisation and decentralisation. As the Figure shows, total fertility under centralisation is a bit larger than under decentralisation for the first four periods. Thus, decentralisation seems to affect the composition of fertility among different population classes more than

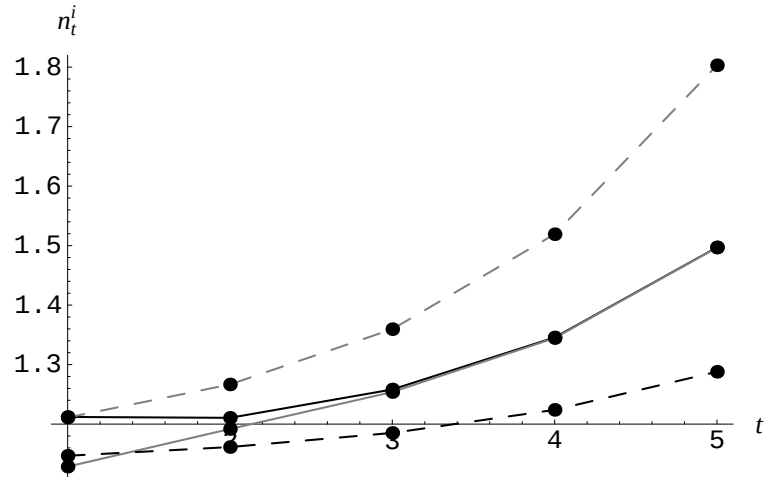

Figure 3: Fertility levels of the poor (dark lines) and rich (gray lines) under central (solid lines) and local (dashed lines) education

the total fertility level. Also, under centralisation, fertility levels converge (since human capital levels converge) while under decentralisation there is slight divergence of fertility levels.

4.2 Welfare and policy implications

In this section I briefly discuss implications for welfare and policy. What would a good policy do? Clearly this depends on the policy objective. A large part of the debates about family policy seem to be motivated by a political desire to increase fertility. The results from the last section indicate that decentralisation of education or childcare policies might have only small overall effects on fertility. However, the composition of fertility among different population segments is likely to change. In Section 5, I will look at OECD data to see whether one can discern any effects of decentralisation on fertility rates.

Even if fertility were unaffected by decentralisation, however, there is a clear impact on growth of human capital which is important for policymakers. As in Brueckner (2006), it turns out from the benchmark simulation that federalism increases the growth rate of average human capital. However, the human capital of the poor was shown to decrease relative to centralisation. Hence, there seems to be a classic conflict between efficiency and equity. Which regime is preferred then depends on the weighting of the welfare of the two groups. With variable population there is no obvious way to aggregate welfare, but it is clear that centralisation is likely to be more favourable when the weight on the poor in the social welfare function is large. For instance, suppose that the social welfare function is a

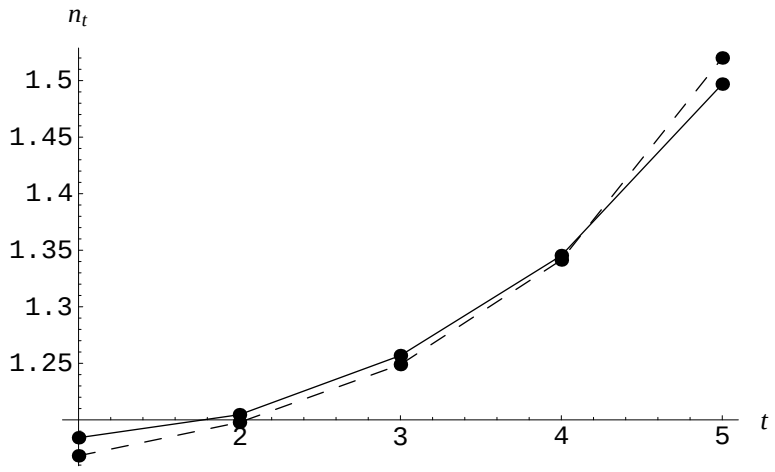

Figure 4: Total fertility rates under central and local education

weighted average of a representative poor and a representative rich agent:[6]

$$W_t = \alpha u_t^A + (1-\alpha) u_t^B.$$

Taking $\alpha = 0.5$, decentralisation clearly dominates centralisation. The reason is that the rich obtain a welfare gain from decentralisation which is so large that it easily outweighs the loss to the poor. However, when $\alpha = 0.85$, decentralisation becomes the dominant alternative in the first three periods, as shown in Figure 5.

