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1. INTRODUCTION

Like most European nations, the Czech Republic is in the midst of a demographic transformation that will have a severe impact on the performance of its pension system, which is primarily a public defined benefit (DB) system financed on a pay-as-you-go (PAYG) basis. The extent of future demographic pressures can be clearly appreciated by the projected path of the old age dependency ratio (the ratio of the elderly population to the working-age population). The dependency ratio is currently 30 percent, but is projected to increase to 50 percent by 2025 and to more than 80 percent by 2050. Given the extraordinary magnitude of this pressure, pension reform will be unavoidable.

During the 1990s, the Czech Government took several steps to address the serious demographic challenge that looms ahead. The PAYG system was subject to various reforms in that decade, including the gradual increase in the retirement age for men and women, changes in the benefit formula, more restrictive eligibility rules, and other parametric reforms. A voluntary private pension system based on individual accounts was introduced in 1994, and participation in this system has been encouraged by the provision of a State contribution to individual accounts. At the end of 2000, approximately 2.3 million workers were enrolled in the supplementary system, or the equivalent of 50 percent of the labor force.

Despite these positive steps, the Czech pension system remains unequipped to cope with the strong demographic pressures projected for this century. The public PAYG system is projected to run increasing deficits in the next decades. Under baseline demographic assumptions, and in the absence of further and deeper reforms, the PAYG deficits will reach 8 percent of GDP by 2050 as pension expenditures soar. Reducing these large actuarial imbalances will inevitably involve a reduction in benefits, given that contribution rates are already excessive at 26 percent of wages, and should not be increased further. [2]

[2] Pension expenditures will rise by more than 7 percent of GDP by 2050. These constitute a rapid increase in pension expenditures and extremely large actuarial imbalances by any international standard. By way of

The voluntary private system could in principle maintain the level of retirement income at reasonable levels, but the performance of the private system has fallen short of expectations. Despite the apparently high coverage of the labor force, participation in the system is strongly tilted toward old workers, and the majority of workers under 40 years of age remain uncovered. This is a matter of concern, as these are precisely the workers that are likely to suffer the strongest reduction in benefits. Moreover, the average contributions to the private system remain very small at less than 3 percent of wages, costs have been relatively high, and the returns have been disappointing, leading to a very slow growth of total assets—after seven years of operation assets remain at around 2 percent of GDP. Finally, pension funds have not been transparent in their operations, due to several legal and regulatory deficiencies. These weaknesses have raised doubts as to whether the voluntary private system will be able to play a meaningful role in the provision of retirement income.

The Czech system is in need of more fundamental reform, involving not only the public PAYG system, but also the private funded system. The reforms to the PAYG should aim at reducing the large actuarial imbalances and possibly strengthen the link between contributions and benefits, which has become tenuous due to a strong element of redistribution in the benefit formula. The reforms to the private system should aim at improving coverage of younger workers, increasing average contributions, and enhancing the transparency and performance of private pension funds. In examining the various reform options, Czech policy-makers will also inevitably have to address the question of whether a fraction of the contributions to the public PAYG system should be diverted to the private system, in order to improve the overall risk diversification properties of the pension system, and ensure an adequate level of retirement income, especially for younger workers.

The purpose of this paper is to review the structure and performance of the Czech pension system and examine alternative reform options. The paper is structured as follows. The second section reviews the structure and performance of the PAYG system and assesses how the system will evolve in the absence of fundamental reform. The third section examines the main PAYG reform options, including a parametric DB reform and the introduction of a system of notional defined contributions (NDC). The fourth section reviews the structure and recent performance of the voluntary private funded system and examines the options to increase coverage and improve its performance. The fifth section assesses the limitations of a reform strategy restricted to the voluntary pillar and the impact of a more comprehensive multi-pillar reform, including reforms to the public PAYG scheme combined with the introduction of a modest but mandatory funded pillar. The sixth and final section summarizes the analysis and provides some concluding thoughts.

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comparison, future pension expenditures in the European Union are projected to rise on average by around 3 percent of GDP in the same period (Oksanen 2001).

2. THE STRUCTURE AND PERFORMANCE OF THE CZECH PUBLIC PAYG SYSTEM

Financial Performance in Recent Years

The Czech public PAYG system has 4.7 million insured persons covering nearly all the labor force, and 2.5 million pensioners. The scheme provides old-age, disability, and survivors' benefits, with old age pensions accounting for roughly three fourths of total pension expenditures. As shown in Table 1, the financial performance of the PAYG scheme weakened steadily throughout the 1990s, with the PAYG balance shifting from surpluses to deficits of 1 percent of GDP by the end of the decade. The shift into deficits occurred despite contribution rates of 26 percent of gross wages—very high rates by international standards.[3]

Table 1: Financial Balance of the Public PAYG System, 1994-2000
(in % of GDP)

	1994	1995	1996	1997	1998	1999	2000
Revenues	8.3	8.2	8.1	8.4	8.3	8.4	8.6
Expenditures	7.1	7.5	7.8	8.8	9.0	9.4	9.5
Balance	1.2	0.7	0.3	-0.5	-0.7	-1.0	-0.9

Source: Czech Ministry of Labor and Social Affairs (CMOLSA).

The financial deterioration of the PAYG was due to a rapid increase in pension expenditures, rather than a decline in pension revenues. As shown in Table 2, the tax base (the covered wage bill) remained relatively stable at around 32 percent of GDP during the decade, leading to an equally stable flow of revenues to the PAYG. Wage growth compensated the decline in the number of insured due to increased unemployment and some modest evasion (Figure 1).[4] This is in contrast with most other transition economies, which experienced a severe erosion of their tax bases and pension revenues during the same period.[5]

Table 2: Fundamental Determinants of PAYG Revenues and Expenditures Relative to GDP

	1994	1995	1996	1997	1998	1999	2000
Contribution Rate (% of Gross Wages)	27.2	27.2	26.0	26.0	26.0	26.0	26.0
Covered Wage Bill (% of GDP)	30.4	30.3	31.1	32.2	32.0	32.5	32.9
System Dependency Ratio (%)	47.6	49.1	48.2	50.7	51.7	54.4	55.7
Replacement Ratio (% of Gross Wages)	44.4	43.8	43.5	45.3	45.9	45.2	44.3
Replacement Ratio (% of Net Wages)	57.2	56.6	56.0	58.3	59.0	58.2	57.2

Sources: Czech Central Statistical Office (CCSO), CMOLSA

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[3] Total social security contributions (including unemployment and sickness benefits) amount to 34 percent of gross wages, of which 8 percent is paid by employees. These rates are significantly higher than average payroll taxes of high-income OECD countries.

[4] From 1994 through 2000, the number of insured declined by 13.5 percent. During the same period, the ratio of insured as percent of the labor force fell from 100 percent to 90 percent.

[5] For example, the tax base in Hungary declined from 33 to 23 percent of GDP during the 1990s. See Palacios and Rocha (1998) and Rocha and Vittas (2001).

The increase in pension expenditures relative to GDP was primarily due to the increase in the system dependency ratio, as shown in Table 2 and Figure 1. The increase in the dependency ratio was in turn due to adverse demographic trends, combined with low penalties for early retirement and a modest fall in the labor force. The decrease in the number of insured may also reflect some evasion. The average replacement rate (defined as average old pension to economy-wide average wage) of beneficiaries remained fairly stable, at around 44 percent of the gross average wage, as Figure 1 illustrates. More cautious pension indexation rules could have partly offset the impact of the worsening dependency ratio, but pension adjustments remained relatively generous—very close to wage indexation.[6]

Figure 1: Replacement Rates and System Dependency Ratio (1994-2000)
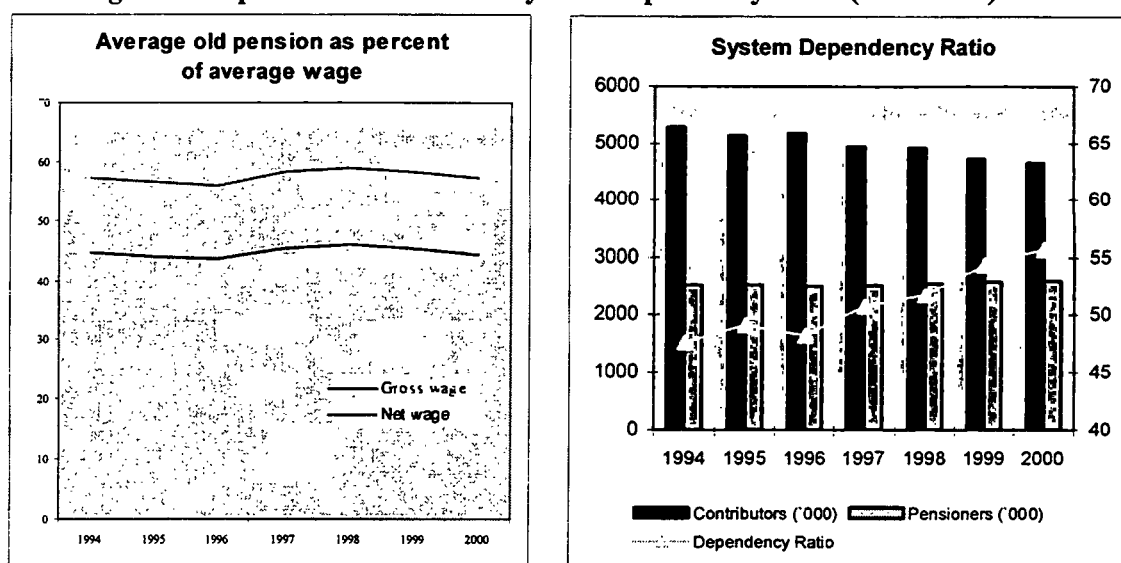
Source: MOLSA

Continuous but Partial Reform Efforts during the 1990s

In the course of the 1990s, the Czech Republic undertook several steps to improve the PAYG scheme. Early in the decade, privileges to special occupations started to be abolished. In 1995, the Czech Parliament approved a new Pension Insurance Code, which sought to contain expenditures due to the rising dependency ratio. The 1995 Law introduced, *inter alia*, a gradual increase in the retirement age for men and women, longer contribution periods for calculating pensions, changes in the benefit formula and in the indexation regime, and restricted criteria to determine disability. The reform also eliminated remaining privileges for special occupations, which makes the Czech Republic one of the first transition economies to abolish these costly provisions. While the 1995 Law constituted a step in the right direction, political compromises prevented a

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[6] Pensions were adjusted by an average of CPI growth plus 87 percent of real wage growth in 1993-2000. During the same period most European countries had already shifted to price indexation.

stronger package. Further amendments were passed in 1997, *inter alia* reducing the wage base assessment for non-contributory periods recognized for students and revising the indexation rule. In 2001, penalties on early retirement (up to 3 years before the statutory retirement age level) were increased becoming closer to actuarially fair levels to contain the growing number of early retirees.

