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THE SUSTAINABILITY
OF THE PRIVATE SECTOR PENSION SYSTEM
FROM A LONG-TERM PERSPECTIVE:
THE CASE OF LUXEMBOURG

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bcc

BANQUE CENTRALE DU LUXEMBOURG

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Introduction

La présente analyse a pour objet de fournir une première évaluation de la situation budgétaire du régime général de pensions au Luxembourg, sur un horizon de long terme. Une telle analyse est certes confrontée à de multiples difficultés, tant il est difficile de prévoir l'évolution des déterminants de l'équilibre financier du régime à plusieurs décennies de distance. Cependant, l'économie luxembourgeoise présente diverses caractéristiques, dont les effets se déploient sur un horizon de long terme. Dans un tel contexte, il importe de développer des outils permettant de baliser les évolutions futures, à défaut de les prévoir.

La BCL a élaboré un tel outil, dont l'articulation logique est brièvement décrite ci-dessous. Certaines projections effectuées avec cet outil révèlent que les résultats budgétaires du système privé de pensions vont vraisemblablement subir le contrecoup de l'arrivée à l'âge de la pension de nombreux travailleurs frontaliers et étrangers, ainsi que de la mise en oeuvre des mesures adoptées dans la foulée du Rentendësch.

1. La situation présente du système de pensions luxembourgeois

Comme l'indique le graphique ci-dessous, la situation budgétaire présente du système de pensions luxembourgeois paraît excellente. Les recettes du système ont été systématiquement supérieures aux dépenses au cours de la période 1990-2001, à raison d'environ 2% du PIB. Par ailleurs, les prestations exprimées en pourcentages du PIB ont décru de 1996 à 2000. La sédimentation de capacités de financement positives sur une longue période a donné lieu à de confortables réserves, qui se sont élevées à 22% du PIB à la fin de l'année 2001.

Graphique 1. Evolution passée de la situation budgétaire du régime général de pensions

En pourcentages du PIB

Sources : IGSS (2002), STATEC.

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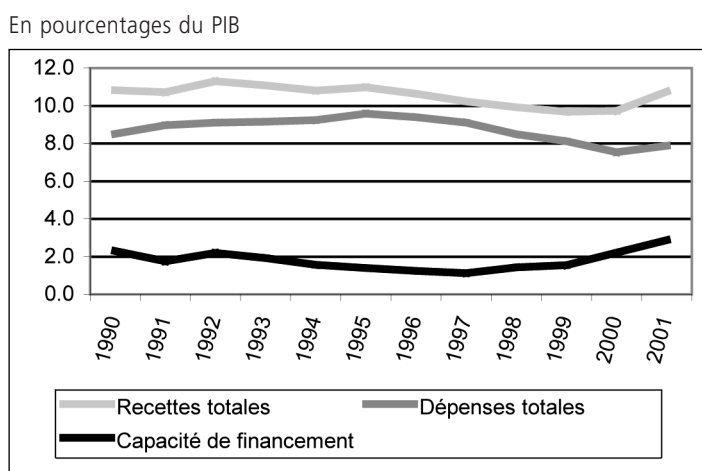
2. Diverses caractéristiques propres au Luxembourg

Diverses caractéristiques de l'économie luxembourgeoise sont à la base des excellents résultats budgétaires du régime général. Il s'agit de la forte proportion de travailleurs frontaliers, de l'important afflux de travailleurs étrangers et enfin du manque de diversification de l'économie luxembourgeoise.

Selon la récente note de conjoncture du STATEC, les frontaliers représentaient 34% de l'emploi intérieur total à la fin de l'année 2001. Il s'agit dans une large mesure d'un phénomène assez récent. La population des frontaliers est relativement jeune, de sorte qu'elle devrait continuer à alimenter une progression soutenue des cotisations de pension au cours des prochaines années. Cette situation est cependant appelée à se modifier lorsque les importants effectifs de frontaliers parviendront à l'âge de la pension.

La même situation prévaut, mutatis mutandis, pour les flux d'immigrants, ces derniers se caractérisant également par une moyenne d'âge assez basse. Les travailleurs étrangers diffèrent cependant des frontaliers à un égard, à savoir leur incidence sur l'évolution du nombre des naissances au Luxembourg, qui contribue à consolider la soutenabilité à terme du régime de pensions.

Une troisième caractéristique du Luxembourg est sa potentielle vulnérabilité aux chocs macroéconomiques ou financiers. Ce facteur a opéré en faveur du régime de pensions au cours des années récentes, en particulier de 1996 à 2000. Une évolution en sens inverse pourrait cependant se manifester du fait, par exemple, de l'importance du secteur financier pour l'économie luxembourgeoise.

3. L'outil de projections développé par la BCL

En raison de la complexité et de l'imbrication des problèmes, l'examen des perspectives de long terme du système de pensions ne pouvait se dispenser d'un outil analytique cohérent. Le simulateur élaboré à la BCL repose sur un modèle démographique complet, qui permet d'inférer l'évolution de la population par sexes et classes d'âge sur la période 2001-2085. Sur la base de taux d'activité, la population active assurée au système de pensions privé est ensuite dérivée. Après multiplication par des salaires moyens représentatifs, l'évolution de la masse salariale peut être dégagée, de même que les cotisations futures.

Les dépenses de pensions sont également estimées à partir de la population répartie par sexes et classes d'âge. Sur la base de matrices de statuts, le nombre de pensionnés futurs est inféré. Les dépenses de pensions totales sont obtenues après multiplication par des pensions moyennes représentatives. Le même schéma est appliqué aux travailleurs frontaliers.

4. Les perspectives d'évolution à long terme du système privé de pensions

4.1 La projection de référence

De nombreuses hypothèses président à la simulation de référence. Les plus importantes d'entre elles sont reprises au tableau ci-dessous. Il est à noter que nombre d'hypothèses favorables au système de pensions ont été retenues. Ainsi, il est supposé que le taux de participation des femmes au marché du travail va s'accroître. En outre, les arrivées nettes de frontaliers et d'immigrants demeureraient à des niveaux élevés. Enfin, le taux de mortalité ne se réduirait que de 0,3% par an, ce qui marquerait une décélération par rapport à l'évolution observée au cours de ces dernières années.

Tableau 1. Hypothèses de base de la simulation de référence

	Taux d'inflation (%)	Croissance des salaires réels (%)	Productivité du travail (%)
2002	2,1	1,4	-2,2
2003	1,4	1,3	1,9
2004	1,7	1,4	1,7
2005-2085	1,9	2,0	2,0

Naissances	Stabilité au niveau de fécondité observé en 2000
Mortalité	Réduction graduelle de la mortalité (-22% au total de 2001 à 2085)
Immigration	Arrivée nette de 4000 immigrants par an
Frontaliers	Arrivée nette de 6700 frontaliers en 2002, 400 en 2003, 3300 en 2004, 5000 en 2005 et 7000 par an de 2006 à 2085
Taux d'occupation	Augmentation graduelle pour les femmes, stabilité pour les hommes. En conséquence, les femmes représentent 45% de la population active résidente en 2085, contre 39% en 2001.
Pensions	Intégration des mesures discutées au Rentendësch. Maintien du taux de cotisations à 24% du revenu brut.

Calculs BCL.

Comme l'illustre le graphique ci-dessous, la soutenabilité à terme du système de pensions paraît précaire sous ces hypothèses. Les soldes budgétaires exprimés en pourcentages du PIB se réduiraient quelque peu de 2001 à 2005 sous l'influence d'une croissance économique plus faible et du ralentissement correspondant des arrivées de frontaliers, et dans le sillage des récentes mesures de revalorisation des pensions. A partir de 2006, cependant, la reprise des entrées de frontaliers et l'immigration soutenue conforteraient la croissance économique, ce qui tendrait à réduire l'importance relative des dépenses. Il en résulterait un cercle vertueux, caractérisé par la croissance des excédents et, en conséquence, par une hausse soutenue du niveau des réserves, qui culmineraient à près de 50% du PIB en 2028.

Graphique 2. Evolution des variables budgétaires

En pourcentages du PIB
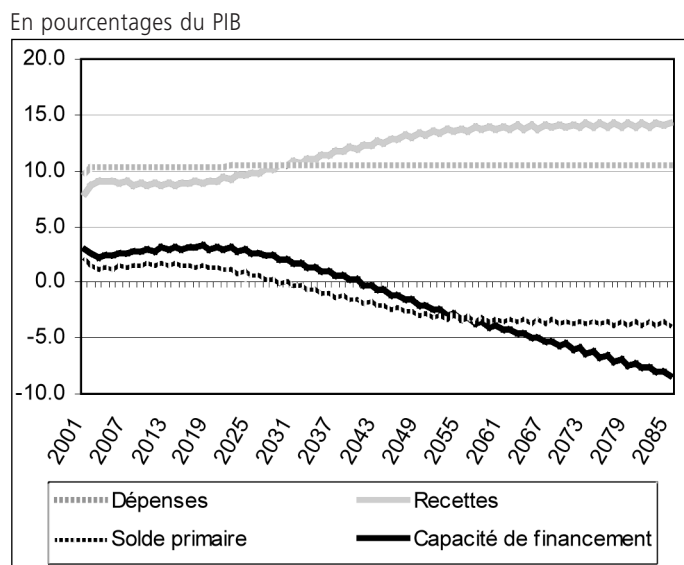
Cette situation favorable s'infléchirait cependant dès 2015, avec l'amorce d'un recul des excédents primaires. Confortée par des revenus d'intérêt toujours croissants, la capacité de financement ne commencerait cependant à décliner que vers 2021. Elle cèderait la place à un besoin de financement dès 2041, qui s'élèverait à quelque 8% du PIB à l'issue de la période de projection. Dans un tel contexte, un premier endettement ferait son apparition en 2055. Il atteindrait 60% du PIB vers 2070 et 109% en 2085.

4.2 Première variante: plafonnement de la population à 700 000 habitants

La population obtenue dans le cadre de la projection de référence dépasserait le seuil des 700 000 habitants à partir de 2048. Une projection a été effectuée, qui permet d'appréhender l'incidence d'un plafonnement de la population résidente à 700 000 habitants. Un tel plafonnement pourrait par exemple résulter d'une saturation des infrastructures publiques, ou encore d'une capacité de logement ou de transport insuffisante. Cette nouvelle projection consiste à annuler le solde migratoire sur l'ensemble de la période 2049 à 2085. Il en résulterait une diminution du nombre de naissances qui, en moyenne annuelle, se réduirait de 1 600 unités de 2049 à 2085. Dans un tel contexte, l'accroissement naturel de la population serait annulé, de sorte que la population plafonnerait bien à 700 000 unités tout au long de cette période.

Graphique 3. Situation budgétaire du système de pensions
en cas de plafonnement de la population résidente à 700 000 habitants

Réserves (+) ou dette (-), en pourcentages du PIB
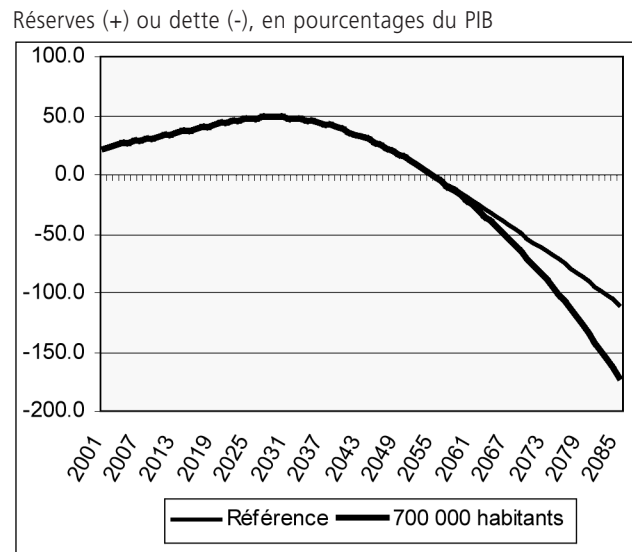
Sources : IGSS, STATEC, BIT, calculs BCL.

Au vu des données budgétaires reprises au graphique ci-dessus, le plafonnement à 700 000 habitants affecterait très négativement l'équilibre du système de pensions, avec à la clef une dette supérieure à 170% du PIB et un besoin de financement considérable, égal à 13,5% du PIB en 2085. Cet impact négatif est dû à la diminution du nombre de cotisants à la sécurité sociale, cet effet étant encore renforcé par le fléchissement du nombre de naissances.

4.3 Deuxième variante: ralentissement des arrivées de frontaliers
Les résultats de la simulation de référence dépendent de façon cruciale de l'hypothèse d'un maintien à un niveau élevé des arrivées nettes de frontaliers. Un scénario alternatif consiste à abaisser ces arrivées nettes à 4 000 individus par an à partir de 2005. Comme l'indique le graphique suivant, un tel scénario induirait dans une première phase un net ralentissement de la constitution de réserves, du fait de la diminution du nombre de jeunes cotisants.

Graphique 4. Evolution des réserves (+) ou de la dette (-)
du régime de pensions en cas de ralentissement des arrivées de frontaliers

En pourcentages du PIB
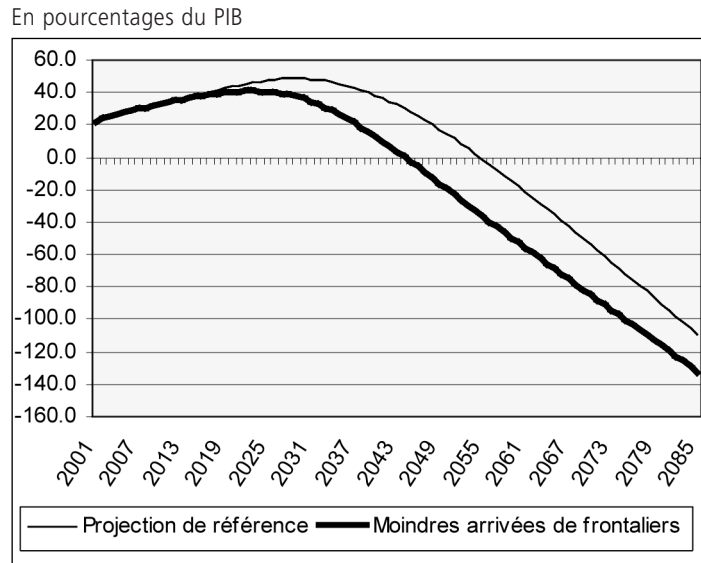
Sources : IGSS, STATEC, BIT, calculs BCL.

Le premier endettement se manifesterait à partir de 2045, soit 10 ans plus tôt que dans la simulation de référence. Il est à noter que l'impact négatif du ralentissement de l'arrivée de frontaliers s'éroderait à partir de 2057, du fait de la diminution du nombre de frontaliers pensionnés.

4.4 Evaluation du coût du Rentendësch
Graphique 5. Estimation "dynamique" du coût des mesures de relèvement des pensions

En pourcentages du PIB
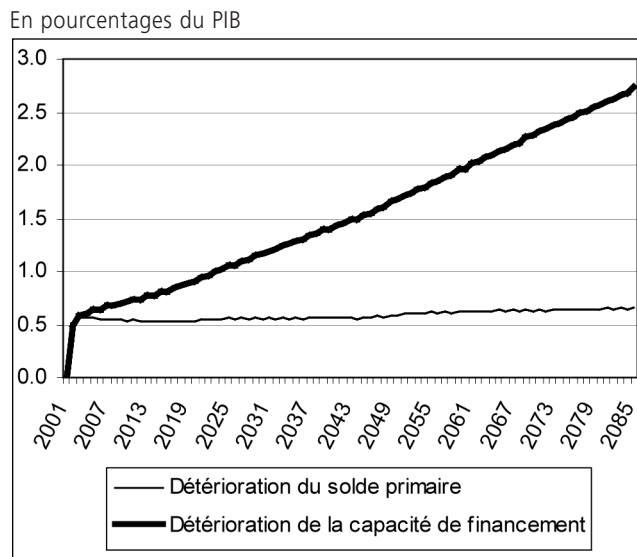
Sources : IGSS, STATEC, BIT, calculs BCL.