4.3 The case of $\sigma < 1$

In this subsection, I briefly consider what happens when the elasticity of substitution is less than one. With all other parameters as in the benchmark simulation, I set $\sigma = 0.9$. Note that the rich now have higher fertility than the poor under central education. It then becomes a possibility that the rich will in some period be in the majority. In the example, this possibility is ruled out if the relative number of the poor is high enough to begin with.

The result on average and relative human capital is very similar to that with a larger σ: higher growth and more inequality with decentralised education finance. The reason for higher growth, however, is somewhat different, and the effects turn on the very different implications for differential fertility.

[6]Other possibilities would be the Benthamite welfare function of total utility or the Millian welfare function of average utility. In the present example, the first would tend to favour centralisation and the second decentralisation. (The picture for the Millian objective function would look similar to Figure 5 for a somewhat higher level of α.)

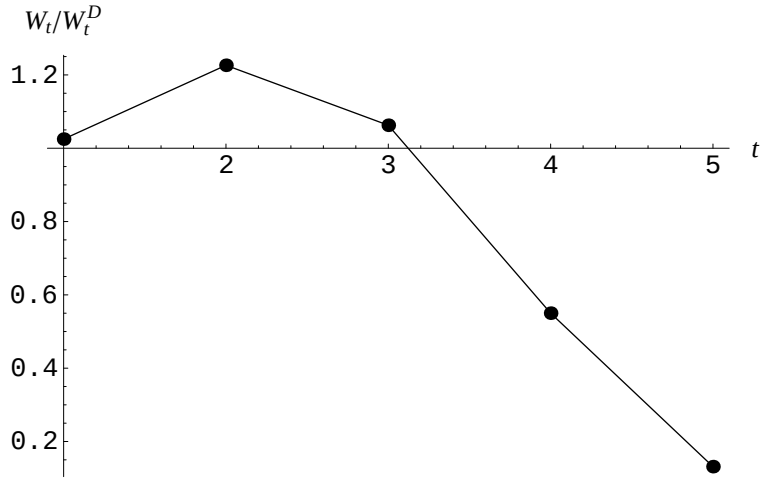

Figure 5: Welfare under central (solid lines) and local (dashed lines) education

Figure 6 shows fertility levels for rich and poor under the two regimes. Under central education, the rich have more children than the poor. However, this is reversed under local education where the poor have higher fertility rates. This is due to the fact that the rich again have higher education levels than the poor under local education. However, they now respond by reducing fertility, whereas with $\sigma > 1$ fertility rises with better public education.

Average human capital still rises more under decentralisation than under centralisation even though the rich now have fewer children and more weight is consequently put on the poor. However, since demand for education by the rich under decentralisation now increases much more, so does their human capital, and as a result, average human capital.

Figure 7 shows that under both central and local education total fertility decreases over time, but it is somewhat higher under decentralisation: the rich have fewer children than under central finance but this is more than outweighed by the fact that the poor have more children.

5 Empirical evidence

In this section I present some empirical evidence on the link between federalism and fertility. According to the model, one would expect differential fertility to fall with decentralisation if the elasticity of substitution is large. The effect on total fertility is theoretically ambiguous (even if we know the value of σ). Since theory had no clear prediction on the link between federalism and fertility, it is of interest to see what the data say. I first look at total fertility rates and then at differential fertility.

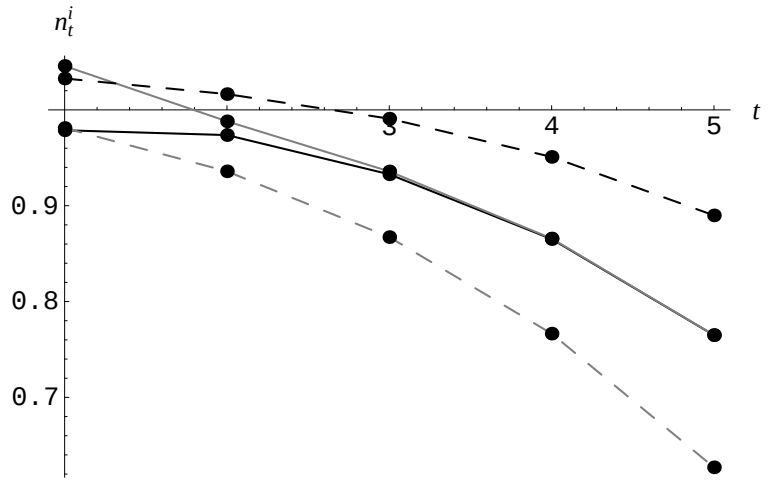

Figure 6: Fertility levels of the poor and rich under central and local education when $\sigma < 1$

