

# **Linking Education and Pensions in Transition: First Empirical Results from the Czech Republic**

**S.Slobodyan**  
CERGE-EI

**V.Vinogradov**  
CERGE-EI

## **Abstract:**

In their recent paper, Boldrin and Montes (2005) analyze the “return on human capital investment” theory and show that if borrowing for education is not possible, then a combined public education and pension system that uses lump sum taxes and transfers can replicate the first-best decentralized allocation achieved in an economy without taxes where borrowing for human capital accumulation (education) is allowed. Taking into account that such borrowing is either absent or inefficient in many countries, a combined public education/public pensions scheme might prove to be welfare enhancing.

Guided by this theoretical framework, we use it to calibrate the parameters of an interconnected pension and education system for the Czech Republic (CR) under different scenarios of demographic and economic development. Separately, both systems are undergoing deep changes, and the study proposed here might prove to be useful in informing policymakers about desirable directions for reforms in the educational and pension systems and estimating the magnitude of such reforms. Our first results, estimated from the Microcensus 1996, indicate that in the CR paying for the education of the next generation provides a higher return than the interest “paid” on educational loans: Education is inexpensive, and pensions are generous. This conclusion is consistent with the currently observed 45% wage replacement rate of pensions and the relatively short supply of educational services in the CR. We further discuss changes to the two systems under different paths of demographic and economic variables.

**Keywords:** Public education, human capital, pay-as-you-go pensions.

**JEL classification:** H52, H55

---

\*We gratefully acknowledge funding from the Global Development Network RRC IV Grant. We also thank discussants and participants in the GDN RRC 2004 conference. The standard caveat applies.

## 1. Introduction

Some theoretical and empirical literature exists (see Boldrin and Montes, 2005) on the theory referred to as “return on human capital investment” (Mulligan and Sala-i-Martin, 2004). They mainly read as research into the relationship between human capital investment (e.g. public education) and the pension systems, and they consider the public pension to be a return on the investment in human capital of the next generation. The generation of current retirees made an investment when they were middle-aged by paying taxes which were partially used to educate their offspring. In turn, the debt incurred by the young for being educated through this system is repaid through their own social security contributions when they become middle-aged. In a pay-as-you-go pension system, these contributions would be transferred to the elderly as pensions. An interconnected pension and public education system can replicate the allocation achieved by complete markets, where the young can borrow against their future income. The two systems are connected through implicit rates of return on public schooling expenditures and educational taxes. This scheme is equivalent to intergenerational transfers among three generations: the young, the old, and the middle aged.<sup>1</sup>

Boldrin and Montes (2005) further calibrate their model to the Spanish data. The normative prediction of the model is that the implicit rate of return  $i$  that equalizes the discounted values of educational services received and social security contributions paid equals the implicit rate of return  $\pi$  that equalizes the discounted values of educational taxes paid and social security contributions received. Finally, both  $\pi$  and  $i$  equal the market interest rate. The authors show that this normative prediction approximately holds in the Spanish case if one assumes that the institutional structure of the public education and pension systems in the last 20 years are in effect for all living cohorts. They further extrapolate their model into the future, using demographic projections and various

---

<sup>1</sup> Alternative financing schemes proposed by Boldrin and Montes (2005) include a special proportional tax on capital or a special debt instrument. Without lump-sum taxation, the replication of the complete markets allocation becomes impossible, though it is still possible to approximate it even when the markets are incomplete and private borrowing to finance education is not available. The analysis is very promising because even in the developed countries the markets for financing accumulation of the human capital (education) through borrowing against future labor income are not very advanced; it sheds light on ways to

assumptions on the behavior of taxes and expenditures over time. The projections reach two conclusions: First, demographic evolution moves the two implicit rates of return apart — individuals receive a higher rate of interest through pensions than they pay through social security contributions, and second, rates of interest paid or received by different cohorts do not monotonically depend on the year of birth. The joint consideration of education and pension systems proposed by the authors does not lead to a systematic transfer of resources from the currently young and not-yet-born generations to the currently old, as the usual conclusion in the Generational Accounting methodology finds (see, e.g., Auerbach, Kotlikoff and Leibfritz [1999]).

Guided by this theoretical framework, we apply it to calibrate an interconnected pension and education system in the CR under different scenarios of demographic and economic development. Both systems are undergoing deep changes, and the study proposed here might prove to be useful in informing policymakers about the desirable direction for reforms in the two and estimating the magnitude of such reforms. In particular, it is important to understand the impact of any possible changes to the structure of funding in higher education and/or pension benefits. For instance, while higher education in the Czech Republic at present is mostly free, parts of the political spectrum propose to fund it privately to a larger extent. The latter scheme suggests less costly transfer to a system where education is not “free” but represents an explicit individual asset with corresponding liabilities (provided such a system is socially optimal and politically feasible). We scrutinize these issues empirically by looking at the Czech Microcensus data of 1996.