Le coût statique en année pleine des mesures de la loi du 28 juin 2002 peut être estimé à 0,6% du PIB, ce qui est très proche de l'estimation du Gouvernement. Cependant, une telle estimation statique ignore les interactions entre les nouvelles mesures et l'environnement macroéconomique et démographique, de même que leur impact sur le niveau de la dette et, partant, sur les charges d'intérêt. L'estimation "dynamique" du coût figure au graphique ci-dessus. L'impact des mesures sur les dépenses et sur le solde primaire tendrait à s'accroître quelque peu en fin de période sous l'effet du vieillissement de la population, mais il ne s'écarterait pas significativement du niveau initial de 0,6%. Par contre, le cumul de soldes moins favorables donnerait lieu à une dette plus élevée, avec à la clef un certain emballement des charges d'intérêt qui renforcerait à son tour la progression de la dette. Le surcroît de besoin de financement imputable aux mesures du Rentendësch atteindrait ainsi 1% du PIB dès 2022 et près de 3% en 2085. En l'absence des nouvelles mesures, le système de pensions n'aurait contracté ses premières dettes qu'en 2065, soit dix ans plus tard que dans la projection de référence, qui intègre ces dispositions. En outre, la dette projetée ne se serait établie qu'à 61% du PIB en 2085.

4.5 Analyses de sensibilité des résultats

Diverses projections alternatives permettent d'évaluer la stabilité des résultats et de mieux illustrer la façon dont opèrent divers déterminants de l'équilibre du système privé de pensions. Les résultats de ces projections, qui font l'objet de commentaires détaillés dans le corps du texte, sont brièvement passés en revue au tableau ci-joint. Les simulations mettent en évidence l'effet durable d'une accélération même temporaire de la hausse des salaires, l'importance cruciale d'une amélioration du taux de rendement des réserves, la sensibilité de la situation budgétaire au taux de participation des femmes au marché du travail et, enfin, les retombées très favorables d'un accroissement du taux de fertilité.

Tableau 2. Vue d'ensemble des projections effectuées par la BCL

Résultats exprimés en % du PIB

	Réserves (+) ou dette (-) du régime général de pensions			Besoin net de financement
	2030	2050	2085	2085
Simulation de référence.	*49*	*14*	*-109*	*-8,4*
Première analyse de sensibilité : accroissement des salaires de 3% au lieu de 2% de 2005 à 2010.	52	16	-115	-8,9
Seconde analyse de sensibilité : hausse de 0,5% du rendement des réserves.	54	24	-99	-8,0
Troisième analyse de sensibilité : taux de participation des femmes au marché du travail constant.	46	6	-142	-10,6
Quatrième analyse de sensibilité : hausse du taux de fertilité à raison de 15%.	48	18	-86	-7,1

Sources : STATEC, IGSS, BIT, calculs BCL.

Conclusion

Comme l'indiquent les simulations effectuées dans cette étude, qui ne prennent pourtant pas en considération les régimes spéciaux de pension, il existe un risque significatif que l'équilibre budgétaire du régime général de pensions luxembourgeois soit compromis à terme, en dépit de l'existence d'importantes réserves de pensions. Les perspectives budgétaires seraient particulièrement préoccupantes sous l'hypothèse d'un plafonnement futur de la population, ou encore en cas de ralentissement des arrivées nettes de travailleurs frontaliers.

Ces résultats soulignent la nécessité d'une gestion rigoureuse du budget de l'Etat central. L'important surplus que dégage le système de pensions permet en effet d'assurer le respect de la condition de soldes "proches de l'équilibre ou en surplus" pour l'ensemble des administrations publiques, même dans l'hypothèse de déficits de l'Etat central. Les excédents de la sécurité sociale sont cependant vraisemblablement appelés à s'étioler à moyen terme. Dans un tel contexte, un déficit structurel de l'Etat central contrarierait davantage qu'actuellement le respect des exigences européennes.

En ce qui concerne plus spécifiquement le système de pensions, l'importance d'une surveillance proactive de l'évolution de la situation budgétaire est clairement établie. Il serait hasardeux de n'adopter d'éventuelles mesures de correction que lorsque les réserves de pensions deviennent inférieures au seuil d'1,5 fois le montant des prestations, d'autant que le contrôle du respect de ce seuil minimal repose sur des évaluations actuarielles confinées à des horizons successifs de 7 ans. Il serait alors trop tard pour contrer avec succès les facteurs de dérive des coûts, ce qui contraindrait les autorités à procéder à une hausse très substantielle des cotisations sociales.

Les autorités pourraient également améliorer significativement les perspectives du système de pensions privé en veillant à mieux diversifier la réserve de compensation. Une hausse même limitée du taux de rendement des réserves se traduirait en effet par une amélioration appréciable des perspectives budgétaires du régime général, comme l'illustre une projection reprise au tableau 2.

General Introduction

The prospects of the pension system have been the focus of a broad range of analyses in the recent past. It has been demonstrated that the long-term sustainability of the pay-as-you-go pension system is under threat in many countries, and some proposals for reforms have been presented. Most of these studies overlook the Luxembourg case, however, for two major reasons. On the one hand, Luxembourg is a small and open country characterised by important inflows of cross-border and foreign workers. The long-term prospects of the pension system are therefore more difficult to predict than is the case in larger countries. On the other hand, it is widely held that the Luxembourg pension system is in such a good financial position that any sustainability study would necessarily be beside the point.

The present paper, which confines itself to the private pension system, will show that the first contention is indeed well grounded. Long-term predictions are difficult to carry out in Luxembourg, due to many sources of volatility originating in the pension regime itself, and also in the macro-economic and demographic environment. The cross-border phenomenon and its impact on future pensions are especially difficult to tackle. Accordingly, long-term projections have to be interpreted with caution.

Part II and III of the study will establish that the second contention is unrealistic. Part II will first describe the current, apparently favourable situation of the Luxembourg pension system. It will then turn to an examination of a range of peculiarities of the Luxembourg pension system, and argue that they might pose some problems in the future. This point will be corroborated in a quantitative way in part III, where the results obtained in previous studies are first reviewed. The paper then turns to an alternative model developed at the BCL, which encompasses a coherent demographic framework. The logical articulation of the model is first reviewed, before an examination of the quantitative results obtained on this basis is presented. A reference projection illustrates that even under some apparently realistic assumptions, the long-term equilibrium of the Luxembourg pension regime is fragile, especially after 2050. Alternative projections are carried out in parallel to the reference projection, in order to unfold the mechanisms at play in the pension system and also to illustrate the sensitivity of our results to changes in the most important hypotheses.

A first part of the paper provides some insights into the concept of fiscal sustainability. As will be made clear, there does not exist at this stage a coherent theoretical framework able to provide policy advice to the authorities. In particular, economic theory does not propose any accurate anchor as regards an optimal level of public debt. However, the resulting uncertainty can be palliated to a certain extent by the commitment to predetermined targets, like the Maastricht reference values.

Part I The assessment of long-term fiscal sustainability

The present part will provide a concise overview of the current state of play in the strand of economic literature concerned with fiscal sustainability. The objective is to provide a flavour of the conclusions reached so far, rather than to present a comprehensive survey of this literature. A first relevant question addressed below is the definition of sustainability, which is much less straightforward as is commonly assumed. A second major problem is the choice of operational indicators of fiscal sustainability. As the economic literature does not provide firm anchors at this stage, the analysis has to resort to pragmatic tools, which are presented at the end of this part.

1. The concept of fiscal sustainability

The definition of a precise concept of sustainability is less straightforward as is commonly assumed, as illustrated by the debate on indicators. However, a sensible general definition has been adopted by Artis (2000). In his opinion, sustainability "denotes whether a government can go on with the existing set of tax schedules and expenditure programme - or not".[1]

Domar (1944) has proposed a more precise concept of sustainability. Under a partial equilibrium framework, he considered a regime where taxes are continuously adjusted so as to offset any increase in interest charges. The public debt dynamic can be expressed as follows in such an economy:

$$d_t = \frac{1}{1+g} * d_{t-1} - c_t$$

Where
g is the rate of growth expressed in real terms
d is the outstanding amount of public debt expressed as a percentage of GDP
c is the overall balance as a percentage of GDP. A positive sign points to a surplus position.
The real rate of interest r does not appear in this equation due to the offsetting behaviour of taxes.

According to Domar (1944), a crucial point for the definition of sustainability is that the debt ratio will converge to a finite level in the steady state:

$$d = -c * \frac{1+g}{g} \qquad\qquad (1)$$

The tax rate t needed to ensure the compensation of interest expenditures would also converge to the finite value

$$t = -c * \frac{r}{g} \qquad\qquad (2)$$

where r is the real interest rate

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[1] A distinction should be made between this concept of sustainability and the solvency condition. Solvency is indeed a much more technical concept, conceptually close to the intertemporal budget constraint. The difference between the two concepts is especially striking in case of a commitment to a predetermined target. This is for instance the case of a country whose debt level was higher than the reference value of 60% under the Maastricht Treaty. Although such a country might be perfectly solvent from a technical point of view owing to a high primary surplus, it will have to change the current course of its budgetary policy in order to comply with the reference value.

This joint convergence process of both the tax rate and the debt ratio to finite values implies that a necessary condition for sustainability is the avoidance of an ever-growing deficit ratio. This should not be confused with a sufficient condition of sustainability, however, to the extent that a high ratio would be accompanied by proportionately high taxes, which would detract from economic growth and could lead to increasing interest rates due to the crowding out effect.

2. The appropriate level of debt and deficits and some indicators of fiscal sustainability

Although the Domar (1944) criterion provides some insight into the definition of fiscal sustainability, it does not refer to any appropriate level of debt and deficit, as it puts an exclusive emphasis on the need to stabilise the deficit, irrespective of its absolute level and of the corresponding steady state debt level. It is therefore unable to provide clear quantitative guidelines to the budgetary authorities. As will appear below, some attempts were made to derive more precise quantitative guidelines, but the indicators proposed are usually either too lax or somewhat arbitrary. In any case, it is impossible in the current theoretical state of play to calculate "optimal" levels of fiscal balances or public debt. This situation is quite understandable, because such an optimal level would indeed have to take into account all the channels of interaction between the macro- and micro economic environment on the one hand, and fiscal policy on the other hand, which would be extremely intricate.

2.1 The criteria of Buiter (1985) and Blanchard et al. (1990)
Buiter (1985) proposes a rather a-theoretical, pragmatic criterion, as he considers that a policy is sustainable provided that it manages to keep the debt-to-GDP ratio unchanged at its current, initial level. Blanchard et al. (1990) have proposed two alternative criteria, whereby (i) the debt ratio should converge to its initial, contemporary level, which is quite similar to the Buiter (1985) framework ; and (ii) " the present discounted value of the ratio of primary deficits to GDP [...] is equal to the negative of the current level of debt to GDP ".

The derivation of the latter condition starts from the intertemporal budget constraint, which is described in a more detailed way in Annex 1. This constraint states that the present value of all future primary surpluses should be sufficient to reimburse the initial level of public debt:

$$\sum_{t=1}^{\infty} \frac{B_t}{(1+i)^t} = D_0 \qquad (3)$$

where
i is the nominal interest rate
B is the amount of the primary surplus[2]
D is the outstanding amount of public debt

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[2] The primary surplus is the difference between total revenue and total expenditure, where the latter does not include interest charges. The overall balance is equal to the primary balance minus interest charges.

Since

$$B_t = Y_0 * (1+a)^t * b_t$$

where
Y is the nominal GDP
a is the nominal rate of GDP growth
b is the primary surplus expressed as a percentage of GDP

The equation (3) can be written as:

$$\lim_{T \to \infty} \sum_{t=1}^{T} Y_0 * b_t * \left[\frac{1+a}{1+i} \right]^t = D_0$$

Or, dividing the two terms by Y_0:

$$\lim_{T \to \infty} \sum_{t=1}^{T} b_t * \left[\frac{1+a}{1+i} \right]^t = d_0 \qquad (4)$$

This is the second condition of Blanchard et al. (1990).

The second condition is less stringent than the first one. It could indeed imply a steady state debt-to-GDP ratio lower, equal to or higher than the initial level d_0, which is the convergence target under the first condition. It is also less demanding than the Domar condition, as the resulting nominal debt might increase indefinitely into the future. The second Blanchard et al. (1990) condition is indeed based on discounted values, which gives less weight to deficit and debt levels recorded far into the future, even when they are growing.

Although the two conditions of Blanchard et al. (1990) could provide some guidance, they are still a far cry from a full-blown criterion for an operational, optimal level of debt or balance. In particular, the reliance on the initial level of debt is somewhat arbitrary, as any initial level of debt is deemed appropriate as a long-term equilibrium.

2.2 Operational criteria: the permanent tax rate, the tax gap and the implicit liabilities
More operational and intuitive indicators of fiscal sustainability than the aforementioned conceptual criteria are frequently relied upon in the empirical literature. They may for instance refer to the Buiter criterion, whereby the debt-to-GDP ratio should be maintained at its initial level. Several indirect, "secondary" indicators could be derived from this starting point.

A first such indicator is the permanent primary surplus that ensures that the debt-to-GDP ratio at the end of the projection horizon is equal to its initial value:

$$b^* = (r_t - g_t) * d_t \qquad (5)$$

where
b is the permanent primary surplus expressed as a percentage of GDP
r is the real interest rate
g is the GDP growth rate expressed in real terms
d is the debt-to-GDP ratio

The higher the debt ratio or the interest rate and the lower the rate of growth, the higher the primary ratio required to comply with the Buiter criterion.

This equation can also be written:

$$t^* = e^* + (r_t - g_t) * d_t \qquad (6)$$

where
t* is the permanent tax-to-GDP ratio
e* is the permanent expenditure-to-GDP ratio

This equation clearly illustrates that two alternative indicators might be derived. First, the permanent tax ratio that stabilises the debt-to-GDP ratio d could be calculated on the assumption that primary expenditure will be kept constant as a proportion of GDP. Conversely, the permanent expenditure ratio compatible with the Buiter criterion could be derived in a similar way, conditionally upon the condition that the ratio t is a constant. The former practice is much more widespread in the literature, but this is basically a convenient convention.

Gap indicators are frequently calculated on the basis of these "sustainability indicators", the corresponding gap being the permanent, Buiter-compliant level of the sustainability indicator minus the contemporary, effective level of the indicator. The most frequently used such indicator is the tax gap, which is equal to

$$tgap_t = t^* - t_t \qquad (7)$$

Blanchard has most prominently argued the use of this indicator. A positive gap indicates that taxes should increase in order to stabilise the debt ratio. Conversely, taxes could be alleviated when the gap is negative.

All the aforementioned indicators have been discussed taking the Buiter criterion as a reference. However, alternative concepts of sustainability could be used to derive similar indicators. For instance, the tax gap could be calculated conditionally upon the attainment of a non-negative net liability at the end of the observation period,[3] or even a predetermined positive net worth.

The aforementioned "gap" indicators are based on the assumption that the intertemporal budget constraint is respected, because either the average tax rate or the expenditure level will adjust in order to offset any disequilibrium. By contrast, the intertemporal public liabilities of the pension system (IPL)[4] are derived on the assumption that the current levels of expenditure and taxes will remain unchanged in the future. As a result, the present value budget constraint is not respected:

$$D_t = \sum_{j=0}^{\infty} \frac{B_{t+j}}{(1+i)^j} + IPL$$

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[3] This is the practice followed in ILO (2000).
[4] The IPL should not be confused with the notion of implicit debt. The latter is in fact equal to the IPL minus the debt level D, namely to the negative of the present value of all primary surpluses.

Or, alternatively,

$$IPL = D_t - \sum_{j=0}^{\infty} \frac{B_{t+j}}{(1+i)^j}$$

The IPL is positive if the present value of all future primary balances is insufficient to cover the contemporaneous level of debt.