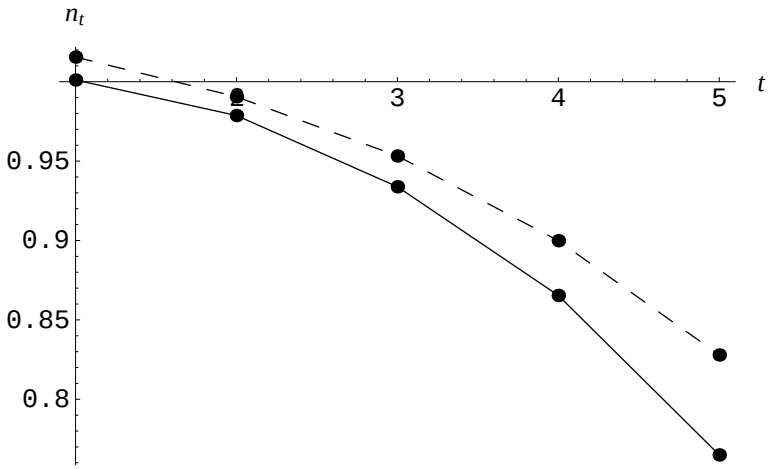

Figure 7: Total fertility rate under central and local education with $\sigma < 1$

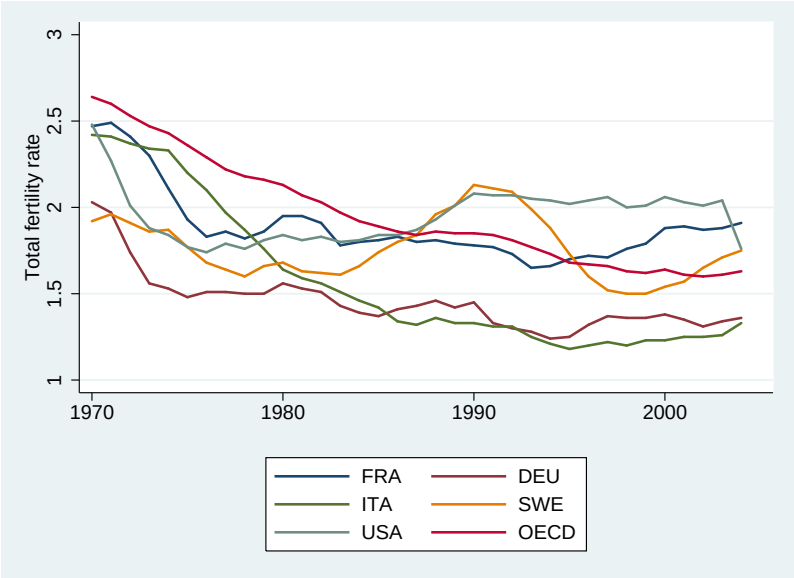

Figure 8: Fertility rates across time for selected OECD countries

5.1 Total fertility

I use panel data for OECD countries to see whether decentralisation affects total fertility. Data were obtained from the OECD and from Gauthier (2003) and Gauthier and Bortnik (2004) (see Appendix B for details).

The basic estimation equation is

$$\ln TFR_{it} = X_{it}\beta + \delta \ln DEC_{it} + \nu_{it}, \tag{7}$$

where TFR is the total fertility rate in country i at time t, X is a vector of controls, DEC is the measure of decentralisation, and ν is an error term. Estimation will be based on fixed effects regression to account for unmeasured country-specific heterogeneity. I also will include year dummies to include any change related to unmeasured variables which vary over time.

The evolution of fertility for selected countries is displayed in Figure 8. This shows the well known decline in fertility rates over the last decades.

As independent variables, I include a number of controls commonly used in the literature (e.g. Adsera, 2004; D'Addio and Mira d'Ercole, 2005): log GDP per capita, total unemployment rate, weeks of maternity leave, maternity leave pay (as percent of women's wages in manufacturing), child care weeks and pay, log index of female wages, log index of male wages, female labour force participation, and family allowance for first, second and third child. Summary statistics are displayed in Table 2.