The paper is organized as follows: Section 2 provides a description of the data and a discussion of different scenarios of demographic and economic development. Section 3 presents the results of our simulations and a discussion on policy tools that could be used to achieve efficiency and fairness in intergenerational transfers. Finally, Section 4 concludes.

---

complete important markets. See Patrinos (2002) for a survey of observed institutional arrangements around the world and Saint-Paul and Verdier (1993) for a theoretical analysis.

## **1. Empirical Framework: Data, Demographic Scenarios, and Fiscal Rules**

In the empirical part of the study, we first attempt to estimate the net present value of transfers that were paid and received by every currently-living cohort in the Czech Republic. Note, however, that such an estimate involves a stationarity assumption that might have been justified in the Spanish case studied by Boldrin and Montes (2005) where both the public school and the social security systems were relatively stable within the last 20 years. However, this could be somehow unrealistic for transition countries where the real values of both education and pension expenditures have been varying greatly since 1989.<sup>2</sup> Therefore, this calculation will serve mainly as a crude benchmark for forward-looking projections.

Given the share in taxes/pensions/education transfers for each cohort,<sup>3</sup> one could determine the NPV of publicly provided education, social security taxes and the taxes used to pay for educating the next cohorts, and social security pensions. The calculation of these net present values requires knowledge of period-to-period survival probabilities (available from standard mortality tables) and of the interest rates. The forward-looking projections also require some assumptions regarding a future fiscal policy (in particular, social security contributions and payments, and public expenditures on education).

A forward-looking prognosis provides an evaluation of the NPV of contributions to and services from the public education and the pension systems. An implicit rate of return along the life cycle that is paid on the debt incurred by going to school is the interest rate that equalizes NPV of education services and of social security contributions, while the implicit rate received as pensions is the one at which the NPV of education taxes equals

---

<sup>2</sup> For instance, the Czech Republic implemented its first pension reform in 1990; another transformation of the pension system is currently being discussed by the Czech government; the Czech educational system experienced a shift of resources in the state budget towards secondary vocational schools after 1995/96, etc.

<sup>3</sup> We briefly describe the methodology later in the section.

the NPV of pensions received. For computational purposes, both implicit rates could be taken as a constant spread over or below the projected market interest rate. The results of the forward projection would then be cast in terms of a spread between the market interest rate and the two implicit rates of return.

To compute these implicit rates, we use the Czech Microcensus as primary source. We start our quantitative exercise with Microcensus 1996. For each individual in the sample — conditional on the age and educational status — we attempt to estimate the amount and value of public education received, the amount of taxes and pension contributions paid, and the amount of public pensions received. A list of primary and constructed variables from the Microcensus used to compute implicit interest rates includes the following: year of birth, citizenship, gender, education level, economic activity status (either economically active, or retired, or student, or child aged 0-15 years), type of retirement (age and/or widow(er)), number of months worked in given year, amount of retirement payment, number of months retirement benefits were paid in given year, total gross yearly income, total net yearly income, mandatory social and health insurance paid in given year, and, finally, income tax paid in given year.

Along with the income tax payments contributed by individuals to the state budget, we also account for the value added tax paid by physical persons. Based on the data provided by the Czech Statistical Office, paid VAT is computed as a percentage of gross total money income by income decile (see Table 1 below).

<b>Decile</b>	<b>First</b>	<b>Second</b>	<b>Third</b>	<b>Fourth</b>	<b>Fifth</b>	<b>Sixth</b>	<b>Seventh</b>	<b>Eighth</b>	<b>Ninth</b>	<b>Last</b>
<b>Gross money income, total</b>	61,051	79,449	88,809	94,648	102,387	111,422	126,941	143,977	175,442	244,117
<b>Consumer expenditure</b>	51371	64339	68747	75487	81155	87725	93276	101905	117552	150549
<b>VAT paid</b>	7469	9429	9975	11281	12025	12916	13682	15036	17097	22660
<b>Percentage of income paid as VAT</b>	12.23%	11.87%	11.23%	11.92%	11.74%	11.59%	10.78%	10.44%	9.75%	9.28%

**Table 1.** VAT as a percentage of total gross money income in the Czech Republic.

We also use the available information to calculate the population shares of studying, working, unemployed and retired individuals. Further, to adjust for the demographic changes (e.g., mortality rates or immigration flows) we use demographic projection and demographic evolution scenarios based on the data available from the national statistical office.