The IPL concept is often referred to in the literature on the sustainability of the pension system.[5] However, it presents some shortcomings. First, it is often compared to the explicit level of debt Dt, in order to calculate a broader concept of public debt. It should be noted, however, that the implicit debt is not tantamount to legal liabilities of the pension system. The latter could indeed deflate the IPL by adjusting the micro features of the pension system in a restrictive fashion. Such behaviour would certainly not be comparable to default, which illustrates the inherent difference between the explicit and the implicit debt. Second, the calculated level of the IPL is crucially dependent on the discount factor used, and the time horizon over which it is calculated. This horizon should theoretically be equal to the infinite, but for practical matters a limited horizon is usually referred to. The latter problem is examined thereafter in a wider context.

2.3 Two major shortcomings of sustainability indicators: the relevant time horizon and the path towards the budgetary equilibrium

All the indicators considered before are of limited practical use, for two reasons. On the one hand, they do not provide any guidance as regards the most appropriate time horizon to consider. This problem is usually circumvented in an elegant way by referring to an infinite time horizon, but any empirical assessment has to focus on limited period for evident reasons of resources and data limitations.

Another problem associated with the aforementioned indicators is that they disregard the path towards a budgetary equilibrium. Chart 1 provides an illustration of this problem. It depicts two evolutions of the primary balance that are both compatible with the present value budget constraint, which means that the corresponding tax or expenditure gaps are equal to zero. In spite of similar sustainability indicators, the first scenario is obviously preferable to the second one. Should the projection be extended by one year only, scenario 2 would indeed give way to a negative present value, and the opposite situation would prevail for the alternative situation. This highlights the need to observe fiscal developments in a continuous way over the predetermined time horizon, and to avoid an exclusive focus on synthetic sustainability indicators. In addition this result underlines the importance of sufficiently long time horizons, especially in the case of downward sloping budgetary schedules.

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[5] See for instance European Economy (1999).

Chart 1. Two scenarios compatible with the present value budget constraint

Absolute amount of the primary balances
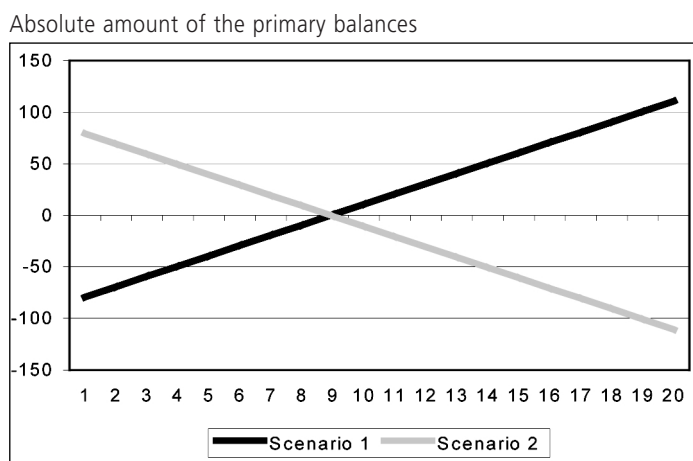
Comment: assuming a discount rate of 5% and the absence of any initial public debt. Based on fictive data. The x axis refers to the time dimension.

2.4 Pragmatic criteria: the Maastricht reference values and the actuarial assessment

The Maastricht reference values are located further away from a purely theoretical framework. In the absence of any firm conceptual benchmark, as illustrated above, they have been set in a rather pragmatic way. In spite of this lack of firm theoretical foundations, they provide clear-cut anchors to budgetary authorities, which helps promote economic stability (see for instance Hiebert and Rostagno (2000)). The reference values will provide useful benchmarks even in the confines of a paper concerned with a subset of the public sector, namely the pension regime. It would indeed be unrealistic to postulate that any breach of these criteria that originates from the pension system could be compensated by surpluses and the building up of additional reserves in the other general government sub-sectors. The latter sub sectors also have to face many challenges and to address legitimate social needs, which excludes any "crowding out" by the pension system. In addition, the current budgetary situation of the Luxembourg General Government suggests that no significant surpluses are available in the other sub-sectors than the pension regime, and some deficits could even occur in the near future. In these circumstances, it would be unrealistic to use the assets of the Luxembourg treasury to palliate the future problems of the pension system.[6]

Therefore, although the Maastricht criteria formally apply to General Government as a whole, including Central Government, it is appropriate to assess the budgetary results of the pension system on the basis of these criteria. The contention that the other sub sectors of the Luxembourg General Government could compensate a deviation from the Maastricht criteria should be rejected. In other words, no pension policy should be considered sustainable if it implies a pension system borrowing requirement in excess of 3% or liabilities of the pension regime that are higher than 60% of GDP. As suggested by the evidence above, there exist no

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[6] According to Cour des comptes (2002), the net assets of the Luxembourg Central Government amounted to EUR 3,354 million or 15% of GDP in September 2002, including the assets of the so-called special and investment funds. This does not take into account the equity capital held by the State in public or private institutions or important tax arrears.

firm, objective indicator or strategy as regards the sustainability of public finances. However, the apparent flexibility brought about by this indeterminacy cannot detract from the continued compliance with the Maastricht criteria.

It should be noted that under normal circumstances, the reference value of 3% is less demanding than the 60% reference value for the debt ratio, according to the Domar formula (1). Taking into account a steady state real growth rate of 4% along with a deficit of 3%, the debt ratio would converge to a steady state value equal to 78% of GDP, i.e. higher than the reference value. The implied long-term debt level would be even higher in case the growth rate turned out to be lower.

Another pragmatic criterion is provided by a specific rule, whereby pension reserves in Luxembourg should reach a minimum of 1.5 times the annual amount of pension expenditure. The compliance to this rule is assessed in an actuarial way over successive 7-year periods. Should the level of reserves prove insufficient, the contribution rate would be adjusted upwards at the beginning of the 7-year period. As will be demonstrated in part III, this rule is useful, but it should be complemented with other indicators of fiscal sustainability.

3. Practice vs. theory and the approach followed in the paper

There exists a wide gap between theory and practice as far as fiscal sustainability is concerned. In the absence of a clear definition of fiscal sustainability and of robust criteria as to the optimal level of public debt or fiscal balances, a rather pragmatic approach based on ad hoc indicators and methods has been privileged.

Long-term projections will be developed, on the basis of a new simulation framework developed at the BCL, which captures the peculiarities of the Luxembourg economy. For the sake of completeness and in order to apprehend in a precise way the magnitude and the consequences of population ageing in Luxembourg, the total and insured populations are broken down by gender, age and statutes, both for the resident population and for cross-border workers. The projection framework therefore enables to capture demographic changes. It also encompasses a macroeconomic module and the calculation of labour force participation rates and the wage bill.

The simulations have been carried out over the horizon 2001-2085. This is a compromise between the horizon used by several academic authors primarily interested in the elaboration of generational accounts and the horizon chosen by the ILO and other institutions. On top of that, this long horizon makes it possible to monitor in an adequate way the long-term consequences of evolutions like the inflow of cross-border workers.

The selection of budgetary indicators is also pragmatic, as the paper is focused on the level of pension expenditure, revenue, the primary balance, the overall balance and the net assets of the pension system. Their evolution will be scrutinised throughout the projection horizon. Other indicators like the net implicit liabilities are not calculated in a systematic way, if only because they are too sensitive to the discount rate.

Part II The current situation of the private pension regime in Luxembourg

1. The budgetary situation of the general pension regime

Judged on the basis of contemporaneous indicators like the budgetary balance and the level of reserves, the financial situation of the Luxembourg pension system is at first sight extremely favourable. As shown in Chart 2, the Luxembourg general pension regime is indeed characterised by a comfortable and stable net lending capacity. The latter reached EUR 620 million in 2001, i.e. 2.9% of GDP. The surplus has continuously increased from 1997 to 2000 owing to a marked decrease in the expenditure-to-GDP ratio in a context also characterised by a high rate of economic growth. This evolution more than offset the steady increase of expenditure observed from 1990 to 1996. In the context of a marked deceleration of economic growth, pension expenditure has increased by 0.4% of GDP in 2001, which is a reversal from the evolution observed over the period 1996-2000. However, this adverse result has been accompanied by an even more sustained increase of the revenue ratio.

Chart 2. Expenditure, revenue and overall balance of the general pension regime[7]

As percentages of GDP
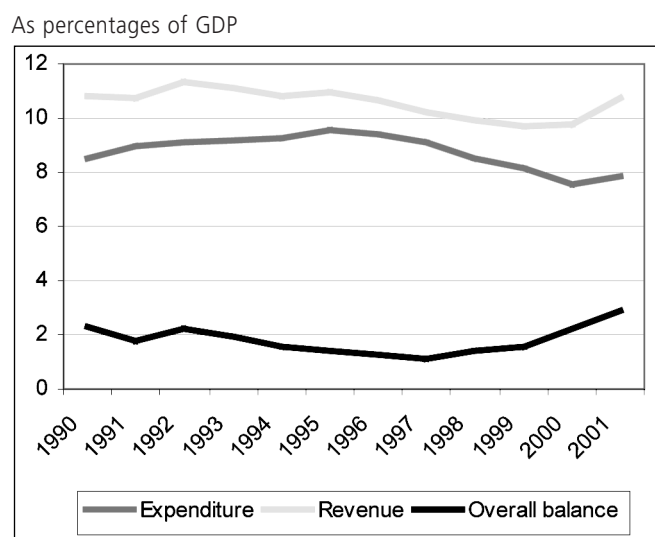
Sources: IGSS (2002), STATEC.

Revenues are mostly composed of social contributions, which are directly linked to the wage bill via a 24% contribution rate.[8] The revenue-to-GDP ratio has been less volatile than the expenditure ratio over the nineties. This has in particular been the case in the last three years owing to large inflows of cross-border workers and to buoyant interest revenues in the context of significant and growing pension reserves. The reserves of the general regime amounted to 22% of GDP at the end of 2001.

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[7] Old age, invalidity and survival pensions. As is the case in the paper as a whole, no distinction is made between the AVI, the CPEP, the CPACI and the CPA, because the same rules apply to each of them and in addition they are managed as a single entity from a financial viewpoint.

[8] The employees, employers and the State share this burden in an equal measure (8% each).

However, an uncertain background casts some doubts on the further continuation of this favourable situation. Luxembourg presents many peculiarities, whose impact has generally been favourable so far. However, they might turn negative at some point into the future, as discussed below.

2. Some Luxembourg peculiarities: the cross-border workers, a high immigration rate, the exposition to asymmetric shocks and a generous pension system

The Luxembourg economy is small and extremely open, which determines three salient differences with respect to the surrounding countries.

2.1 A very high proportion of cross-border and foreign workers

A first salient characteristic is the high reliance of the Luxembourg economy on cross-border workers. According to data published by STATEC (1995 and 2002), foreign commuters would represent about 34% of the workforce at the end of 2001. Although they were already an important component of the workforce as far back as in the beginning of the 1980s, this is to a large extent a recent phenomenon, since the number of those workers has recorded a considerable increase over the last years. In addition, the average age of cross-border workers is quite low. On the basis of some figures provided in ILO (2000), the average age of cross-border workers can indeed be estimated at 34 years. Turnover rates, age structures and especially average pensions observed in the past may not provide accurate measures of the future level of these variables in such a dynamic context.

Chart 3. Evolution of the number of cross-border workers

In thousands
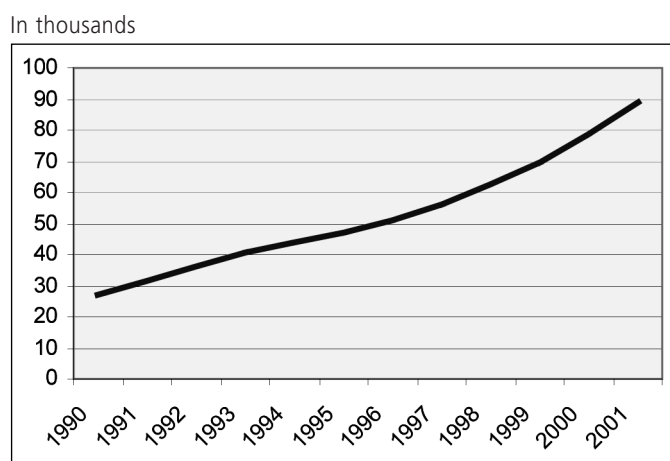
Sources: STATEC (1995 and 2002) and BCL calculations prior to 1995.
Note: Net number of cross-border workers, disregarding the employees of international organisations.

The situation depicted in the case of cross-border workers prevails mutatis mutandis for another peculiarity of Luxembourg, namely the large inflow of foreign labour. The average annual inflow observed over the nineties has indeed reached about 4,000 units.[9] The total inflow was therefore of about the same magnitude as the inflow of cross-border workers.

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[9] STATEC.

The most important similarity between the foreign residents and the cross-border population is their impact on the average age of the total workforce. Commuter and foreign workers are indeed much younger-than-average. This reflects the large inflows over the recent past as well as the low age of the new entrants. As a result, the average age of the active population insured with the general pension regime reached 37 years for men and 35 years for women in 2000.[10] This is the major reason behind the large surpluses recorded by the general pension regime over the last years. As new foreign and commuter workers are relatively young, they account for a large proportion of all pension contributions, and at the same time they represent a disproportionately low proportion of pension expenditure. Active cross-border workers alone contributed about 31% of social contributions in 2000. At the same time, they received only 17% of total pension expenditure. As a result, they accounted for about 80% of the surplus observed in 2000.[11]

A reverse situation could prevail into the future, when the currently active foreign and cross-border workers will retire. The related negative impact could of course be compensated by the positive impact of the arrival of new waves of such workers on future social contributions. The crucial question for the sustainability of the Luxembourg pension regime is therefore whether the future stream of cross-border and foreign resident workers will be sufficient to ensure that such compensation takes place. The answer is far from straightforward, because it depends on a multitude of factors, for instance the age structure of the "stock" and of the flows of cross-border and foreign workers, the average duration of their careers, the influence of immigration on the fertility rate, and above all the impact of foreign and cross-border workers on macroeconomic developments.

2.2 A high vulnerability to idiosyncratic shocks
The intricate nature of any fiscal projection in Luxembourg is further magnified by the high reliance of the economy on a limited number of sectors, most prominently the financial sector. Stated otherwise, the Luxembourg economy is vulnerable to idiosyncratic shocks. Due to a buoyant activity in the financial sector over the last two or even three decades, Luxembourg has achieved a sustained rate of economic growth, which helped to contain the expenditure-to-GDP ratio. However, it should not be taken for granted that this trend will continue unscathed in the future, as some negative idiosyncratic shocks might unfold. In addition, some sectors of the Luxembourg economy might become more mature and yield lower growth rates. The evolution of pension expenditure in 2001, in a less favourable macroeconomic context, is a first illustration of the materiality of this problem. It is even more important to ensure the long-term sustainability of the pension regime in these potentially volatile circumstances.

2.3 A generous pension system
A third feature of the Luxembourg pension system is its generosity compared to the situation that prevails in other countries. A synthetic replacement ratio presented in a recent report by the Economic Policy Committee[12] highlights this generosity. The rate, calculated for a

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[10] IGSS (2001).
[11] Own calculations on the basis of data collected by ILO (2000) (proportion of commuter workers in the active population and the number of pensions) and STATEC (average wage of cross-border workers). It should be noted that the proportion of cross-border workers in the surplus calculated by the ILO and used in its simulations is higher.
[12] Economic Policy Committee (2002).

representative individual with a full career, would reach 56% in Luxembourg and 58% in France, compared to 41% in Belgium and 49% in Germany.[13] This situation is observed in spite of the high level of incomes in Luxembourg, which means that the absolute level of the average pension is much higher than in the rest of Europe.