Although the PAYG scheme has undergone continuous reforms during the last decade, these gradual and partial parametric changes have not been able to restore the financial viability of the system. Deficits have continued to widen, and large actuarial imbalances remain, as explained in more detail below. Moreover, the changes in the benefit formula introduced in the 1990s did little to strengthen the link between contributions and benefits, raising the possibility of an erosion of the tax base due to an increasing unwillingness to pay the high contribution rate. The deficiencies of the Czech PAYG scheme after the partial 1990 reforms are better appreciated through a basic description of the current PAYG rules and a projection of the system in the absence of further and deeper reforms.

The Current PAYG Scheme

The 1995 Law mandates a gradual increase in retirement ages until they reach 62 for men and 57-61 for women (depending on the number of children) in 2007 from the original level of 60 for men and 53-57 for women. At present, the levels are 61 for men and 55-59 for women. Moreover, the combination of generous early retirement provisions and difficult economic conditions (in particular during 1997-1999) led to a high percentage of early retirement. More than 50 percent of new benefit claims in 1999 corresponded to early retirement pensions. The tightening of early retirement provisions and increase in the retirement age were steps in the right direction, but the final retirement age will still lie below that of most OECD countries (where the 65 minimum retirement age prevails) and that of other Central European economies, such as Poland and Hungary, following its recent reforms.[7]

The 1995 Law also introduced a number of changes in the benefit formula. A positive change was the increase in the number of years for computing the pension base, from the last 10 years to the last 30 years by 2015. This amendment represents a move towards the computation of lifetime earnings, which has been adopted by most countries, and which tends by itself to tighten the link between past contributions and future benefits. These provisions, however, will not be fully effective given the highly redistributive benefit formula, which contains a flat benefit of 1310 Czech Crowns (CZK) and "bend-points" that are triggered at relatively low levels of wages.[8]

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[7] In Hungary, the retirement age for both men and women will reach 62 after its final state in 2009. In Poland, the retirement age is 60 and 65 for women and men, respectively.

[8] The total benefit is equal to two components, a flat benefit and a variable benefit depending on the past earnings history. The second component of the benefit formula is calculated as follows:
      Assessment Base * Service Factor
      Service Factor = 1.5% * total service years
      Assessment Base = 100% * (segment 1) + 30% * (segment 2) + 10%* (segment 3)
      Segment 1= wage income below 6300 crowns

Table 3 illustrates the high degree of redistribution implied by the current benefit formula. Workers with a 40-year contribution history who earn 50 percent of the economy-wide average wage obtain a pension equal to 77 percent of their personal wages, while workers who earn 200 percent of the economy-wide average wage receive a pension equal to 27 percent of their personal wages. The replacement ratios measured against the economy-wide average gross wage are very compressed around the 48 percent average.

Table 3: Old-age Replacement Rates and Redistributive Pattern

Personal Wage/Average Wage	Pension/Personal Wage	Pension /Average Wage
50%	77%	39%
100%	**48%**	**48%**
150%	34%	51%
200%	27%	54%

Source: CMOLSA and World Bank estimates.

Despite the 1995 changes and subsequent amendments in 1997, the mechanism for indexing pensions remains complex and subject to a significant element of political discretion. Pensions must be adjusted whenever the rise in CPI surpasses 5 percent, and the adjustment must be at least 70 percent of the CPI increase plus one third of real wage growth. In practice, pensions in recent years (1993-2000) have increased at a rate equivalent to CPI inflation plus 87 percent of real wage growth. This historical pattern will be used as an *ad hoc* rule for projecting future pension expenditures and the PAYG balances.

Finally, the 1995 Law introduced stricter disability rules and eliminated remaining occupational privileges, but failed to tighten the rules in other areas, such as the rules on non-contributory periods (i.e., periods during which premiums are not made, but which are counted as service years). Non-contributory periods remain significant compared to other countries, including the periods of compulsory military service, registered unemployment (up to 3.5 years), maternity leave (up to 4 years per child), care of family dependents (partially disabled and those over 80), short-term sickness and the period spent on high level education (up to 6 years from age 18). These liberal non-contributory rules imply a significant burden on the finances of the PAYG. Although the self-employed are subject to the same contribution rate (26 percent), the taxable assessment base is only 35 percent of net income (revenues minus expenditures), significantly lower than the average wage. This policy results in a redistribution from workers to the self-employed.

Segment 2=wage income between 6300 and 14200 crowns
Segment 3=wage income above 14200 crowns
These bend points are revalued whenever pensions are indexed. On January 2002, the bend points where increased to 7100 and 16800 crowns, respectively.

As other countries in the region, the Czech Republic will experience rapid population aging over the next few decades due to low fertility rates and increased life expectancy. Baseline demographic projections indicate that the old age dependency ratio (i.e., the population over 60 years to the population within the 18 to 59 year range) will increase from 30 to 45 percent within the next 15 years and will surpass 80 percent by 2050 as Figure 2 illustrates.[9] This will generate a dramatic rise in the system dependency ratio from 56 percent in 2000 to more than 115 percent in 2050.[10]

Figure 2. Demographic and System Dependency Ratio, 2000-2070
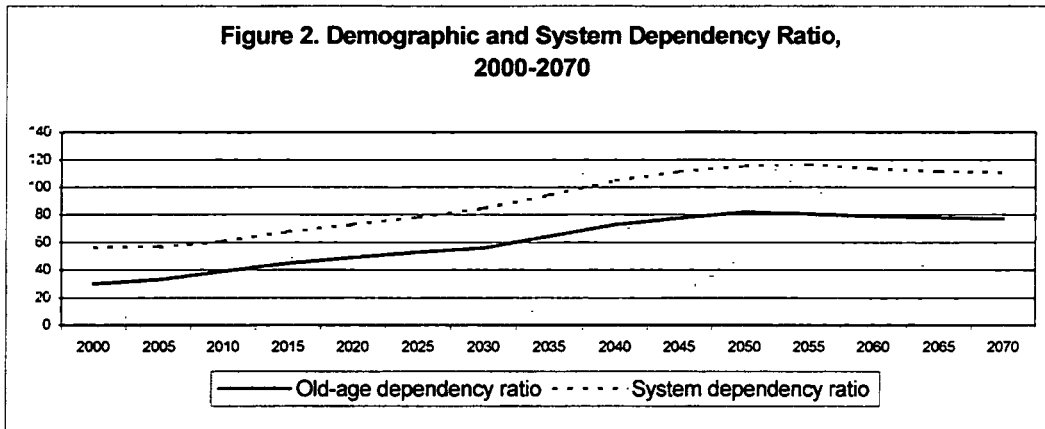
Source: Department of Demography and Geodemography of Charles University and World Bank estimates.

The negative demographic trends projected for the next decades will put an enormous strain on the PAYG scheme. The actuarial model developed for the Czech pension system, described in Annex I, projects that expenditures will jump by more than one percent of GDP to nearly 11 percent by 2015 and rise at even faster pace thereafter, reaching a peak of 17.1 percent in 2050. At the same time, revenues are projected to remain stable, due to a stable labor share and a stable tax base (i.e., no significant compliance problems). As a consequence, the deficit is projected to widen to an unsustainable 2.3 percent of GDP by 2015 and to continue increasing to staggering levels, surpassing 8 percent in 2050 (Figure 3).[11] To balance the system, the contribution rate would need to jump from the current rate of 26 percent to 53 percent in 2050 (Figure

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[9] These demographic projections have been elaborated by Tomas Kucera, of the department of demography and geodemography of Charles University in Prague, and have been incorporated into the actuarial model.
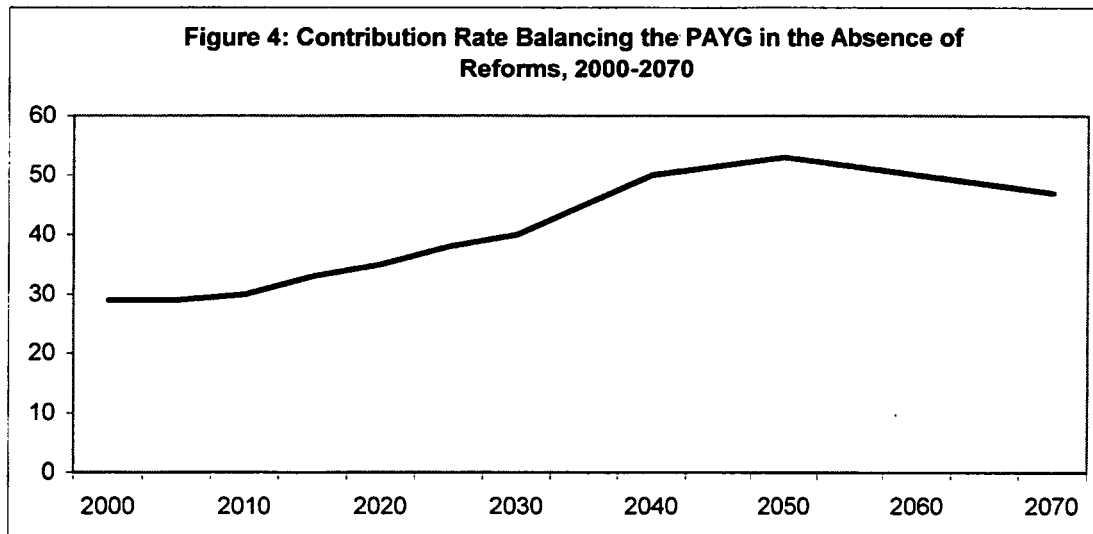
[10] The dependency ratio is projected to improve slightly thereafter, due to a moderate increase in the fertility rate projected for the next decades.