Based on the Czech Microcensus 1996, in sequel, our methodological approach is as follows: We include only males (to avoid fertility-related variability both in income figures and retirement age), who are either employed, self-employed, or has received pensions for 12 months in the year the Microcensus was taken.<sup>4</sup> Retirees could have additional income, either from a wage or self-employment. They are considered retirees for sample description purposes. We also adhere stick to the assumption that according to Czech law, currently the retirement age for males is 61. Further, *pension* is defined as the sum of age pension and (if any) widow(er) pension received by an individual (orphan pensions, disability pensions, etc., are not included). We assume that all pensions are coming from the state pension fund (i.e. private pensions funds can be neglected; this assumption was fully legitimate under socialism and is still applicable, by and large, in the CR.).

As far as education is concerned, five types of educational levels are distinguished: (0) no education or incomplete elementary; (1) elementary; (2) incomplete secondary or secondary without leaving diploma (*maturita*); (3) complete secondary with leaving diploma (*maturita*); (4) high school (including Bachelor, Magisterial, or Doctoral degree). Based on the yearly information of the structure and costs of education in the Czech Republic provided by the Ministry of Education, Youth, and Sport, we compute that 4.4% of children aged 0-2 years attend nursery schools, while among children aged 3-6 years this proportion reaches 90%. From the same source we compute that out of a pool of students enrolled in secondary education, 42.5% study in secondary vocational schools, 19.5% in *gymnasia*, and 38% in secondary professional schools (SOŠ in Czech).

---

<sup>4</sup> We are aware that going along this line we are probably overestimating the tax and social security payments and underestimating the pension benefits, while projecting our results to the total population. However, the error should not be significant.

The same source reveals the amount of educational transfers per student in the Czech Republic in 1995/96 academic year by type of school, see Table 2 below.

<b>Type of school</b>	<b>Expenditures per student in CZK</b>
Nursery	21618
Basic	19604
Gymnasia	25416
Secondary vocational	33586
Secondary professional	27560
University	69221

**Table 2.** Expenditures per student by type of school in 1995/96 academic year in the Czech Republic.

School enrollment data and per capita expenditures by type of school enable us to compute for each cohort per capita educational transfers as presented in Table 3:

<b>Type of school</b>	<b>Educational transfers per student in CZK</b>
Nursery, age 0--2 years	951.2
Nursery, age 3--5 years	19456.2
Basic, age 6--15 years	19604.0
Secondary, with or without <i>maturita</i> , age 15+	29711.7
University	69221.0

**Table 3.** Educational transfers per student by type of education in the Czech Republic in 1996.

To evaluate transfers made by an individual to the budget in the year of the Microcensus, we use the difference between gross income and net income reported by the individual in the Microcensus, combined with the VAT payment projected as a fraction of an individual's gross total money income (cf. Table 1.) While computing per-capita social security and tax payments, and education and pension transfers, we follow the methodology of Boldrin and Montes (2005). As the best available source of information, we employ Microcensus data that may be biased in a sense that statistically, certain age cohorts are under-represented (e.g. students) and some are over-represented (e.g., retirees) as compared to the demographic pyramid in the 1996 population. However, by normalizing the above per-capita values for each cohort to the Microcensus shares of this cohort, we correctly measure the “participation rate” of each cohort in tax and social security contributions and in education and pension transfers.

The methodology described above allows us to estimate the “age profiles” of taxes paid and transfers received. For instance, we know that in 1996 a typical 10-year-old received 20 times as large educational transfer as a typical one-year-old, and a typical 35-year-old paid approximately twice as much in taxes as a typical 24-year-old. These age profiles are then kept fixed in all projections.

The analysis of the 1996 Czech Microcensus data reveals that the tax system is progressive: Less educated respondents receive a smaller income and pay a lower share of it in taxes (from 0.19-0.20 for those with elementary and incomplete secondary education to 0.22 for secondary school graduates with diploma to 0.25 for those with tertiary education). At the same time, pensions are increasing in the highest education level attained but are essentially independent of age.<sup>5</sup> Taking into account the secular rise in real wages and the essential constancy of the wage replacement rate for pensions (43.4 to 45.9 in 1997-2002), the latter means that younger cohorts of retirees obtain a worse deal on their pensions. One possible reason for this phenomenon might be perfect indexation of pensions to the real wage growth.

---

<sup>5</sup> For very old retirees pensions are lower, but their share in the population is tiny.



## 2. Simulation Results and Policy Recommendations

In line with Boldrin and Montes (2005), our quantitative exercise might inform policymakers about the possible ways of education and pension reforms. Such reforms might include more/less generous pension benefits; an increase or a decrease in educational transfers; or attempts to affect the demographic structure of the population. A comparison of the implicit rate of returns to education transfers and pensions suggests possible directions for reforms. These, however, will depend upon different fiscal and demographic scenarios.