In addition, employees usually retire at an early age. According to the IGSS (2002), the average retirement age would reach 61.3 years for a man and 63.5 years for a woman as far as old age pensions are concerned. However, the average retirement age is as low as 57.5 years for men and 57.1 for women for the pensioners entitled to old age invalidity and early retirement schemes.

2.4 The need for long-term projections in the Luxembourg context
The three factors mentioned above clearly underline the usefulness of long-term projections in Luxembourg. The latter would indeed contribute to lift somewhat the veil of uncertainty, by providing clear quantitative outputs and some illustrations of the dynamics at play. At the same time, however, these factors make it more difficult to infer future developments. For instance, the magnitude as well as the age or gender composition of the future inflows of cross-border and foreign workers is extremely difficult to predict, as they may not be in line with past or contemporaneous developments. In addition, the vulnerability of Luxembourg to idiosyncratic shocks also means that the macroeconomic developments are much more difficult to predict than elsewhere. The contention that long-term scenarios have to be interpreted with caution is therefore even more justified in Luxembourg than in other countries.

3. Pension reform: the "Rentendësch"

Even though the pension system was already generous, Luxembourg has recently gone against the wind as regards pension reforms. The so-called "Rentendësch" has indeed proposed a set of generous measures for private sector pensions. These measures have been embedded into the 28 June 2002 law. The salient changes are the following:
- The so-called "majorations proportionnelles" (proportional adjustments), which are used to weight past salaries in the calculation of pension rights, will increase by 3.9%, from 1.78% to 1.85%, for all pensions.
- The fixed ("forfaitaire") adjustments will increase by 11.9%. By contrast to its proportional counterpart, this adjustment is an amount proportional to the length of the career, but not related to the amount of past wages.
- The proportional adjustment will increase in a gradual way for future pensions, depending on the age and the length of the career. It will increase by 0.01 percentage point for every year in excess of the age 55 and an affiliation to the pension system in excess of 38 years. The adjustment is capped to 2.05%. The cost of the measure is difficult to estimate, since it could induce some employees to work longer than initially expected.

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[13] The rate is computed as the average ratio between the pension benefits and the wage that would have been received during the period spent in retirement.

- All pensioners will benefit from an additional allowance, equal to EUR 12.71 per year of affiliation.
- The level of the minimum pension benefits will increase.
- The "survival pension" paid to widows and orphans will also be adjusted upwards.

Most of the measures have been applied from March 2002 onwards. The annual cost on a full-year basis is indicated in the table below. The global cost of the additional measures should reach about EUR 130 million per year according to the Government. However, this is a purely static estimate of the cost, based on the contemporaneous situation. In particular, such a calculation disregards dynamic factors likely to unfold into the future, for instance an increase in the dependency ratio, the evolution of the GDP growth rate or wage developments. Given the importance of the amount involved, which represents about 0.6% of GDP, the new measures could significantly affect the long-term sustainability of the pension system, especially against the uncertain background described above.[14] An estimate of the impact of the new measures over a long-term horizon is all the more required in such a context. This exercise is carried out in part III of the paper.

<u>Table1. Annual cost of the measures agreed at the "Rentendësch"</u>

In EUR million

Measure	Beneficiaries	Cost (full-year)
Across-the-board increase of the proportional adjustment	All pensions	47
Specific increase of the proportional adjustment	Pensions after 38 years of affiliation and the age of 55	2.5
Fixed adjustment from EUR 437.66 to 489.98 (1984 basis)	All pensions	32
New end-year allowance	All pensions	32
Increase of the minimum pension	Minimum pension	5
Survival pension	Widows and orphans	10

Source: Ministry of Finance.

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[14] Other measures have been adopted at the "Rentendësch", for instance the extension of the "baby year" arrangement and the introduction of an education allowance. However, these measures are not considered in this paper, because they are only indirectly related to the pension system. In addition, most of their cost will be borne by the State budget.

Part III The prospective situation of the private pension regime

As mentioned above, a pragmatic approach has been privileged in the present paper as regards the assessment of the fiscal sustainability of the private sector pension system. The framework used to this end is based on long-term projections, with a particular focus on demographic evolutions and cross-border workers. This particular emphasis is especially appropriate in Luxembourg, where large-scale changes have occurred in these fields. The evolution of indicators is scrutinised over the period 2001-2085 in order to alleviate somewhat the "finite horizon" bias. In addition, the dynamics of future pension expenditure and revenue is captured in an explicit way, for instance via the inclusion of the micro characteristics of the pension system and some exogenous macro-economic variables.

After a short review of the quantitative results obtained for Luxembourg in a range of alternative frameworks, the next sections provide a concise description of the model used to assess the long-term sustainability of the Luxembourg pension regime.

1. Future developments in Luxembourg: results of alternative long-term projections

The most exhaustive pension framework by far is the one developed by the International Labour Organisation (ILO) following a request by the Government. The results of the ILO (2000) simulations were supposed to provide some guidance to the participants in the "Rentendësch". The IMF has published another prominent study.

1.1 The ILO study
The ILO has carried out some projections for the Luxembourg Government in the study entitled "Evaluation actuarielle et financière du régime général d'assurance pension du Grand-Duché de Luxembourg". The projections have been made for the period 2000-2050 under two distinct macro-economic environments. The first one is characterised by the continuation of high rates of real GDP growth of 4% a year. Under this scenario, the number of employees would grow from 245,200 in 2000 to 616,700 in 2050. The second scenario rests on a much lower GDP growth rate of about 2% a year, due to some constraints on the available labour force, caused by a shortage of commuters. The financial equilibrium of the pension system is broadly ensured under the first set of macro-economic hypotheses. The average contribution rate required over the period 2001-2050 in order to guarantee a non-negative level of reserves in 2050 would reach 22.9% of gross wages, namely 1% less than the current rate of 24%. However, the system would be strained to a certain extent from 2020 onwards, as pension reserves would begin to decrease as a percentage of GDP. For this reason, the ILO makes it clear that "une augmentation généreuse des dépenses dans le futur immédiat réduirait la réserve de façon significative et devrait inévitablement être compensée plus tard pour éviter un déficit du régime général d'assurance pension avant 2050".

The picture is even less favourable under the second scenario. In this case, the level of pension reserves would decline from 2012 onwards, and they would be depleted in 2028. The average contribution rate needed to ensure a non-negative level of reserves in 2050 would be higher

than 30%, compared to a present rate of 24%, meaning that the tax gap would reach 6% of gross wages.

The ILO framework is very detailed, and rests on an impressive range of statistical evidence. However, two shortcomings could be identified. On the one hand, the projections do not extend beyond 2050. As will be illustrated in part 2, this could give way to biased policy conclusions, particularly in a country where cross-border workers play an important role. Even a slight extension of the time horizon (e.g. to 2060) could significantly affect the final diagnosis. On the other hand, the ILO simulations have not been updated so far. They therefore do not incorporate the recent demographic and macroeconomic developments, and the decisions agreed upon at the "Rentendësch".

1.2 The IMF projections

Some projections over the period 2000-2050 are displayed in the IMF Article IV Staff Report on Luxembourg, published in 2002. The IMF includes the impact of the "Rentendësch" measures and has carried out two simulations. A "status quo" scenario rests on the hypothesis of a 5% rate of real GDP growth and a 3% annual growth of total employment. Under this scenario, the contribution rate required to ensure the budgetary equilibrium of the pension regime would hover around 23% from 2000 to 2030, and would decline in a gradual way thereafter to less than 21% in 2050.

The financial prospects would be much less favourable under a second, "average growth" scenario characterised by a real GDP growth of 2.1%. Under this scenario, the required contribution rate would increase in a dramatic way from 2000 to 2030. It would then stabilise at around 45% of gross wages.

According to the IMF, the effective growth rate will probably lie between these two extremes. A 4 to 5% rate of growth would be improbable over the long term, especially in a country where "the risk of a growth reversal due to an adverse shock to one of the dominant sectors of the economy cannot be entirely discarded".[15]

1.3 Other pieces of evidence

The quantitative evidence on the long-term prospects of the Luxembourg pension system is very scarce once the ILO and the IMF are disregarded. An exception is the Crédit Suisse First Boston. In a study published in 1993, this Bank estimated the implicit liabilities of the pension system in several countries, including Luxembourg. The result obtained for Luxembourg drew some attention, as it indicated that the implicit debt would have amounted to 238% of GDP in 1990. This would be the worst result among the countries examined in the study. The corresponding figure would reach 179, 112 and 106% in Germany, Belgium and France, respectively. It should be noted, however, that the study did not deal in a very precise way with the micro features of the Luxembourg pension system.

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[15] IMF (2002). For a precise description of the pension model developed at the IMF, see IMF (1998).

2. The BCL simulation framework

The present section endeavours to describe the simulation model used by the BCL in order to assess the budgetary prospects of the pension system in Luxembourg. Due to the fairly complicated structure of the model, the salient aspects and the logical articulation are simply touched upon.

2.1 The demographic module.

The integration of a demographic module greatly enhances the coherence of the projection framework. It enables to calculate the incidence of alternative demographic scenarios in a flexible manner. In addition, the full-blown integration of a demographic module ensures that the connection with the major determinants of revenue and expenditure is made in an adequate manner. The starting point of the demographic module is the structure of the Luxembourg resident population at the end of the base year, namely 2001, with a breakdown by age and gender.

A mortality table is then applied in a sequential way, in order to calculate the number of residents and the future population structure. For instance, the number of women aged 55 in 2002 is supposed equal to the number aged 54 in 2001, multiplied by the appropriate mortality coefficient. The same procedure is applied for all age and gender categories, and the number of newborn individuals is introduced by the user of the model. The last step is the inclusion of the net inflows of immigrants. These inflows are also introduced in an exogenous way, with a breakdown by gender and age on the basis of a matrix calculated by STATEC. This structure is kept unchanged throughout the projection horizon.

The whole procedure is replicated for 2003 based on the population structure inferred for 2002, and the process is continued until the last year of the projection horizon, namely 2085. The demographic module has been tested for different assumptions. It yields results that are largely comparable to the ILO and STATEC demographic projections, at least when the exogenous variables (e.g. mortality, fertility and immigration) are identical.

2.2 Derivation of the insured, resident active population

The evolution of the insured resident population is essential for the calculation of pension revenue and expenditure. This population is close to the active population per se, but there are some differences. For instance, civil servants and assimilated employees, like the CFL staff, are not included in the insured population calculated in the present document due to its exclusive focus on the private pension system. The calculation of the insured population proceeds in two phases. In the first phase, a matrix of participation rates calculated on the basis of IGSS (2001) data is derived. For each age and gender category, the matrix consists in a breakdown by occupation, namely old age pensions, invalidity pensions, survival pensions, activity and all other statutes,[16] where the corresponding proportions sum up to 1, by definition. The matrix cannot be changed for the base year 2001, but by contrast it can be amended for the rest of

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[16] For instance unemployed people or students.

the projection horizon. In particular, the proportions of pensioners can be adapted for each of the three pension categories (old age, invalidity, survival), and the same prevails for the proportion of active individuals. By hypothesis, the weight of the category "other statutes" is derived in a residual manner, so as to ensure that the weights sum to 1. For each subsequent year, the matrixes are applied to the population structure derived in accordance with the procedure described above (see point 2.1.). The end result is the evolution of the insured and active resident population, broken down by age and gender.

The second step is a calibration exercise that ensures that this active population coincides with the insured population in the base year 2001. To this end, a proportional adjustment is carried out.[17] The figure for 2001 obtained at the issue of the first step is adjusted accordingly. The same adjustment is also applied to the insured population forecast over the rest of the projection horizon.

2.3 Projection of the wage bill and the pension contributions for the resident population

It is of the foremost importance to derive the evolution of revenues, since they constitute the basis for the calculation of pension contributions. The evolution of wages is estimated starting from the insured, active resident population calculated in the previous phase. All age and gender categories of the population are multiplied by the appropriate average wages.[18] The age and gender specific wages are then adjusted in order to guarantee that the total wage bill calculated in the simulator is equal to the corresponding macro figure, namely EUR 5938 million for residents.[19] For all future years, the contribution base can be calculated in a straightforward way, by combining the matrix of average wages with the gender and age specific cohorts of the insured resident population. Average wages are of course adapted each year on the basis of two exogenous variables, namely inflation and the change in real wages. For the years 2002-2004, these variables are aligned on the internal projections made by the BCL. For the subsequent years the real wage is set in line with another exogenous variable, namely the rate of growth of labour productivity.[20]

The total amount of pension contributions is by construction equal to the contribution base multiplied by the contribution rate, which is treated as an exogenous variable. The starting contribution rate observed in 2001 is equal to 24%, divided in an equal way among employers, employees and the State (8% each).

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[17] According to the IGSS (2002), 262,000 persons were active and insured at the end of 2001. According to STATEC (2002), 89,100 cross-border workers were recorded at the end of 2001, of which 700 in the public sector. Consequently, the number of active and insured residents used in the base year has been set equal to 262,000 - 88,400 = 173,600.

[18] Based on IGSS (2001), page 387, where a chart is provided on the average hourly wage by age categories for men and women. The implicit hypothesis used here presupposes that there exists a purely linear relationship between the hourly and the annual wage across all age categories. In other words, working time is assumed constant from one age category to the other.

[19] Since the rate of social contribution is uniformly equal to 24% (contributions of employers, employees and the State), the relevant macro wage bill can be calculated in an easy way, on the basis of the amount of pension contributions collected in 2001. Since this amount was equal to EUR 2,074.6 million in 2001 (see IGSS(2002)), the corresponding wage bill amounted to 2,074.6/0.24=EUR 8,644.2 million, of which 5,938 for the resident, insured population. It should be borne in mind that the absolute amount of the contribution base is much lower than the total wage bill published by STATEC. One of the salient reasons for this discrepancy is the existence of a ceiling for the calculation of pension contributions. Revenues in excess of five times the minimum wage are indeed not liable to such contributions. Another reason is the inclusion of wages and salaries in kind in the STATEC wage bill.

[20] Given the long-term projection horizon, any other hypothesis would give way to unreasonable results as to the ratio of the wage bill to GDP.

2.4 Calculation of pension expenditure for the resident population

The calculation of pension expenditure pays respect to three different categories, namely old age, invalidity and survival pensions. This standard treatment, also applied by the ILO, ensures that the expenditure side is covered in an exhaustive manner. For each of these categories, the number of pensioners is first calculated on the basis of the status matrixes already described above (see point 2.2.). This ensures an integrated, coherent treatment of the workforce participation rates on the one hand, and the proportion of pensioners by age and gender groups on the other hand. The latter proportions have been calculated for the base year 2001, on the basis of the gender and age structure of the resident population and the corresponding structure of the population of resident pensioners.[21] The status matrixes are adjusted in order to take into account a gradual increase in the labour force participation rate of women, which would increase their proportion in the resident workforce from 39% in 2001 to 45% in 2085.

The number of pensioners in each category is then multiplied by the corresponding average pension, in order to infer the pension expenditure by age and gender groups. The starting average pensions are calculated for each of the groups on the basis of data provided in ILO (2000).[22] These average pension amounts are finally calibrated in order to yield the overall amount of pension payments mentioned in IGSS (2002).[23] After inclusion of the measures agreed upon at the "Rentendësch", the calibration coefficients are applied to the projection of future pension expenditure.

2.5 Inclusion of the "cross-border" segment of the active, insured population

As already indicated above, the inclusion of the cross-border insured workers is of an overriding importance in Luxembourg, where they represented about 34% of the workforce at the end of 2001. At the same time, the inclusion of this segment is challenging. The available statistical evidence is indeed somewhat misleading, because the behaviour of retired or soon-to-retire cross-border workers is a poor predictor of the future behaviour of present-day commuters. This is particularly the case as regards the average duration of the Luxembourg career of cross-border workers, which was quite low in the past. As a consequence of a high turnover rate, the number of pensions currently paid is proportionately quite high, but at the same time the average pension is comparatively low. It could be misleading to assume that these patterns will be replicated in the future. The ILO (2000) indeed departs from such a hypothesis, by assuming that cross-border workers will partially and gradually converge to the resident workers as regards the duration of their career and, accordingly, their average pension. The simulations provided in this paper rely on a similar assumption of a gradual and partial convergence that

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[21] This information has been estimated on the basis of the age and gender structure of the population of pensioners as published in IGSS (2001), and the equivalent structure published in ILO (2000) where the additional distinction residents/commuters is provided. The first set of data dates back to 2000, the second to 1998.