[11] Annex II summarizes the assumptions for key economic and demographic variables used in the projections, while Annex III presents a sensitivity analysis of the PAYG long-term deficit under different demographic assumptions.

4). Workers would have to give up one more quarter of their earnings to finance these burdensome pension costs. The distortions in the labor market implied by these contribution rates and the likelihood of severe tax evasion would tend to increase the PAYG deficit further.

Figure 3: Financial Performance of the PAYG with no Reforms, 2000-2070 (as percent of GDP)

Source: World Bank estimates.

Figure 4: Contribution Rate Balancing the PAYG in the Absence of Reforms, 2000-2070
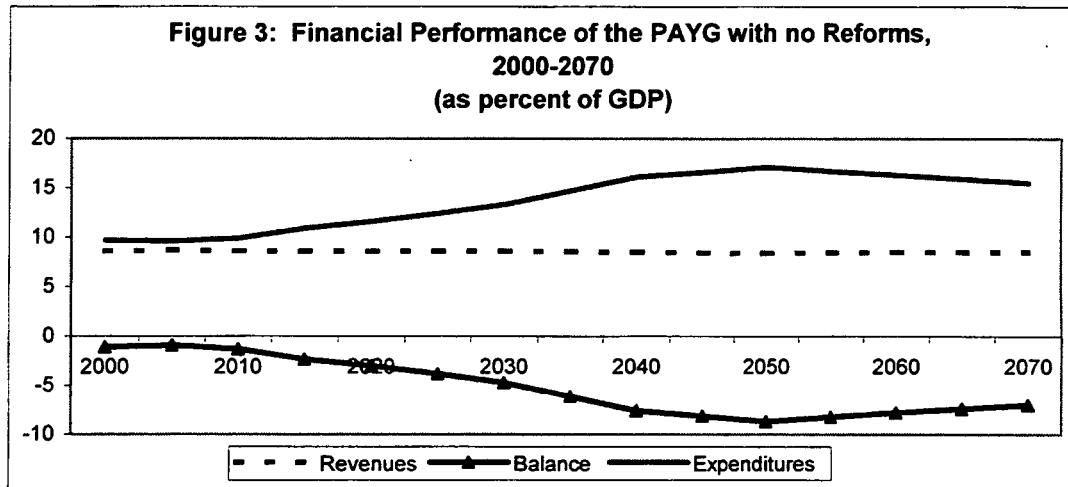
Source: World Bank estimates.

The projections indicate that reform is unavoidable and needs to be addressed soon to avert the fast rising deficits. Given that total pension contributions are already high, amounting to 26 percent, there is clearly no room for further increases that could induce negative labor market effects. Financial viability will have to focus on constraining the explosive rise of expenditures and linking them more closely to resource availability. The elimination of the actuarial imbalances can be achieved by implementing "parametric reforms" to the existing Defined Benefit (DB) system, or by

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moving towards a Notional Defined Contribution (NDC) system. Either of these reforms will invariably involve a decline in replacement ratios, particularly for young workers, and a reassessment of current retirement ages.

Ensuring financial viability should not be the sole objective of the reform. In evaluating various reform options, policy makers will need to consider the adequacy of benefits and security of future retirement income, and foster a system that may be more effective at enhancing the incentive to contribute and preventing evasion, by tightening the link between contributions and benefits. The following sections analyze different reform options, bearing in mind the objectives mentioned above.

3.   ALTERNATIVE REFORMS TO THE PAYG SCHEME

The first set of reform options focuses on improving the existing PAYG scheme by modifying its key parameters while maintaining its DB structure. The scope for balancing the PAYG system through parametric reforms is assessed in this section through the simulation of two specific reform packages. The first, labeled as mild parametric reform, comprises a change to CPI indexation of pensions in 2002; a further and gradual increase of the retirement age to 63 by 2010 for both men and women; and the elimination of service credit for future students. The second, labeled as strong parametric reform, includes all these elements plus a freeze in the flat pension. The section also discusses alternative designs to the DB formula that can strengthen the link between contributions and benefits and possibly address incentive problems.

In the mild reform package, the equalization of the retirement age will not only help contain expenditures but will also treat male and female participants more fairly within the system. Many transition economies have already moved in this direction e.g., Hungary as noted earlier. EU countries are also eliminating this gap in line with EU principles that do not permit gender discrimination.[12] Simulations on the retirement age increase maintain a one-year gap between the effective or average retirement age and the statutory level in accordance with observed retirement patterns. The number of working years is raised along with changes in the statutory retirement age. The policy of non-contributory periods is also generous in terms of social circumstances that merit special credits, the choice of reference wage, and duration. Credits for non-contributory periods should be debated in the context of the reform to reevaluate which of these programs remain a social priority after accounting for their costs. For the purpose of the simulations, we modeled the elimination of student periods since this provision loses its justification in a market economy and could result in unintended and perverse redistribution from low-income, unskilled workers to high-income, skilled workers.[13,14]
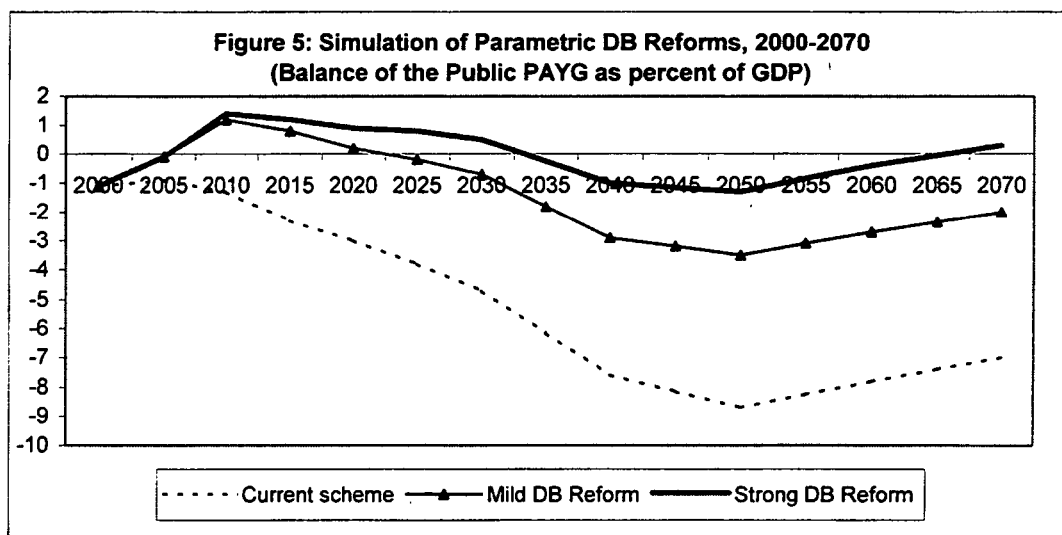
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[12] For example, the United Kingdom will redress the 5-year retirement age gap over a two-decade period, bringing the retirement age to 65 years by 2020.

[13] There is strong evidence that earnings and the level of education are positively correlated in market economies. See e.g., Krueger and Lindahl (2001). The foregone years of contribution due to time invested in higher education will be more than offset by the higher replacement rate obtained through stronger earnings.

[14] Annex 4 presents a summary of individuals that are eligible for non-contributory periods.

The mild reform package would generate substantive improvements in the financial viability of the system, as indicated in Figure 5. The pension system would even experience a period of surpluses from 2006-07 through 2020. However, this reform package would not achieve long-term stability. Deficits would re-emerge in 2020, and would remain sizable in the long-run, as high as 3.5 percent of GDP in the year 2050. The mild DB reform would fail to restore the long-run balance of the PAYG because, *inter alia*, of its failure to arrest the dramatic increase in the system's dependency ratio to any significant extent. As shown in Figure 6, the dependency ratio would still increase to 100 percent by 2050, almost double its present level, despite the further increase in the retirement age to 63 for both men and women.

The option to strengthen the package of parametric reforms would be to increase the retirement age even further, say, to 65 or 67 years of age. Although several European countries have already raised the retirement age to these levels, this is a measure that could face political opposition. If further increases in the retirement age were not possible (above and beyond those contained in the "mild reform"), it would be necessary to decrease the system's average replacement rate. Thus, a second and stronger reform package was modeled comprising the above reforms plus a freeze in the flat pension that reduces the average entry pension from 48 percent in 2000 to 39 percent in 2040. (Previous scenarios assumed that the flat pension—currently equal to 10 percent of the average wage—is indexed to nominal wage growth, thus maintaining its level relative to wages.)

Figure 5: Simulation of Parametric DB Reforms, 2000-2070
(Balance of the Public PAYG as percent of GDP)

Source: World Bank estimates.

As shown in Figure 5, the stronger reform package would be able to attain financial stability through the mid-2030s, but would still be unable to avert deficits after the second demographic shock. The PAYG scheme would improve at the end of the projection period reaching a balanced position, but this result is due to the assumed

increase in the fertility rate, which may or may not materialize. Therefore, although the strong reform package would enhance significantly the long-run financial performance of the PAYG scheme, the system would remain vulnerable to uncertainties in future economic and demographic trends. The sensitivity analysis presented in Annex III shows that under more pessimistic demographic assumptions the reformed DB scheme would still run large deficits in the long run. The sensitivity of PAYG DB balances to shocks that cannot be predicted with any reasonable accuracy raises the question of whether there are alternative PAYG systems that can be more robust to unforeseen shocks.