Table 2: Summary statistics

Variable	Mean	Std. Dev.	N
Total fertility rate	1.967	0.771	1029
Differential fertility rate	0.423	0.278	25
Tax decentralisation	19.218	16.68	753
Expenditure decentralisation	31.296	12.756	674
Education decentralisation	55.842	28.421	460
Social protection decentralisation	16.486	13.463	459
Unemployment rate	6.845	3.813	745
gdppc	16776.795	8980.989	967
Maternity leave	15.804	11.725	662
Maternity pay	63.629	35.819	662
Child care leave	32.497	48.23	662
Child care pay	4.594	13.438	588
Wage gap	0.724	0.096	638
Female labour force participation	54.83	12.139	659
Family allowance 1st child	4.289	15.04	657
Family allowance 2nd child	6.773	23.774	657
Family allowance 3rd child	6.541	16.266	657

GDP is a proxy for income and should have a negative effect on fertility if the elasticity of substitution between consumption and (quality weighted) children is larger than one. Female wages should also have a negative effect on fertility if $\sigma > 1$. Maternity leave policies may have positive or negative effects on fertility: on the one hand, generous leave policies make it easier for mothers to return to their job, while on the other hand, very long leave may reduce women's wages which might make childbearing less attractive. Previous work, however, has found that generous leave policies have a positive impact on fertility (Adsera, 2004; Lalive and Zweimüller, 2005). Unemployment has previously been found to have a negative effect on fertility. Although temporary unemployment may make childbearing cheap, persistent unemployment has income and risk effects which are expected to decrease fertility (Adsera, 2004). While high female labour force participation used to be associated with low fertility, the cross country correlation between fertility and labour force participation has recently turned positive (e.g. Adsera, 2004; D'Addio and Mira d'Ercole, 2005).

In measuring decentralisation, a number of well known concerns arise. One method is to use some sort of constitutional variable, i.e., what kind of responsibilities are constitutionally assigned to upper and lower level governments. The drawback of this approach is, however, that it has limited variation within countries and also misses a lot of important

variation within the constitutional assignment.

The other – and usually followed – approach in the literature is to use the realised decentralisation of government expenditures or revenues. While this allows for a lot more variation, it also begs the question what is actually being measured (see Stegarescu, 2005, for an overview). For instance, by the usual measure for tax decentralisation – the share of total tax revenue accruing to sub-national governments – Germany is rather decentralised, while in fact, the lower level governments have no independent taxing power and receive most of their revenue from shared tax sources.

To remedy this, Stegarescu (2005) constructs a measure of tax decentralisation that takes into account the tax raising power of the subnational governments, based on work done by the OECD. The measure used here is constructed as follows:[7]

$$TAXDEC = \frac{\text{Subcentral govt own tax revenue}}{\text{General govt. total tax revenue}}, \tag{8}$$

$$\tag{9}$$

where own taxes refers to those where subcentral governments can determine either the tax rate or the tax base or both. Thus, shared taxes where subcentral governments have at best partial control of tax rates and based are excluded from this measure.

I also use data on expenditure decentralisation from the IMF Government Finance Statistics. Unfortunately, there is as of now no measure which would take account of jurisdictions' power to autonomously determine expenditure, but nonetheless, the hope is that these indicators are correlated with decentralisation of real spending power. In addition to total expenditure, the IMF statistics also record expenditures by function. I therefore use three expenditure based decentralisation measures:

$$EXPDEC = \frac{\text{Subcentral govt own expenditure}}{\text{General govt. total expenditure}} \tag{10}$$

$$EDDEC = \frac{\text{Subcentral govt education expenditure}}{\text{General govt. education expenditure}} \tag{11}$$

$$SOCDEC = \frac{\text{Subcentral govt social protection expenditure}}{\text{General govt. social protection expenditure}}. \tag{12}$$

$$\tag{13}$$

The theoretical part focused on education spending, so this measure might be most closely linked to the model. However, other spending items will impact on fertility as well, and this will most likely be the case for social spending, so this measure is included here as well.

[7]Stegarescu (2005) analyses trends in decentralisation over time and argues that both his adjusted and the unadjusted measures seem to capture the same trends.