[22] The gender and age-specific average pensions are converging with time to a uniform level equal to the overall average observed in 2001 for each of the two gender groups. This reflects the assumption of a gradual equalisation of the average career duration within each gender group. This hypothesis is especially important for women. For example, the average old age pension observed for resident female pensioners is much lower for the 75-79 than for the 60-64 age group. This profile should no longer prevail in the future, since it simply replicates a gradual increase in the professional duration of women over the last fifteen years. It should be noted that all the aforementioned average pensions are expressed in the 1984 base. They are adjusted for the price level and real adjustments to wages only afterwards.

[23] The amount mentioned on page 178 of the IGSS (2002) report is EUR 1,591 million. For the resident population only, this amount is supposed equal to EUR 1,327 million, as 83,4% of the total is ascribed to residents on the basis of the breakdown published in ILO (2000), annex 2.

would take place between 2001 and 2025. The average pension to which cross-border workers would converge would still be lower than the similar pensions paid to residents, by 30%. The latter figure reflects lower wages, by 10%,[24] and a shorter average duration of the career. The hypothesis of a convergence to a lower pension level has also been used in the IMF (1998) study.

For the rest, the pension expenditure and revenue ascribable to cross-border workers are calculated in the same way as the corresponding aggregates for resident workers, according to the steps already reviewed above. Data specific to commuters are of course used at each stage. This is for instance the case for the demographic structure per age and per gender and for the average retirement date. The calculation of pension expenditure also pays respect to the current population of cross-border pensioners broken down by age and gender on the basis of ILO (2000) data. As is the case for resident workers, this hypothesis can be adapted in an exogenous way.

2.6 Calibration of the budgetary situation of the private pension regime in 2001

Since the base year for all projections is 2001, it is of the foremost importance to calibrate the results, in order to ensure that they are perfectly in line with the budgetary results of the pension regime in 2001, as they were published in IGSS (2002). These starting results are displayed in Table 2, where they are compared with the similar data for 2000.

Table 2. Calibration of the budgetary situation of the private pension regime

In EUR million, unless stated otherwise

	2000	2001	Rate of growth
1. Pension expenditure	1475.1	1591.4	7.9%
2. Other expenditure	92.8	104.2	12.3%
3. Total expenditure	**1567.8**	**1695.6**	**8.2%**
4. Pension contributions	1828.9	2074.6	13.4
5. Other primary revenue	39.7	42.0	5.8
6. Interest revenue	159.7	198.5	24.3
7. Total revenue (=4.+5.+6.)	**2028.3**	**2315.1**	**14.1**
8. Overall surplus (=7.-3.)	460.5	619.5	34.5
9. Primary surplus (=8.-6.)	300.8	421,0	40,0

Source: IGSS.

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[24] Based on some evidence collected in STATEC (1995). See in particular page 129, where it appears that the average hourly wage of cross-border workers is 12% below the average.

Pension expenditure has increased by 7.9% in 2001. This high rate of growth is due to the occurrence of a biannual adjustment to real wages by 3.1%. On the revenue side, pension contributions have grown by 13.4% due to the evolution of the total gross income of the individuals affiliated to the pension system. This rate of growth is much higher than the increase assumed for 2001 in the ILO (2000) study, namely 7%. Interest revenues have evolved in line with the net assets of the pension regime, which amounted to 22% of GDP in 2001 compared to 20% in 2000.

All the "residual" expenditure and revenue covered under the items 2 and 5,[25] which are not derived in the pension model itself, are assumed to grow in line with nominal GDP throughout the projection horizon. This should not affect significantly the end results, because the amounts at stake do not account for more than 6% of expenditure and 2% of total primary revenue.

3. Results of the projections

A reference scenario is first described, which cannot be assimilated to a full-blown economic forecast. It should instead be considered as a benchmark, aimed at providing some guidance for the comparisons with alternative simulations. Due to the many uncertainties surrounding the estimation of the number of foreign residents and cross-border workers in the future, the reference projection is complemented with three alternative simulations. The first one rests on the assumption that the population of Luxembourg will be confined to a maximum of 700,000 individuals. This could reflect some explicit decisions, a saturation of public infrastructures and the transport system or a housing shortage. The second complementary projection rests on the assumption of a lower inflow of cross-border workers. The third variant is of a more counterfactual nature, since it replicates the reference simulation under the assumption that the measures agreed upon at the "Rentendësch" would not have been implemented.

A second set of projections is devoted to a sensitivity analysis. Even some minor departures from the reference hypotheses could cause the simulation results to differ in a significant way, due to the long-term focus of the simulations and the difficult choice of "reasonable" assumptions for many variables. Although the projections involved do not have the same "strategic" nature as the ones considered in the previous set, they help understand in a comprehensive way the link between the budgetary results and the basic features of the economic, demographic and social environment.

The sensitivity analysis relies on four groups of projections. A first group is dedicated to the dynamic impact of new macroeconomic assumptions (part 3.5.). The focus lies on inflation and the evolution of wages. The analysis then turns to the incidence of a higher implicit yield on pension reserves. The third sensitivity analysis highlights the impact of lower labour force participation rates than assumed in the reference simulation. The last projection is related to the number of births. The table below provides a presentation of the sequence of projections as well as a first overview of the results. Given the importance of the underlying hypotheses, however, it is strongly recommended to read the detailed explanation of the results.

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[25] For instance, the specific State contributions and the administrative costs.

Table 3. Overview of the projections carried out in the paper

As percentages of GDP

	Reserves (+) or debt (-) of the private pension regime			Overall balance
	2030	2050	2085	2085
Reference simulation	**49**	**14**	**-109**	**-8.4**
First variant: population limited to 700,000 residents	**49**	**14**	**-171**	**-13.5**
Second variant: decreased inflow of cross-border workers (4,000 per year from 2006 onwards)	**36**	**-19**	**-132**	**-9.0**
Third variant: no implementation of the «Rentendësch» measures	**63**	**40**	**-61**	**-5.7**
First sensitivity analysis: accelerated increase of wages from 2005 to 2010	52	16	-115	-8.9
Second sensitivity analysis: increase by 0.5% of the implicit yield on reserves	54	24	-99	-8.0
Third sensitivity analysis: constant labour force participation of women	46	6	-142	-10.6
Fourth sensitivity analysis: increase of the fertility rate by 15%	48	18	-86	-7.1

Sources : STATEC, IGSS, BIT, BCL calculations.

3.1 Description of the reference projection

The reference projection is based on a set of demographic and macro-economic assumptions described in a more systematic way in annex 2. As regards **the macro-economic variables**, it should first be noted that real GDP is not an exogenous variable in the pension model. It is determined in an endogenous way instead, as it is proportional to the evolution of the active, insured population. In addition, it is augmented by an exogenous rate of growth of labour productivity. The endogenous real rate of GDP growth reaches an average of 3.0% a year from 2001 to 2050 in the reference projection. It would decelerate to 2.5% per year afterwards, due to the stagnation of the total number of cross-border workers (see infra).

Over the horizon 2001-2004, the macro hypotheses are based to the largest extent possible on some internal macroeconomic estimates carried out by the BCL. For instance the endogeneity of GDP is "suspended" during this period, as GDP growth is set in line with the results of the macroeconomic projections. The number of cross-border workers is the residual variable during this sub-period, as it merely adjusts to the growth rates. For the subsequent years, the inflation rate and the rate of growth of labour productivity have been set to 1.9 and 2%, respectively. In order to ensure the stability of the ratio of the wage bill to GDP, the rate of growth of real wages has also been set equal to 2%. According to some BCL calculations, the latter figure is in line with the average real growth rate of wages observed over the period 1970-2001, which reached 1.8% per year.

Consistently with the "unchanged policy" assumption, the **rate of pension contributions** paid either by the employees and the employers or directly by the State remains constant throughout the projection period, at 24% of gross wages. In particular, the mechanism whereby pension contributions would be recalculated every seven years on the basis of new actuarial evaluations by the IGSS is not considered at this stage.

As far as **demographic changes** are concerned, the two crucial variables are the number of births and of immigrants. The number of births has been calculated in order to ensure the stability of the fertility rate over the whole projection horizon. In spite of this assumption, a sharp increase in the number of births is observed due to a steep increase of the Luxembourg population, in particular the young to middle-aged women likely to have children. Immigration is a crucial factor behind this sustained population increase. The scenario adopted in the context of the reference projection postulates a high number of net immigrants, since this number would indeed reach 4,000 persons from 2002 to 2085. Over the 2001-2050 sub-period, this scenario is basically in line with the third variant of the demographic projections published in STATEC (1995b), i.e. the one with the higher hypothesised net number of immigrants.

The mortality tables used in the projection exercise are based on a 2001 table transmitted by STATEC. The mortality rates for the subsequent years are adjusted downward, by - 0.3% a year, which means that mortality rates are supposed to decline by about 20% from 2001 to 2085, in a linear way for all age categories. This would reflect the medical progress over the projection horizon. This rate of decline would be much lower than the decrease observed over the recent past.

Under this set of hypotheses, the Luxembourg population would increase from 444,000 in 2001 to 551,000 in 2020, 709,000 in 2050 and 895,000 in 2085. The latest figures have to be considered with reservation, however, as they postulate the continuation of past trends over a long period of time. In addition, the projections do not include any feedback effect of population developments on economic developments as well as a potential saturation of public infrastructures or the housing capacity. The results of the projections up to 2050 are in line with the number of residents predicted under the "most optimist" variant of the STATEC (1995b) projections. This should not come as a surprise, as the underlying hypotheses are reasonably close to one another. By contrast, the population figure projected by the BCL for 2050 falls

short of the corresponding ILO (2000) figure by about 80,000 inhabitants. This reflects the assumption of a higher inflow of immigrants made by the ILO. The population projections end up being extremely similar once this dissimilarity is removed.[26]

In spite of the absolute importance of the net inflow of immigrants hypothesised in the reference projection, and notwithstanding the facts that net immigrants are considerably younger than the average population, immigration flows would not be sufficient to offset population ageing over the projection horizon. The proportion of residents aged 60 or more would increase in a significant way from 2001 to 2030. Population ageing would temporally stop between 2030 and 2065, as the proportion of people aged 60 or more would stabilise, and at the same time the younger part of the population would tend to become more prominent. However, population ageing would resume from 2065 onwards. This development would be partly attributable to the increase of the population itself, which would decrease the importance of net immigration as a percentage of the resident population. A powerful counterweight to population ageing would therefore gradually fade away. In any case, the identification of a turning point in 2065 further strengthens the need to anchor pension policies on projections that extend beyond the "traditional" boundary of 2050.

Chart 4. Age structure of the resident population

As percentages of the total resident population
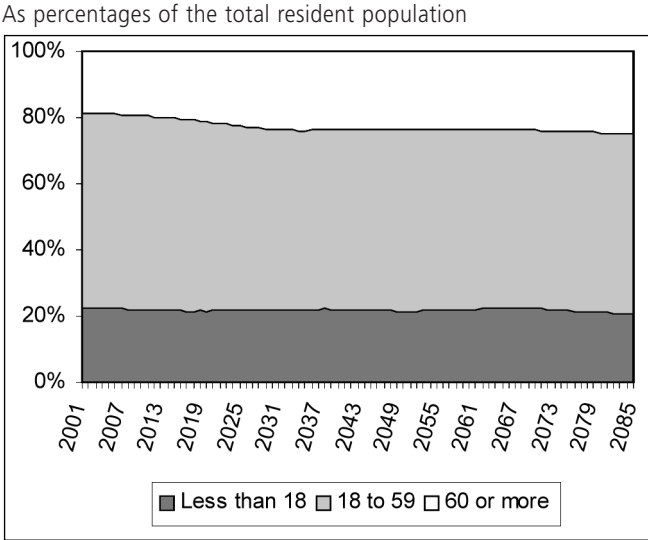
Sources: STATEC, BCL calculations.

Another important hypothesis presiding upon the base projection is an **increase in the labour force participation rate of women**. This evolution would take place in a gradual way over the projection horizon. As a result, the proportion of women in the insured, active resident population would go up from 39% in 2001 to 45% in 2085. All other participation rates would be kept unchanged. Likewise, the proportion of retirees observed for each age category is kept constant throughout the projection horizon. It should also be noted that the **average nominal**

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[26] The ILO postulates that net immigration would go from 2,000 per year during the next 10 years to 3,900 by 2020, 5,750 by 2030, 7,600 by 2040 and 9,500 in 2050.

yield on pension reserves is stuck at 4.5% a year.[27] The latter assumption is far from negligible in Luxembourg, where pension reserves amounted to no less than 22% of GDP in 2001. Finally, all the **measures adopted in the aftermath of the "Rentendësch"** have been included into the projections.

As far as **cross-border** workers are concerned, the net inflow observed during the period 2002-2004 has been inferred in a residual way, in order to ensure that the workforce calculated in the projections moves in tandem with the BCL internal employment forecast. Due to a marked deceleration of the growth of total employment, the inflow of cross-border workers observed during this sub period would slow down considerably compared to the previous years. By hypothesis, the arrival of cross-border workers would then resume at an accelerated pace, with an annual inflow of 7,000 individuals from 2006 onwards. The implicit assumption is that the Luxembourg economy would emerge from the recent growth deceleration relatively unscathed, since real GDP growth would reach approximately 4% over the period 2005-2020. However, it would decline somewhat thereafter, when large numbers of cross-border workers reach the retirement age.

Under the reference scenario, the number of cross-border workers would indeed increase sharply in a first phase. They would represent 43% of the insured, active population in 2020, compared to 34% in 2002. However, this proportion would decrease to 41% in 2040 and 33% in 2085, as a plateau of about 170,000 workers would be reached in 2040.

<u>Chart 5. Number of cross-border workers</u>

In units
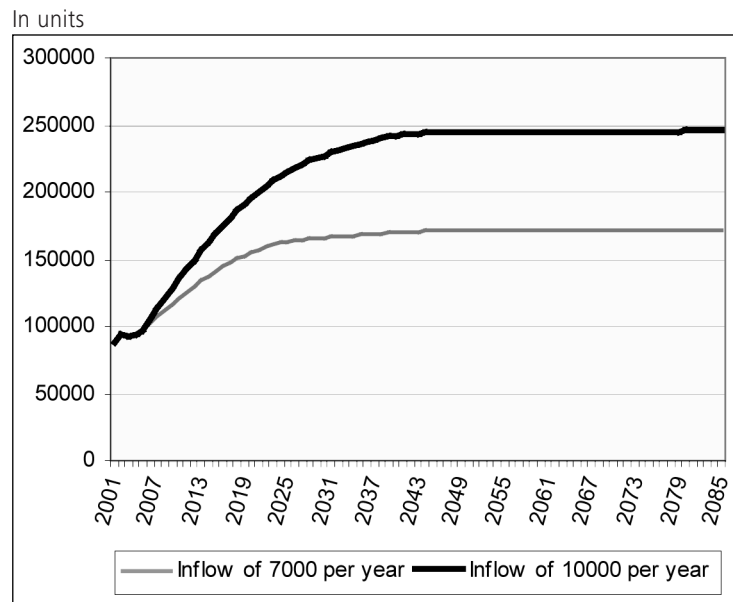
Sources: ILO, IGSS, STATEC, BCL calculations.

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[27] According to IGSS (2002), page 177, the yield was equal to 4.44% in 2001.