Figure 6: PAYG System Dependency Ratio, 2000-2070 (pensioners/insured, in percent)
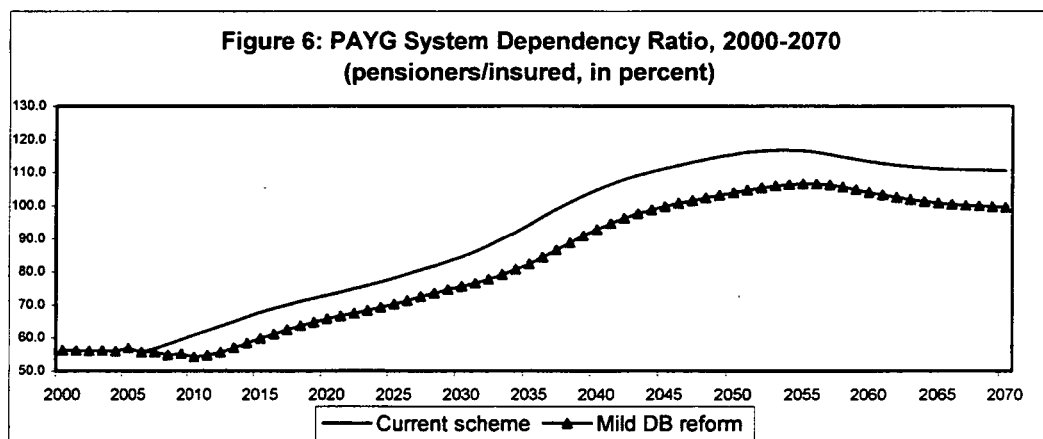
Source: World Bank estimates.

The parametric reforms presented above primarily focused on the scheme's financial stability. Another important issue that needs to be addressed is the link between contributions and benefits. There has been a decompression of the earnings distribution in the labor market since the start of the transition from communism in 1990. Participants in the PAYG scheme with above-average earnings and contributions may exert a growing pressure to enjoy similar differentials on their pension benefits, especially given the high contribution rates paid into the system. A very compressed pension structure may weaken contribution incentives, particularly among the self-employed, who will tend to declare and contribute the minimum assessment base regardless of their underlying earnings. Other transition economies with compressed benefit formulas have shifted to greater benefit differentiation according to historical earnings, e.g. Hungary by modifying the structure of the DB formula and Poland by introducing an NDC scheme.[15] In recent reforms, some EU countries, e.g., Sweden and Italy, have also strengthened the contribution and benefit link to minimize labor distortions and encourage longer working careers along with improvements in life expectancy.[16] Therefore, whereas the degree of redistribution in the pension system is

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[15] Both countries also introduced a second pillar. See Palacios and Rocha (ibid), Rocha and Vittas (ibid) and Chlon, Gora, Rutkowski (1999).

[16] Both countries also introduced NDCs. See e.g., Palmer (2002), Brugiavini (2001), and Franco (2002).

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ultimately a societal choice, the Czech pension system may have to follow developments in the labor market and gradually move to a less redistributive structure.

The "strong" DB reform scenario presented helps to diminish the high degree of redistribution by freezing the flat component of the benefit formula. But the reform does not modify the earnings related component, which remains highly redistributive. There are alternative DB reforms that would achieve similar PAYG balances, but that would tie more closely contributions and benefits.[17] The increase could be done progressively, over a 20 to 30 year period, permitting a gradual shift from the highly redistributive scheme to a decompressed benefit structure.

Most of the countries that have decompressed their benefit formulas have simultaneously introduced a minimum pension guarantee to prevent low-income workers from falling into poverty. There has been a tendency to use general tax revenues to finance this guarantee as well as other social programs that the system might support, e.g., non-contributory periods for child care in early years.[18] From a public policy perspective, this approach fosters greater transparency of costs and makes it easier for society to determine priorities among social programs. Equity considerations also support the financing of these social programs from general revenues rather than social security contributions, since the former are levied on a broader tax base—capital and labor.

Alternative Approaches to PAYG Reforms: The NDC model

In recent years, a number of European countries—Sweden, Poland, Italy, and Latvia—have introduced an NDC structure in their PAYG systems.[19] If properly designed, the NDC structure can attain greater financial stability than DB-PAYG schemes, by incorporating some automatic stabilizers to changing demographic and economic conditions. A properly designed NDC system is also an effective mechanism to tighten the link between contributions and benefits, an additional objective of the reforms mentioned above that sought to minimize labor market distortions and other incentive problems.

The NDC model remains a PAYG financing scheme, but contributions are recorded in individual accounts and a notional interest rate is credited to the notional accumulated balances. The growth rate of the covered wage bill constitutes the best choice for the notional interest rate, since the system's revenues fluctuate along with it.

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[17] Referring to footnote 7, the revised benefit formula could, for example, contain an increase in the weights attached to segments two and three of the wage assessment base combined with a reduction in the accrual rate. The latter would offset the increase in the average reference wage produced by the higher weights attached to segments two and three.

[18] In Sweden, Hungary and Poland, the pension schemes comprise a minimum pension guarantee financed from general tax revenues. The Swedish, Polish and Italian systems also credit non-contributory periods, primarily for child birth and unemployment, but length duration is generally shorter.

[19] See Chlon, Gora, Rutkowski (1999), Palmer (2002), Fox and Palmer (1999) and Brugiavini (2001) for a discussion of the Polish, Swedish, Latvian and Italian NDC reforms. Note that Sweden, Poland and Latvia also introduced a second pillar along with the NDC.

By contrast to fully funded DC schemes, funds recorded in the accounts are notional. The entry pension is calculated by multiplying the notional balance accumulated in the NDC account by an annuity conversion factor, which varies according to the age of the retiree.[20] As life expectancy increases, the estimated entry pension is automatically adjusted downwards, making the system more resilient to longevity risk. Individuals who are targeting a specific replacement rate are induced to work longer.[21] The basic principles of the NDC model are summarized in the formula below:

$$P_r = \frac{\sum_{i=n}^{r}\left(cw_i \prod_{j=i}^{r}(1 + I_j)\right)}{F_r}, \text{ where:}$$

P_r entry pension for individual retiring at age r

c contribution rate

w_i contribution base in year i

I_j indexation of notional capital in year j

n age entering social security system

F_r annuity factor dependent on life expectancy at age r, pension indexation, and the expected notional interest rate credit after retirement.

These automatic adjustments introduce flexibility in the system and greater financial stability to cope with changes in labor and demographic trends.[22] Critics of the NDC system, e.g., Disney (2000) and Valdes-Prieto (2000), claim that the PAYG could still display imbalances over short-term periods due to lags in the impact of automatic stabilizers and argue that a DB model can also attain long-term stability through repeated adjustments to the benefit formula. Whereas these arguments are valid, they also fail to account for the political and credibility costs of implementing continuous legislative amendments to a pension system. Note also that the Swedish NDC scheme also incorporates a special 'balance index' that seeks to correct any sources of short-term imbalances.[23]

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[20] The annuity factor is also dependent on the expected pension indexation and the expected notional interest rate credit after retirement. For example, in the Swedish NDC system, the annuity factor takes into account projections for real economic growth, highly correlated with the growth rate of the contribution base as long as the contribution base is not forever decreasing. Benefits are later indexed to inflation.

[21] Minimizing labor market distortions of the pension schemes and encouraging individuals to work longer along with longevity improvements were important objectives of the Swedish and Italian reforms (Palmer (ibid) and Brugiavini (ibid). See also Blondal and Scarpetta (1998) and Boeri, Brugiavini and Maignan (2001) for a discussion on retirement incentives.

[22] See Palmer and Gora (2001) for a more extensive description of the NDC model.

[23] When the current valuation of assets fails to meet the valuation of liabilities and their ratio (or 'balance index') falls below unity, both pensions and 'nominal account balances' of contributors are deflated by the difference between this ratio and unity. The Swedish National Insurance Board has performed simulations under a wide variety of system shocks to assess the resilience of the 'balance index'. See Settergren (2001) and Palmer (2002) for a further discussion of the index.

The conversion from a DB to an NDC structure in the Czech PAYG was simulated assuming that the NDC pension is gradually phased in over a 40-year period, while the DB pension is gradually phased out. However, disability and survivor pensions remain DB. Two sets of simulations were performed, the first assuming no parametric reforms and the second assuming the introduction of the same parametric reforms discussed above.
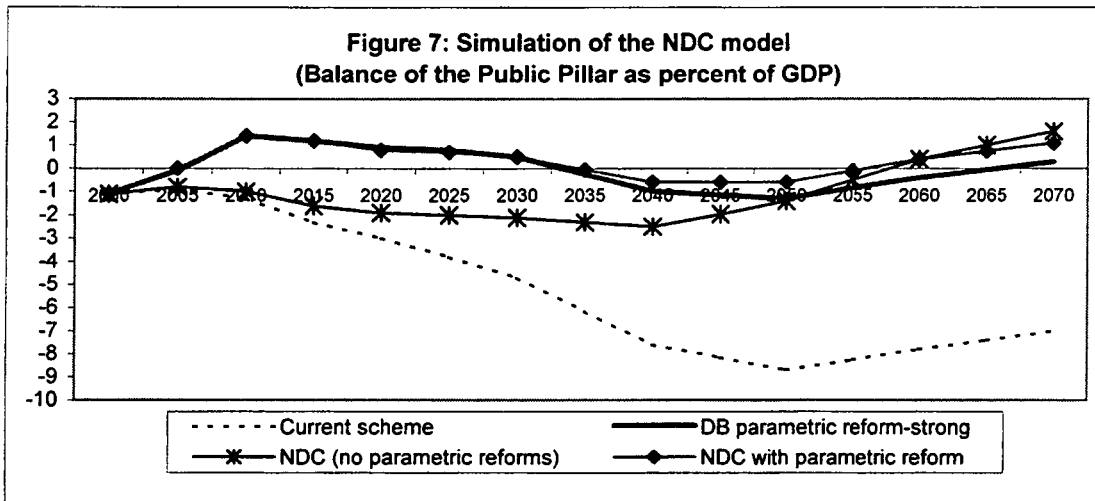
More specifically, the first simulation is based on the following working assumptions:

- Notional accounts are introduced in the year 2003 with a zero opening balance;[24]
- Notional accounts are credited with a notional interest rate equal to the growth of the wage bill (growth of contributors plus average wage growth);
- Upon retirement, the pension is determined as the sum of two components: a pension determined from the notional account and a residual DB pension calculated by applying the existing old-age pension formula to all service years accrued prior to 2003. The flat pension is frozen at 1310 Crowns.
- The notional account pension is determined by dividing each worker's notional account balance by an annuity factor that reflects projected mortality rates, the rate of pension indexation equal to projected inflation, and the notional interest rate equivalent to the projected growth rate of the covered wage bill. Thus, the model implicitly assumes perfect foresight.
- The conversion to NDC is not accompanied by a retirement age increase nor a change in the method of indexation. The sole parametric reform implemented in this scenario is the freezing of the flat pension.

