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THE TRANSITION FROM PAYG TO FUNDING: APPLICATION TO THE LUXEMBOURG PRIVATE SECTOR PENSION SYSTEM

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THE TRANSITION FROM PAYG TO FUNDING: APPLICATION TO THE LUXEMBOURG PRIVATE SECTOR PENSION SYSTEM

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Résumé non-technique

Les perspectives budgétaires du régime général sur un horizon de long terme

Un récent rapport préparé par le Comité de Politique Economique et par la Commission européenne met en exergue la forte augmentation attendue des dépenses de pension au Luxembourg, qui s'accroîtraient de plus de 7% du PIB de 2004 à 2050, soit la plus forte progression de l'Union européenne après le Portugal et Chypre. Comme l'indiquent de récentes projections de l'IGSS, le régime général de pension du Luxembourg est d'ailleurs susceptible d'enregistrer d'importants déficits dès 2020, alors qu'il dégage pour l'instant de substantiels excédents. Sous l'hypothèse d'une croissance du PIB réel égale à 3% par an à partir de 2030, les réserves du régime général laisseraient la place à une dette substantielle, qui atteindrait quelque 49% du PIB en 2050. Un scénario alternatif, où la croissance serait limitée à 2,2% par an, donnerait lieu à une évolution encore plus préoccupante. Dans ce dernier cas, l'endettement du régime général de pension se monterait en effet à 151% du PIB en 2050 selon l'IGSS. Comme l'indique le graphique ci-dessous, les projections actualisées de la BCL, qui reposent sur les hypothèses synthétisées au tableau suivant, livrent des résultats similaires vers 2050. De surcroît, la prise en compte par la BCL d'un horizon de projection plus long, qui permet d'incorporer l'ensemble du cycle de vie des nombreux frontaliers qui ont rejoint la population active du Luxembourg depuis le début des années quatre-vingt-dix, met en relief une accélération de la détérioration budgétaire au cours des années ultérieures à 2050. La détérioration budgétaire serait imputable dans une large mesure à l'arrivée à l'âge de la pension d'importants contingents de frontaliers et de résidents étrangers. Selon le rapport annuel 2004 de l'IGSS, les frontaliers ne représentaient que 17,6% des prestations en 2004, ce qui est nettement inférieur à leur part dans les cotisations – soit plus de 30%. Ce décalage donne lieu à un excédent certes substantiel, mais qui est nécessairement appelé à s'étioler. Même une croissance du PIB de 4% par an ne permettrait pas d'assurer la soutenabilité à terme du régime général de pension. En outre un tel scénario présuppose un accroissement peu réaliste du nombre de frontaliers, qui dépasserait le million à la fin de l'horizon de projection.

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Tableau 1R: Hypothèses de base des projections de pension actualisées de la BCL

	Inflation	Croissance du PIB	Salaires réels	Productivité du travail
2004-2007	Projections d'automne 2005 de la BCL (1)			
2008-2085	1,9%	3,0%	2,0%	2,0%

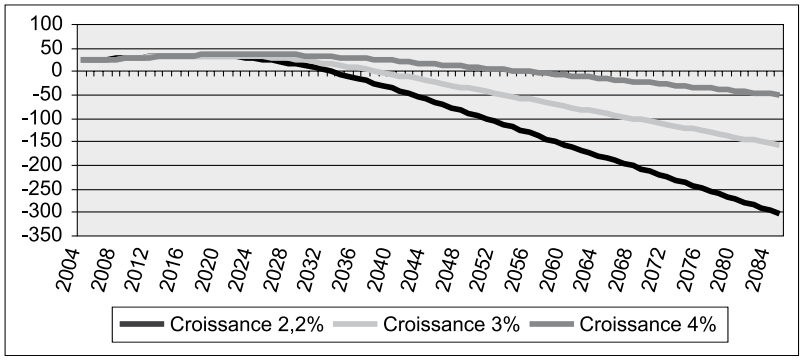
Natalité	Fertilité constante au niveau atteint en 2004
Mortalité	Hypothèse semblable à celle retenue par le BIT dans son étude de 2000
Immigration	4 000 immigrants par an de 2008 à 2085
Frontaliers	Dépend du taux de croissance postulé (variable résiduelle)
Taux de participation au marché du travail	Augmentation graduelle pour les femmes et stabilité pour les hommes. Les femmes représenteraient par conséquent 45% de la population assurée en 2085, au lieu de 39% en 2004. Par hypothèse, le taux de chômage des résidents serait constant.

(1) Les simulations décrites ci-joint ont été effectuées avant la finalisation des projections de printemps 2006 de la BCL. Sur un horizon de long terme, l'inclusion de ces projections ne modifierait cependant les résultats commentés ci-dessous que de façon marginale.

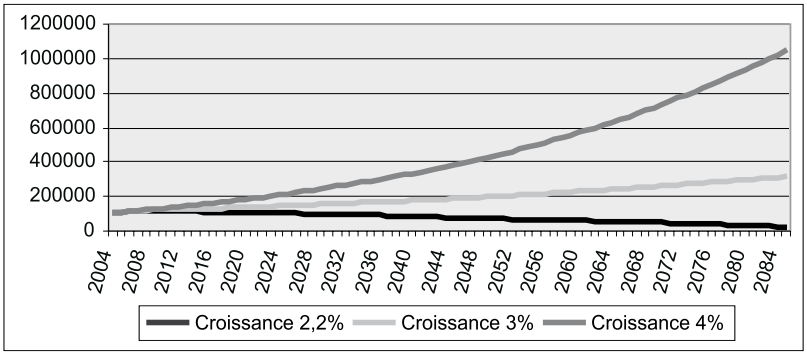
Dans un ouvrage publié en 2004, Franco Modigliani et Arun Muralidhar (2004) affirment que de nombreux problèmes inhérents aux systèmes de pension par répartition pourraient être palliés, voire même éradiqués grâce à la mise en place de mécanismes de capitalisation « defined benefits ». Le présent encadré évalue la pertinence d'une telle proposition dans le cas spécifique du Luxembourg. Par souci de simplicité, il est supposé que la proposition de Modigliani et Muralidhar serait appliquée à l'ensemble du régime général de pension. Or les auteurs eux-mêmes considèrent que dans certains cas, une capitalisation partielle pourrait se justifier.

Graphique 1R: Projections de pension actualisées: les principaux résultats budgétaires

1. Evolution des réserves (+) ou des engagements (-) du régime général de pension (en % du PIB)



2. Nombre correspondant de frontaliers



Sources: BIT, IGSS, STATEC, calculs BCL.

Mise en œuvre dans le cadre luxembourgeois des propositions de Modigliani et Muralidhar

Dans un premier stade, la BCL a simulé « à politique inchangée par ailleurs » la mise en œuvre graduelle des propositions de Modigliani et Muralidhar, à savoir la transition d'un régime de pension régi par la répartition à un système fonctionnant sous l'égide d'un fonds public (le « Fonds » dans la suite du texte), dont les avoirs pourraient être gérés avec le concours de sociétés privées. A l'instar du présent régime, ce Fonds payerait des pensions selon le principe des « defined benefits », qui serait compatible avec la formule de calcul des pensions actuellement en vigueur au Luxembourg. Un système de « swap » entre le Fonds et l'Etat permettrait de garantir à tout moment le respect des engagements « defined benefits », même en cas de fléchissement imprévu du rendement des réserves. En vertu de ce swap, l'Etat effectuerait un transfert spécifique en faveur du Fonds en cas de rendement inférieur à un taux de référence donné, tandis qu'un transfert en sens inverse surviendrait lorsque le rendement excéderait ce seuil. Par hypothèse, la réforme serait mise en œuvre dès décembre 2007. A cette date, les réserves du régime général seraient dans leur intégralité transférées au Fonds. Les prestations de pension feraient également l'objet d'un transfert au Fonds, qui s'effectuerait cependant de manière très graduelle. Les pensions payées à un affilié ne seraient en effet prises en charge par le Fonds qu'au prorata des cotisations payées par cet affilié à partir de la mise en œuvre de la réforme. Les autres prestations dont cet affilié bénéficie seraient toujours régies par le régime général de répartition. A titre d'exemple, un affilié ayant effectué l'ensemble de sa carrière avant la mise en œuvre de la réforme resterait à charge du régime de répartition pendant l'intégralité de sa période de pension, même après 2008. En revanche, un affilié qui aurait versé des cotisations pendant 30 ans au 31 décembre 2007 et qui presterait 10 années de travail additionnelles après cette date verrait ses pensions futures prises en charge par le Fonds à raison d'un quart, les trois-quarts restants demeurant à charge du régime général de répartition. Il convient de noter que le mécanisme de transfert revêtirait avant tout une dimension institutionnelle. Il n'affecterait pas les affiliés qui, par convention, bénéficieraient tous du même système de calcul des pensions, quel que soit par ailleurs l'organisme payeur (Fonds ou régime classique).

Tableau 2R: Application de la proposition Modigliani-Muralidhar au Luxembourg : transfert immédiat des réserves, transfert graduel des dépenses au Fonds, croissance du PIB de 3% par an en volume, ratio de dépenses compatible avec les projections de pension de la BCL et rendement réel des réserves égal à 4,4%

(en pourcentages du revenu contributif, sauf mentions contraires)

	contri-butions versées au Fonds	Revenus de la propriété du Fonds	Pensions à charge du Fonds	Solde budgétaire du Fonds	Réserves du Fonds	% de pensions transférées au Fonds	Ratio de dépenses	dont coût des pensions de répartition	Finance-ment requis total	Coût de transition
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	23.2	4.0	0.0	27.2	90.2	0.2	20.5	20.5	43.6	23.1
2009	23.2	5.5	0.1	28.5	114.1	0.6	20.7	20.6	43.8	23.0
2010	23.2	7.0	0.3	29.9	138.3	1.2	20.6	20.3	43.5	22.9
2011	23.2	8.4	0.4	31.2	162.6	2.1	21.2	20.7	43.9	22.7
2012	23.2	9.9	0.6	32.4	187.2	3.1	21.0	20.4	43.6	22.5
2013	23.2	11.4	0.9	33.7	211.8	4.3	21.7	20.8	43.9	22.2
2014	23.2	12.9	1.2	34.9	236.5	5.7	21.6	20.3	43.5	21.9
2015	23.2	14.5	1.6	36.0	261.2	7.2	22.3	20.7	43.8	21.6
2016	23.2	16.0	2.0	37.2	286.0	8.9	22.1	20.2	43.3	21.2
2017	23.2	17.5	2.4	38.2	310.6	10.7	22.9	20.4	43.6	20.7
2018	23.2	19.0	2.9	39.3	335.3	12.6	22.8	19.9	43.1	20.3
2019	23.2	20.5	3.5	40.2	359.7	14.7	23.6	20.1	43.3	19.7
2020	23.2	22.0	4.0	41.2	384.0	17.0	23.6	19.6	42.7	19.1
2025	23.2	29.3	7.9	44.5	500.5	29.9	26.6	18.6	41.8	15.2
2030	23.2	35.8	12.3	46.6	604.1	42.8	28.8	16.4	39.6	10.8
2035	23.2	41.3	17.2	47.2	690.2	54.8	31.4	14.2	37.3	5.9
2040	23.2	45.5	21.2	47.6	757.0	65.9	32.1	10.9	34.1	2.0
2045	23.2	48.8	25.4	46.6	806.8	76.1	33.4	8.0	31.2	0.0
2050	23.2	51.2	28.0	46.4	844.4	84.3	33.2	5.2	28.4	0.0
2055	23.2	53.1	31.0	45.2	871.6	90.8	34.2	3.2	26.3	0.0
2060	23.2	54.3	32.2	45.2	890.6	95.2	33.8	1.6	24.8	0.0
2065	23.2	55.1	34.0	44.3	902.4	97.8	34.7	0.8	23.9	0.0
2070	23.2	55.6	34.0	44.8	911.2	99.0	34.4	0.3	23.5	0.0
2075	23.2	56.1	35.3	43.9	917.3	99.5	35.5	0.2	23.3	0.0
2080	23.2	56.3	35.2	44.3	921.2	99.7	35.3	0.1	23.3	0.0
2081	23.2	56.3	35.9	43.6	921.2	99.7	36.0	0.1	23.3	0.0
2082	23.2	56.4	35.4	44.2	921.9	99.8	35.4	0.1	23.2	0.0
2083	23.2	56.4	36.2	43.4	921.8	99.9	36.2	0.1	23.2	0.0
2084	23.2	56.4	35.6	44.0	922.2	99.9	35.6	0.0	23.2	0.0
2085	23.2	56.4	36.4	43.2	921.9	100.0	36.4	0.0	23.2	0.0

Sources: BIT, IGSS, STATEC, calculs BCL . Basé sur Modigliani et Muralidhar (2004).

Comme l'indique la colonne 6 du tableau ci-dessus, qui illustre la mise en œuvre au Luxembourg de la proposition de Modigliani et Muralidhar conditionnellement à une croissance économique de 3% par an sur la période 2008-2085, ce mécanisme de transfert des prestations donnerait lieu à une transition assez graduelle. Seule une petite moitié des pensions du régime général serait prise en charge par le

Fonds en 2030 et la proportion transférée au Fonds n'excéderait 90% qu'après 2050. La transition serait cependant plus rapide que dans les scénarios élaborés pour les Etats-Unis par Modigliani et Muralidhar, car la durée de la carrière est fréquemment inférieure à 40 ans au Luxembourg. L'intégralité des prestations de pension serait transférée au Fonds à la fin de la période de projection. Les pensions (et les dépenses afférentes, notamment de nature administrative) atteindraient alors 36,4% de la masse contributive, contre 20,5% en 2008. Cette proportion, nommée « ratio de dépenses » dans le reste du texte, reflète notamment l'incidence de l'arrivée à l'âge de la pension d'importants contingents de travailleurs frontaliers et étrangers. L'évolution du ratio, qui figure à la colonne 7 du tableau, est directement extraite des projections budgétaires illustrées au graphique 1R.