The attainment of a plateau seems overly restrictive at first sight, but any scenario with a constant inflow of workers is bound to produce a similar plateau-like result over a long time horizon, even in the case of very large inflows. This is clearly illustrated in Chart 5, where an annual inflow of 10,000 cross-border workers also gives way to a ceiling at around 245,000 cross-border workers. The reason is that the net inflow of cross-border workers is accompanied by an outflow when some commuters reach the retirement age.[28] As most of the current cross-border workers are rather young, the outflow is dwarfed by the net inflow in the present circumstances. However, the proportion of retiring commuters is bound to increase in the future, and this proportion will furthermore apply to a growing absolute number of cross-border workers. To compensate for both effects, the net inflow would have to increase to a considerable extent and in a continuous way. Such an evolution would probably be unsustainable. The net inflow cannot reasonably grow forever, and will necessary stabilise at a given level. This means that the number of cross-border workers will in turn inevitably reach a plateau,[29] at which the rate of growth of GDP will decelerate due to the stagnation of the labour input.

A further indication of the fact that the hypothesis is not overly restrictive is provided by a simple comparison with the corresponding assumptions in ILO (2000). Except at the beginning of the projection period, the increase in cross-border workers assumed in the reference projection is more subdued than in the most "optimistic" scenario of the ILO ("scenario 1"), which was derived in favourable economic circumstances. It should be noted, however, that the final number of cross-border workers inferred on the basis of the BCL model for 2050 is about twice the number recorded under the second scenario of the ILO study.

<u>Chart 6. Budgetary outcomes of the reference projection</u>

As percentages of GDP
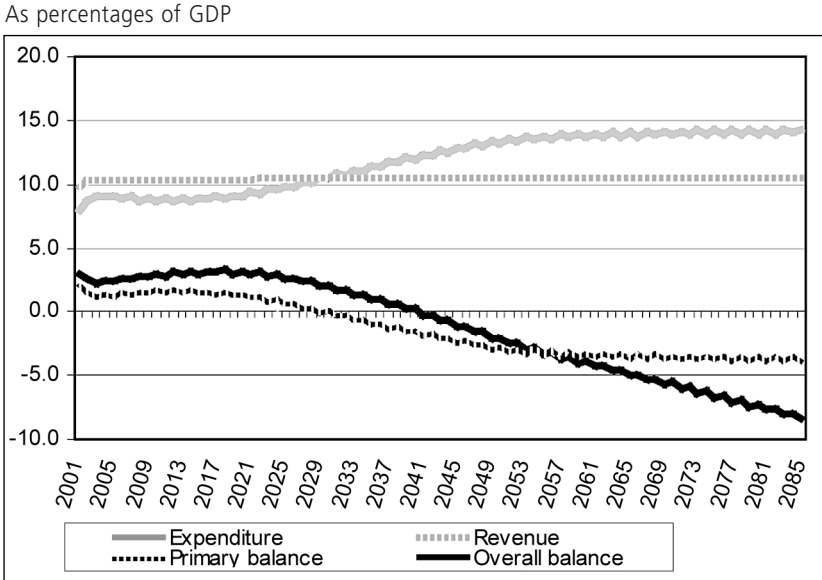
Sources: IGSS, ILO, STATEC, BCL calculations.

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[28] Another outflow consists in those cross-border workers who leave their job in Luxembourg. This type of outflow is treated here as a negative inflow, thus the expression "net inflow".

[29] The steady state number of cross-border workers is related in a linear way to the annual inflow. The former is indeed equal to the latter, divided by the proportion of retiring commuter workers. A higher inflow will therefore result in a commensurately higher final number of commuter workers, but also with a plateau at some point in the future.

The budgetary results associated with the base projection are synthesised in Chart 6. All budgetary results and debt levels are confined to the private pension system. They therefore do not refer to the Luxembourg Central Government and to the other branches of the social security system. The same convention is used throughout the rest of the paper.

As already explained in part II, the situation of the Luxembourg private pension regime is very comfortable at first sight. The pension reserves represent 22% of GDP in 2001 and this percentage would further increase to 49% in 2028, as both the primary ratio and the overall balance would be in surplus over this period. The latter would be enhanced by significant interest revenues, which would reach close to 2% of GDP around 2028.

However, a negative inflection would already occur around 2020, as the overall surplus would begin to decline due to a more sustained increase of pension expenditure. Although this evolution would also be attributable to the retirement of resident employees, it would primarily reflect the retirement of large numbers of cross-border workers that would echo the large inflows of commuters observed - or assumed - around the base year 2001. By contrast to pension expenditure, total revenue would remain remarkably stable at about 10% of GDP throughout the projection period. This is the reflection of the assumed parallelism between the evolution of the tax base - i.e. basically gross wages - and labour productivity, as both would increase by 2% a year from 2005 onwards in a context where the contribution rate would also remain stable at 24% of gross wages. In addition, the evolution of the total workforce would affect the wage bill and GDP in a similar fashion, as GDP growth is linked to the evolution of the number of employees.[30]

The dichotomy between the evolution of expenditure and revenue from around 2020 onwards would imply a deteriorating primary balance, which would turn negative from 2031 onwards. The overall balance would remain in surplus for several more years owing to the aforementioned interest revenues, but it would also record a deficit from 2041 onwards. In this context, pension reserves would gradually decline to 14% of GDP in 2050. Net liabilities would appear from 2055 and the debt would further increase thereafter, to reach 18% in 2060. This adverse evolution would continue afterwards in spite of a stabilisation of the primary deficit at about 4% of GDP. As a result, the debt-to-GDP ratio would reach 109% of GDP in 2085 and the situation would further deteriorate thereafter. Conditionally upon a discount rat of 4.5%, the intertemporal public liability (IPL) calculated over the finite horizon 2001-2085 would reach 150% of the 2001 GDP. However, the IPL increases by 63% of GDP to 213% once a discount rate of 4% is considered instead, which illustrates the lack of accuracy of the IPL as an indicator of fiscal sustainability.

Even the fiscal sustainability condition of Domar (1944), which ultimately rests on a stable deficit-to-GDP ratio, would not be satisfied in these circumstances. The overall deficit would indeed increase in a continuous way throughout the projection horizon. This means that no stabilisation of the debt-to-GDP ratio would be in sight, even at the very end of the horizon.

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[30] The only difference is that the GDP is influenced by the absolute number of workers, whereas the contribution base (gross wages) is also influenced by average wages.

Disregarding the other sub sectors of General Government, the more stringent Maastricht reference criteria would a fortiori be breached, starting in 2055 for the 3% reference value and in 2072 for the 60% threshold. Furthermore, the requirement that the compensation reserve should be higher than 1.5 times the annual pension expenditure would be breached from 2049 onwards.

This scenario could of course be avoided, provided for instance that pension contributions are increased. However, the implementation of a passive strategy, where the authorities would adjust the contribution rate over successive 7-year periods only when the level of reserves would drop below 1.5 times the annual pension expenditure, would require a substantial adjustment from 2048, as shown in Chart 7. The contribution rate would have to be adjusted from 24 to 29.9% in one stroke, in 2048, and would gradually increase to 33.2% in 2085. This move would amount to 2.5% of GDP in 2048 and to 4% over the period to 2085.

The permanent contribution rate compatible with a non-negative level of reserves in 2085 would reach 29% of gross wages. The corresponding tax gap would therefore amount to 5% of gross wages or 2% of GDP.

Chart 7. Reference projection: evolution of social contributions under a "passive" adjustment path

As percentages of gross wages
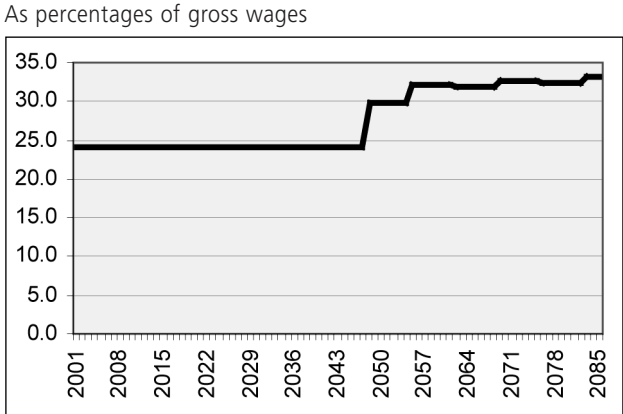
Sources: IGSS, ILO, STATEC, BCL calculations.

As the reference projection crucially depends on the hypotheses used, the question is posed whether these basic features are resilient to different demographic, macro or micro assumptions. The three variants of the reference projection and the sensitivity exercises discussed thereafter are likely to shed more light on the dynamics at play.

3.2 First variant of the reference projection: a population limited to 700,000 residents
The number of residents inferred in the reference projection would exceed 700,000 from 2048. The alternative projection discussed here is based on the assumption that the Luxembourg population will level off at this figure, which could reflect for instance the consequence of an insufficient transport or housing capacity or a saturation of public infrastructures. In order to stabilise the population at 700,000 in the projection framework, the net number of immigrants has been set to zero from 2049 onwards. In these circumstances, the number of births would

also decline, by 1,600 a year. By coincidence, this decline would ensure that the birth rate is in line with the mortality rate for the rest of the projection horizon. In conjunction with the null inflow of immigrants, this would guarantee that the population remains stable around 700,000 Luxembourg residents. By contrast to the number of immigrants, the net inflows of cross-border workers would be unchanged compared to the reference projection.

Chart 8. Pension reserves (+) or debt (-) in case
the population is restricted to 700,000 inhabitants

As percentages of GDP
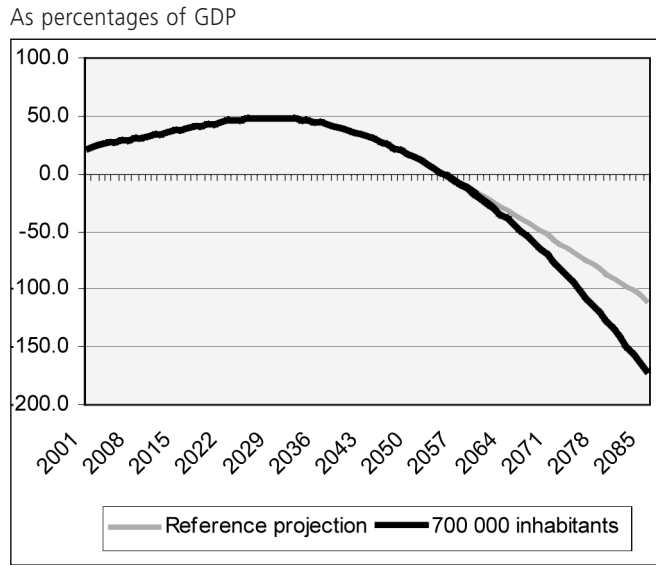
Sources: IGSS, ILO, STATEC, BCL calculations.

As illustrated in Chart 8, the stabilisation of the population at 700,000 would be detrimental to the budgetary equilibrium of the pension system. The debt ratio would indeed deteriorate in a significant way from 2053, as it would reach 171% of GDP in 2085 instead of 109% in the reference projection. This would be related to a marked increase in the borrowing requirement, which would amount to 13.5% of GDP in 2085.

The deterioration in the budgetary situation of the pension system is also clearly illustrated by the evolution of the contribution rate that would ensure compliance with the requirement that pension reserves should be higher than 1.5 times the annual level of expenditure. The contribution rate would indeed have to increase in a drastic way in 2048, to 30% of gross wages instead of 24%. The upward adjustment would continue at a sustained pace during the rest of the projection period and would reach 39% of gross wages in 2085. This illustrates once more that the "1.5 times" rule should be complemented with a more proactive assessment of the budgetary situation of the pension system.

Chart 9. Population restricted to 700,000:
evolution of social contributions under a "passive" adjustment path

As percentages of gross wages

Sources: IGSS, ILO, STATEC, BCL calculations.

These adverse developments are basically linked to the restrictions to the number of net immigrants, which would give way to a sharp decrease in the number of employees and in GDP. In comparison with the reference projection, the workforce would indeed decline by 24,000 units in 2060, 53,000 in 2070 and 100,000 in 2085. This would be reflected in a sharp decrease of GDP, which would be respectively 5%, 11% and 20% below the level reached under the reference projection. As a result, the average GDP growth rate recorded over the period 2050-2085 would reach 1.8%, compared to 2,5% in the reference projection. Due to its relative stickiness, expenditure would therefore drift upwards in a pronounced way from 2050 to 2085.

This result ultimately rests on three explanations. First, immigrants are usually young, and they therefore contribute to increase the labour force. This gives way to a parallel increase in the wage bill, in the amount of social contributions paid and in GDP growth. Second, net immigration has a favourable effect on the number of births due to the young age of immigrants. As shown in part 3.8., such a boost to the number of births is likely to strongly enhance the budgetary stability of the pension system. Third, the impact of net immigration on pension expenditure is less than proportional to its incidence on revenue. The professional career of foreign workers tends to start at a later age than residents. For this reason, their average pension is generally lower.[31] The restrictive immigration policy associated with the stabilisation of the population at 700,000 is detrimental to these various advantages, which explains the unfavourable budgetary results.

An additional advantage of net immigration is that it could be considered as a substitute to a larger inflow of cross-border workers. The number of commuters is indeed bound to reach a ceiling in the future due to the limited pool of available workers in the immediate surroundings of Luxembourg and to the retirement of many commuters in the future.

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[31] By hypothesis, the average pension of immigrants is supposed to be 20% lower than the average pension of residents. This rests on the observation that the average carrier of immigrants is on average lower than the carrier of national residents.

3.3 Second variant of the reference projection: a decrease by 50% of the inflow of cross-border workers

It might be argued that the reference simulation is excessively optimistic as regards the inflow of cross-border workers. It is indeed assumed that this inflow would reach 7,000 individuals a year, which is even more than the average level observed over the period 1990-2000, under very favourable economic circumstances. Such an inflow would give way to a sustained increase of the total number of cross-border workers, which would reach a plateau at 172,000, namely approximately twice the level observed in 2001.

In order to test for this possible bias, an alternative scenario has been elaborated, in which the net inflow of cross-border workers is reduced from 5000 to 4000 in 1995 and from 7000 to 4000 a year over the period 2006-2085. As illustrated in Chart 10, a plateau-like evolution would emerge under these circumstances, but at a much lower level of 98,000 against 172,000 in the reference projection. In addition, the plateau would be reached much earlier. The less sustained evolution would depress GDP growth, which would be confined to 2.6%, on average, from 2001 to 2050. It would reach the same rate as under the reference projection from 2050 to 2085.[32]

Chart 10. Number of cross-border workers: comparison between the reference scenario and the alternative scenario (inflow of 4000 commuters a year)
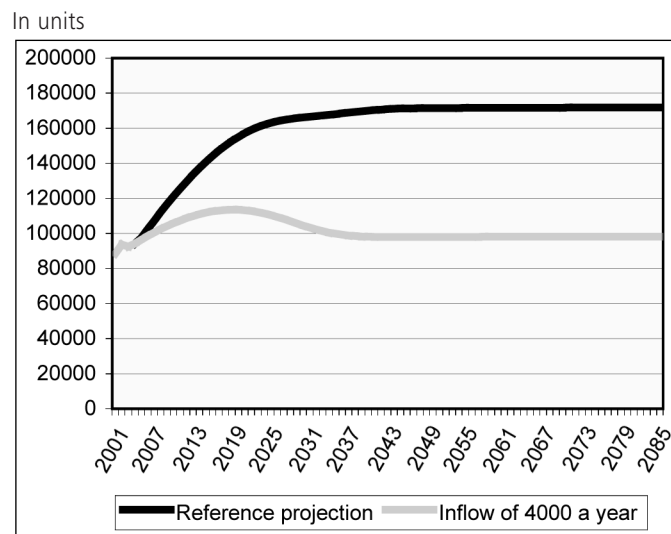
Sources: IGSS, ILO, STATEC, BCL calculations.