The second simulation assumes that the transition to NDC is accompanied by the same parametric reforms discussed in the previous section, i.e., a switch to inflation indexation, an increase in the retirement age to 63, and the abolishment of credits for student years. In addition, the second simulation includes a minimum pension equal to 25 percent of the average economy-wide wage to protect the life-time poor.

As shown in Figure 7, the implementation of notional accounts would eliminate the actuarial imbalances of the pension system in the long run, even if the retirement age is not increased and the method of pension indexation remains unchanged. The NDC system would be able to adapt itself automatically to the demographic shocks and eventually reduce benefits to the levels required to balance the pension system. However, the simulations also show that, without parametric reforms, the elimination of the imbalances would take more than 50 years, and during this period the pension systems would still run sizable deficits.

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[24] The contribution rate is divided into two components: a 20 percent contribution rate designated as the DC component and recorded in the notional account, and the remaining 6 percent designated as a DB component to cover disability and survivor benefits.

Figure 7: Simulation of the NDC model
(Balance of the Public Pillar as percent of GDP)

- - - - - Current scheme   ───────DB parametric reform-strong
──✳──NDC (no parametric reforms)   ──◆──NDC with parametric reform

Source: World Bank estimates[25]

If an increase in the retirement age to 63, a switch to inflation indexation, and the reduction in non-contributory years accompany the NDC introduction, the pension system would be stabilized both in the short and long runs, as Figure 7 shows. These results indicate that the parametric reforms would ensure a much faster elimination of the financial imbalances of the pension system, and should be regarded as a necessary complement to the NDC reform.

The NDC system would be able adapt itself better to demographic shocks than the DB system, whether these shocks are well predicted or not. This is because the NDC structure has built-in financial stabilizers (the notional interest rate and the annuity factor) that lead to adjustments in the replacement rates as economic and demographic conditions fluctuate.. This is further confirmed in the sensitivity analysis presented in Annex III, which shows a better performance of the NDC compared to the DB, even under highly adverse demographic conditions.

The NDC structure closely links contributions and benefits, as shown in Table 4. The ratios of pensions over personal wage would become more uniform across different income groups, and the ratios of pensions over the average wage in the economy would show a greater dispersion. The excessive mismatch between contributions and benefits for the self-employed and higher income workers would be avoided, possibly reducing the incentives for evasive behavior by these classes of workers. However, the balancing of the PAYG would inevitably entail lower replacement rates across all income classes, reflecting the low implicit rate of return of the balanced PAYG system. Note that the simulations incorporate a minimum pension guarantee equivalent to 25 percent of the average wage to prevent pensioners with lifetime earnings from receiving pensions below the poverty line. For this reason, the replacement rate as percent of the personal wage is

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[25] The NDC simulations generate a small surplus in the long term because approximately 10 percent of contributors die before reaching retirement age, and consequently do not receive an NDC pension. Thus, the average notional interest rate paid to all contributors is below the sustainable rate of GDP growth.

the same for the average and high income worker (32 percent) but the rate for the low income worker is higher (50 percent).

Table 4: Replacement Rates Across Wage Levels Under the NDC Reform (in%)

Personal Wage/Average Wage	Pension/Personal Wage		Pension/Average Wage	
	Current	2050	Current	2050
50	77	50	39	25
100	48	32	48	32
150	34	32	51	48

Note: Values in 2050 reflect the NDC system supported by a minimum pension guarantee equal to 25 percent of average wage. For an analysis of replacement rate sensitivity to changes in economic and demographic assumptions, please see Annex V.
Source: World Bank estimates

The NDC and DB simulations have illustrated various options for attaining financial viability, minimizing distortions within the scheme, and treating individuals fairly on the basis of their past contribution histories. A DB formula can replicate in principle many of the characteristics of the NDC, but this would require more frequent changes in the benefit formula. In this regard, the NDC capacity to accommodate unforeseen shocks becomes an attractive feature. The DB system is politically more dependent and the restoration of financial viability in the event of unpredicted shocks can become a slower and more arduous process.

If reforms are not delayed, a gradual transition period is viable and the transformation from a compressed to an earnings related formula can be smooth. These simulations also highlight the unavoidable fall in the replacement rate—32 percent of the personal wage for a worker earning the average wage—and the vital need to create the proper environment for supplementary pension plans to grow, particularly for younger workers who will suffer the brunt of this adjustment. A related question to analyze is whether supplementary pensions will be sufficient by themselves to compensate workers for the decline in the PAYG replacement rate or additional measures (e.g., mandating a funded pillar) might be advisable. The next two sections address these issues.

4.   STRENGTHENING THE THIRD PILLAR

The Structure and Performance of the Third Pillar

The Czech Republic introduced private pension funds in 1994, becoming one of the first Central European countries to introduce supplementary private pension provision. Participation has been encouraged through the payment of a State contribution that adds between 30 to 50 percent of the amount contributed by participants, favoring low-income workers. The number of affiliates is roughly 2.3 million workers. The pension funds are joint stock companies organized as profit participation funds. Under this legal construction, pension funds have shareholders and plan participants holding a common asset pool and sharing profits from investment income. Participation in the

system is based on individual contracts and switching across funds is allowed. There has been an impressive consolidation of the pension industry in recent years, as indicated by the reduction in the number of licensed funds from 44 in 1995 to 20 in 2000. Despite some positive features, the Czech third pillar remains deficient in many aspects—especially low participation of younger workers, disappointing rates of return and slow asset growth, and deficient regulation--and there are doubts about its capacity to become a significant and reliable source of supplementary retirement income.

Although the total number of affiliates (2.5 million) is roughly equivalent to 50 percent of the labor force, nearly 20 percent of affiliates are above 60 years of age and retired, an outcome that reflects the weak links between plan rules and normal retirement rules. The average age of participants is nearly 49 years, well above the average age of mandatory schemes in Hungary, Poland, and several Latin American countries, which is around 35 years of age. As shown in Figure 8, less than 20 percent of workers under 35 years of age participate in the third pillar, a source of concern, as these are precisely the generations that will be more affected by the inevitable reforms to the PAYG scheme, and that will be more dependent on supplementary sources of retirement income.

Figure 8: Third Pillar Coverage by Age Group
(Number of participants divided by population in each age group)
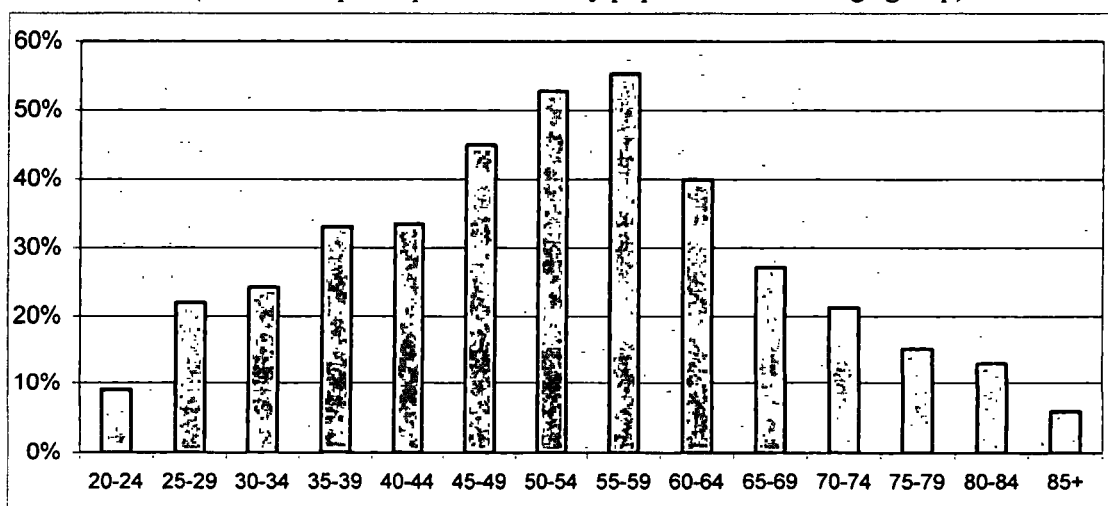
Source: Czech Ministry of Finance, Office of Pension Fund Supervision, and CCSO

In addition to the narrow coverage of younger workers, average contributions to the system have remained small—below 3 percent of average wages (Table 5). Largely because of the low level of contributions, total assets have grown at only 0.3 percent of GDP p.a. in the recent years and amounted to only 2.3 percent of GDP at end-2000, after seven years of operation.

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Table 5: Number of Participants, Average Contributions, and Total Assets
in the Third Pillar, 1994-2000

	1994	1995	1996	1997	1998	1999	2000
Number of participants (in thousands)	183.3	1290.1	1564.2	1637.6	1740.1	2006.3	2298.3
Average contribution/average wage (%)	1.71	2.51	2.94	2.94	2.81	2.38	2.45
Total Assets/GDP (%)	0.10	0.51	1.52	1.39	1.73	2.04	2.32

Source: Czech Ministry of Finance, Office of Pension Fund Supervision

The low average real returns and the relatively high operating costs have also contributed to the slow pace of asset accumulation. As shown in Table 6, the average yearly real return has amounted to only 0.8-1.4 percent p.a., depending on whether nominal returns are deflated by the average or the end-year variations in the CPI. The average real return has been well below the growth rate of real wages, whereas the average real return of pension funds in the OECD has been 3-4 percent above average real wage growth in the last three decades (Rocha, Gutierrez and Hinz (2001), OECD (1998), and EFRP (1996)).