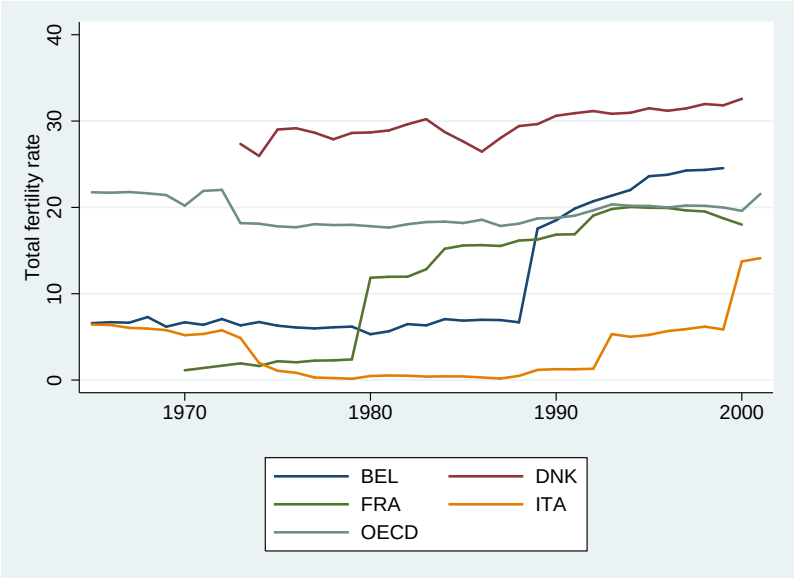

Figure 9: Tax decentralisation across time for selected OECD countries

Therefore, four decentralisation measures are used in the empirical analysis. There may be arguments for using revenue or expenditure variables. The tax variable has the advantage of capturing real autonomy on the part of subcentral governments. On the other hand, in some countries such as Germany, lower level governments have very limited tax autonomy but may still influence policies by their spending decisions. Hence, we use all of these variables here to see which one works best.

The evolution of the decentralisation measure for selected countries is displayed in Figure 9. As Stegarescu (2005) shows, there is a marked trend of decentralisation for several countries, notably Belgium and Spain, but also Canada, France, Italy, Denmark, Portugal and Greece. Hence, there is some variation of fiscal decentralisation across countries and time, which makes panel estimation possible.

The regression results are displayed in Table 3.

Looking at the table, the findings can be summarised as follows. Variables that positively affect fertility are the length of maternity leave, female labour force participation and family allowance for the first child. The positive effect of female labour force participation has recently been found in a number of other empirical studies. Unemployment, GDP per capita, and family allowance for the third child seem to have a negative impact on fertility. For the other parameters, the results do not seem to show a clear pattern.

Looking at the decentralisation measures, the coefficient for tax decentralisation is negative and is significant at 1%. This result gives some indication that fiscal decentralisation may have a negative effect on fertility. The estimated elasticity of -0.03 is, however, rel-

Table 3: Regression results (Total fertility rate)

	(1)	(2)	(3)	(4)
Log tax decentralisation	-0.031			
	(2.35)*			
Log expenditure decentralisation		-0.325		
		(4.75)**		
Log education decentralisation			-0.077	
			(3.57)**	
Log social protection decentralisation				0.196
				(2.91)**
Unemployment rate	-0.018	-0.022	-0.009	-0.009
	(4.96)**	(4.38)**	(1.19)	(1.07)
Log GDP per capita	-0.26	-0.795	-1.042	-0.839
	(2.01)*	(5.04)**	(3.96)**	(3.17)**
Maternity leave	0.009	0.007	0.008	0.007
	(10.34)**	(5.02)**	(4.59)**	(3.64)**
Maternity pay	-0.001	-0.001	0.004	0.004
	(1.84)†	(1.29)	(1.1)	(1.23)
Child care leave	-0.001	0	0.002	0.002
	(1.85)†	(0.88)	(2.33)*	(2.10)*
Child care pay	0.002	0.002	0.001	0
	(4.72)**	(2.28)*	(0.69)	(0.55)
Log female wage	0.486	-0.058	-0.708	-0.708
	(2.71)**	(0.2)	(0.88)	(0.85)
Log male wage	-0.517	-0.151	0.277	0.237
	(3.45)**	(0.65)	(0.45)	(0.38)
Female labour force participation	0.007	0.016	0.017	0.02
	(3.50)**	(2.94)**	(2.07)*	(2.21)*
Family allowance 1st child	0.008	0.046	0.077	0.06
	(2.74)**	(2.82)**	(3.72)**	(2.89)**
Family allowance 2nd child	-0.001	0.072	0.054	0.04
	(4.16)**	(2.87)**	(1.56)	(1.12)
Family allowance 3rd child	-0.006	-0.118	-0.131	-0.1
	(2.22)*	(4.11)**	(2.95)**	(2.14)*
Constant	2.784	8.113	7.958	6.415
	(2.07)*	(5.31)**	(3.58)**	(2.84)**
Observations	424	299	197	197
R-squared	0.44	0.41	0.54	0.52

Robust t-statistics in parentheses. Country fixed effects and year dummies included.