Par hypothèse, le financement par le Fonds des dépenses de pension futures serait assuré par une cotisation constante, calculée en pourcentages de la masse contributive à l'instar de l'actuelle contribution de 24% (soit 3 fois 8% à charge des employés, des employeurs et de l'Etat, respectivement). Ce taux constant, repris à la première colonne du tableau 2R, serait calibré afin de permettre au Fonds d'atteindre à la fin de la période de projection le niveau d'actifs compatible avec le respect de la contrainte budgétaire intertemporelle sur un horizon infini, le tout sous l'hypothèse implicite d'une stabilisation du rapport prestations/masse contributive après l'horizon de projection. Le respect de cette contrainte intertemporelle est strictement équivalent à un critère alternatif, qui revient à choisir le niveau de cotisation compatible avec la stabilisation des ratios de soldes budgétaires et d'actifs à la fin de la période de projection (convergence vers un équilibre de « steady state »; voir l'annexe 4). Ces critères permettent de conférer un contenu précis à la notion de soutenabilité à terme. Leur respect prémunit le régime de pension d'un double écueil, à savoir un niveau d'actifs nets ne permettant pas de couvrir les prestations de pension futures à la fin de la période de projection ou un déclin de ces actifs à la fin de ce même horizon, qui révèlerait l'instabilité de l'équilibre.

Dans le cas luxembourgeois et pour autant que la croissance du PIB atteigne 3% de 2008 à 2085, le taux de cotisation compatible avec les critères de soutenabilité précités s'établirait à un peu plus de 23% de la masse contributive. Ce taux postule notamment un taux réel de rendement des actifs du Fonds de l'ordre de 4,4% par an, le portefeuille du Fonds étant par hypothèse composé de 35% d'actions et de 65% d'obligations. Si un tel rendement peut a priori sembler élevé, il paraît raisonnable à l'aune de l'évolution des marchés financiers au cours des 20 ou 30 dernières années ou de l'expérience de divers fonds étrangers, par exemple le Government Pension Fund en Norvège. En outre, le taux de 4,4% est inférieur à raison d'environ 1% au taux postulé par Modigliani et Muralidhar dans leurs propres simulations, relatives aux Etats-Unis. Enfin, une analyse de sensibilité démontre que la convergence vers l'équilibre de long terme ne serait pas remise en cause si le taux de rendement réel de référence était ramené à 3,4% par an. Il s'ensuivrait naturellement un taux de financement requis plus élevé, de l'ordre de 28% tout au long de la période de simulation. Ce dernier taux demeurerait cependant nettement inférieur au taux de cotisation requis en l'absence de réforme, qui pourrait atteindre voire même excéder 40% des revenus contributifs au cours de l'horizon de projection. La même analyse de sensibilité révèle que le taux de cotisation requis pourrait être ramené à 17% de la masse contributive vers la fin de l'horizon de projection en cas de rendement réel égal à 5,4%, soit le taux considéré dans le cas des Etats-Unis par Modigliani et Muralidhar. L'adoption par la Chambre des Députés en 2004 d'une loi visant à assurer une plus grande diversification de la réserve de compensation du régime général de pension est de nature à induire un rendement accru de la réserve de compensation. Un tel objectif revêt une considérable importance au Luxembourg en raison du niveau absolu élevé de cette réserve.

En début de période, le financement des pensions requis par le mécanisme de transition (voir la colonne 9 du tableau 2R) serait élevé, car à la contribution constante de 23,2% s'ajouterait le coût des « pensions de répartition » (voir la colonne 8 du tableau), à savoir les pensions qui n'ont pas encore fait l'objet d'un

transfert au Fonds et sont de ce fait toujours financées par le truchement du régime général. Le « coût de transition » correspondant, dont il est fréquemment question dans la littérature sur les systèmes de capitalisation, permettrait d'amorcer un cercle vertueux. Il en résulterait en effet l'accumulation d'importants excédents dès le début de la période de transition. La sédimentation de ces surplus induirait une montée en puissance des réserves, avec à la clef de substantiels revenus du patrimoine (voir la colonne 2). Ces derniers renforceraient à leur tour l'accumulation initiale d'actifs. La transition vers l'équilibre de « steady state » serait alors assurée, du moins sous les hypothèses précitées. Les surplus du régime de pension dépasseraient 40% des revenus contributifs – soit 16% du PIB – dès 2020, tandis que le ratio de réserves d'équilibre serait de l'ordre de 400% du PIB. Les perspectives budgétaires du régime de pension et au-delà de l'ensemble des administrations publiques luxembourgeoises seraient bien évidemment des plus favorables dans de telles conditions.

Cet équilibre paraît cependant peu réaliste, pour deux raisons. En premier lieu, il postule une considérable ponction financière en début de période. Du fait de l'importance du coût de transition, les ressources devant être mobilisées afin d'assurer le financement des pensions du secteur privé devraient atteindre près de 44% de la masse contributive dès 2008, à comparer avec un taux de cotisation actuellement égal à 24%. Le surcoût de près de 20% de la masse contributive – soit de 8% du PIB – pourrait certes être financé par d'autres biais que les seules cotisations. Au total, il semble cependant constituer un obstacle rédhibitoire à la mise en place d'un régime de capitalisation, du moins à politique inchangée. En second lieu, le mécanisme proposé donnerait lieu à des réserves certes disproportionnées, mais dont le niveau élevé refléterait l'importance des déficits primaires en fin de période. En vertu de la contrainte budgétaire intertemporelle, les actifs de fin de période doivent en effet être égaux à la valeur actualisée des déficits primaires futurs. En d'autres termes, les actifs présents doivent couvrir les dépenses futures. Or les déficits seraient de l'ordre de 13% des revenus contributifs – soit 36% (le ratio de dépenses) moins 23% (le taux constant de contributions canalisées vers le Fonds) – à la fin de l'horizon de simulation et, par hypothèse et pour les besoins de l'actualisation, au-delà de cet horizon. Dans de telles conditions, seul un niveau de réserves très élevé permettrait de garantir le respect de la contrainte budgétaire intertemporelle.

Deux aménagements: plafonnement du financement et suspension temporaire de l'ajustement aux salaires réels

Un cheminement plus réaliste vers la capitalisation est présenté au tableau ci-après, qui intègre deux aménagements d'importance. En premier lieu, le transfert de recettes au Fonds ne serait pas d'emblée fixé au niveau du taux constant de cotisation, comme l'illustre la première colonne du tableau. Il serait choisi de telle manière que le taux global de financement requis (cotisations Fonds + coût résiduel des pensions de répartition ; voir la colonne 9) demeure inférieur à un plafond donné. Par hypothèse, ce plafond serait fixé à 26% de la masse contributive en 2008 et il augmenterait graduellement par la suite pour atteindre 27% en 2012. En dépit de cet amoindrissement des recettes initiales du Fonds, ce dernier serait à tout moment en mesure de financer ses dépenses de pension (voir la colonne 3), ces dernières n'étant de toute manière transférées au Fonds que de façon graduelle.

En second lieu, l'importante progression du ratio de dépenses serait quelque peu endiguée. Il est en effet supposé que l'ajustement des pensions aux salaires réels, qui a lieu tous les deux ans au Luxembourg, serait suspendu de 2007 à 2017. Il en résulterait une nette diminution du ratio de dépenses (19,6% en 2020, contre 23,6% dans le scénario du tableau 2R), sans diminution du pouvoir d'achat des pensions. Le taux de remplacement du salaire par la pension en serait bien évidemment affecté, mais ce taux est élevé au Luxembourg pour une carrière complète, comme l'atteste une récente étude de l'OCDE (2005).

Tableau 3R: Application de la proposition Modigliani-Muralidhar au Luxembourg : tableau 2R avec plafonnement du financement requis et suspension de l'ajustement aux salaires réels de 2007 à 2017

En pourcentages du revenu contributif, sauf mentions contraires

	contri-butions versées au Fonds	Revenus de la propriété du Fonds	Pensions à charge du Fonds	Solde budgétaire du Fonds	Réserves du Fonds	% de pensions trans-férées au Fonds	Ratio de dépenses	dont coût des pensions de répartition	Finance-ment requis total	Coût de transition
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	5.8	4.1	0.0	9.8	73.1	0.2	20.2	20.2	26.0	5.8
2009	6.4	4.5	0.1	10.7	80.1	0.6	20.0	19.9	26.3	6.3
2010	6.9	4.9	0.2	11.5	87.6	1.2	19.9	19.6	26.5	6.6
2011	7.4	5.3	0.4	12.3	95.6	2.1	19.7	19.3	26.7	7.0
2012	8.0	5.8	0.6	13.2	104.2	3.1	19.6	19.0	27.0	7.4
2013	8.3	6.4	0.8	13.9	113.0	4.3	19.5	18.6	27.0	7.5
2014	8.7	6.9	1.1	14.5	122.1	5.7	19.4	18.3	27.0	7.6
2015	9.1	7.5	1.4	15.2	131.5	7.2	19.3	17.9	27.0	7.7
2016	9.6	8.0	1.7	15.9	141.1	8.9	19.2	17.5	27.0	7.9
2017	9.9	8.6	2.0	16.5	151.0	10.7	19.1	17.0	27.0	7.9
2018	10.4	9.2	2.4	17.2	161.1	12.6	19.0	16.6	27.0	8.0
2019	10.2	9.9	2.9	17.2	170.6	14.7	19.7	16.8	27.0	7.3
2020	10.7	10.4	3.3	17.8	180.4	17.0	19.6	16.3	27.0	7.4
2025	11.5	13.3	6.6	18.2	224.9	29.9	22.1	15.5	27.0	4.9
2030	13.3	15.6	10.2	18.7	261.8	42.8	23.9	13.7	27.0	3.1
2035	15.2	17.5	14.3	18.4	290.5	54.8	26.1	11.8	27.0	0.9
2040	18.0	18.9	17.6	19.3	313.7	65.9	26.6	9.1	27.0	0.4
2045	20.4	20.2	21.0	19.6	334.3	76.1	27.7	6.6	27.0	0.0
2050	22.7	21.5	23.2	21.0	355.1	84.3	27.5	4.3	27.0	0.0
2055	24.0	22.8	25.7	21.0	375.4	90.8	28.3	2.6	26.6	0.0
2060	24.0	23.7	26.6	21.1	390.7	95.2	28.0	1.3	25.3	0.0
2065	24.0	24.4	28.1	20.3	400.3	97.8	28.7	0.6	24.6	0.0
2070	24.0	24.8	28.2	20.6	407.5	99.0	28.4	0.3	24.2	0.0
2075	24.0	25.2	29.2	19.9	412.2	99.5	29.4	0.2	24.1	0.0
2080	24.0	25.4	29.1	20.2	415.3	99.7	29.2	0.1	24.1	0.0
2081	24.0	25.4	29.7	19.6	415.3	99.7	29.8	0.1	24.0	0.0
2082	24.0	25.4	29.2	20.1	415.8	99.8	29.3	0.1	24.0	0.0
2083	24.0	25.4	29.9	19.5	415.7	99.9	29.9	0.0	24.0	0.0
2084	24.0	25.4	29.4	20.0	416.0	99.9	29.4	0.0	24.0	0.0
2085	24.0	25.4	30.1	19.4	415.7	100.0	30.1	0.0	24.0	0.0

Sources: BIT, IGSS, STATEC, calculs BCL . Basé sur Modigliani et Muralidhar (2004).

La conjonction des deux aménagements précités permettrait d'amoindrir considérablement les inconvénients du processus de transition illustré au tableau 2R. La progression de 24% (le taux de cotisation actuel) à 26, puis 27% de la masse contributive ne paraît nullement hors de portée, d'autant que ces 2 et 3% de financement additionnel ne représenteraient que 0,8 et 1,2% du PIB, respectivement. Ces montants sont d'ailleurs du même ordre de grandeur que le transfert additionnel de l'Etat central au régime de pension qu'a envisagé le FMI à l'occasion de sa récente mission Article IV au Luxembourg (voir IMF (2006)). En outre, ces ressources supplémentaires pourraient être collectées à travers la mise en œuvre de différentes

mesures ponctuelles. Le choix et le dosage de ces mesures (hausse des contributions de pension, transferts additionnels de l'Etat central, financement alternatif, etc.) sont bien entendu du seul ressort des autorités.

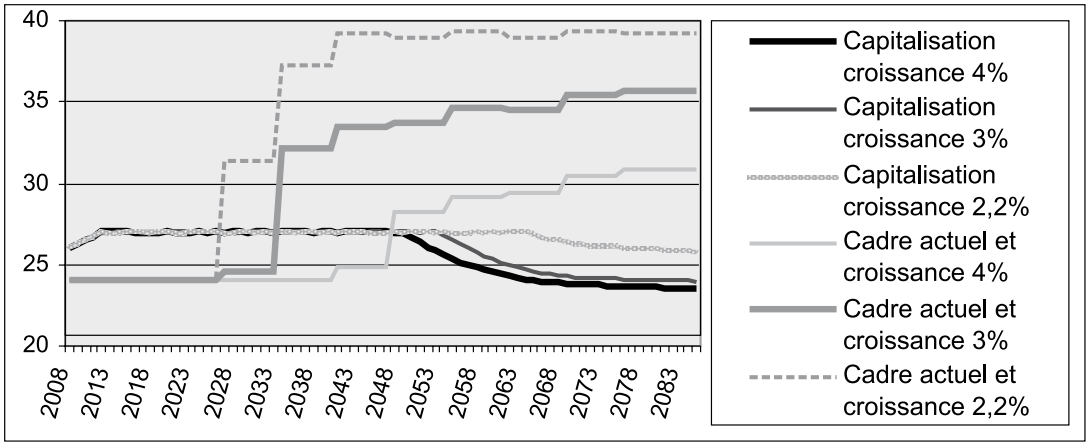
En dépit du caractère plus graduel de la transition et grâce aux mesures de consolidation additionnelles, le processus de transition s'apparenterait à un cercle vertueux. L'équilibre de long terme serait bel et bien atteint à la fin de la période de transition, avec à la clef des résultats budgétaires favorables. Le Fonds enregistrerait en effet des excédents de l'ordre de 8% du PIB, tandis que les réserves se stabiliseraient à plus de 160% du PIB. La soutenabilité à terme du système de pension serait assurée, du moins en l'absence de chocs négatifs. De surcroît, ces résultats budgétaires exceptionnels viendraient conforter les finances publiques de l'ensemble des administrations publiques, ce qui concourrait à préserver le Luxembourg d'une violation de la norme de référence de 3% de déficits. Cette situation serait évidemment de nature à grandement renforcer la stabilité de l'économie luxembourgeoise.