To scrutinize this idea empirically for the Czech Republic, we consider several demographic scenarios and budgeting rules. First, we impose an assumption of “no-change”, that is we combine current budget rules (i.e. fixed per capita education and pension transfers, and tax and social security payments) with an artificially frozen current age structure. Furthermore, the public pensions / public education system is assumed to run a balanced budget at every point in time. We estimate that under such assumptions paying for education of the next generation provides a higher return than the interest “paid” on educational loans: Education is cheaper than pensions, with the gap between implicit interest rates at about 1.8%. This conclusion is consistent with the currently observed 45% wage replacement rate of pensions and the relatively short supply of educational services in the CR.

Demographic change is bound to affect this gap. So, we consider four distinct scenarios of demographic development that differ in the fertility rate that is the number of children born to a female over her life cycle. Currently, the fertility rate in the Czech Republic is 1.19, and in the 'current' scenario the fertility rate stays constant over time at the current level. We also consider moderately and highly optimistic scenarios, with the fertility parameter increasing from the current level of 1.19 to 1.4 and 1.9, respectively, and finally, we consider the highly pessimistic scenario where the fertility drops to 1.05 from the current level.<sup>6</sup> Given that demographic projections spanning more than 100 years are

---

<sup>6</sup> It is also feasible to introduce a one-time legalization of illegal migrants, similar to what was done in Spain in the spring of 2005. By expert opinion, the number of illegal workers, mostly young Ukrainian males, may be as large as 200 000, and this comprises a significant percentage of the Czech labor force.

highly uncertain, in all 4 scenarios we assume that the population and its structure remain unchanged after 2100.

Following Boldrin and Montes (2005), we consider several fiscal rules used to adjust for changing population structure. For example, consider “demand driven” budgeting: fix per capita educational transfers and pensions and preserve the balanced budget assumption.<sup>7</sup> With “supply driven” budgeting, per capita taxes paid are fixed, and the total educational transfers and pensions are determined by the tax revenue, no matter what the number of students and pensioners is. It is also possible to consider “partially driven” budgeting rules which fix either per capita educational transfers — “to educate the young”—or per capita pension payments — “to support the old”.

Consider the projection with the “demand driven” budgeting and four demographic scenarios. Figure 1 provides an illustration. The gap between the two implicit interest rates disappears for cohorts born in the 1980s no matter what the assumed fertility rate is. For still younger people, the current situation is reversed: The interest rate on “educational loans” exceeds that paid as pensions by as much as 1.2% under “moderately” and “highly optimistic” demographic scenarios. With the “current” scenario, the difference between education and pension implicit interest rates increases to 1.5%. In the “highly pessimistic” case, this difference increases further and reaches the 1.9% level (note, however, that the “highly pessimistic case” is unlikely to be realized in the Czech Republic).

In the distant future, as the population structure freezes at different levels determined by assumed demographic projections, it becomes feasible to equalize these two interest rates by means of various fiscal tools. Again, the efficiency of the fiscal tools will be heavily conditional on demographic developments. For instance, at current fertility rates with “demand driven” budgeting and with a 16.6% increment in pensions from the 1996 level (*without* a corresponding increase in social security contributions), the two interest rates will be equalized just above 3 percent. Note, however, that preserving a balanced budget

---

However, this one-time measure will affect only short-run tax payments to the budget because — again by expert estimate — the vast majority of these illegal workers will return to their home country and will unlikely claim retirement benefits in the Czech Republic.

by *not* increasing pensions leads to an implicit interest rate on pension benefits being 0.5% lower than that on educational loans. Also, the 16.6% increase in pensions seems to undershoot the equalization of the two implicit interest rates if the demographic development is believed to be optimistic, and overshoots it if the budgeting is “supply driven”.<sup>8</sup> This point is visualized in Figures 2 and 3. Alternatively, the same objective can be achieved by increasing per capita educational transfers by 12.7% *without* a corresponding rise in taxes, but the common interest rate now will become as low as 2.55% — see Figure 4 for an illustration. Nevertheless, efficiency requires not only pairwise equality of the two interest rates, but also their simultaneous equality to the market interest rate, which we estimate to be close to 3 percent.<sup>9</sup> Thus, pension adjustments and education transfer adjustments lead to different outcomes in this framework. For instance, it may happen that an increase in educational transfers is deemed socially superior to an increase in pensions, but is inferior from a general macroeconomic point of view.

### 3. Conclusion

Using the framework developed by Boldrin and Montes, our empirical results, estimated from the Czech Republic Microcensus 1996, indicate that if current budget rules are combined with an artificially frozen current age structure, paying for educating the next generation provides a higher return than the interest “paid” on educational loans. Demographic change, however, is bound to affect the gap between the two implicit interest rates. The direction of movement of these interest rates and the size of this gap over time depends on an assumed scenario of demographic development, and on the type of budgeting rules chosen (i.e. “supply driven”, “demand driven”, or “partially driven”).