† significant at 10%; * significant at 5%; ** significant at 1%

atively small. It implies that a one-standard-deviation increase (16.68 percentage points) of tax decentralisation would decrease the total fertility rate by 0.02. While the standard deviation is large relative to the sample mean of 19.21, it may be noted that this sort of increase has been realised by Belgium, France and Spain over the period of 1970-2001 (Stegarescu, 2005).

The expenditure decentralisation variable also has a negative and highly significant coefficient. Moreover, expenditure decentralisation seems to have a more sizeable effect on fertility, with an estimated elasticity of -0.33. This implies that a one standard-deviation increase in expenditure decentralisation could reduce total fertility from the mean of 1.97 to 1.76. Interestingly, the same pattern holds for decentralisation of education spending: according to the estimates shown in column (3), the effect is again negative and significant at 1%. On the other hand, decentralising social protection seems to have a positive impact on fertility. It would be interesting to build a model which encompasses some element of social spending to see whether this finding is consistent with the proposed framework.

In summary, there seems to be some evidence that total fertility falls with the degree of fiscal decentralisation. While the effect of tax decentralisation seems to be small, expenditure decentralisation seems to have more sizeable effects. It would obviously be desirable to delve somewhat deeper into these findings. In particular, it would be interesting to look at expenditure measures that show the real degree of autonomy of lower levels of government for different spending categories. Since these measures do not yet exist, however, the analysis here is confined to conventional measures of expenditure decentralisation.

5.2 Differential fertility

Comparable international data on differential fertility are much harder to come by. One possibility would be to use household surveys, but those that are comparable across countries generally do not contain enough observations to construct reliable statistics.

Here, I follow de la Croix and Doepke (2007) and use data from the OECD PISA study on student achievement (PISA 2000). The study contains information on 15-year old students and their family backgrounds. In particular, it asks students on the number of siblings and it records the socioeconomic status of the student's father in four categories. The measure of differential fertility used here is then the difference in average family size between students of the lowest status minus that of those with the highest status.

Since this is only a cross section of countries for the year 2000, the results are at best indicative since the sample size is very small. Nonetheless, Table 4 shows the results of regressing log differential fertility on the decentralisation measures, log GDP, and length of maternity leave. As the Table shows, all decentralisation indicators have a negative effect on differential fertility. For two of them the coefficient is significant at 10% – and almost 5 % (the p-values are 0.057 for expenditure decentralisation and 0.062 for educational

Table 4: Regression results (differential fertility)

	(1)	(2)	(3)	(4)
Log tax decentralisation	-0.176			
	(1.39)			
Log expenditure decentralisation		-0.632		
		(2.08)†		
Log education decentralisation			-0.399	
			(2.07)†	
Log social protection decentralisation				-0.257
				(1.70)
Log GDP per capita	0.668	1.255	1.526	1.826
	(1.29)	(2.22)*	(2.53)*	(2.29)*
Maternity leave	-0.012	-0.011	-0.012	-0.008
	(1.08)	(1.06)	(1.10)	(0.74)
Constant	-7.185	-11.41	-14.857	-18.847
	(1.44)	(2.29)*	(2.64)*	(2.44)*
Observations	19	18	15	15
R-squared	0.18	0.29	0.4	0.33

Robust t-statistics in parentheses.

† significant at 10%; * significant at 5%; ** significant at 1%

decentralisation). This shows that decentralisation may have effects on differential as well as total fertility. Obviously, more research is needed to establish whether this relation holds up with better data.

6 Conclusion

The paper has presented a model to analyse the decentralisation of policies – such as education and child care – which simultaneously affect fertility and growth. Although such policies are widely debated in industrialised countries due to the decline in fertility, not much seems to be known about the effects of decentralising policy on fertility and the interaction between fertility and growth.