Un avantage décisif du cheminement vers la capitalisation: une moindre sensibilité aux inflexions de la croissance du PIB

Le mécanisme de transition illustré au tableau 3R permettrait en outre de protéger le système de pension des conséquences d'inflexions de la croissance économique. Cet avantage serait particulièrement bienvenu au Luxembourg, dont la petite taille concourt à exacerber la volatilité des indicateurs macro-économiques. L'évolution du financement requis sous différents scénarios de croissance est présentée au graphique 2R sous deux régimes alternatifs, à savoir un simple alignement sur la règle selon laquelle les réserves ne peuvent être inférieures à 1,5 fois le montant annuel des prestations dans le cadre du régime actuel et d'autre part le mécanisme présenté au tableau 3R. Sous le présent régime, les taux de cotisation subiraient de plein fouet les inflexions de la croissance économique. En revanche, le système de capitalisation dérivé de Modigliani et Muralidhar amortirait considérablement les aléas de la croissance économique. Ce résultat s'explique principalement par le fait que le ratio de réserves tend – du moins toutes autres choses égales par ailleurs – à s'améliorer lorsque survient un fléchissement de la progression du dénominateur du ratio, soit la masse contributive. Or par hypothèse cette dernière croît au même rythme que le PIB dans les simulations présentées ci-dessus. Dans de telles circonstances, la réforme recommandée par Modigliani et Muralidhar constitue une assurance contre les chocs de croissance négatifs, qui ne sont nullement à exclure dans une petite économie ouverte.

Graphique 2R: Evolution du taux de financement requis sous différents scénarios de croissance

(En pourcentages des revenus contributifs)



Sources: BIT, IGSS, STATEC, calculs BCL.

Note: il est supposé que le maintien du cadre actuel donnerait lieu à un taux de rendement réel des réserves égal à 2,6% par an, la gestion de portefeuille active du Fonds se traduisant par un rendement réel plus élevé, égal à 4,4%. L'évolution divergente des taux de cotisation illustrée au graphique ne s'explique que marginalement par cette hypothèse.

Eléments de conclusion

Le cheminement vers un système de capitalisation « defined benefits » présenté au tableau 3R présenterait au total de nombreux avantages, notamment une bien moindre vulnérabilité aux inflexions de la croissance économique, la restauration de la soutenabilité financière à long terme du régime général de pension et dans la même foulée une amélioration sensible des perspectives budgétaires des administrations publiques considérées dans leur globalité, avec à la clef un respect bien plus aisé des dispositions du Pacte de Stabilité et de Croissance. A ces avantages macro-économiques s'ajouterait sur un plan plus micro-économique une sécurité financière accrue pour les affiliés du régime, puisque le Fonds aurait précisément pour mission de garantir à tout moment l'équilibre actuariel du système, en couvrant les engagements futurs par un niveau approprié de réserves. L'équilibre actuariel nécessiterait d'ailleurs des réserves d'un ordre de grandeur bien supérieur à celui de l'actuelle réserve de compensation, à l'instar de la situation prévalant dans des pays tels que la Norvège (voir le Government Pension Fund) ou les Pays-Bas (voir en particulier le fonds de pension ABP).

Le Luxembourg devrait mettre à profit une fenêtre d'opportunité d'une dizaine d'années, au cours de laquelle le ratio de dépenses devrait demeurer inférieur à l'actuel taux de cotisation, soit 24%. C'est précisément au cours d'une telle période que le Luxembourg serait en mesure d'amorcer à un coût supportable le processus de convergence vers un niveau suffisant de réserves. Le coût de financement total n'excède jamais 27% de la masse contributive dans la simulation reprise au tableau, alors que le taux de cotisation est déjà égal à 24% actuellement. La convergence vers l'équilibre actuariel, qui est loin d'être acquis actuellement, nécessiterait certes une suspension limitée dans le temps de l'ajustement des pensions aux salaires réels. Cette mesure ne donnerait cependant nullement lieu à un déclin du pouvoir d'achat des pensions, puisque ces dernières feraient toujours l'objet d'un ajustement au niveau des prix. En outre, elle renforcerait considérablement la sécurité financière du système, tant au niveau macro-économique qu'en ce qui concerne les affiliés individuels. Enfin, si le préfinancement requis est relativement important, le coût de l'attentisme serait quant à lui considérable. Ainsi, la proposition présentée au tableau 3R s'assortirait sous les hypothèses précitées d'un prélèvement sur la masse contributive de l'ordre de 24% en fin de période de simulation, qui serait pratiquement égal au taux de cotisation actuel. Le taux correspondant pourrait atteindre voire même excéder 40% en l'absence de mesures nouvelles, ce qui pénaliserait la compétitivité de l'économie luxembourgeoise et porterait gravement préjudice à l'équité entre les générations.

Abstract

The Luxembourg private sector pension system ("régime général de pension") is at crossroads. On the one hand, the current budgetary situation of the system appears extremely favourable. On the other hand, projections based on reasonable assumptions suggest that the pension regime is not sustainable over a long-term horizon. Pension benefits are indeed bound to increase steeply when large contingents of cross-border and immigrant employees will retire.

The primary objective of the paper is to assess whether a solution proposed by Modigliani and Muralidhar, where pensioners are gradually transferred from pay-as-you-go (PAYG) to a public fund in accordance with the defined benefit principle, is suitable to the Luxembourg situation. A baseline funding scenario designed in a stepwise manner and under reasonable return assumptions illustrates how fruitful such a solution could be in Luxembourg, provided that a significant prefunding effort takes place at the beginning of the transition period. In the steady state, this scenario would lead to very comfortable reserves and budgetary surpluses with no additional cost in terms of long-term, equilibrium contribution rates. These very favourable results would be achieved in spite of a continuously increasing pension cost ratio induced by ageing and by the gradual retirement of large contingents of cross-border workers. Another particularly attractive

feature of the baseline funding scenario presented in the paper – especially in the context of a small and very open economy – is that it would mitigate in an effective way the impact on the pension regime of adverse GDP growth developments. By contrast, PAYG does not provide a sound basis for a social security scheme as contributions are very sensitive to small changes in the key macroeconomic variables. Finally, the baseline funding scenario is reasonably resilient to alternative return or demographic assumptions. However, even the funding system would have to be monitored in a rigourous way.

To sum up, the currently favourable situation of the private sector pension regime should be considered as a window of opportunity during which the pension system should set aside the large assets required in order to cover future pension liabilities. This would mark the onset of a virtuous circle, where increasing assets and the related property incomes would offset the rising cost of pension benefits and at the same time mitigate adverse macroeconomic developments.

JEL classification: E62, H55, J11.

Keywords: Pensions, funding, defined-benefits, sustainability.

Introduction

As illustrated in IGSS (2006), the current budgetary situation of the Luxembourg private sector pension system is extremely favourable, with large surpluses and the accumulation of substantial reserves. However, as illustrated also in IGSS (2006) and in Chapter 1 of this paper, the pension system does not appear sustainable over the long-term. Pension benefits are indeed bound to increase steeply in the next decades, when large contingents of cross-border and immigrant employees will retire.

The primary objective of this paper is to assess the extent to which funding, along the lines proposed in Modigliani and Muralidhar (2004), would alleviate the long-term budgetary challenges to the private sector pension regime ("régime général de pensions"). The latter regime is organised on a pay-as-you-go (PAYG) basis, whereas the scheme proposed in Modigliani and Muralidhar (2004) would rest on funding, with two important distinguishing features. First, this funding system would revolve around a "New Fund" under the aegis of the public sector. According to the authors, a "pension market" with atomised competition between several private funds would be suboptimal, as it would induce substantial administrative costs and would penalise the poorest and less informed investors. Second, the solution proposed by Modigliani and Muralidhar (2004) would be a "defined benefit" and not a "defined contribution" scheme. In the Luxembourg context, this means that pension benefits could still be calculated based on the current pension formula – with a fixed component and coefficients that are proportional to past incomes.

After a concise presentation of the Modigliani and Muralidhar (2004) funding system in Chapter 2, this framework is fined tuned to the current Luxembourg context in a stepwise manner in Chapter 3. First, the reserves of the general regime and the upward shift in pension expenditure projected in the future are integrated into the Modigliani/Muralidhar framework in section 3.1. Funding would give way to a very favourable steady state equilibrium in the Luxembourg context, but the required financing would be extremely burdensome at the beginning of the funding process ("transition costs"). An alternative transition path with more gradual prefunding and the suspension of the adjustment of pension to real wages during a limited period of time is therefore proposed in section 3.2 in order to alleviate the transition problem. Under reasonable assumptions, this "baseline funding scenario" would enable Luxembourg to reap very substantial long-term benefits – inter alia very comfortable budgetary indicators – with a realistic transition burden. By contrast, contributions would jump dramatically – possibly to about 40% – under a "wait-and-see approach" where the currently favourable situation of the pension regime would encourage complacency. Luxembourg would then become an unattractive place for labour. The currently favourable situation should be considered as a "window of opportunity" instead, during which the transition "cost" would enable Luxembourg to set aside large assets. This would mark the onset of a virtuous circle, where increasing assets and the related property incomes would offset the rising cost of pension benefits.

Another particularly attractive feature of the funding process presented in section 3.2. is its limited sensitivity to GDP growth developments (section 3.3). This result illustrates that PAYG does not provide a sound basis for a social security scheme as contributions are very sensitive to small changes in the key variables, whereas funding provides a buffer to make the system more stable. Finally, although the baseline funding scenario seems quite resilient to alternative returns or demographic developments, it is per se not immune from external shocks. This calls for a continuous monitoring of the system (see the sensitivity analysis carried out in section 3.4).

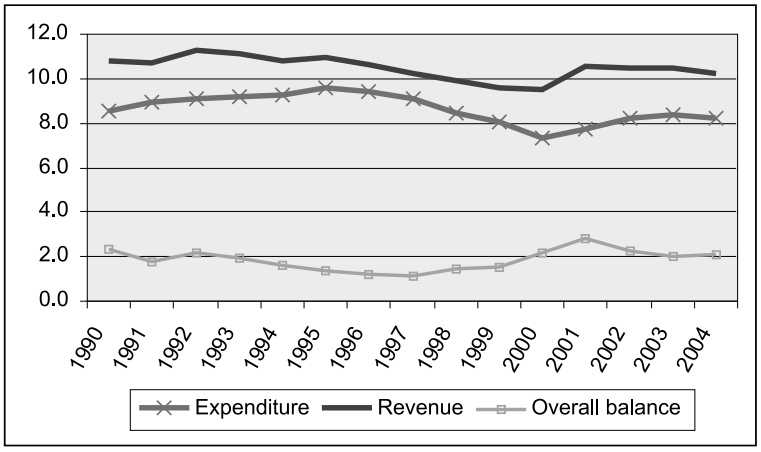
1. The challenges to the sustainability of the luxembourg private sector pension system

1.1 Financial situation and peculiarities of the private sector pension regime

From the yardstick of simple indicators like the current budgetary balance and the level of reserves, the financial situation of the Luxembourg pension system is extremely favourable. As shown in Chart 1, the Luxembourg general pension regime, which confines itself to the private sector, is indeed characterised by a substantial and rather stable net lending capacity. The latter reached EUR 529 million in 2004, namely 2.1% of GDP.[1] The surplus increased in a continuous way from 1997 to 2000 owing to a marked decrease in the expenditure-to-GDP ratio in a context characterised by high economic growth. This evolution more than offset the steady increase in the expenditure ratio observed from 1990 to 1996.

Chart 1 – Expenditure, revenue and overall balance of the general pension regime[2]

As percentages of GDP



Sources: IGSS (2001, 2005), STATEC.
Note: Total expenditure are corrected for the impact of one-off effects in 2002 (baby-year transfer) and 2004 (transfer to Union des Caisses de Maladie).

Revenues are mostly composed of social contributions, which are directly linked to the wage bill via a 24% contribution rate.[3] The revenue-to-GDP ratio has been less volatile than the expenditure ratio over the nineties. The reserves held by the general pension regime amounted to 24% of GDP at the end of 2004.

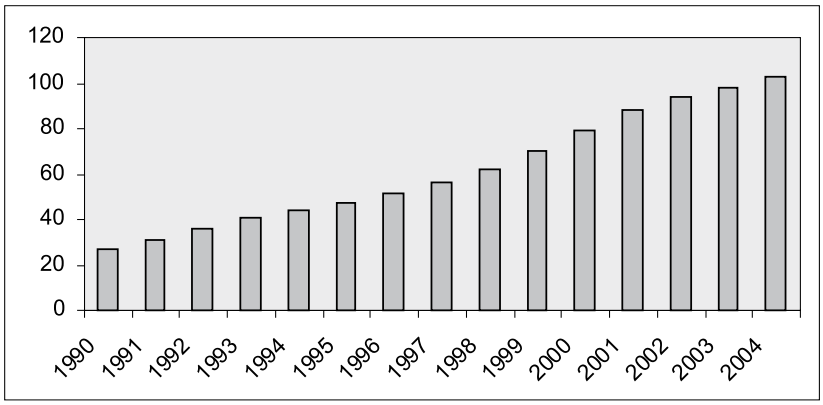
However, the further continuation of this favourable situation is far from ensured. Luxembourg presents many peculiarities, whose impact has been favourable so far. However, they are likely to turn negative at some point into the future. A first salient characteristic is the **high reliance of the Luxembourg economy on cross-border workers**. According to data published by STATEC (1995, 2002 and 2005) and by Berger (2005), foreign commuters would represent about 37% of the workforce at the end of 2004 once the employees of international organisations are disregarded. 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 recorded a considerable increase in the recent past. In addition, the average age of cross-border workers is quite low. Turnover rates, age structures and especially average pensions observed in the past may not provide accurate measures of future trends in such a dynamic context.

1 IGSS (2005). Once an exceptional transfer to Union des Caisses de Maladie is disregarded.
2 Old age, invalidity and survival pensions.
3 The employees, employers and the State share this burden in an equal measure (8% each).

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

Chart 2 – Evolution of the number of cross-border workers

In thousands



Sources: STATEC (1995, 2002 and 2005) and BCL calculations prior to 1995.
Note: Net number of cross-border workers, disregarding the employees of international organisations.

The most important similarity between foreign residents and the cross-border population is their impact on the average age of the total workforce. Commuter and foreign workers are indeed younger-than-average. The average age of the active cross-border population insured with the general pension regime reached 37 years for men and 35 years for women in 2003.[5] 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. 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 2004. At the same time, they received only 17% of total pension expenditure. As a result, they accounted for most of the pension regime surplus observed in 2004.

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.

The intricate nature of any fiscal projection in Luxembourg is further magnified by the vulnerability of the Luxembourg economy 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,

[4] STATEC.
[5] IGSS (2004).

which helped contain the expenditure-to-GDP ratio. However, it should not be taken for granted that this trend will continue unscathed in the future. In addition, some sectors of the Luxembourg economy might become more mature and yield lower growth rates. The evolution of pension expenditure in 2001 and 2002, 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.