The decelerated inflow of commuters would have an unfavourable impact on the financial balance of the pension system during the forecast horizon, as illustrated in chart 11. Revenue expressed in nominal terms would significantly decrease in line with the much more subdued rate of economic growth, but would remain broadly stable as a percentage of GDP. By contrast, expenditure would increase in a significant way as a percentage of GDP. Due to the rather young average age of cross-border workers, the lower contingent would not have a significant impact on nominal pension expenditure before 2010. As can be seen in Chart 11, part b, the

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[32] The reason is that the total number of cross-border worker was already stagnant between 2050 and 2085 in the reference projection.

decrease of nominal expenditure compared to the reference scenario would not exceed 5% before 2033, but it would reach about 17% from 2060 onwards. GDP would reach the bottom nearly 30 years before pension expenditure due to the immediate impact on the workforce of the more limited inflow of cross-border workers.

In a first stage, this joint evolution would determine a strongly negative impact on the budgetary balances. The primary balance would deteriorate by a maximum of 1.4% of GDP in 2033 compared with the reference projection. The change in the overall balance would be even more pronounced, as it would reach 2.3% of GDP in 2039. In this adverse context, the pension reserves would be lower by 26% of GDP in 2040.

However, the contribution of the lower inflows of cross-border workers would turn positive thereafter, as the number of retired cross-border workers would start to decrease in comparison with the reference simulation. The adverse impact of the lower inflows on the budgetary indicators would therefore fade away in a gradual manner. The result recorded in 2085 would still be less favourable than under the reference projection as regards the debt level and the overall balance, but some alternative simulations carried out over a longer horizon suggest that the debt ratio would be back to the level reached in the latter projection around 2100. This highlights the fact that an increased inflow of cross-border workers is not likely to enhance the budgetary prospects of the pension system over a long time horizon.

Chart 11. Decreased inflow of cross-border workers

a. Deviations from the reference scenario, as percentages of GDP

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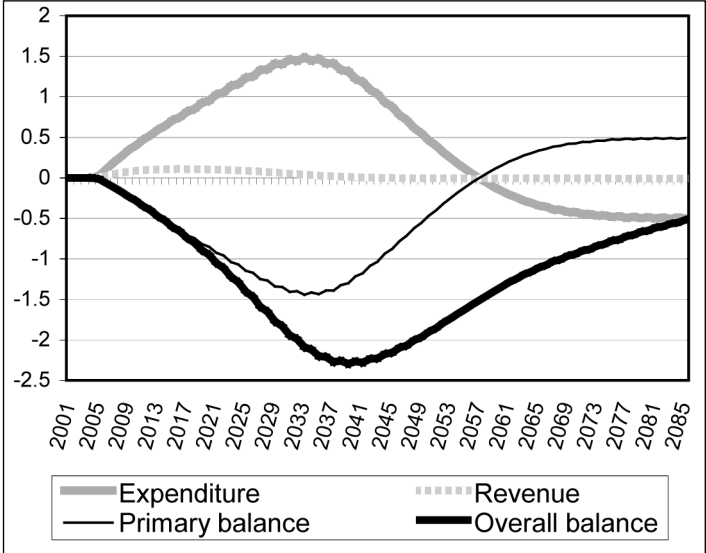
b. Total pension expenditure and nominal GDP; Indices:
reference scenario = 1
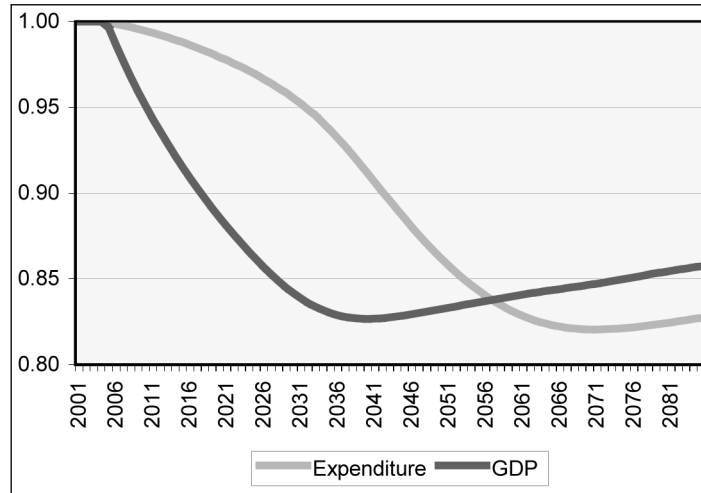
Sources: IGSS, STATEC, BCL calculations.

The impact of a lesser inflow of cross-border workers is negative over the projection horizon, and it is more so than in the case of a lesser inflow of immigrants in spite of a similar age profile. The main reason for this discrepancy is the impact of foreign residents on the number of births in Luxembourg, which has a favourable impact on the financial equilibrium of the pension system.

Stated otherwise, net immigration seems to be a more effective means to offset population ageing, due to this indirect impact on the number of births. A very high and continuously growing inflows of commuters would indeed be required in order to avoid the attainment of a plateau-like situation in the total number of cross-border workers. However, such a "rolling over" strategy is probably unsustainable over the long term.

The simulation also offers a clear illustration of the need to extend the projection horizon long into the future, and especially beyond 2050. The budgetary impact of changes in the inflow of cross-border workers is indeed strikingly different before and after the pivotal year 2050.

<u>3.4 Third variant of the reference projection: no implementation of the "Rentendësch" measures</u>
In order to assess the cost of the measures agreed upon at the "Rentendësch" in a more dynamic context, an alternative to the reference projection has been run, where the latter measures are disregarded. A comparison with the reference projection provides a dynamic assessment of the cost of the new measures, where account is taken of the interaction with population ageing, the macroeconomic assumptions and some micro features of the pension system, like future adjustments of pensions to the price level or to the evolution of real wages. The results of the comparison, which are displayed in Chart 12, show that the cost expressed as a percentage of GDP is likely to be much higher than is commonly held.

Chart 12. Impact of the pension measures agreed upon at the "Rentendësch"

As percentages of GDP
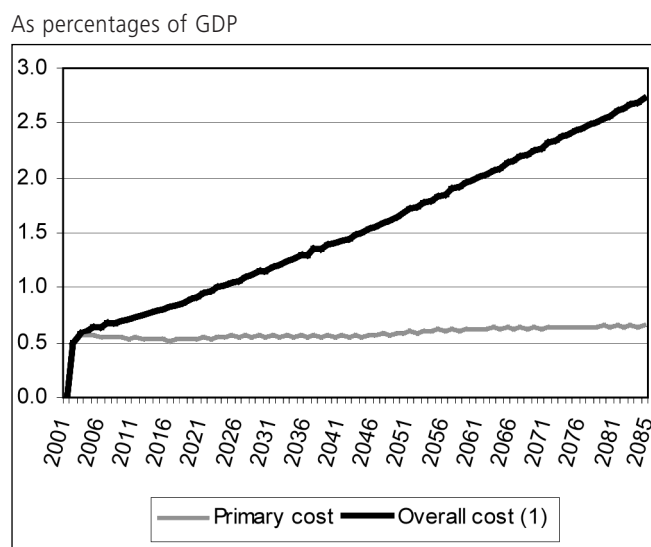
Sources: IGSS, STATEC, BCL calculations.
(1) The overall cost includes the impact of the "Rentendësch" measures on interest charges.

The increase in pension expenditure would reach about 0.5% of GDP in 2002, once account is taken of the implementation of the new measures from the 1 March. The full-year cost of the measures would be observed from 2003, when it would reach 0.6% of GDP. It would remain broadly stable around this level over the projection horizon, with a slight increase to 0.7% in 2085. This small drift is attributable to the ageing of the Luxembourg population projected for this period. In addition, the number of cross-border workers going to retirement would increase compared to the current situation.

The "Rentendësch" measures appear even more costly once account is taken of the additional interest expenditures involved. These measures would indeed contribute to lower the overall balance by 1% in 2020 already, by close to 2% in 2050 and by about 3% in 2085. The new pension measures would also induce a marked increase in the debt-to-GDP ratio. Their contribution to this ratio would indeed amount to 26% and 48% of GDP in 2050 and 2085, respectively. Without the implementation of the new pension measures, the ratio would indeed amount to 61% of GDP compared to 109% in the reference projection.

All the aforementioned figures should be interpreted with caution, especially when they are calculated in the distant future. The simulations do not take into account potential feedback effects of the new pension measures on variables such as the labour force participation rates or households consumption. Moreover, the figures are also dependent on various hypotheses related to macroeconomic, demographic developments and cross-border workers. However, they provide an insightful illustration of the need to consider interest charges and all relevant future developments when new pension measures are decided upon.

3.5 First sensitivity analysis: alternative macroeconomic assumptions

In a first simulation, the annual increase of wages is set to 3% instead of 2% during the sub-period 2005-2010. However, this annual increase is back to the figure of 2% used in the reference projection from 2011 to 2085. The projection does not take into account the impact of such a wage increase on competitiveness, as the rate of GDP growth is unchanged compared to the reference projection.

As shown in Chart 13, the departure from the reference scenario is significant and long lasting, in spite of the temporary nature of the acceleration in wage increases. The impact on balances and reserves is favourable in the immediate aftermath of the shock, as contributions would grow in excess of total expenditure. As a result, pension reserves would culminate at 51.5% of GDP in 2028 instead of 48.6 in the reference scenario. The immediate growth in total revenue is attributable to the direct link between pension contributions and gross wages. Total expenditure also tends to move in tandem with gross wages, because pensions are adjusted to the growth of real wages in Luxembourg. However, the latter adjustment comes with a delay, as it takes place every two years. A positive impact on the primary balance is observed in the meantime, and this drift continues as long as wages continue to grow at a more sustained pace.

Chart 13. Accelerated wage increase from 2005 to 2010: differences in budgetary outcomes with respect to the reference scenario

As percentages of GDP
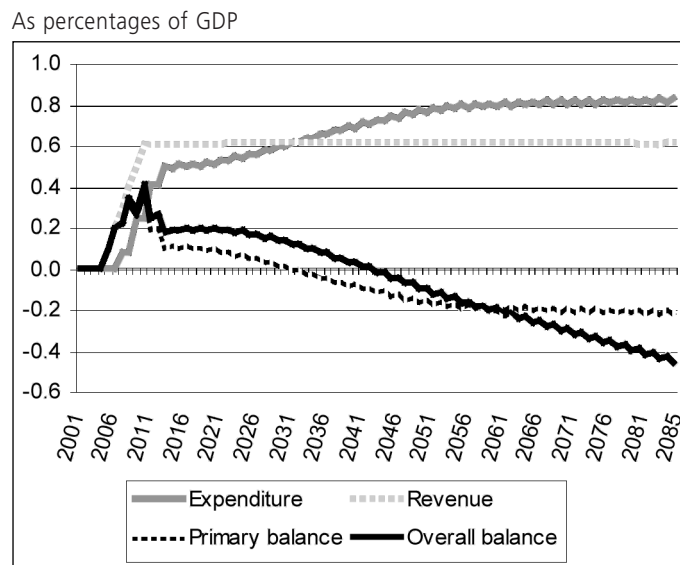
Sources: IGSS, STATEC, BCL calculations.

However, this impact fades away as soon as the increase of wages is back to the "reference" path of 2%. In addition, average wages are higher by 5% from 2010 onwards and for the rest of the projection period, which means that the budgetary imbalance caused by population ageing and cross-border workers is further magnified. This explains the continuous increase in expenditure from 2020. The final result is a permanent deterioration in the primary balance by 0.2% of GDP from 2050 onwards. This worsening in turn induces a permanent downward drift in the overall balance, which would deteriorate by 0.4% of GDP in 2085. Accordingly, the debt-to-GDP ratio would increase by 6% of GDP in 2085 compared to the reference scenario. These

results clearly illustrate the need for reasonable wage increases in a context where wages and pensions are linked to one another.

The second simulation focuses on a purely illustrative, fictitious scenario. It postulates an increase in inflation by 1%, from 1.9 to 2.9%, over the period 2005-2085. Interest rates are adjusted upwards in a commensurate manner, from 4.5 to 5.5%, in order to guarantee a constant real rate of interest. In other words, financial investors are supposed to ask for a higher premium in order to offset the accelerated inflation. As shown in Chart 14, the higher inflation rate does not have any impact on the primary balance, even at the beginning of the projection period. The reason is that the contribution base, i.e. gross wages, and pension rights are adjusted to inflation in a similar way in Luxembourg, under the aegis of the automatic indexation mechanism.

After an initial phase where higher interest revenue would magnify the existing pension reserves, the overall balance would deteriorate as a result of the higher nominal interest rates, to the point where the additional deficit would reach 1% of GDP in 2085, which would further impair the compliance with the 3% Maastricht reference value. However, the higher inflation rate would not per se complicate the adherence to the debt reference value. The debt-to-GDP ratio would indeed be absolutely unchanged with respect to the reference projection, because the impact of the additional overall deficit would be offset by a higher increase in nominal GDP.

Chart 14. Increase by 1% of the inflation rate and the interest rate (2005-2085): differences in budgetary outcomes with respect to the reference projection

As percentages of GDP
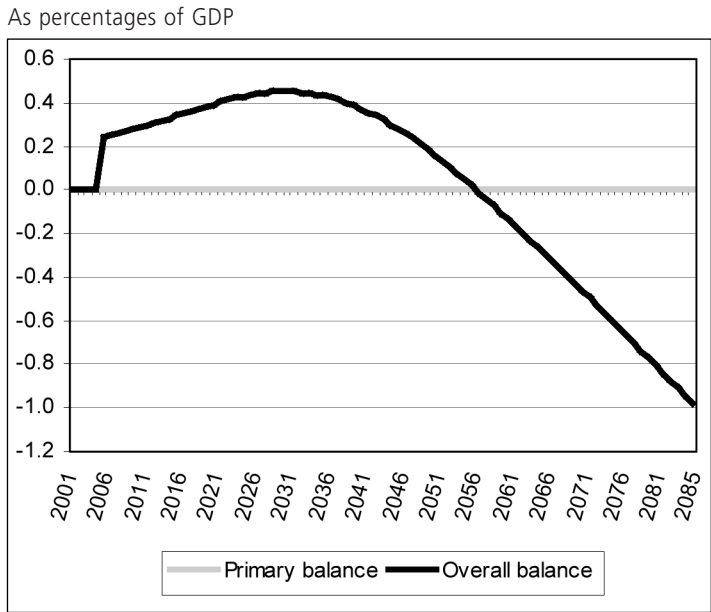
Sources: IGSS, STATEC, BCL calculations.

The conclusion of the simulation is that a higher inflation rate would require additional expenditure cuts or contribution increases in order to ensure the continued compliance of the Luxembourg General Government with the 3% reference value. It should be borne in mind that this impact of inflation is observed irrespective of the many other downsides of inflation. In particular, the incidence of inflation and of its volatility on the economic behaviour of investors

or corporations is not taken into account. This would probably lead to a lower GDP growth rate, and that would in turn further deteriorate the prospects of the Luxembourg pension system.

3.6 Second sensitivity analysis: a higher implicit revenue on pension reserves
In order to provide some evidence on the management of pension reserves to the participants in the roundtable on the pension system, the Government ordered a specific analysis to PricewaterhouseCoopers (PWC) in 2001. The salient conclusions of the study are the following:

- The management of pension reserves should pay attention to the security, liquidity and return of financial investments. Given the amounts at stake, a sound management could contribute in a significant way to economic and social progress.
- A larger proportion of pension reserves should be invested in longer-term financial instruments, which would contribute to enhance the average return.
- Pension reserves would ideally be managed by a new, special-purpose UCIT, whose statutes would be in accordance with the 19 July 1991 law. This would guarantee that assets would be managed in a centralised and co-ordinated way. That would in turn translate into significant economies of scale.

Figures from IGSS (2002) confirm the relevance of these recommendations. First, the most important investment items in 2001 were long-term loans (EUR 796 million) and short-term investments (EUR 2644). By contrast, securities (including bonds) amounted to EUR 463 million only, i.e. less than 10% of pension reserves. Second, the average return of pension reserves did not exceed 4.44% in 2001, and was even lower the year before (4.09%). These rates are quite low, even in comparison with medium-term bond yields. In order to illustrate the importance of the issue at stake, the impact of an increase in the implicit return of pension reserves from the 4.5% assumed in the reference projection to 5.0% has been assessed.