The low returns of pension funds in the Czech Republic can be explained by their very conservative investment policies, which have favored large holdings of low yielding bonds and term deposits. These conservative policies are partly justified by the problems in the Czech capital market during the 1990s, caused by an excessive number of listed companies and a flawed regulatory framework.[26] However, the predominance of low yielding and liquid instruments in the portfolios of pension funds is also due to the short time horizon with which asset managers operate—the large participation of older workers who can withdraw their balances with short periods of accumulation and the few restrictions for switching across funds lead asset managers to adopt defensive strategies favoring disproportionately short-term and liquid assets. These investment policies operate to the detriment of younger workers, who have a longer period of asset accumulation and would greatly benefit from larger equity holdings.

Operating costs have been high around 14-18 percent of contributions, depending on whether State contributions are included or not in the denominator, and have also held back the asset growth rate. These cost ratios are lower than equivalent ratios in Latin American countries, but they are higher than cost ratios of occupational pension funds in the OECD, that have hovered around 10 percent of contributions.[27]

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[26] The World Bank (1999) and Jelinek and Schneider (1998) provide a detailed review of the Czech capital market and the pension fund industry during the 1990s.

[27] See Rocha, Hinz, and Gutierrez (2001). The Czech cost ratios probably underestimate actual costs, as many pension funds utilize the sales force of insurance companies in the same financial group. Excluding promotion and acquisition costs, operating costs have been around 9 percent of contributions, in line with the costs of occupational funds in the OECD.

Table 6: Average Yearly Nominal and Real Returns and Real Wage Growth in 1995-2000
(in percent p.a.)

Nominal Return	Real Return (Average CPI)	Real Return (December CPI)	Real Wage Growth
8.0	0.8	1.4	4.3

Finally, despite the regulatory and supervisory improvements introduced in recent years, the regulatory framework still contains many weaknesses. Most worrisome, the legal structure establishes a profit participation structure where assets of shareholders and participants are not segregated and the distribution of profits between shareholders and members is not transparent, with excessive room for the possible siphoning of resources from participants, particularly participants switching across funds.

Strengthening the Third Pillar: Basic Elements of the Reform Agenda

Enhancing the role of the third pillar and improving its performance may require a number of measures, including: (i) linking the rules of the private pension system to retirement; (ii) separating the assets of shareholders and participants, by eliminating the profit participation model and adopting the mutual fund model; and (iii) strengthening further the regulatory framework for the existing pension funds. Of these measures, the conversion of the profit participation funds into mutual funds may face some legal obstacles. However, there should be a strong effort to overcome these, as the conversion would greatly enhance the security and transparency of the system, to the benefit of all participants. [28]

One important question that is being addressed by the Czech authorities is whether these reforms would be able to establish a robust private pension system with a wide coverage of the labor force, including younger workers, or whether further measures are called for, such as the introduction of occupational funds that would operate side by side with the existing funds. The Government presented to Parliament a draft Law on Defined Contribution (DC) occupational funds but the draft was not approved by Parliament. Representatives of trade unions and employers have been generally supportive of the proposal, but many industry participants have questioned the need to introduce another type of pension fund.

The introduction of DC occupational funds merits further consideration as it could contribute positively to the growth and performance of the private pillar. [29] Based on other international experiences, such a construction could broaden the coverage of the labor force (especially among younger workers), as there is evidence that employer-based

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[28] Total assets would be allocated to shareholders and participants proportionately, shareholders would constitute a separate asset management company, and the assets of participants would be placed on a mutual fund constituted as a unit trust. The conversion would enable the more frequent valuation of participants' accounts on a mark to market basis, and a transparent distribution of income and capital gains among all participants.

[29] The DC construction would not impair labor market mobility. Workers would be able to easily transfer their balances when they switch employers, as in the U.S. case.

funds tend to induce higher worker participation than individual schemes.[30] Employer-based schemes could also facilitate an overall increase in the average contribution rates, as these plans usually involve matching contributions by the employer. Lastly, these plans could contribute to an improvement in the industry's long-run performance, by providing an alternative form of pension provision at a lower cost, enhancing competition, and lengthening the time horizon of asset managers. Moreover, the increase in coverage and in contribution rates could create the conditions for the future introduction of a mandatory pillar, which do not seem to exist at the present time in the Czech Republic.[31] It goes without saying that these favorable outcomes would depend on the quality of the regulatory framework under which these funds operate.[32]

5.   WILL THIRD PILLAR REFORMS ENSURE ADEQUATE REPLACEMENT RATES?

Possible Limitations of a Strategy Restricted to Third Pillar Arrangements

Although the expansion of third pillar coverage would be a desirable outcome, it is important to have in mind the potential limitations of a pension reform strategy restricted to first pillar reforms and efforts to expand voluntary arrangements. The central question that Czech policy-makers must address is the extent to which coverage could be increased by voluntary arrangements. As shown in Table 7, there are several developed countries with a long tradition of private pension provision that have not been able to increase coverage to levels above half of the labor force, despite the existence of a variety of private arrangements, proper regulatory frameworks, and tax incentives. A few exceptions are Denmark, Netherlands and Sweden, which have been able to ensure almost universal coverage through collective agreements between unions and employers. This outcome has been due to historical circumstances and institutional arrangements specific to these three countries, however, and the possibility for the same outcome to be replicated in the Czech Republic seems rather low. Therefore, there is a risk that third pillar coverage would remain unsatisfactory, especially among younger workers.

Table 7: Coverage Rates in Countries with Developed Third Pillars
(participation in private pension schemes as a percent of the labor force)

			Participation Increased Through Collective Agreements		
Canada	Ireland	US	Denmark	Netherlands	Sweden
33	40	45	75	91	80

Source: OECD, US Department of Labor, Irish Pensions Board, Poskute (2001) and Palmer (2001)
Note: For the US case, the figure illustrates coverage of full- and part-time workers in the private sector.

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[30] See Springstead and Wilson (2000) for an analysis of coverage of occupational pension schemes among young and low income workers in the US.

[31] Some OECD countries have introduced second pillars (mandated by a law) or quasi-second pillars (mandated by collective agreements) based on occupational funds that were originally strictly voluntary for the employers.

[32] Besides regulations applying to personal private pension plans, regulations of occupational pension schemes would have to pay special attention to governance—a critical issue to foster the sound performance of this type of plan.

The related question is the extent to which the third pillar would provide a reasonable remedy to the overall decline in the first pillar replacement ratio. As shown above and in Table 8, uncovered workers would experience a sharp decline in replacement ratios, on average from the current level of 48 percent to 32 percent. Workers covered by the third pillar and contributing 5 percent to their individual accounts would be able to stabilize their replacement ratios, assuming that future third pillar returns are increased to the historical levels in OECD countries (around 2 percent above wage growth). However, this stability of replacement ratios would only be achieved at the cost of high contribution rates—31 percent, including the first and third pillars.

Table 8: Average Replacement Ratios Under Alternative Multi-Pillar Constructions

	Contribution Rates				Replacement Rates	
	NDC	2nd Pillar	3rd Pillar	Total	2000	2050
NDC only	26	0	0	26	48	32
NDC + 3rd pillar	26	0	5	31	48	50
NDC + 2nd pillar	21	5	0	26	48	42
NDC + 2nd and 3rd pillars	21	5	5	31	48	60

Source: World Bank estimates
Notes: Notional interest rate in the NDC equals wage bill growth. Interest rate on second and third pillars assumed to be equal to 3 percent wage growth plus 2 percent. For an analysis of replacement rate sensitivity to changes in economic and demographic assumptions, please refer to Annex V.

An alternative policy option that merits serious consideration would involve a diversion of contributions from the reformed PAYG scheme to the mandated fully-funded pillar for all workers. As Table 8 illustrates, the transfer of a 5 percent contribution rate from the PAYG to the second pillar could almost stabilize the overall replacement rate for all workers due to the higher expected rate of return of the funded pillar compared to the implicit rate of return of a balanced PAYG. Workers participating in a supplementary system, e.g., contributing an additional 5 percent to the third pillar, could then attain even higher replacement rates of 60 percent.

To secure an adequate retirement income for younger generations, many countries have adopted multi-pillar reforms with greater reliance on funded pillars. Neighboring countries such as Hungary and Poland have already adopted a multi-pillar system introducing a mandatory funded pillar along with the voluntary pillar at an early development stage. Sweden has also established a mandatory funded pillar, financed with a contribution rate of 2.5 percent that complements mandatory occupational pension plans with an average contribution rate of 3.5 percent.[33] The United Kingdom also permits individuals to opt out of the earnings-related component of the PAYG scheme by either joining an occupational plan or a private pension plan; the optional diversion of a

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[33] Therefore, the total contribution to funded pillars in Sweden is 6 percent. Contribution rates to the PAYG are 16 percent.

share of mandatory PAYG contributions to the funded pillar is an alternative that merits study within the set of reforms available for the Czech pension system.

The recent German and Italian reforms of the PAYG pillar that will also entail a decline in replacement rates, particularly for younger workers, were combined with a reform of their supplementary pillars to halt this decline. Brugiavini (2001) and Wagner (2001) in their respective assessments of the Italian and German reforms pose the risk that younger workers might not be adequately covered by the supplementary pension funds. Thus, third pillar pensions might not be sufficient to offset the decline in the PAYG replacement ratio—a risk might also materialize in the Czech Republic if the reform only relies on the expansion of the third pillar.

Simulations of a Two-Pillar Mandatory system: NDC Paired with a Funded Pillar

For illustrative purposes, this section presents some simulations of a two-pillar reform of the mandatory system, assuming that the reform would involve a combination of the NDC system with a funded pillar. More specifically, the simulations assume that there would be a gradual transition from DB to NDC, beginning in 2003, as described in section 3, and that the second pillar would be introduced in 2005 by diverting a 5 percent contribution rate from the PAYG to the funded pillar. The simulations also assume that only workers under 40 years of age would be shifted to the mixed system (i.e., workers born after 1965).