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, the very same 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. The contention that long-term scenarios have to be interpreted with caution is therefore even more justified in Luxembourg than in other countries.

1.2 Structure of the BCL pension model

The pension model is articulated as follows:

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 2004,[6] 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 2005 is supposed equal to the number aged 54 in 2004, multiplied by the appropriate mortality coefficient. The same procedure is applied for all age and gender categories, and the user of the model introduces the number of newborn individuals. 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 based on a matrix calculated by STATEC. This structure is kept unchanged throughout the projection horizon.

The whole procedure is replicated for 2006 based on the population structure inferred for 2005, and the process is continued until the last year of the projection horizon, namely 2085, is reached. The demographic module has been tested for different assumptions. It yields results that are largely comparable to the STATEC demographic projections,[7] at least when the exogenous variables (e.g. mortality, fertility and immigration) are identical.

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

[6] This is the last year covered in the most recent IGSS annual report (2005).
[7] See for instance STATEC (2006).

population. The calculation of the insured population proceeds in two phases. In the first phase, a matrix of participation rates calculated based on IGSS (2001 and 2005) 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,[8] where the corresponding proportions sum up to 1, by definition. The matrix cannot be changed for the base year 2004. However, it can be amended for the rest of 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. For each subsequent year, the matrixes are applied to the population structure derived in accordance with the procedure described above. 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 2004.

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

It is of the foremost importance to derive the evolution of revenue, 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. 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 macroeconomic figure for residents. 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 based on two exogenous variables, namely inflation and the change in real wages. For the years 2005-2007, these variables are aligned on the internal projections made by the BCL. For subsequent years the real wage is set in line with another exogenous variable, namely the rate of growth of labour productivity.

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 2004 is equal to 24%, divided in an equal way among employers, employees and the State (8% each).

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, which also carried out pension projections for Luxembourg in 2000, ensures that the expenditure side is covered in an exhaustive manner. For each of these categories, the number of pensioners is first calculated based on the status matrixes already described above. 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 2004, based on the gender and age structure of the resident population and the corresponding structure of the population of resident pensioners. The status matrixes are adjusted in order to take into account a gradual increase in the labour force participation rate of women, which would by assumption 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 based on data provided in ILO (2000), updated on the basis of IGSS data.

[8] For instance unemployed people or students.

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 37% of the workforce at the end of 2004. 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. Because of this feature, the average pension is comparatively low. It could be misleading to assume that these patterns will replicate in the future. The ILO (2000) and the IGSS (2006) 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 rest on the similar assumption of a gradual and partial convergence that would take place between 2004 and 2025. The average pension to which cross-border workers would converge would still be lower than the similar pensions paid to residents, by 10% due to lower average wages.[9]

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 based on ILO (2000) data updated on the basis of IGSS statistics. As is the case for resident workers, demographic variables can be adapted in an exogenous way.

1.3 The baseline pension scenario and its sensitivity to flows of cross-border workers

A baseline pension scenario is first briefly described. It 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 numerous uncertainties surrounding the estimation of especially cross-border workers in the future, the reference projection is complemented with a sensitivity analysis.

The reference projection is based on a set of demographic and macro-economic assumptions described in a synthetic way in Table 1. As regards **macroeconomic variables**, it should first be noted that real GDP is an exogenous variable in the baseline scenario. Given the fixed growth of labour productivity, which is held constant throughout the 2008-2085 horizon, employment must adjust in a flexible way. This is done using as an endogenous, "residual" variable the number of cross-border workers. In other words, the number of cross-border workers merely adjusts to the rate of GDP growth chosen in an exogenous way in order to ensure compatibility with productivity developments. By contrast, immigration flows have been set to 4,000 persons every year all over the projection period. The choice of the residual variable – namely the number of cross-border workers or alternatively immigration flows – does not impact in a significant way the projection results, because the age structure of these two categories of workers is quite similar.

[9] Based on some evidence collected in STATEC (1995 and 2005).

Table 1 – Key assumptions

	Inflation and GDP growth (%)	Real wages (%)	Labour productivity (%)
2004-2007	BCL December 2005 projections		
2008-2085	1,9 and 3%	2,0	2,0
Birth rate	Fertility kept constant at its 2004 level		
Mortality	In line with the ILO (2000) assumptions		
Immigration	4,000 immigrants a year from 2008 to 2070		
Cross-border workers	In line with GDP developments (residual variable)		
Labour force participation rate	Increases in a gradual way for women, stable for men. Therefore, women would represent 45% of the labour force in 2085, compared to 39% in 2004. The unemployment rate would be stable for residents.		

The macroeconomic hypotheses are based on the autumn 2005 macroeconomic forecasts carried out by the BCL over the 2005-2007 period. 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 BCL calculations, the latter figure is in line with the average real growth rate of wages observed over the period 1970-2004, which reached 1.7% per year.

Consistently with the "unchanged policy" assumption, the **rate of pension contributions** jointly paid by employees, employers and the State would remain constant throughout the projection period, at 24% of gross wages.

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 at the level observed in 2004 all over the 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 mortality rates are in line with the ones used by ILO in its own projections, carried out in 2000.

Under this set of hypotheses, the Luxembourg population would increase from 457,000 in 2004 to 540,000 in 2020, close to 700,000 in 2050 and 880,000 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 potential saturation of public infrastructures or the housing capacity.

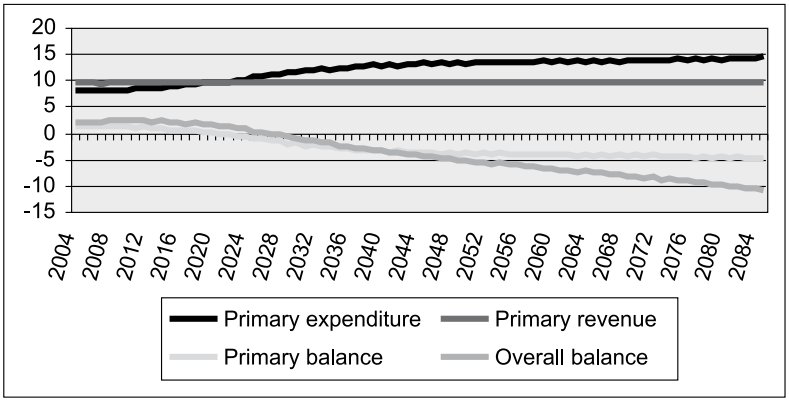
Another important hypothesis presiding upon the baseline projection is an **increase in the labour force participation rate of women**. This evolution would take place in a gradual way over the projection horizon. As a result, the proportion of women in the insured, active resident population would go 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 yield on pension reserves** is stuck at 4.5% a year – under the assumption that the diversification strategy will remain quite subdued. The interest rate charged on liabilities is set equal to 4% a year.

The **budgetary results** associated with the baseline projection are synthesised in Chart 3. 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. Although a precise comparison is difficult to carry out due to different underlying assumptions, on face value the budgetary outcomes are quite similar to the indicators projected in IGSS (2006) over the 2005-2050 period. For instance, the liabilities of the private sector pension regime would reach 49% of GDP in 2050 under the 3% GDP growth scenario according to IGSS (2006), compared to 39% in the BCL baseline scenario.

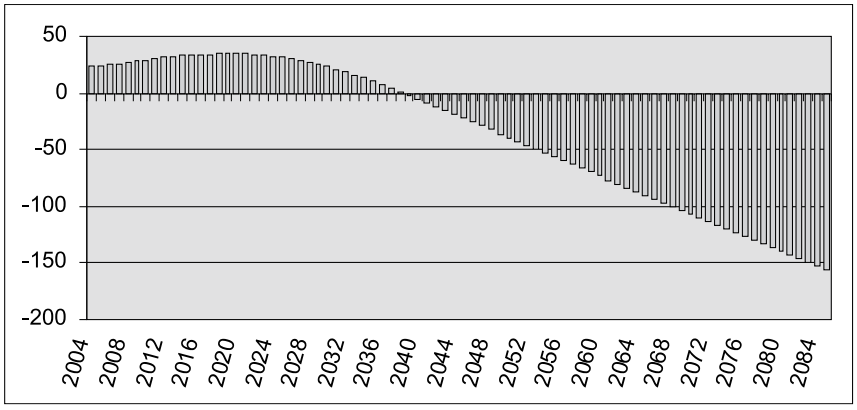
Chart 3 – Budgetary outcomes of the private pension regime under the baseline projection

As percentages of GDP

1. Budgetary flows of the general pension regime



2. Net financial assets (+) or liabilities (-) of the general pension regime



Sources: IGSS, ILO, STATEC, BCL calculations.

As already explained in section 1.1, the current situation of the Luxembourg private pension regime is very comfortable at first sight. Pension reserves represented 24% of GDP in 2004 and this percentage would further increase to 35% in 2020, as both the primary ratio and the overall balance would be in surplus over this period. The overall balance would be enhanced by significant interest revenues, which would reach 1.5% of GDP around 2020.

However, a negative inflection would already occur around 2012, as the overall surplus would begin to decline due to the more sustained increase of pension expenditure. This increase would further accelerate thereafter, in particular from 2020 to 2050. 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

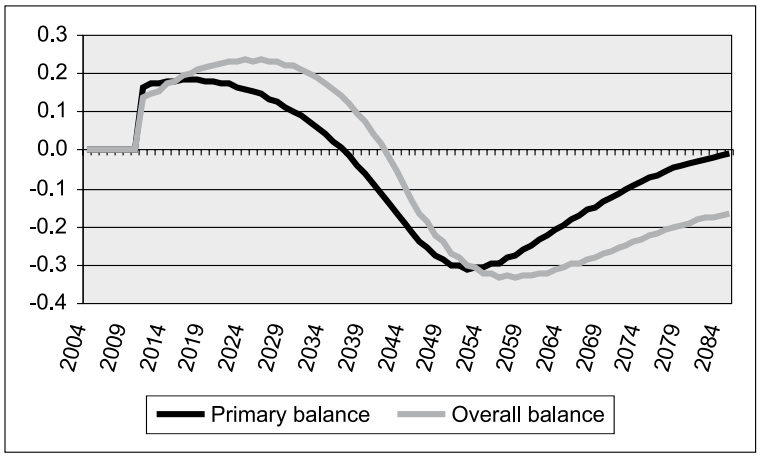
workers that would echo the large inflows of commuters observed or assumed at the beginning of the projection period. By contrast to pension expenditure, total revenue would remain remarkably stable at about 10% of GDP throughout the projection period. This is the reflection of the assumed parallelism between the evolution of the tax base – i.e. basically real gross wages – and labour productivity, as both would increase by 2% a year from 2008 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 and the evolution of the number of employees are closely linked.

The dichotomy between the evolution of expenditure and revenue from around 2012 onwards would imply a deteriorating primary balance, which would turn negative from 2021. The overall balance would remain in surplus for several more years owing to interest revenue, but it would also record a deficit from 2027 onwards. Net liabilities would appear from 2039 and the debt ratio would further increase thereafter, to reach 39% of GDP in 2050, more than 100% in 2070 and about 160% at the end of the projection period.

Pension projections are extremely sensitive to the number of cross-border workers. As illustrated in Chart 4, which simulates the impact of 10,000 additional cross-border workers in 2008 on budgetary flows all over the projection horizon, this impact persists for a very long time, which provides a justification for long projection horizons.[10] The incidence on the primary balance is neutral at the end of the life cycle of the oldest commuters. After an initially positive impact related to higher social contributions, the primary balance turns negative due to the retirement of gradually larger contingents of cross-border workers. The incidence on the overall balance is less intuitive due to complex interest rate dynamics. It would be slightly negative over the long term, but this result should be interpreted with caution.

Chart 4 – Impact on the primary and overall balances of the pension system of 10,000 additional cross-border workers in 2008

Changes in the respective ratios to GDP



Sources: IGSS, ILO, STATEC, BCL calculations.

Since a high and constant rate of economic growth implies constantly growing inflows of cross-border workers, the neutral or even slightly negative long-term fiscal impacts identified in the longitudinal analysis of Chart 4 would not materialise in high growth conditions. In this case, the initial, positive phase induced

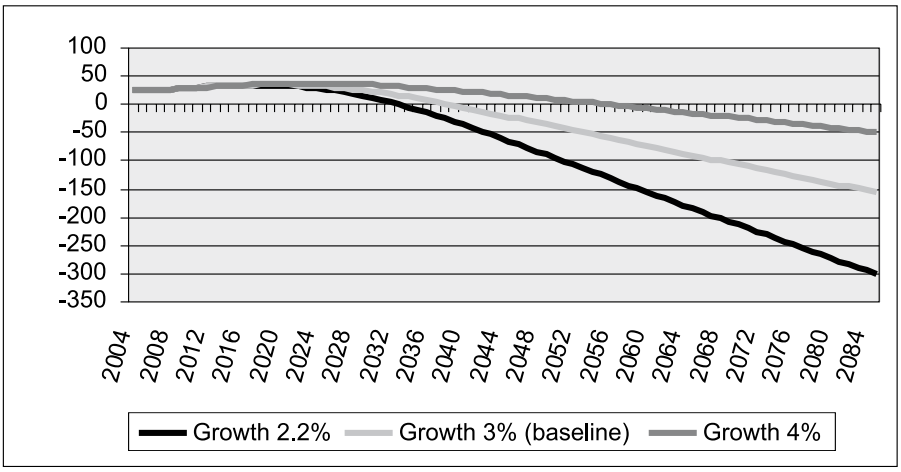
[10] It is in particular essential to take on board the large inflows of cross-border workers observed from 1990 to 2005 all over their life cycle.

by higher contributions would indeed overshadow the negative phase in the aggregated figures. However, it would require a high rate of economic growth to achieve such a result all over the projection period. This phenomenon is illustrated in Chart 5. At the current juncture, even a GDP growth rate of 4% a year would not be sufficient to palliate the "adverse tail" of the longitudinal curve. In addition, a 4% GDP growth rate would require considerable inflows of cross-border workers (second part of Chart 5). These results underline the need to base sustainability assessment on a joint monitoring of financial and immigration/cross-border developments in an open country like Luxembourg.