The main results can be summarised as follows. In the benchmark model, decentralisation leads to higher growth of human capital with greatly increased inequality. While total fertility is not strongly affected, the distribution of fertility between rich and poor is, and in particular, the ranking of fertility rates is reversed (with a large elasticity of substitution). Whereas in the centralised system the poor have more children, in the decentralised system they have fewer children than the rich. This is an interesting observation. In particular, it

implies that whether richer families have more or less children depends on the institutional setting of family policy, including whether it is carried out by central or local governments.

For policy purposes, there emerges a trade-off between growth maximising and equality preserving policies. The paper also has shown that depending on parameters, decentralisation may lead to higher or lower fertility than centralisation.

The paper has also presented first evidence on the link between fiscal decentralisation and fertility. The evidence shows that decentralisation seems to have a negative effect on total fertility. For tax decentralisation, this effect seems to be small. Expenditure decentralisation, on the other hand, seems to have more economically important effects. The finding that decentralisation affects fertility should be important for policy makers attempting to increase fertility in the wake of demographic pressure on the welfare states.

The paper has also presented some evidence that differential fertility – i.e. the difference in fertility rates between poor and rich families – decreases with decentralisation, which is consistent with the model. It also highlights the importance of a disaggregated view on fertility. While a look at aggregate fertility might lead to the conclusion that decentralisation erodes the basis of pay-as-you-go pension systems, this view might be somewhat misleading. Indeed, if centralisation reduces the fertility differential, this may be good news from the point of sustainability of social security.

Finally, there are some issues with the data which point toward the need for further research. First, data on subcentral government spending do not as yet allow any inference on the extent of decision making authority. And second, there are only very limited data available on differential fertility. Therefore, if one is interested in these questions, collecting better data seems to be of high priority.

Appendix

A Proof of Proposition 1

The proof follows de la Croix and Doepke (2004). From the human capital production function (2), we have:

$$x_{t+1}^i = \mu(e_t)^\eta (x_t^i)^\beta \frac{1}{g_t}, \tag{A.1}$$

where $g_t \equiv \bar{h}_{t+1}/\bar{h}_t$ is the growth factor of average human capital. From the definition of average human capital (3),

$$x_t^B = 1 + \lambda_t(1 - x_t^A), \tag{A.2}$$

where $\lambda_t \equiv P_t^A/P_t^B$ is the relative size of group A. Inserting into (A.1) gives

$$1 + \lambda_t(1 - x_{t+1}^A) = \frac{1}{g_t}\mu(e_t)^\eta (1 + \lambda_t(1 - x_t^A))^\beta. \tag{A.3}$$

Solving (A.3), using the definition of g_t from (A.1) gives

$$x_{t+1}^A \equiv \phi(x_t^A) = \frac{1 + \lambda_{t+1}}{\lambda_{t+1} + \left(\frac{1+\lambda_t}{x_t^A} - \lambda_t\right)^\beta}. \tag{A.4}$$

The dynamics in (A.4) show that there are two steady states, $x_t^A = 0$ and $x_t^A = 1$. Since

$$\begin{aligned} \phi'(x_t^A) &= \frac{\beta(x_t^A)^{\beta-1}(1+\lambda_t)(1+(1-x_t^A)\lambda_t)^\beta(1+\lambda_{t+1})}{(1+(1-x_t^A)\lambda_t)^{1-\beta}((1+(1-x_t^A)\lambda_t)^\beta + (x_t^A)^\beta\lambda_{t+1})^2} > 0 \\ \phi'(0^+) = +\infty \quad &, \quad \phi'(1) = \frac{\beta(1+\lambda_t)}{1+\lambda_{t+1}}, \end{aligned}$$

the fixed point at 0 is locally unstable and the fixed point at 1 is globally stable. ■

B Data sources

Fertility rates are from OECD (2006). Differential fertility comes from the OECD PISA database and is taken from de la Croix and Doepke (2007).

The index for tax decentralisation is from Stegarescu (2005), and the indices for expenditure decentralisation are from the IMF *Government Finance Statistics Yearbooks* (1972-2006).

GDP and standardised unemployment rates are from the OECD *National Accounts* (various years).

Maternity benefits and pay, child care benefits and pay were compiled by Gauthier and Bortnik (2004) from various international sources. Family allowance, indices of male and female wages as well as female labour force participation were taken from Gauthier (2003): family allowances are from United States, *Social Security Programs Throughout the World*(various years); male and female wages are from International Labor Office, *Year Book of Labor Statistics* (various years) and additional country-specific sources; female labour force participation from OECD, *OECD Historical Statistics* (various issues).

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