As shown in Figure 9, the early implementation of the NDC with parametric reforms would create sufficient savings early on to permit the introduction of a second pillar. During the transition period, deficits in the PAYG system would emerge from 2020 through 2050 but would be manageable, hovering around 0.5 percent during most of this period. Moreover, these transitional deficits would not have adverse macroeconomic consequences, as they would be outweighed by the increase in private savings (i.e., the contributions to the second pillar). Indeed, the total private and public savings effect of the NDC and second-pillar reform would be positive in the first decades, and roughly equivalent to the positive balances of the mono-pillar NDC reform shown in Figure 7 and reproduced in Figure 9.[34]

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[34] Total pension savings resulting from a multi-pillar reform are roughly equal to the balance of the PAYG after the parametric/NDC reforms but before the introduction of the second pillar. This is because the loss of revenues to the second pillar (an increase in public deficit) and the contributions to the second pillar (an increase in private savings) tend to offset each other. See Rocha and Vittas (2002) for a more detailed analysis of the Hungarian pension reform. Kotlikoff (1998) presents an analysis of transition of different financing strategies.

Figure 9: Transition to Second Pillar Reform, 2000-2070
(Balance of the Public Pillar as percent of GDP)

Legend: - - - - - Current scheme   ▲ NDC with parametric reform   ▬▬ NDC and Second Pillar Reform
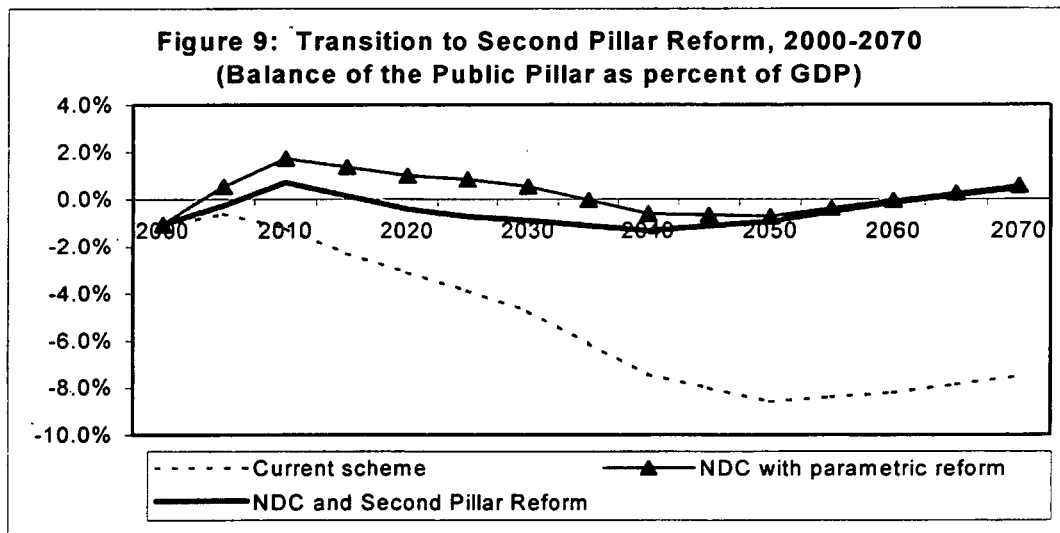
Source: World Bank estimates

6.   SUMMARY AND CONCLUSIONS

The paper reviews the challenges facing the Czech pension system and examines alternative reform scenarios. The paper shows that the current financial deficits of the DB PAYG will rise at a fast pace as the aging demographics puts ever growing pressure on the system. Continuing the small reform steps of the 1990s will be insufficient to redress the severity of the financial imbalances; continuous but incomplete policy reforms will also erode the confidence of younger workers on the system as the scheme's rules are repeatedly amended. The pension system calls for profound reforms.

The paper examines two main alternative reforms to the PAYG scheme that would bring stability to the pension system in the long-run. The first would involve a set of strong parametric reforms to the DB scheme, including an increase in the retirement age to 63 years, adoption of price indexation, freezing of the flat benefit, and elimination of non-contributory years for students. This DB parametric reform could also include changes in the benefit formula so as to further reduce the degree of redistribution. Independently of whether the DB system becomes less redistributive or not, the reform would entail a reduction in the replacement rate for all workers. Maintaining the replacement rate would require further increases in the retirement age that might be difficult to introduce.

Alternatively, the DB system could be gradually transformed into an NDC system. A reform restricted to the introduction of an NDC scheme would take a long time to eliminate the PAYG imbalances, however. Therefore, it would be necessary to combine the NDC with some parametric reforms such as an increase in the retirement age to ensure both the short- and long-run stability of the pension system. One advantage of the NDC reform over the parametric DB reform lies in the greater resilience of the NDC scheme to demographic fluctuations. The NDC scheme would also automatically ensure

a tighter link between benefits and contributions, which may be an objective of the reform. Attaining the same results in the DB scheme would require more changes in the benefit formula which may be more difficult to implement. However, the NDC cum parametric reform would also entail a reduction in replacement rates, particularly for younger workers. This is the side-effect of any reform restricted to changes in the PAYG scheme, regardless of whether the PAYG remains DB or is converted into an NDC.

In order to avoid an excessive decline in future replacement ratios, Czech policy-makers should step up ongoing efforts to improve the structure and performance of the third pillar, to increase coverage of younger workers (who will suffer the largest cuts in the replacement rate), and to expand average contribution rates. The introduction of DC occupational funds could contribute to the achievement of these objectives. However, the increase in coverage and in the average contribution may still prove insufficient to ensure an adequate replacement ratio for young and unborn generations. For this reason, Czech policy-makers should maintain open the alternative to introduce a mandatory funded pillar. As a starting option, the reform could allow workers who have a preference for a more diversified pension portfolio to reallocate a fraction of mandatory contributions from the PAYG to the funded pillar.

The paper presents simulations of a multi-pillar reform involving an NDC with parametric reforms and the diversion of a 5 percent contribution to a new second pillar. Under baseline assumptions, the NDC cum parametric reforms would produce a long-term replacement rate equivalent to 32 percent for the average-income worker, while the two-pillar system could secure a replacement rate closer to 42 percent. An early start of the PAYG reforms will be necessary to create a cushion for the introduction of the second pillar.

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A Description Of C-PRISM,
The Czech Pension Reform Simulation Model

1.   Introduction

The Czech Pension Reform Simulation Model (C-PRISM) is a long-range forecasting tool that can simulate the impact of economic, demographic and policy changes upon the operation of the Czech Republic's mandatory pension scheme. The model was developed through the joint-efforts of the World Bank and the Ministry of Labor and Social Policy, and reflects all of the key features of the Czech pension system. The following pages provide a brief description of the model's structure, capabilities and internal algorithms.

2.   The Model's Basic Structure

C-PRISM is written in Excel / Visual Basic, and consists of three files: an input file, an output file, and an "engine" file. The engine file contains a visual basic computer program which, when activated, reads the input file, performs the calculations required to forecast the operation of the pension system, and then writes the results of the forecast to the output file.

The input file is divided into three sections: data, assumptions and policies. The data section contains statistics that describe the current demographic and economic conditions of the Czech Republic, as well as the financial condition of the pension system in a particular "base year" (e.g. 2000). The assumption section contains economic and demographic assumptions which the user can adjust, and which are used to project the future development of GDP, wages, employment and the size and age-sex structure of the population. The policy section contains parameters that describe the rules governing the pension system, such as contribution rates, retirement ages, benefit formulae and pension indexation rules.

The output file is divided into three sections: summary, finance and pension. The summary section contains key economic, demographic and pension system statistics for each year of the forecast. The finance section comprises a detailed forecast of the pay-as-you-go system's revenue, expenditures and implicit pension debt. If the particular policy scenario involves a capitalized pillar, then the finance section will also display a forecast of the contributions, assets and distributions of the capitalized pillar. The pension section displays the projected entry[35] and stock[36] pensions for each year of the forecast. In addition to presenting pension averages computed across all pensioners, the pension

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[35] An "entry" pension is defined as the pension awarded at time of retirement.
[36] A "stock" pension is defined as the average pension computed across both new entrants and those who were first awarded their pensions in prior years.

section also displays pension averages for different sub-categories of pensioners defined by type of pension (old age, disability, or survivor), sex, income class, and financing system (PAYG defined benefit, PAYG defined contribution, or capitalized defined contribution).

3.   The Model's Capabilities

C-PRISM can forecast the impact of demographic and economic changes upon the operation of the existing PAYG defined benefit system, and can also simulate a wide-range of policy reform options. The model has an unlimited time horizon, but is typically used to generate 80-year forecasts. Up to 100 sets of policies and assumptions can be neatly stored in the model's "library", and retrieved quickly when needed for a particular simulation. Similarly, up to 100 sets of output results can also be stored in the library. Thus, multiple simulations and sensitivity analyses can be performed rapidly and conveniently.

The model can simulate the impact of the following types of reforms:

1. Retirement age increases.
2. Changes in contribution rates.
3. Changes in pension indexation.
4. Changes to PAYG defined benefit formulae.
5. Changes in the valuation of non-contributory years[37].
6. The introduction of a notional defined contribution pillar.
7. The introduction of a capitalized defined contribution pillar.
8. The replacement of the Czech system's "flat" pension with a targeted minimum pension.[38]
9. Any combination of the reforms listed above.

C-PRISM can simulate complex reform combinations such a transition to a two-pillar system in which older workers remain in the existing defined benefit system, middle-aged workers are placed in a new notional defined contribution system, and younger workers are moved a two-pillar system with a notional defined contribution component and a capitalized defined contribution component. In addition, the model can simulate fast-paced transitions in which the entire work-force is immediately placed in a new system, slow-paced transitions in which only younger workers enter the new system, or medium-paced transitions in which a portion of the work-force initially enters the new system. Finally, the model can simulate any level of "accrued rights" valuation for workers entering a new system, ranging from the complete elimination of accrued rights to full credit for accrued rights.

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[37] The Czech pension system provides students, unemployed persons and women on maternity leave with service credit for periods in which they are not working. C-PRISM can simulate changes in this policy.
[38] The Czech pension system has a universal flat pension which is paid to all pensioners. In contrast, a "targeted" minimum pension would be paid solely to those pensioners whose pensions would otherwise fall beneath a particular threshold.