Chart 15. Impact on the net assets of the private pension system of a higher implicit return on reserves by 0.5% (difference with respect to the reference projection)

As percentages of GDP
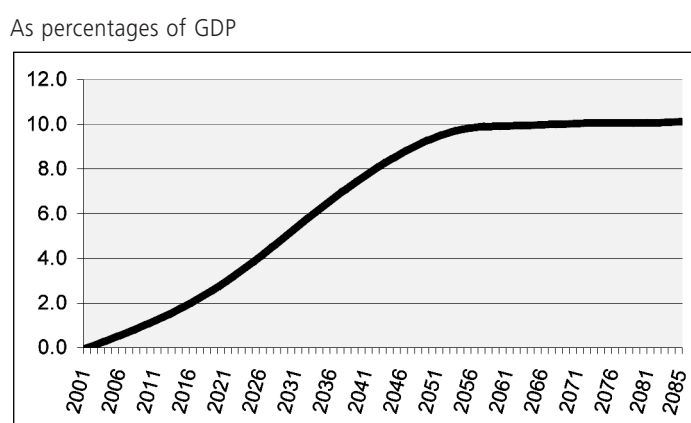
Sources: IGSS, STATEC, BCL calculations.

In spite of the small magnitude of the adjustment, its impact on the debt-to-GDP ratio would be noteworthy. In a first stage, the higher return would of course contribute to enhance the building up of pension reserves. As a result, the compensation reserve would reach 24% of GDP

in 2050, compared to 14% only in the reference simulation. This improvement by 10% of GDP would remain constant throughout the rest of the projection horizon, even after the advent of net liabilities.[33]

3.7 Third sensitivity analyses: a lower labour force participation rate

Pursuant to the conclusions of the Lisbon summit, the EU Member States should strive to increase their labour force participation rates. These objectives also apply to Luxembourg, where the labour force participation rate is among the lowest in Europe, especially for women.[34] For this reason, it was assumed in the reference simulation that the participation of women to the workforce would increase in a continuous way from 2001 to 2085, which would bring the share of women in the resident workforce from 39 to 45%. The present projection consists in a departure from this hypothesis, as it relies on the assumption of constant labour force participation rates throughout the projection horizon.

As illustrated in Chart 16, a lower participation rate would entail an increase of pension expenditure as a percentage of GDP, which would be the mere reflection of a significantly lower GDP level. As the wage bill would be kept constant as a percentage of GDP throughout the projection horizon and due to the absence of any assumed increase in the contribution rate, the ratio of pension revenue would also remain unchanged. In this context, both the primary and the overall balance would deteriorate significantly. As a result, the pension regime would already incur net liabilities in 2052, and the debt would amount to 142% of GDP in 2085, compared to 109% in the reference projection.

Chart 16. Constant labour force participation rates: comparison with the reference projection

As percentages of GDP
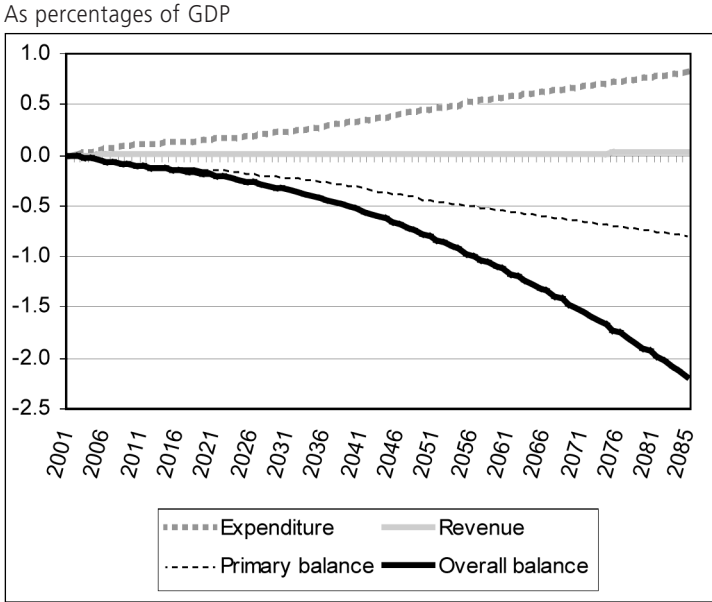
Sources: IGSS, STATEC, BCL calculations.

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[33] The interest rate paid on liabilities is kept equal to the level assumed in the reference simulation.
[34] This is clearly illustrated in Economic Policy Committee (2002), page V, where it appears that the employment rates of workers aged 55-65 was the lowest in the EU, with less than 25% in 2001.

3.8 Fourth sensitivity analysis: increase in the number of births

An increase in the fertility rate by 15% from 2005 onwards would significantly improve the prospects of the Luxembourg pension regime, as shown in Chart 17. Total expenditure in nominal terms would remain broadly unaffected before 2060, when the first new-borns go to retirement. By contrast, nominal GDP would increase significantly from about 2020 onwards, as these new-borns are gradually integrated into the Luxembourg workforce. Compared to the reference scenario, GDP would be about 5% higher in 2050, and the corresponding gain would reach 7.2% by 2085. Accordingly, expenditures expressed as a percentage of GDP would sharply decrease during the period 2002-2060 compared with the reference projection. Due to the stability of total revenue as a percentage of GDP, the lower expenditure to GDP ratio would result in a commensurate improvement of the primary balance, and the overall balance would be further magnified due to a virtuous decrease in interest expenditure.

Chart 17. Incidence of an increase in the fertility rate by 15% from 2005:
deviations from the reference projection

As percentages of GDP
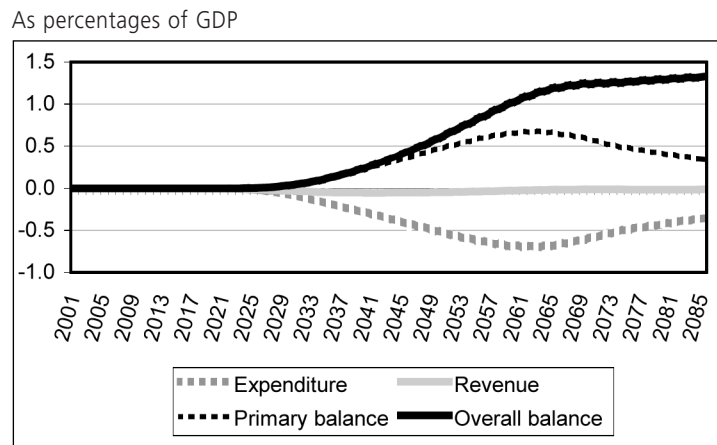
Sources: IGSS, STATEC, BCL calculations.

The favourable impact on pension expenditure and the primary balance would tend to wither away after 2060, as the new-borns arrive to retirement. However, the impact would remain positive throughout the period. Furthermore, the effect on the overall balance would basically continue to grow, as it would reach close to 1.5% of GDP at the end of the projection period. In such a context, the reserves of the pension system would improve by 4% of GDP in 2050 and the debt-to-GDP ratio would decline by 23% in 2085.

Concluding remarks

The paper has provided some quantitative indications about the future prospects of the private pension regime in Luxembourg. The results of the projections have to be interpreted with caution. On the one hand, Luxembourg is a small open economy exposed to idiosyncratic shocks, and has to rely to a considerable extent on cross-border and foreign workers. The derivation of accurate macroeconomic and demographic assumption becomes very difficult in such a context, especially over a long-term horizon. On the other hand, a departure from the initial hypotheses can have a far-reaching impact on the projection results, in particular at the end of the projection horizon.

A reference projection illustrated that the long-term sustainability of the general pension regime is far from guaranteed, especially after 2050. Although a reserve would still be observed in 2050, a debt position would already appear in 2055. The debt level would reach 18% of GDP in 2060 and 109% in 2085, which underlines the importance of the choice of a particular time horizon for the projections.

Some alternative projections were also carried out. They highlight the considerable importance of the inflow of cross-border workers and immigrants. The number of commuters is bound to reach a plateau at some stage in the future, which would impair economic growth. This negative development could be palliated by an increased recourse to immigration. By contrast, a limitation of the Luxembourg population to 700,000, for instance, would entail a severe restriction of immigration flows and, consequently, a deterioration of the budgetary prospects of the private pension regime.

A second salient message is that the overall cost of the new pension measures adopted in the aftermath of the "Rentendësch" is usually underestimated, because no account is taken of the interaction between these measures and a range of dynamic evolutions in the demographic field and as regards the future pensions of cross-border workers. In addition, the impact of the measures on interest charges is usually disregarded.

Some sensitivity analyses also illustrated that the debate should not focus too much on the rate of GDP growth per se. The structure of economic growth, and in particular the evolution of wages compared to productivity growth, is indeed a crucial factor. A relatively low rate of growth accompanied by moderate wage increases may be preferable, from a sustainability viewpoint, to a higher but less balanced rate of growth. In addition, inflation would negatively affect the overall balance of the pension regime.

Finally, the considerable importance of the way pension reserves are managed has been underlined. Even a small increase in the implicit revenue on pension reserves could greatly enhance the long-term prospects of the private pension regime.

Both the reference projection and the alternative projections suggest that the sustainability of the pension system is far from guaranteed in the medium to long term, which would also entail a deterioration of the budgetary prospects of the Luxembourg General Government considered

as a whole, which includes the social security system, the municipalities and the Central Government. In these adverse circumstances, the latter entity should implement a rigorous budgetary policy from the outset. The conjunction of a Central Government deficit and a growing borrowing requirement of the pension system would indeed put the continuous compliance with the Maastricht reference values at risk in the future.

As regards more specifically the pension system, it is of the foremost importance to apply the "precaution principle". The implementation of this principle over a long-term horizon would usefully complement the requirement that the pension reserves of the Luxembourg private pension regime should be higher than 1.5 times the annual level of pension expenditure. Although this rule could help prevent an excessive deterioration of the budgetary equilibrium, it is not sufficiently proactive. A purely mechanistic implementation of the rule could indeed result in adjustments in contribution rates that are too late and, therefore, excessively large.

Annex 1. The present value budget constraint

The present value budget constraint is a cornerstone of any sustainability analysis. The starting point of the constraint is the present value budget constraint (PVBC):

$$D_{t+1} = D_t * (1 + i_t) + B_{t+1} \qquad (1)$$

Solving forward, the equation becomes:

$$D_t = \sum_{j=0}^{T} \frac{B_{t+j}}{(1+i)^j} + \frac{D_{t+T}}{(1+i)^T} \qquad (2)$$

where T tends to infinity, i is the nominal interest rate and the last term represents the terminal stock of debt.

The PVBC in its version (2) means that the present value of all future revenue must be higher than the present value of future primary expenditure by a margin that is sufficient to finance the difference between the current stock of debt and the discounted value of the terminal stock of debt. Equation (2) is not very constraining, and is therefore an inadequate guideline to sustainability. This constraint could indeed be satisfied even under a strategy where the government borrows continuously in order to roll over both the principal and the interest payments. Stated otherwise, it would be able to behave according to the "Ponzi game", while complying at the same time with the PVBC.

In order to remove this adverse situation, a no-Ponzi game restriction is usually imposed, whereby the discounted value of the terminal debt is equal to 0. This means that the condition is imposed that the stock of debt does not grow faster than the interest rate.

The final form of the PVBC privileged in the economic literature is therefore:

$$D_t = \sum_{j=0}^{\infty} \frac{B_{t+j}}{(1+i)^j} \qquad (3)$$

Which means that the present value of all future primary surpluses should match the current stock of debt.

A growing debt to GDP ratio could be observed even under condition (3). This would be the situation in a case where the interest rate would be higher than the nominal rate of growth. Should the growth rate of the stock of debt be between these two values, the no-Ponzi condition would be respected, but at the same time the debt to GDP ratio would increase in a continuous way.

Annex 2. The hypotheses that underlie the reference simulation

A.2.1 Macro-economic environment

	Inflation rate	Real wage increases	Labour productivity
2002	2.1	1.4	-2.2
2003	1.4	1.3	1.9
2004	1.7	1.4	1.7
2005	1.9	2.0	2.0
2006	1.9	2.0	2.0
2007	1.9	2.0	2.0
2008	1.9	2.0	2.0
2009	1.9	2.0	2.0
2010	1.9	2.0	2.0
2011-2085	1.9	2.0	2.0

The GDP growth rate would be determined in an endogenous way, except from 2002 to 2004.

The rate of pension contributions would be kept at 24% of gross wages throughout the projection horizon.

The implicit nominal interest rate on pension reserves or liabilities would be equal to 4.5% throughout the projection horizon.

A.2.2 Demographic factors

Annual number of **births**:

	Men	Women	Total
2002	2850	2850	5700
2003	2850	2850	5700
2004	2850	2850	5700
2005	2850	2850	5700
2006	2850	2850	5700
2007	2850	2850	5700
2008	2900	2900	5800
2009	2900	2900	5800
2010	2900	2900	5800
2011-2020	3250	3250	6500
2021-2030	3650	3650	7300
2031-2050	4000	4000	8000
2051-2085	4900	4900	9800

These rates would ensure that fertility rates remain stable at the level observed in 2001.

The **mortality rate** would decline by 0.3% a year over the entire projection horizon.

Net immigration per year:

	Men	Women	Total
2002	2000	2000	4000
2003	2000	2000	4000
2004	2000	2000	4000
2005	2000	2000	4000
2006	2000	2000	4000
2007	2000	2000	4000
2008	2000	2000	4000
2009	2000	2000	4000
2010	2000	2000	4000
2011-2020	2000	2000	4000
2021-2030	2000	2000	4000
2031-2050	2000	2000	4000
2051-2085	2000	2000	4000

A.2.3 Micro features of the pension system

The proportional adjustment is set at 1.85% from 2003 to 2085. It is set at 1.84 in 2002 in order to allow for the fact that the new pensions measures are not effective before March. The fixed ("forfaitaire") adjustment increases by 11.9% from 2003 compared to 2001. The corresponding figure reaches 9.9% in 2002, once again because of the introduction from March onwards. The new end-year allowance is also introduced. It is proportional to the length of the career. All the other pension measures decided upon at the Rentendësch, which account for about 13% of the total cost of the whole package, are integrated as a proportional increase of all pensions by 1.1%.

A.2.4 Number of cross-border workers

Net annual inflow of cross-border workers:

	Men	Women	Total
2002	4570	2150	6720
2003	285	135	420
2004	2275	1070	3345
2005	3400	1600	5000
2006	4760	2240	7000
2007	4760	2240	7000
2008	4760	2240	7000
2009	4760	2240	7000
2010	4760	2240	7000
2011-2085	4760	2240	7000

A.2.5 Labour force participation rates

The female labour force participation rate would increase in a linear way from 2001 to 2085. As a result, the proportion of women in the resident workforce would go up from 39% of GDP in 2001 to 45% in 2085.

List of abbreviations

AVI: Etablissement d'Assurance contre la Vieillesse et l'Invalidité.
BCL: Banque Centrale du Luxembourg.
CFL: Chemins De Fer luxembourgeois.
CPA: Caisse de Pension Agricole.
CPACI: Caisse de Pension des Artisans, Commerçants et Industriels.
CPEP: Caisse de Pension des Employés Privés.
EU: European Union.
GDP: Gross Domestic Product
IGSS: Inspection Générale de la Sécurité Sociale.
ILO: International Labour Organisation.
IPL: Intertemporal Public Liabilities.
IMF: International Monetary Fund.
OECD: Organisation for Economic Cooperation and Development.
PAYG: Pay-As-You-Go.
PVBC: Present Value Budget Constraint.
STATEC: Service central de la Statistique et des Etudes Economiques.
UCITs : Units for Collective Investment Undertakings.

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