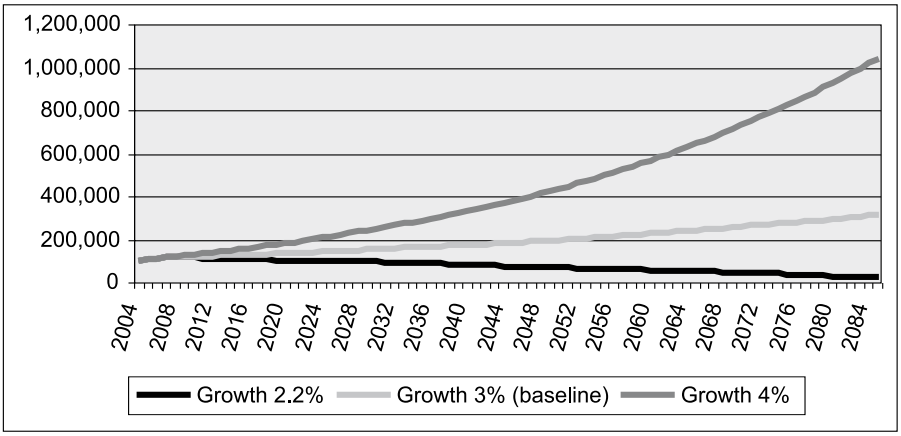
Chart 5 – Sustainability of the private pension regime under several GDP growth assumptions (1)

As percentages of GDP

1. Evolution of pension reserves



2. Corresponding evolution of the number of cross-border workers



Sources: IGSS, ILO, STATEC, BCL calculations.
(1) All other assumptions are kept unchanged.

2 Presentation of the Modigliani/Muralidhar reform proposal

In their book "Rethinking Pension Reform", Modigliani and Muralidhar (2004) advocate a gradual transition from PAYG to a partially or fully funded pension system. Under their proposal, a new pension fund (labelled "New Fund" in the rest of this paper) would be set up. It would be a public entity but the underlying reserves could be managed by private sector financial intermediaries within the confines of ad hoc rules.

Most importantly, the New Fund would finance pensions based on "defined benefits" (and not "defined contributions"). Pension benefits could be defined in the same way as under the current PAYG system and would be financed with the social contributions channelled to the NF and with the interest revenue stockpiled by the Fund on its own accumulated reserves. The contribution rate would be calibrated in order to guarantee that the pension system is balanced over the long-term, assuming a reference, target yield on reserves. The latter rate is of course conditional on the proportion of stocks and risk-free assets held in the NF portfolio. A central government transfer to the NF would offset the financing gaps that would occur in the short-term, when the achieved returns are lower than the targeted rate. The opposite transfer – from the NF to the Treasury – would take place when market yields exceed the targeted rate. These smoothing transfers would occur under the aegis of a formal swap agreement between the Treasury and the NF. According to simulations carried out by Modigliani and Muralidhar in the U.S. case, no significant transfers from the Treasury to the NF would have taken place in the 1926-2000 period, even with a target yield equal to 5% or more in real terms and in spite of the inclusion of the major stock market crisis that took place in 1929 and at the beginning of the thirties. For more detailed explanations on the Modigliani/ Muralidhar solution, see in particular Chapter 5 of their book.

Modigliani and Muralidhar (2004) argue that the transition cost would be minimised under their proposed solution and that it should normally lead to the conjunction of much lower contribution rates and comfortable reserves once the transition phase has been completed. The underlying mechanism at stake is illustrated in Table 2 and Chart 6, which have been set up in an hypothetical way in order to describe the working of a specific version of the model, namely the one with a quick transition process where NF contributions are set equal to their long-term equilibrium level from the beginning of the projection period. A range of more gradual alternatives is proposed in Modigliani and Muralidhar (2004) – there is indeed a trade-off between speed of adjustment and intergenerational fairness that is addressed carefully by the authors. By the same token, a gradual transition process is presented in part 3.2 below. All figures in the table are expressed as percentages of the contributory base – namely basically the wage bill before taxes and social contributions – over the 2008-2085 horizon. It is indeed assumed in a purely illustrative manner that the pension reform would become effective from January 2008.

Table 2 – Illustration of the Modigliani/Muralidhar proposal (yield on assets: 4.4% in real terms; macroeconomic and demographic assumptions in line with the baseline projection in Chapter 1)

As a percentage of gross contributory incomes, unless stated otherwise

	NF contributions	Property income NF	Pensions paid by NF	NF balance	Pension reserves	% of pensions transferred to NF	Cost ratio	Of which cost PAYG pensions	Total required financing	Transition cost
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	14.4	0.0	0.0	14.3	14.3	0.2	20.5	20.5	34.8	14.3
2009	14.4	0.9	0.1	15.1	28.7	0.6	20.5	20.4	34.7	14.2
2010	14.4	1.8	0.3	15.9	43.2	1.2	20.5	20.2	34.6	14.1
2011	14.4	2.6	0.4	16.6	57.6	2.1	20.5	20.1	34.5	14.0
2012	14.4	3.5	0.6	17.3	72.1	3.1	20.5	19.9	34.2	13.7
2013	14.4	4.4	0.9	17.9	86.5	4.3	20.5	19.6	34.0	13.5
2014	14.4	5.3	1.2	18.5	100.9	5.7	20.5	19.3	33.7	13.2
2015	14.4	6.2	1.5	19.1	115.1	7.2	20.5	19.0	33.4	12.9
2016	14.4	7.0	1.8	19.6	129.2	8.9	20.5	18.7	33.1	12.6
2017	14.4	7.9	2.2	20.1	143.2	10.7	20.5	18.3	32.7	12.2
2018	14.4	8.8	2.6	20.5	157.0	12.6	20.5	17.9	32.3	11.8
2019	14.4	9.6	3.0	21.0	170.6	14.7	20.5	17.5	31.9	11.4
2020	14.4	10.4	3.5	21.3	183.9	17.0	20.5	17.0	31.4	10.9
2021	14.4	11.3	4.0	21.6	197.0	19.5	20.5	16.5	30.9	10.4
2022	14.4	12.1	4.5	21.9	209.6	22.0	20.5	16.0	30.4	9.9
2023	14.4	12.8	5.0	22.2	222.1	24.6	20.5	15.5	29.8	9.3
2024	14.4	13.6	5.6	22.4	234.2	27.2	20.5	14.9	29.3	8.8
2025	14.4	14.3	6.1	22.6	246.0	29.9	20.5	14.4	28.7	8.2
2026	14.4	15.1	6.7	22.8	257.4	32.6	20.5	13.8	28.2	7.7
2027	14.4	15.8	7.2	22.9	268.4	35.2	20.5	13.3	27.7	7.2
2028	14.4	16.4	7.7	23.1	279.1	37.7	20.5	12.8	27.1	6.6
2029	14.4	17.1	8.3	23.2	289.4	40.3	20.5	12.2	26.6	6.1
2030	14.4	17.7	8.8	23.3	299.3	42.8	20.5	11.7	26.1	5.6
2035	14.4	20.5	11.2	23.6	342.9	54.8	20.5	9.3	23.6	3.1
2040	14.4	22.6	13.5	23.5	376.1	65.9	20.5	7.0	21.4	0.9
2045	14.4	24.2	15.6	23.0	400.2	76.1	20.5	4.9	19.3	0.0
2050	14.4	25.3	17.3	22.4	417.1	84.3	20.5	3.2	17.6	0.0
2055	14.4	26.1	18.6	21.9	428.3	90.8	20.5	1.9	16.3	0.0
2060	14.4	26.5	19.5	21.4	434.8	95.2	20.5	1.0	15.4	0.0
2065	14.4	26.8	20.1	21.1	437.7	97.8	20.5	0.4	14.8	0.0
2070	14.4	26.8	20.3	20.9	439.0	99.0	20.5	0.2	14.6	0.0
2075	14.4	26.9	20.4	20.9	440.0	99.5	20.5	0.1	14.5	0.0
2080	14.4	26.9	20.4	20.9	440.6	99.7	20.5	0.1	14.4	0.0
2081	14.4	27.0	20.4	20.9	440.7	99.7	20.5	0.1	14.4	0.0
2082	14.4	27.0	20.5	20.9	440.8	99.8	20.5	0.0	14.4	0.0
2083	14.4	27.0	20.5	20.9	440.8	99.9	20.5	0.0	14.4	0.0
2084	14.4	27.0	20.5	20.9	440.8	99.9	20.5	0.0	14.4	0.0
2085	14.4	27.0	20.5	20.8	440.8	100.0	20.5	0.0	14.4	0.0

Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

Table 2 draws on the current situation of the Luxembourg private sector pension system, with two important exceptions. First, the initial pension reserve (i.e. reserves as of 31 December 2007) is set at zero. Second, it is assumed that the cost ratio, namely primary pension expenditure[11] divided by the contribution base, will remain constant at the level projected by the BCL for 2008 all over the projection horizon. The proportion of pensions transferred to the NF, which determines the speed of the transition, plays a crucial role, as explained below and in Annex 1. By convention, pensions would be transferred to the NF on a pro rata basis, depending on the relative weight in the carrier of contributory incomes earned from January 2008 onwards – as the pension reform would by assumption be implemented in 2008. This means that for a 40-year career, the future pension benefits of employees who joined the insured population in December 1990 would be split between the PAYG system and the NF regime. A share of pension benefits equal to 42.5% (i.e. 17/40) would remain under the PAYG system and would therefore appear in column 8. of Table 2, whereas the rest (i.e. 23/40) would be paid by the NF and be included in the amount mentioned in column 3. of the same table. It should be noted that the splitting coefficient would not make any difference at the individual level. The NF would indeed operate under the defined-benefit principle. Pensions would be calculated with the PAYG pension formula, exactly in the same way as under the currently prevailing system and with the very same wage replacement ratio. For the record, net pensions are equal to 109,8% of gross wages in Luxembourg according to the OECD (2005), at least when a full career is considered.

The transition rates used in Table 2 (column 6.) are calculated in the same way but on an aggregated basis and taking into account for instance the length of careers and the age structure for each gender and pension category (i.e. old age pensions, disability, survival pensions), for residents as well as for cross-border workers, as explained in Annex 1. The proportion of transferred pensions – namely the speed of the transition process – tends to increase with the number of cross-border workers, because their career is on average shorter than the career of resident employees, as already mentioned in Chapter 1. The most prominent implication is that the speed of transition tends to increase with economic growth in Luxembourg.

As shown in Table 2 and Chart 6, the payment of pensions would be gradually transferred to the NF, as illustrated by the increasing amount in column 3. and the concomitant and commensurate decrease in column 8. The transition process would be completed only at the very end of the projection period. Employees who became affiliated to pension insurance in January 2007 and who will retire in December 2046 – thus after a 40-year carrier – will indeed still earn part of their pension benefits under the aegis of the PAYG system under the above-mentioned convention (this will be the case for 1/40 or 2.5% of the total pension benefits of these employees). Since some of them could collect pension benefits for 30 years or even more, the transition period may conceivably last until after 2075. In practice, however, the transition would basically have elapsed around 2065 under the scenario illustrated in Table 2.

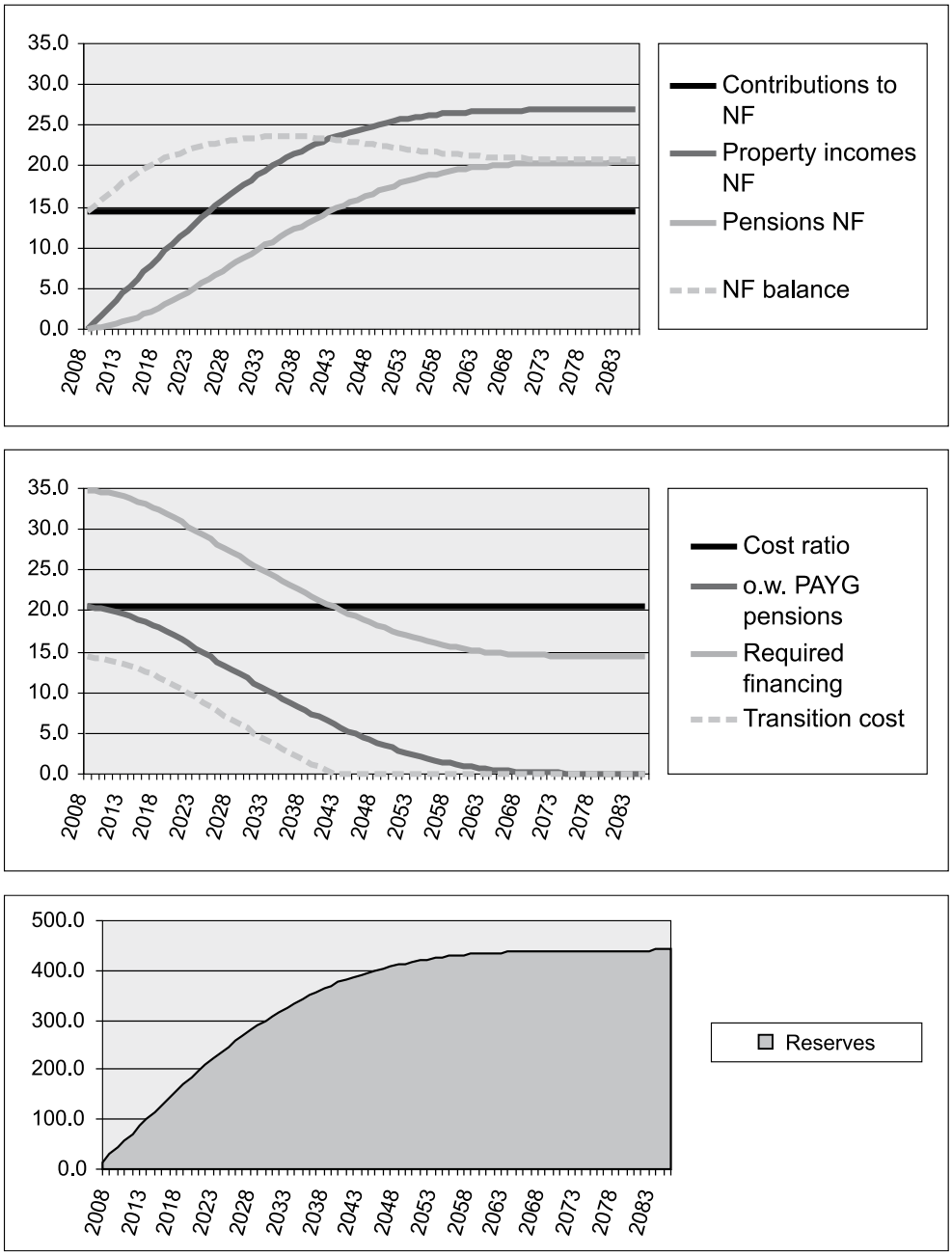
The first step of the calibration of the funding process is the choice of the reference real yield on reserves. As illustrated in section 3.4 devoted to the sensitivity analysis, this choice is of paramount importance. The funding projections presented in Table 2 and Chart 6 were made on the assumption that the NF will diversify its reserves, by investing 35% in stocks and the rest in risk-free assets. Based on realistic assumption about the equity risk premium and the average real risk-free interest rate, the benchmark rate of real return used throughout the projection period is set equal to 4.4%. The rationale that presided over this calculation is further described in Annex 2. Two remarks are worth mentioning at this stage, however. First, the relevant yield is the pre-tax rate because the NF would be a public entity. It is assumed in the projections that it would be exempted from taxes on property incomes. Alternatively, the NF may have to pay these taxes that would therefore flow to the central government, but the central government would then transfer the corresponding additional revenue to the NF.