---

<sup>7</sup> Considering rapid ageing of the population, this implies dramatic increase in social security contributions in the near future, as the number of workers per retiree declines.

<sup>8</sup> Ironically, with a fixed current demographic structure and “supply driven” budgeting, no correction is needed at all.

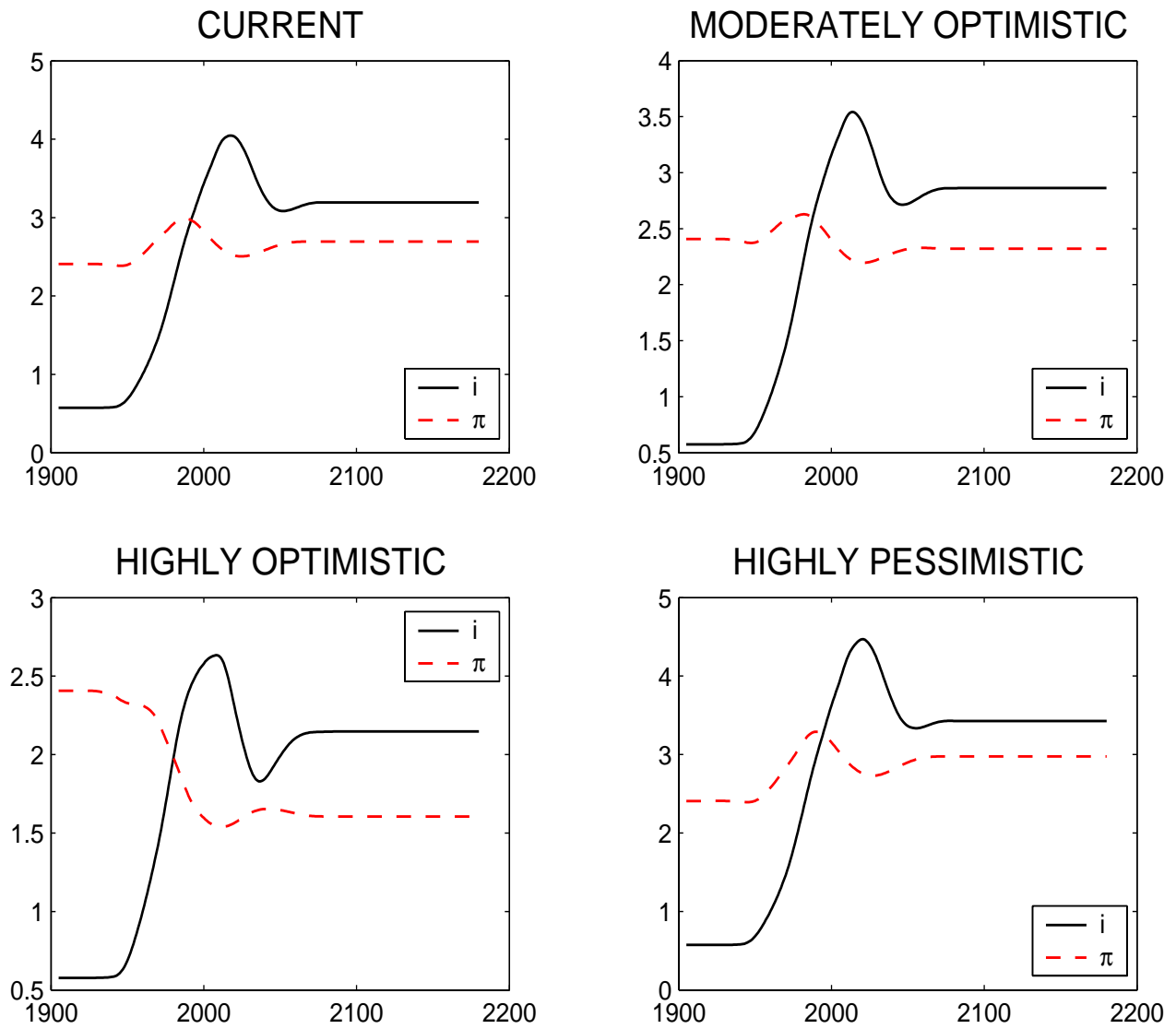
<sup>9</sup> Bond markets in the Czech Republic are very weak and illiquid. As a measure of real interest rate, we take the average midpoint between long-term deposit and loan rates minus 12-months CPI inflation. We average the years 1999 through 2003 in order to exclude extreme volatility in 1998, possibly related to the Czech banking crisis of 1997.