4. The Model's Internal Algorithms

C-PRISM forecasts the operation of the pension system as a function of user-inputted parameters that describe expected economic and demographic changes. The model does not predict future economic growth, future mortality rates or future fertility rates. Rather, these values are exogenous inputs specified by the user. Therefore, the model could most accurately be described as an "actuarial" model rather than an "economic" model.

The model's engine is subdivided into five primary components: a data input module, a demographic module, an economic module, a pension system module, and an output module. The data module is executed first and reads data describing the initial demographic, economic and pension system conditions for a particular base year. After this data is read, the model enters a "loop" which cycles forward in time from the base year to the final year of the projection. The demographic module, economic module and pension module are positioned inside of this loop, and are executed once for each year of the projection. Thus, the basic "skeleton" of the model is as follows:

(1) **Read Data** Describing The Initial Conditions

For Each Year From Base Year To Final Year Of Projection:

(2) **Demographic Module:** Project population forward one year

(3) **Economic Module:** Project GDP, wages and employment forward one year

(4) **Pension Module:** Calculate revenues and expenditures for the particular projection year

(5) **Output Module:** Write results to output file.

Return To Step 2

The **demographic module** is executed once each year of the forecast, and uses user-inputted fertility rates, mortality rates and migration rates to project the size and age-sex structure of the population forward one year. Thus, each time the demographic module is executed, the population is projected forward in time from year "x" to year "x+1".

Similarly, the **economic module** is executed once each year of the forecast, and calculates GDP, the average economy-wide wage, and the number of employed persons by age and sex. To calculate the number of employed, the population at each age and sex is multiplied by an age-sex specific labor force participation rate, and this product is then multiplied by one minus the age-sex specific unemployment rate. Labor force rates and unemployment rates are entered exogenously by the user. At the user's discretion, an option may be activated which partially endogenizes labor force rates to automatically estimate the impact of retirement age increases. In addition, the calculation of either wage growth or GDP growth (but not both simultaneously) can also be endogenized. In this case, the model uses a simple algorithm to ensure the harmonization of GDP growth, wage growth and employment growth.

The **pension module** is executed after the execution of the economic module, and performs a complex chain of calculations necessary to calculate the revenues, expenditures, and pensions of the PAYGO system, as well as the contributions, assets, distributions and pensions of the capitalized pillar (if the particular policy scenario involves capitalization).

The pension module's calculations are too numerous and too complex to list here, but one aspect of the module's calculations should be elaborated because of its particular importance. Rather than calculating pensions simply for retiring workers at the average income level, C-PRISM uses a wage distribution to calculate pensions for retiring workers at a variety of different wage levels. This is of critical importance when modeling the Czech pension system, since the existing benefit formula is extraordinarily redistributive, yielding very high replacement rates for persons at low wage levels (relative to the average wage) and low replacement rates for persons at relatively high wage levels. Reform options involving the introduction of a notional or capitalized defined contribution system would have a profound impact on the distribution of pension income. In such a reform, the introduction of a minimum pension to provide support for the lifetime poor might be necessary. To model the effects of transforming the system from highly re-distributive to non-redistributive (or less re-distributive), a distribution of wage levels is therefore essential.

ECONOMIC AND DEMOGRAPHIC ASSUMPTIONS

	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060	2070
Real Wage Growth											
Pess	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Base	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Opt	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Employment Growth											
Pess	0.0%	-0.1%	-0.4%	-0.7%	-0.8%	-1.1%	-1.2%	-1.7%	-1.6%	-1.3%	-1.4%
Base	0.0%	0.1%	-0.2%	-0.5%	-0.6%	-0.7%	-0.8%	-1.1%	-0.9%	-0.6%	-0.8%
Opt	0.0%	0.1%	-0.2%	-0.5%	-0.5%	-0.6%	-0.6%	-0.8%	-0.4%	-0.1%	-0.3%

For all scenarios: Real GDP growth = real wage growth + employment growth
For all scenarios: Unemployment rate = 8.8% constant

Total Fertility Rate											
Pess	1.17	1.25	1.30	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Base	1.17	1.32	1.45	1.52	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Opt	1.17	1.40	1.60	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Average Lifetime Men											
Pess	71.1	72.4	74.0	75.0	77.0	78.0	79.0	80.0	81.0	81.0	81.0
Base	71.1	72.4	73.7	74.8	76.0	77.0	78.0	79.0	80.0	80.0	80.0
Opt	71.1	72.4	73.0	74.0	75.0	76.0	77.0	78.0	79.0	79.0	79.0
Average Lifetime Women											
Pess	78.1	79.3	81.0	82.0	83.0	84.0	85.0	85.5	86.0	86.0	86.0
Base	78.1	79.3	80.6	81.6	82.7	83.5	84.4	85.0	85.0	85.0	85.0
Opt	78.1	79.3	80.0	81.0	82.0	83.0	84.0	84.0	84.0	84.0	84.0
Net Migration Into Czech Republic As A Percent Of Total Population											
Pess	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Base	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Opt	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

The base case demographic assumptions closely approximate the base case assumptions developed by the Department of Demography and Geodemography. The pessimistic assumptions were constructed by decreasing fertility rates and increasing life expectancies relative to the base case scenario. Conversely, the optimistic assumptions were constructed by increasing fertility rates and decreasing life expectancies relative to the base case scenario. Thus, the scenarios are pessimistic or optimistic from the perspective of PAYGO financing, because a PAYGO system is more financially sound if fertility rates are high and life expectancies are low.

SUMMARY OF POLICY REFORM OPTIONS:
ANALYSIS OF SENSITIVITY TO DIFFERENT DEMOGRAPHIC SCENARIOS

Figure A.2-a: Financial Performance of the Public Pillar without Reforms, 2000-2070 (as percent of GDP)

Figure A.2-b: Financial Performance of the Public Pillar with Strong-DB Parametric Reforms and No Redistribution, 2000-2070 (as percent of GDP)

Figure A-2-c: Financial Performance of the Public Pillar
with Transition to NDC and Parametric Reforms, 2000-2070
(as percent of GDP)

Figure A.2-d: Financial Performance of the Public Pillar with
Transition to NDC and Second Pillar Reforms, 2000-2070
(as percent of GDP)

Non-contributory Periods and Number of Eligible Individuals

Category of Non-Contributory Periods	Estimated Number of Persons per Year
Registered unemployed	400,000
Sickness benefit recipients	320,000
Child caring period ·	310,000
Full disability till normal retirement age	240,000
Students in higher education	140,000
Basic and substitute military service	40,000
Taking care of disabled family members	15,000

Source: MLSA.

**Sensitivity Analysis:
NDC And DC Entry Replacement Rates Under Different
Economic and Demographic Scenarios**

1. **NDC Entry Replacement Rates Across Wage Levels Under Different
    Economic and Demographic Scenarios (2050)**

<u>NDC Contribution Rate = 26%</u>

Personal Wage/ Average Wage	Pension/Personal Wage		
	Pessimistic Assumptions	Base Case Assumptions	Optimistic Assumptions
50%	50%*	50%*	50%*
100%	25%*	32%	43%
150%	23%	32%	43%

*The replacement rates reflect the minimum pension guarantee equivalent to 25% of the average wage.

The table shows that more (less) favorable economic and demographic conditions lead to higher (lower) replacement rates within an NDC system. The set of demographic and economic assumptions applied in each scenario are presented in Annex II. Under all three scenarios, the NDC pension for workers earning 50 percent of the average wage falls below 25 percent of the average wage in the economy and thus must be supported by the minimum pension guarantee. Note that the 26 percent contribution rate is divided into two components: a 20 percent contribution rate designated as the DC component and recorded in the notional account, and the remaining 6 percent designated as a DB component to cover disability and survivor benefits.

2. **Average Entry Replacement Rates Under Alternative Multi-Pillar
    Constructions (2050).**

	Contribution Rates				Pension / Personal Wage		
	NDC	2nd Pillar	3rd Pillar	Total	Pes Scenario	Base Scenario	Opt Scenario
NDC only	26	0	0	26	25	32	43
NDC + 3rd pillar	26	0	5	31	34	50	72
NDC + 2nd pillar	21	5	0	26	26	42	61
NDC + 2nd + 3rd pillars	21	5	5	31	35	60	90

This table shows that more (less) favorable economic and demographic conditions lead to higher (lower) replacement rates within a NDC-DC multi-pillar system. A critical assumption for second and third pillar calculations is the relationship between the interest rate and wage growth. The pessimistic scenario assumes that the real interest rate equals real wage growth, while the base case and optimistic scenarios assume that the real interest rate exceeds real wage growth by 2% and 3%, respectively. Real wage growth under the pessimistic, base case and optimistic scenarios is 2%, 3%, and 4% respectively, and the real interest rate is 2%, 5%, and 7% respectively.

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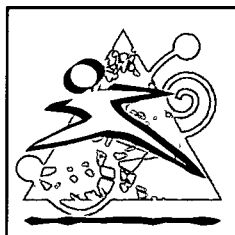
Summary Findings

The purpose of the paper is to review the structure and performance of the Czech pension system and examine alternative reform options. The paper shows that in the absence of reform the deficits of the Czech pension system may exceed 8 percent of GDP in 2050. To contain these deficits the paper explore two major PAYG reform options. The first major option is a standard parametric reform that preserves the defined benefit (DB) scheme. The second major option involves parametric reforms combined with a switch to a notional defined contribution (NDC) scheme. The paper shows that the NDC cum parametric reforms would automatically tighten the link between contributions and benefits and be more resilient to unpredicted demographic shocks However, both the DB and the NDC options would produce a significant reduction in replacement rates, especially for young generations. To avoid an excessive drop in replacement ratios the authorities should make an effort to increase coverage of the third pillar and improve the regulatory framework for third pillar funds. The authorities may also have to consider introducing a second pillar to ensure universal coverage, especially of young workers. Introducing a second pillar will be easier if the PAYG reforms start immediately. This is because an early implementation of the PAYG reforms would produce a significant improvement of the PAYG and offset at least partly the revenue losses arising from the diversion of contributions to the second pillar.

HUMAN DEVELOPMENT NETWORK