[11] Including administrative costs.

Second, the benchmark yield could appear overestimated at first sight, in particular with respect to the implicit yield on pension reserves observed in Luxembourg at the end of 2004.[12] This reflects the benefits of diversification out of short-term assets. In addition, the benchmark 4.4% rate presupposes an equity risk premium below the level considered as reasonable – in the U.S. case – by Modigliani and Muralidhar. This is the reason why the benchmark rate is quite conservative with respect to the reference rates of return adopted by the authors, which are in the range 5-5.5% in real, pre-tax terms. Finally, the benchmark rate would be in line with the average yield achieved by the Government Pension Fund in Norway (see Annex 2).

Chart 6 – Illustration of the Modigliani/Muralidhar proposal

As a percentage of gross contributory incomes, unless stated otherwise



Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

[12] See IGSS (2005).

In order to ensure a higher return on the investment of the reserves of the public pension system, a new investment strategy was devised in 2003. It was described in the 5th update of the Luxembourg Stability Programme, presented in November 2003. This strategy foresees that private sector pension reserves could be invested in a range of instruments in order to improve returns. The portfolio will be managed by a mutual investment fund overseen by the Minister in charge of social security. Provided that it is fully enforced, this strategy would ease the transition to funding.

The next step of the funding projections is the calculation of the social contribution that would be channelled to the NF (see column 1. of Table 2). This constant rate is chosen in order to guarantee that the fund is fully balanced in the short-term and that sustainability is guaranteed after the transition process has elapsed. As illustrated in Table 2 and Chart 6, a contribution rate equal to 14,4% of contributory incomes all over the projection horizon would ensure the advent of a stable steady state situation, characterised by a constant reserve ratio when the transition is completed and by a NF balance which is also fully stable with respect to contributory incomes and GDP. In such a situation, reserves would be large enough to produce a stream of property income sufficient to finance the gap between the cost ratio and the long-term contribution rate and to ensure long-term sustainability, as explained in the analytical Annex 4. Total reserves would accumulate especially at the beginning of the transition period, because the pensions paid by the NF would still be well below the contributions channelled to the fund. The NF budgetary surplus (including property incomes) would amount to 14% of gross incomes in 2008 and would further increase thereafter, as property incomes would grow in line with the accumulation of reserves. NF reserves would stabilise at 441% of incomes at the end of the projection period (i.e. 175% of GDP) in the scenario envisaged in Table 2, provided that the cost ratio remains constant throughout the projection horizon. It is interesting to note that the 441% ratio does not only satisfy these stabilising properties. It is also fully compliant with the present value budget constraint, since it coincides with the present value of the primary balance of the NF over an infinite time horizon, assuming that the primary deficit remains equal to the level reached at the end of the projection period, namely 20.5% (the cost ratio) minus 14.4% (the constant contribution rate) over this infinite horizon.[13] The equivalence between the steady state equilibrium and the present value budget constraint is demonstrated in Annex 4. This is a crucial property, because it ensures that the transition to funding illustrated in Table 2 is fully consistent with long-term sustainability and the actuarial equilibrium of the pension system. NF contribution rates lower than 14.4% would necessarily lead to deteriorating budgetary ratios at the end of the projection period and the present value budget constraint would be breached, unless the total required financing is intensified at the beginning of the projection period.

The overall balance[14] consistent with the steady state equilibrium would reach 21% of gross incomes (see equations (6) and (7) in Annex 4 for an analytical calculation of this consistent balance). This may appear quite substantial, but such a high level is required in order to stabilise the asset ratio under the scenario envisaged in Table 2. The annual growth rate of gross nominal income is indeed equal to about 5% (i.e. real growth of 3% and inflation rate of 1.9%) in this scenario (see the baseline projection in Chapter I). The denominator of the asset ratio therefore increases by 5% each year, thus the need for a commensurate overall surplus in order to offset this "asset dilution" phenomenon. Most interestingly, the latter phenomenon contributes to dampen the impact on the funded pension system of GDP growth inflexions, as explained in section 3.3 below.

[13] Should the cost ratio prove non-stable after the projection horizon, this problem could be addressed through innovative means such as the one described in Modigliani and Muralidhar, in Chapter 8 ("The Case for Mixed Systems and Variable Contributions: Improving the Peformance of Pension Systems").

[14] The overall balance is the primary balance plus property incomes.

The equilibrium constant contribution rate of 14.4% achieved in the long term is well below the current 24% contribution rate, owing to the prefunding inherent in the Modigliani/Muralidhar proposal. The so-called "transition cost" (see column 10. of Table 2) would indeed give way to significantly positive NF budgetary balances and to the correlative accumulation of reserves, which would be further magnified by comfortable property incomes. Thanks to prefunding, property incomes would represent no less than 27% of gross incomes from 2060 onwards in the hypothetical case presented in Table 2. This large amount would cover the overall balance needed in order to offset the "reserve dilution effect" – namely 21% of gross incomes – on the one hand and the difference between the cost ratio and the equilibrium contribution rate (i.e. 20.5-14.4%=6.1%) on the other hand. Although considerable, the decrease in contribution rate would be of a lesser magnitude than the gain identified by Modigliani and Muralidhar in Chapter 5 of "Rethinking Pension Reform". This reflects the quicker transition to funding in Table 2, which is mostly attributable to the short career of cross-border workers.[15] The initial accumulation of assets is therefore less pronounced than in the Modigliani/Muralidhar simulations centred on the U.S. case. In addition, as mentioned above, the benchmark real yield rate used in this paper is more conservative than the one assumed by Modigliani and Muralidhar (2004). Finally, the initial simulation carried out by the authors is made for a hypothetical stationary economy, where economic growth – and therefore the reserve dilution effect – is nonexistent.

The prefunding inherent in the Modigliani/Muralidhar proposal is best illustrated in column 9. of Table 2, where the total required financing is singled out. The required financing is equal to the constant contribution rate channelled to the NF plus the remaining cost of the PAYG system.[16] Since the latter system is by assumption phased out in a gradual way, this remaining cost will gradually disappear, as shown in column 8. of the Table, and the required financing will therefore narrow down to the fixed contribution to the NF in the medium-term. The transition cost, which is equal to the difference between the required financing and the cost ratio,[17] would be close to the contribution rate at the beginning of the transition process, but would then erode away. It would be fully neutralised from 2042 onwards in the hypothetical simulation presented in Table 2 and Chart 6, namely well before the completion of the transition period (the cost of PAYG pensions would indeed still amount to 6% of gross incomes in 2042). The transition costs would vanish within a relatively short time horizon owing to the virtuous asset and property income dynamic.

The transition to funding outlined below in the case of a constant cost ratio appears extremely successful in the long-term, as it would give way to large and stable assets and budgetary surpluses in spite of a low steady state contribution rate. This very favourable situation would reflect the prefunding inherent in the transition process. However, the magnitude of the prefunding effort is such that the required financing would be close to 35% of gross incomes at the beginning of the transition period. This would exceed the current contribution rates by 11% or 4.3% of GDP. This prefunding burden and its impact on contributions could be alleviated owing to a wider range of financing channels that could extend for instance to higher central government transfers[18] or alternative levies, but on the whole such a burden appears too large. Another shortcoming of the hypothetical simulation conducted in Table 2 and Chart 6 is the assumption of a constant cost ratio and of zero initial reserves, which is extremely unrealistic in the present Luxembourg context. These flaws will be addressed in Chapter 3. of the paper.

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[15] It is assumed in the projection that the length of their career will gradually converge to the one observed for resident workers. However, this assumption does not change significantly the speed of the transition due to the gradual implementation of this career convergence assumption.

[16] Namely the aggregated amount of pensions that have not yet been transferred to the NF.

[17] The transition cost would appear even more limited if it were calculated with respect to the current contribution rate, namely 24% of gross incomes.

[18] Such a move was mentioned by the IMF in the concluding statements of its January 2006 Article IV mission to Luxembourg (see IMF (2006)).

3 Application to Luxembourg

Although it already drew on some characteristics of the Luxembourg situation, the simulation conducted in the previous chapter was purely illustrative, as it was carried out in order to highlight the peculiarities of the Modigliani/Muralidhar proposal. In order to make it more relevant in the current Luxembourg context, its major shortcomings are successively addressed. An increasing cost ratio in line with the BCL pension projections and non-zero initial reserves are first put into the picture (section 3.1). Since this "solution" is still characterised by an unrealistically high prefunding burden, an alternative transition path with lower initial transfers to the NF and a less systematic link between pensions and real wage developments as is currently the case in Luxembourg is presented in section 3.2. This simulation is considered as the "baseline funding scenario" in the rest of the paper. A very interesting property of this new baseline projection – namely the fact that the budgetary situation of the private sector pension regime becomes much less vulnerable to GDP growth developments than under the current system – is highlighted in section 3.3. The baseline scenario is submitted to the "acid test" of sensitivity analyses in section 3.4.

3.1 Inclusion of initial assets and an increasing cost ratio

The funding projection presented in Table 3 departs from the illustrative simulation made in Table 2 in two respects, as explained above. First, an initial reserve is introduced into the picture. This reserve is equal to the total assets of the general pension regime, as projected in the BCL model for the end of 2007. By assumption, the reserves would be transferred to the NF in full on 31 December 2007. Second, the hypothesis of a constant cost ratio is dropped. The cost ratio presented in Table 3 is projected using the BCL baseline projection outlined in Chapter 1. This new assumption about the cost ratio will give way to a higher equilibrium contribution rate. However, the inclusion of significant initial reserves will have the opposite effect.

Table 3 makes it clear that the former, negative effect will strongly outweigh the latter impact. The cost ratio would increase from 20.5% of gross incomes to 36.4% at the end of the projection period. In this context, the steady state contribution rate would have to be set to 23.2%, which would exceed by a wide margin the contribution rate required under the constant cost ratio scenario (see Table 2). Although pension reserves would represent about 65% of gross incomes at the end of 2007, this would hardly compensate the impact of the continuously increasing cost ratio. In spite of their high magnitude in absolute terms, the "compensation reserves" accumulated within the current pension framework would be clearly insufficient to address the prospective increase in pension benefits, which illustrates the need for much more demanding targets. The twin criteria of stable budgetary indicators and compliance with the present value budget constraint[19] at the end of the projection horizon would require extremely high reserve and balance ratios. It is only in such a case that the stream of property incomes could cover the high cost ratios observed at the end of the projection horizon and would ensure at the same time a relatively moderate steady state contribution rates. The latter would indeed be below the current 24% contribution rate. Scenarios with less demanding target ratios would not satisfy the present value budget constraint and would lead to decreasing balance and reserve ratios at the end of the projection horizon, unless prefunding is further enhanced.

[19] Compliance with the present value budget constraint over an infinite horizon after 2085, where the cost ratio is assumed to remain constant at 36.4% and the discount rate is equal to 6.4%, namely the assumed nominal rate of return on pension reserves. It is further assumed that gross incomes would grow by about 5% a year in real terms (3% in real terms plus 1.9% inflation). This rule gives way to a steady state contribution rate equal to the rate that would stabilise the debt and balance ratios at the end of the projection horizon, as explained in Annex 4.

Table 3 – Application to the Luxembourg situation: inclusion of initial assets and an increasing cost ratio (yield on assets: 4.4% in real terms)

As a percentage of gross contributory incomes, unless stated otherwise

	NF contributions	Property income NF	Pensions paid by NF	NF balance	Pension reserves	% of pensions transferred to NF	Cost ratio	Of which cost PAYG pensions	Total required financing	Transition cost
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	23.2	4.0	0.0	27.2	90.2	0.2	20.5	20.5	43.6	23.1
2009	23.2	5.5	0.1	28.5	114.1	0.6	20.7	20.6	43.8	23.0
2010	23.2	7.0	0.3	29.9	138.3	1.2	20.6	20.3	43.5	22.9
2011	23.2	8.4	0.4	31.2	162.6	2.1	21.2	20.7	43.9	22.7
2012	23.2	9.9	0.6	32.4	187.2	3.1	21.0	20.4	43.6	22.5
2013	23.2	11.4	0.9	33.7	211.8	4.3	21.7	20.8	43.9	22.2
2014	23.2	12.9	1.2	34.9	236.5	5.7	21.6	20.3	43.5	21.9
2015	23.2	14.5	1.6	36.0	261.2	7.2	22.3	20.7	43.8	21.6
2016	23.2	16.0	2.0	37.2	286.0	8.9	22.1	20.2	43.3	21.2
2017	23.2	17.5	2.4	38.2	310.6	10.7	22.9	20.4	43.6	20.7
2018	23.2	19.0	2.9	39.3	335.3	12.6	22.8	19.9	43.1	20.3
2019	23.2	20.5	3.5	40.2	359.7	14.7	23.6	20.1	43.3	19.7
2020	23.2	22.0	4.0	41.2	384.0	17.0	23.6	19.6	42.7	19.1
2021	23.2	23.5	4.8	41.9	408.0	19.5	24.5	19.7	42.9	18.4
2022	23.2	25.0	5.4	42.7	431.6	22.0	24.5	19.1	42.2	17.8
2023	23.2	26.4	6.2	43.3	454.9	24.6	25.4	19.2	42.3	16.9
2024	23.2	27.9	6.9	44.1	478.0	27.2	25.5	18.5	41.7	16.2
2025	23.2	29.3	7.9	44.5	500.5	29.9	26.6	18.6	41.8	15.2
2026	23.2	30.6	8.7	45.1	522.4	32.6	26.6	17.9	41.1	14.5
2027	23.2	32.0	9.7	45.4	543.6	35.2	27.7	17.9	41.1	13.4
2028	23.2	33.3	10.5	46.0	564.6	37.7	27.7	17.3	40.4	12.7
2029	23.2	34.6	11.6	46.1	584.6	40.3	28.8	17.2	40.4	11.6
2030	23.2	35.8	12.3	46.6	604.1	42.8	28.8	16.4	39.6	10.8
2035	23.2	41.3	17.2	47.2	690.2	54.8	31.4	14.2	37.3	5.9
2040	23.2	45.5	21.2	47.6	757.0	65.9	32.1	10.9	34.1	2.0
2045	23.2	48.8	25.4	46.6	806.8	76.1	33.4	8.0	31.2	0.0
2050	23.2	51.2	28.0	46.4	844.4	84.3	33.2	5.2	28.4	0.0
2055	23.2	53.1	31.0	45.2	871.6	90.8	34.2	3.2	26.3	0.0
2060	23.2	54.3	32.2	45.2	890.6	95.2	33.8	1.6	24.8	0.0
2065	23.2	55.1	34.0	44.3	902.4	97.8	34.7	0.8	23.9	0.0
2070	23.2	55.6	34.0	44.8	911.2	99.0	34.4	0.3	23.5	0.0
2075	23.2	56.1	35.3	43.9	917.3	99.5	35.5	0.2	23.3	0.0
2080	23.2	56.3	35.2	44.3	921.2	99.7	35.3	0.1	23.3	0.0
2081	23.2	56.3	35.9	43.6	921.2	99.7	36.0	0.1	23.3	0.0
2082	23.2	56.4	35.4	44.2	921.9	99.8	35.4	0.1	23.2	0.0
2083	23.2	56.4	36.2	43.4	921.8	99.9	36.2	0.1	23.2	0.0
2084	23.2	56.4	35.6	44.0	922.2	99.9	35.6	0.0	23.2	0.0
2085	23.2	56.4	36.4	43.2	921.9	100.0	36.4	0.0	23.2	0.0

Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

Although the scenario would address the sustainability problem in a structural way, the short-term cost of such a solution appears unbearable. The required financing, namely the sum of the 23.3% steady state contribution to the NF on the one hand and the cost of the remaining PAYG pensions on the other hand, would indeed reach about 44% of gross incomes at the beginning of the projection horizon. This would imply additional resources equal to about 20% of gross wages (i.e. 44% minus the current contribution rate of 24%) or 8% of GDP. Such a massive transfer is off course out of reach of the Luxembourg authorities. A tentative solution to this transition problem is assessed in the following section.

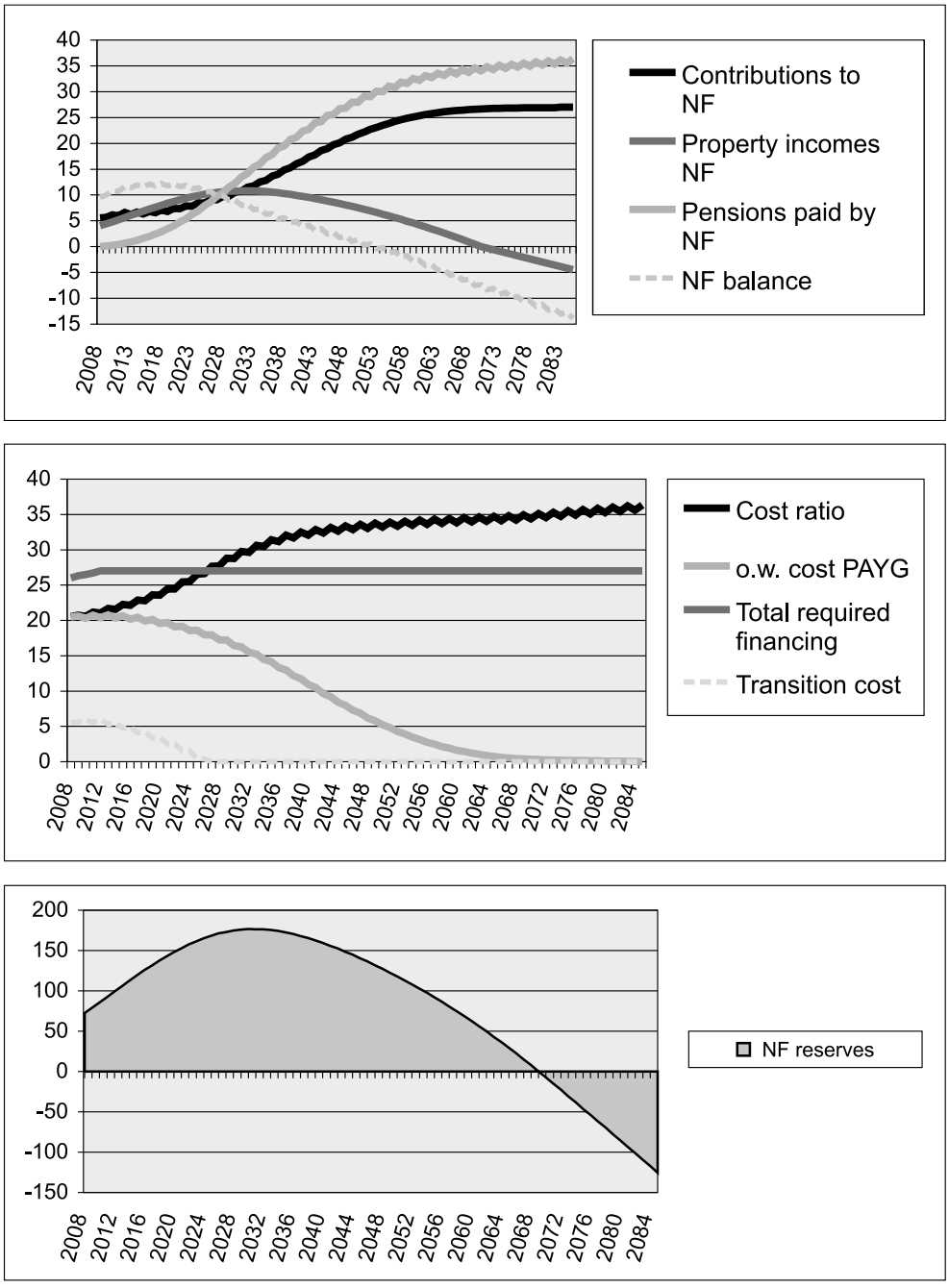
3.2 New baseline with contribution smoothing and suspension of the adjustments of pensions to real wages from 2007 to 2017

As explained by Modigliani and Muralidhar (2004), several transition paths to the funding equilibrium could be envisaged. The simulation illustrated in Chart 7 presupposes that a cap on the total required financing is imposed during the transition period. The initial transfers to the NF would be below the steady state contribution rate in order to contain the transition cost. The transfer would converge to the level compatible with the steady state contribution rate in a gradual manner, according to a pre-specified schedule. Provided that this schedule is strictly complied with, the NF would never be in an unbalanced position, because its pension expenditure would be of a low magnitude at the beginning of the transition process. A delicate balance should be struck when choosing the cap on the required financing and the correlative initial transfers to the NF.[20] On the one hand, a tight cap ensures that the transition cost is limited and realistic from a political perspective. On the other hand, too tight a cap would hamper or even derail the convergence process to the steady state equilibrium, as it could neutralise the virtuous reserve increasing process highlighted in Tables 2 and 3 above. By assumption, the total required financing is caped at 27% of gross incomes in the projection presented in Chart 7.

[20] The initial transfers would be equal to the cap minus the cost ratio plus the NF pension expenditure.

Chart 7 – Application to the Luxembourg situation with a 27% financing cap (yield on assets: 4.4% in real terms)

As a percentage of gross contributory incomes, unless stated otherwise



Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

In addition, the transition to 27% would by convention be gradual at the very beginning of the transition period. The total resources channelled to the pension system as a whole (NF and remaining PAYG pensions) would be set to 26% in 2008, 26.3% in 2009, 26.5% in 2010 and 26.7% in 2011. Such a step forward in the collection of resources would not be over-demanding. The required adjustment over the first five years of the transition period would not exceed 1.2% of GDP, i.e. about the additional transfer from the central government to the pension system mentioned in the concluding statement of the January 2006 IMF Article IV mission to Luxembourg. Moreover, this additional amount would be collected in a gradual

way from 2008 to 2011 as indicated above. Finally, the additional resources could also be collected through higher contribution rates from employees and/or employers – with appropriate moves in order to avoid the adverse impact of this measure on competitiveness – or via new, alternative financing resources. The arbitrage between these different levers is beyond the scope of this paper.

As illustrated in the first panel of Chart 7, the contribution rate that would flow to the NF would be limited at the beginning of the period, as it would by design no longer exceed 27% of gross wages (or even less from 2008 to 2011) minus the remaining cost of the PAYG pillar. Due to its low initial pension burden, the NF would still record surpluses at the beginning of the projection horizon, which would give way to the building up of significant assets from 2008 to 2030. However, the resulting property income and NF overall surpluses would not be significant enough to offset the "reserve dilution" effect. The reserve-to-gross income ratio would therefore decline from 2030 onwards. This would set in motion a downward spiral, where lower reserves would give way to declining property incomes and deteriorating balances, which would in turn further magnify the decrease in the asset ratio in the face of ever increasing pension expenditure. At the end of the projection period, the NF would be in an unsustainable situation, characterised by significant and increasing deficits and by substantial liabilities.

At first sight, Luxembourg would therefore not be in a position to reap the substantial gains associated with the funding strategy highlighted in the previous simulations, due to the steeply increasing cost ratio. However, the scenario presented in Chart 7 is conditional on an "unchanged policy assumption", whereby accrued and future pension benefits would continue to be adjusted in full to real wage developments throughout the projection horizon.[21] An alternative simulation presented in Table 4 below rests on a different hypothesis. It is assumed that the adjustment to real wages would be suspended from 2007 to 2017, meaning that six adjustments would not take place (2007, 2009, 2011, 2013, 2015 and 2017). Such a move would fully preserve the purchasing power of pensioners, which would remain stuck at its 2005 level until 2017. As real wages would by assumption increase by 2% a year from 2008 onwards – and less before this date, in line with the BCL December 2005 macroeconomic projections – the wage replacement ratio would decline by 18%, however. According to the OECD (2005), the wage replacement ratio calculated as a percentage of net incomes for a full career would have reached 109,8% in Luxembourg in 2003. In spite of the above-mentioned delinking, the replacement ratio would therefore still be very comfortable from 2017 to the end of the projection horizon, as it would reach 90% of net incomes earned prior to retirement. Ceteris paribus, this ratio would still exceed to a large extent the corresponding figures observed in the neighbouring countries – namely 72% in Germany, 69% in France and 63% in Belgium according to the OECD. The suspension measure included in Table 4 serves an illustrative purpose. Suspension of wage indexation could conceivably be introduced in a more gradual way and could be confined to specific categories (for instance pensions above a given threshold). However, a more gradual suspension would have to be spread over a longer period and would be more costly in the medium-term, as delayed adjustments have adverse consequences on property incomes. Alternative measures could also be adopted, for instance changes in the pension formula or a partial delinking of pensions from price developments.

Table 4 makes it clear that the suspended indexation to real wages would enable Luxembourg to reap the benefits of funding, which means that the long-term budgetary impact of the measure would extend far beyond the direct cost savings involved. The required steady state contribution to the NF would be equal to 24% of gross incomes, namely the current contribution rate. This result would be achieved in spite of the growing cost ratio, owing to the significant property incomes brought about by funding. The total required financing would remain at the 27% mark until about 2055, but it would then gradually converge

[21] This adjustment takes place every two years, hence the indented evolution of the cost ratio in Chart 2.

to the steady state 24% rate. Prefunding is embedded in the scenario depicted in Table 3 in two manners. First, total primary revenue (i.e. contributions channelled to the NF and the revenue that would cover the remaining cost of the PAYG system) would be equal or close to 27% of gross incomes during most of the projection horizon, which would be in excess of the current contribution rate and well above the cost ratio. Second, the suspension of indexation to real wages would decrease the cost ratio recorded in 2017 by about 4% of gross wages – namely 1.5% of GDP – compared to the "spontaneous" evolution of the ratio. In this context, reserves would increase steeply and converge to about 415% of gross incomes at the end of the projection horizon. As was the case in the previous scenarios, this asset ratio would ensure the stability of reserve and balance ratios at the end of the projection horizon. At the same time, it would guarantee that the present value budget constraint is fulfilled.[22] The equilibrium asset ratio would of course be lower in case a partially funded solution is adopted rather than full funding, but such a solution would also require higher equilibrium contributions.

A reserve level equal to 415% of gross incomes would represent 165% of GDP. This may seems over-demanding at first sight, but such a level would certainly not be unprecedented. In Norway, the total assets of the Government Pension Fund amounted to 78% of GDP at the end of 2005, and this ratio is on a steeply ascending trend.[23] In the Netherlands, the total assets of the civil servant pension fund ABP, which are calculated in an actuarial way in order to guarantee the payment of future pensions, reached 36% of GDP on 31 December 2004.[24] However, the coverage of the ABP in the Netherlands is well below the coverage of the private sector pension regime in Luxembourg. Should the coverage rate of the ABP be brought in line with the corresponding figure in Luxembourg, the assets of ABP would ceteris paribus have to swell to more than 150% of GDP in order to preserve the actuarial equilibrium. A prefunding strategy leading to the accumulation of large pension reserves is also recommended in OECD (2006).

Furthermore, Luxembourg is a small and very open economy vulnerable to idiosyncratic shocks, which requires larger "shock absorber" – i.e. more substantial reserves – than is the case in larger countries. The large NF surplus that would be recorded during most of the projection horizon – namely about 20% of gross incomes or 8% of GDP – would further alleviate the impact of adverse developments. For instance, the 8% of GDP surplus would make it much easier for Luxembourg to avoid breaching the 3% deficit reference value embedded in one of the protocols of the Treaty Establishing the European Community.[25] According to the ESA 95 rules, the NF would indeed be included in general government.[26] The surplus of the fund would therefore be taken into account in the calculation of ESA 95 balances. This wider room for manoeuvre would allow Luxembourg to address potential adverse shocks in a more flexible way, without incurring the risk of breaching the 3% reference value.

[22] Assuming that the pension cost ratio will be stable at its 2085 level over an infinite horizon.

[23] Government Pension Fund (2005). The total asset of the Fund at market value represented 59% of GDP at the end of 2004.

[24] ABP (2004).

[25] The overall surplus would be below 8% in the ESA 95 system of accounts, however, because capital gains on equity, either realised or not, are not considered as non-financial revenue in ESA 95.