As the population structure eventually freezes at different levels determined by assumed demographic projections, various fiscal tools can be applied to eliminate the gap between the two implicit rates of return  $i$  and  $\pi$  and make equal  $i$ , which equalizes the discounted values of educational services received and social security contributions paid, with  $\pi$ , which equalizes the discounted values of educational taxes paid and social security contributions received.

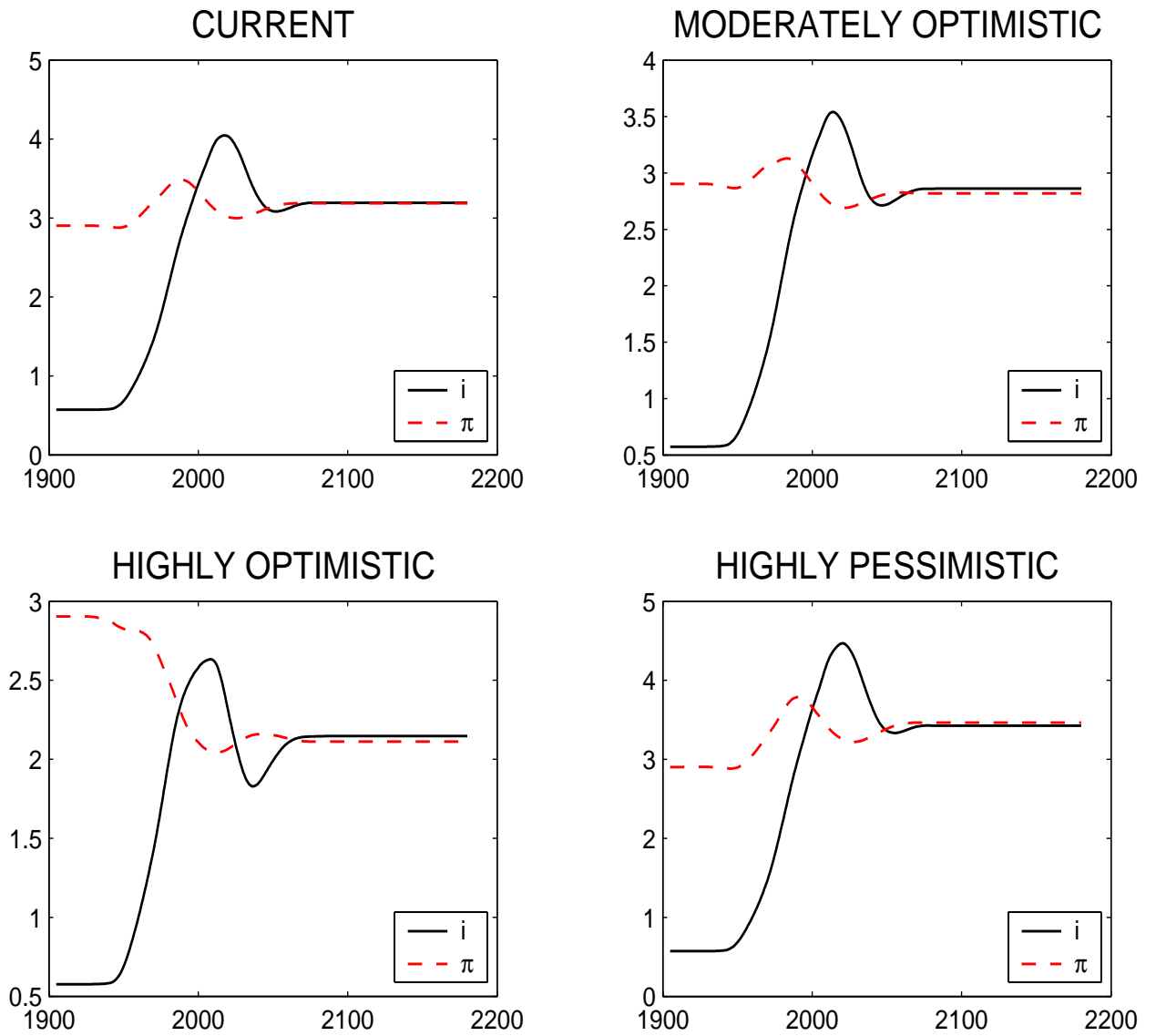
The choice and efficiency of the applied fiscal tools is conditional on projected demographic changes and existing budgeting rules. Even if different tools — e.g. pension adjustments or educational transfer adjustments — result in the equalization of the two implicit interest rates, the level of the common interest rate may vary. Thus, the relative efficiency of these tools would be different as well because along with pair-wise equality of the implicit interest rates, efficiency also requires their simultaneous equality to the market interest rate.

## References

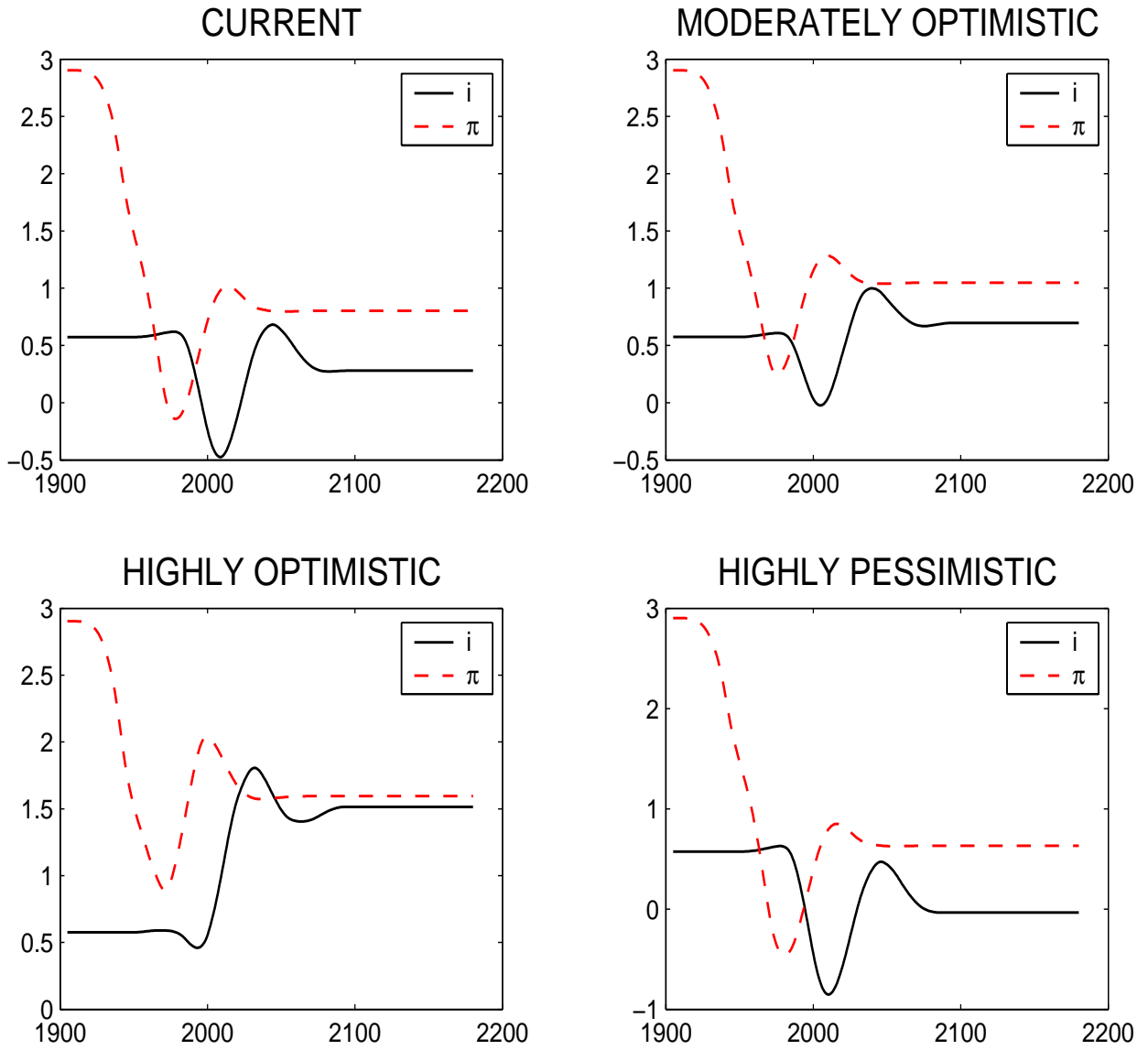
- Auerbach, Alan J., Kotlikoff, Laurence J., and Leibfritz, Willi (eds.) (1999), *Generational Accounting Around the World*, University of Chicago Press, Chicago and London.
- Boldrin, Michele, and Montes, Ana (2005), “The Intergenerational State: Education and Pensions”, *Review of Economic Studies*, forthcoming.
- Mulligan, Casey B., and Sala-i-Martin, Xavier (2004), “Political and Economic Forces Sustaining Social Security”, *Advances in Economic Analysis and Policy*, vol. 4, No 1, Article 5. <http://www.bepress.com/bejeap/advances/vol4/iss1/art5>.
- Patrinos, Harry (2002), “Return to Education and Private Financing Options”, mimeo.
- Saint-Paul, Gilles, and Verdier, Thierry (1993), “Education, Democracy and Growth”, *Journal of Development Economics*, vol. 42, pp. 399-407.



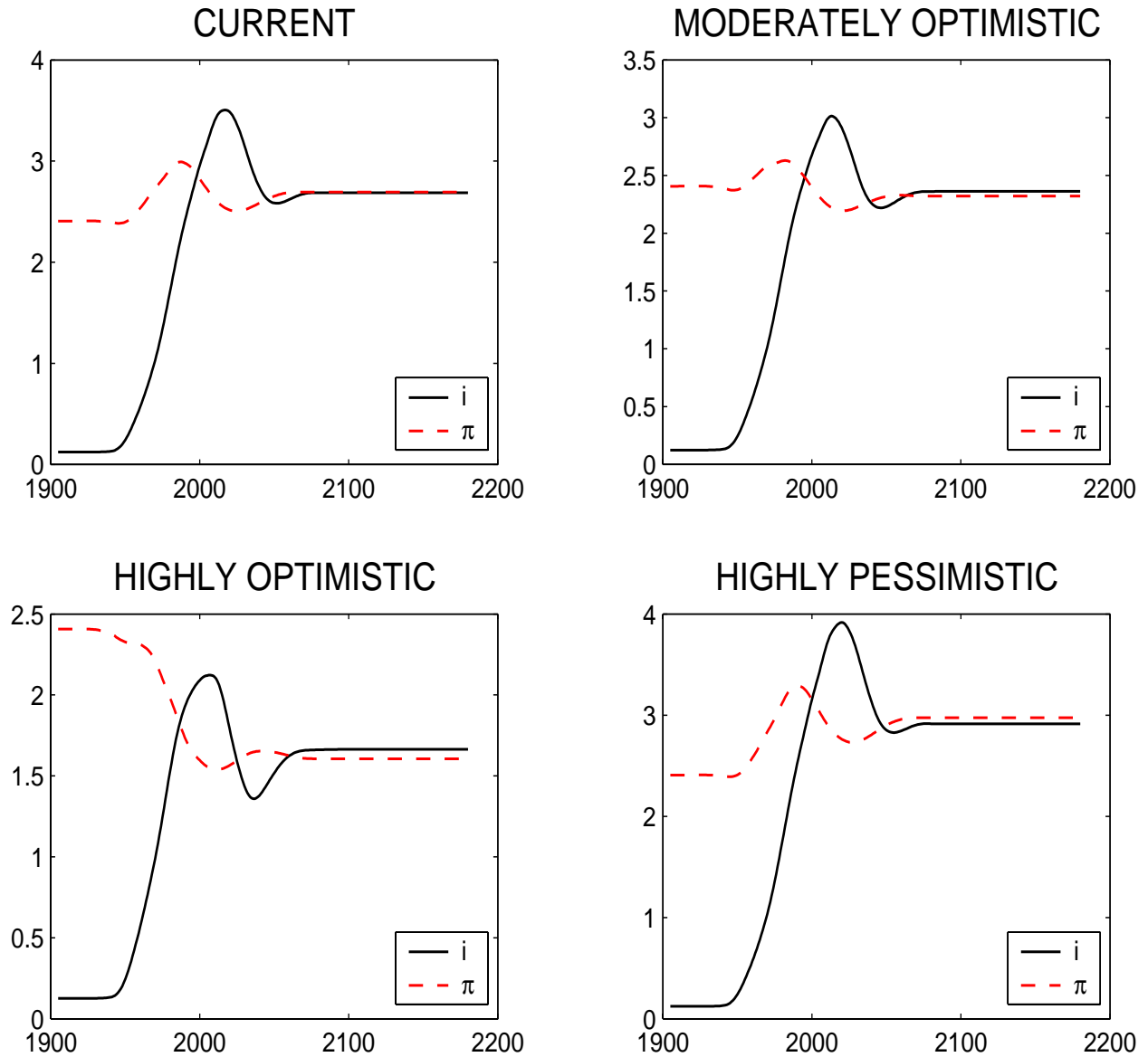
**Figure 1.** The behavior of implicit interest rates  $\pi$  and  $i$  for the case of *demand driven* budgeting under different demographic scenarios.



**Figure 2.** The behavior of implicit interest rates  $\pi$  and  $i$ : *Demand driven* budgeting and unbalanced pensions increase by 16.6%.



**Figure 3.** The behavior of implicit interest rates  $\pi$  and  $i$ : *Supply driven* budgeting and unbalanced pensions increase by 16.6%.



**Figure 4.** The behavior of implicit interest rates  $\pi$  and  $i$ : *Demand driven* budgeting and unbalanced educational expenditures increase by 12.7%.