[26] Following a decision taken by Eurostat in March 2004, defined-benefits pension funds have to be included in the general government figures, irrespective of their public or private status. By contrast, defined-contribution funded pension schemes cannot be classified as social security schemes and are therefore classified outside of the government sector, even if the government is involved as a manager of the flow of contributions and pension benefits or as a guarantor for the risk of defaulting payments of pensions.

Table 4 – Application to the Luxembourg situation: baseline funding scenario with suspension of real wage indexation from 2007 to 2017 (yield on assets: 4.4% in real terms)

As a percentage of gross contributory incomes, unless stated otherwise

	NF contributions	Property income NF	Pensions paid by NF	NF balance	Pension reserves	% of pensions transferred to NF	Cost ratio	Of which cost PAYG pensions	Total required financing	Transition cost
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	5.8	4.1	0.0	9.8	73.1	0.2	20.2	20.2	26.0	5.8
2009	6.4	4.5	0.1	10.7	80.1	0.6	20.0	19.9	26.3	6.3
2010	6.9	4.9	0.2	11.5	87.6	1.2	19.9	19.6	26.5	6.6
2011	7.4	5.3	0.4	12.3	95.6	2.1	19.7	19.3	26.7	7.0
2012	8.0	5.8	0.6	13.2	104.2	3.1	19.6	19.0	27.0	7.4
2013	8.3	6.4	0.8	13.9	113.0	4.3	19.5	18.6	27.0	7.5
2014	8.7	6.9	1.1	14.5	122.1	5.7	19.4	18.3	27.0	7.6
2015	9.1	7.5	1.4	15.2	131.5	7.2	19.3	17.9	27.0	7.7
2016	9.6	8.0	1.7	15.9	141.1	8.9	19.2	17.5	27.0	7.9
2017	9.9	8.6	2.0	16.5	151.0	10.7	19.1	17.0	27.0	7.9
2018	10.4	9.2	2.4	17.2	161.1	12.6	19.0	16.6	27.0	8.0
2019	10.2	9.9	2.9	17.2	170.6	14.7	19.7	16.8	27.0	7.3
2020	10.7	10.4	3.3	17.8	180.4	17.0	19.6	16.3	27.0	7.4
2021	10.6	11.0	4.0	17.7	189.7	19.5	20.4	16.4	27.0	6.6
2022	11.1	11.6	4.5	18.2	199.0	22.0	20.4	15.9	27.0	6.6
2023	11.0	12.2	5.2	18.0	207.8	24.6	21.2	16.0	27.0	5.8
2024	11.6	12.7	5.8	18.5	216.7	27.2	21.2	15.4	27.0	5.8
2025	11.5	13.3	6.6	18.2	224.9	29.9	22.1	15.5	27.0	4.9
2026	12.1	13.8	7.2	18.6	233.1	32.6	22.2	14.9	27.0	4.8
2027	12.1	14.3	8.1	18.2	240.6	35.2	23.0	14.9	27.0	4.0
2028	12.6	14.7	8.7	18.7	248.1	37.7	23.1	14.4	27.0	3.9
2029	12.7	15.2	9.6	18.2	254.9	40.3	23.9	14.3	27.0	3.0
2030	13.3	15.6	10.2	18.7	261.8	42.8	23.9	13.7	27.0	3.1
2035	15.2	17.5	14.3	18.4	290.5	54.8	26.1	11.8	27.0	0.9
2040	18.0	18.9	17.6	19.3	313.7	65.9	26.6	9.1	27.0	0.4
2045	20.4	20.2	21.0	19.6	334.3	76.1	27.7	6.6	27.0	0.0
2050	22.7	21.5	23.2	21.0	355.1	84.3	27.5	4.3	27.0	0.0
2055	24.0	22.8	25.7	21.0	375.4	90.8	28.3	2.6	26.6	0.0
2060	24.0	23.7	26.6	21.1	390.7	95.2	28.0	1.3	25.3	0.0
2065	24.0	24.4	28.1	20.3	400.3	97.8	28.7	0.6	24.6	0.0
2070	24.0	24.8	28.2	20.6	407.5	99.0	28.4	0.3	24.2	0.0
2075	24.0	25.2	29.2	19.9	412.2	99.5	29.4	0.2	24.1	0.0
2080	24.0	25.4	29.1	20.2	415.3	99.7	29.2	0.1	24.1	0.0
2081	24.0	25.4	29.7	19.6	415.3	99.7	29.8	0.1	24.0	0.0
2082	24.0	25.4	29.2	20.1	415.8	99.8	29.3	0.1	24.0	0.0
2083	24.0	25.4	29.9	19.5	415.7	99.9	29.9	0.0	24.0	0.0
2084	24.0	25.4	29.4	20.0	416.0	99.9	29.4	0.0	24.0	0.0
2085	24.0	25.4	30.1	19.4	415.7	100.0	30.1	0.0	24.0	0.0

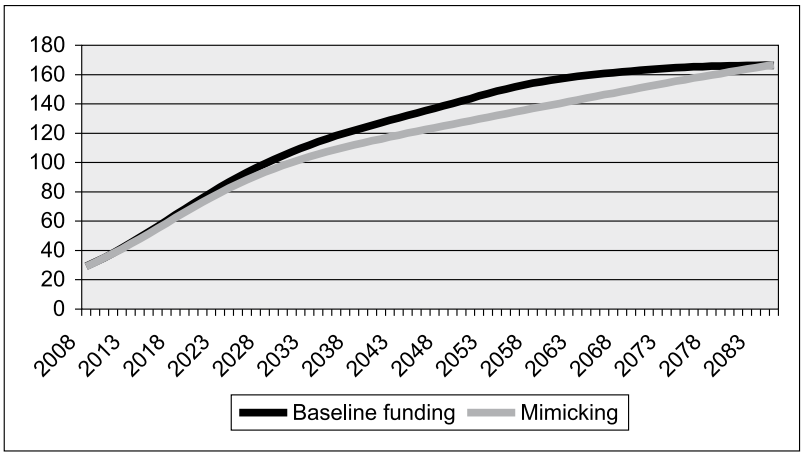
Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

The funding strategy illustrated in Table 4 – henceforth referred to as the "baseline funding scenario" – could conceivably me mimicked within the current pension framework, with a similar prefunding strategy and

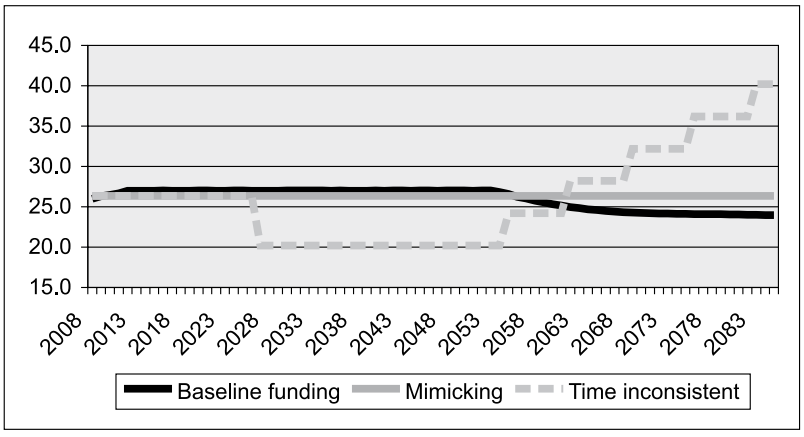
asset diversification policy. As shown in Chart 8, a strategy where real wage indexation would also be suspended from 2007 to 2017 and where the contribution rate would be adjusted from 24% to 26.4% from 2008 onwards would induce about the same evolution of reserves as under the baseline funding scenario. However, such a scenario would have two decisive shortcomings. First, the required contribution rate would reach 26,4% at the end of the projection horizon, compared to 24% under the baseline funding scenario. Second, the funding process proposed in Table 4 presupposes the existence of an independent pension fund held accountable by individual pensioners and by monitoring institutions. Due to this commitment framework, the Fund would always act in line with the actuarial equilibrium. By contrast, the "mimicking" solution presented in Chart 8 would not safeguard the pension system against time inconsistent behaviours. In some circumstances, the authorities might indeed depart from the actuarial equilibrium in order to reap some benefits in the short or medium term to the detriment of the long-term perspective of the pension system. The subsequent return to this long-term equilibrium is bound to be extremely painful once such a departure has taken place, thus the advantage of the commitment technology provided by funding.

Chart 8 – Evolution of reserves and contributions in the baseline funding scenario (see Table 4), the "mimicking" scenario and the time inconsistency scenario

1. Reserves as percentages of GDP



2. Contributions as percentages of gross incomes



Sources: STATEC, IGSS, ILO, BCL calculations.

Note: the baseline funding, mimicking and time inconsistent scenarios presented in the chart all presuppose that indexation of pensions to real wage developments is suspended from 2007 to 2017. In addition, the real rate of return on assets is equal to 4.4% in the three scenarios.

A simple example illustrates the relevance of this time inconsistency problem within the "mimicking" strategy. It is assumed that the authorities are fully compliant with the mimicking strategy from 2008 to 2026. As reserves would have reached more than 90% of GDP in 2026, which seems very comfortable in absolute terms, the authorities could be inclined to conduct a more lenient policy at this stage. By assumption, they would decrease contributions from 26.4 to 20.2% of gross incomes from 2027 onwards, 20.2% being the contribution rate compatible with a new reserve target level equal to 50% of GDP in 2054. Although such a target would a priori make sense in the short or even the medium term, it would totally disrupt the actuarial equilibrium of the pension system and lead to a cumulative deterioration of the budgetary situation of the pension system.

It is further assumed that in order to prevent such a downward spiral, the authorities would decide from 2055 onwards to revert to a more stringent policy. They would increase the contribution rate in a stepwise manner in order to put the system back on track at the end of the projection horizon, which means that the overall balance of the pension system would have to converge to 8% of GDP – namely the level estimated for the end of the projection horizon in the baseline funding and the mimicking scenarios. As illustrated in Chart 8, such a strategy would imply a contribution rate higher than 40% of gross wages at the end of the projection horizon. Should the contribution rate be capped to 24%, benefits would then have to adjust downwards in order to restore the budgetary situation. In this case, the wage replacement ratio would have to decrease from 90% in 2054 to only about 40% by the end of the horizon.[27]Such a level would be well below the level considered appropriate in the literature.[28]

The projection presented in Table 4 rests on substantial prefunding, but on the other hand it exhibits many desirable features, much more so than a "mimicking" of the funding strategy within the current pension framework. An additional and decisive advantage of the baseline funding process, namely its relative insulation from GDP growth inflexions, is reviewed below, in section 3.3.

3.3 A decisive advantage of the new baseline: GDP growth developments are mitigated under the funding scheme

In order to assess the resilience of the baseline funding scenario to macroeconomic developments, this scenario is reestimated conditionally on GDP growth rates above (i.e. 4%) and below (i.e. 2.2%) the 3% growth rate considered in the baseline. As explained in Chapter I, the annual inflow of immigrants is kept unchanged (4,000 persons a year), the number of cross-border workers being the residual variable.

The detailed results of the 4% growth and 2.2% growth scenarios are provided in Annex 3. They are synthesised in Chart 9 and Table 5. Chart 9 compares the evolution of the total required financing (namely the contribution to the NF plus the remaining cost of PAYG pension benefits) under the funding system with the contribution rate required under a "wait-and-see" strategy, where pension benefits are fully indexed to real wage developments, where no asset diversification strategy is adopted and where contribution rates are revised upwards only when pension reserves fall under the legal requirement – namely 1.5 times the amount of annual pension benefits – over successive 7-year periods.[29] The two strategies are assessed conditionally on the three GDP growth scenarios (4%, the baseline 3% and 2.2%). The results highlight once more that the funding process depicted in Table 4 is a winning strategy over the long term, by a wide margin and whatever the growth scenario considered. Contribution rates are lower and at the same time

[27] The increase in contribution or the downward adjustment of benefits would be even more drastic should the authorities target a 165% of GDP reserve ratio in 2085 (namely the prospective ratio in the baseline funding scenario and also – by definition – in the mimicking scenario). For instance, the contribution rate would reach about 50% of gross income at the end of the projection horizon in this case.

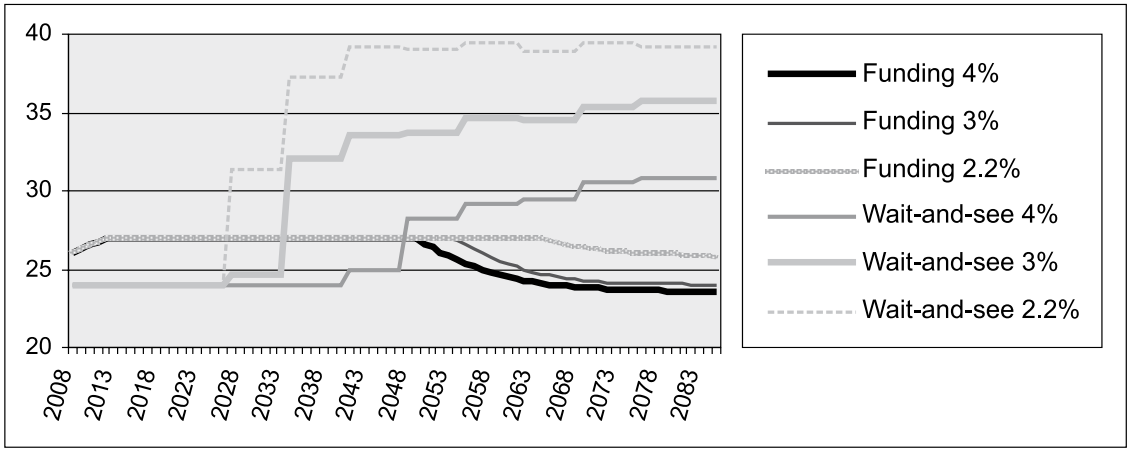
[28] See for instance OECD (2005).

[29] Both the 1.5 criterion and the 7-year successive periods are provided for in Article 238 of Code des Assurances Sociales.

reserves are much more substantial than under the wait-and-see strategy. Another crucial message is that the contribution rate – or more exactly the total required financing – is much more sensitive to growth rates under the wait-and-see strategy than in the funding case. A simple look at Chart 9 and Table 5 shows that the required financing does not differ in a significant way in the three funding cases, but that this pattern does not hold under the alternative strategy. The terminal contribution rate indeed ranges from 30.8 to 39.2% in the wait-and-see case and from 23.5 to 25.8% under funding. Stated otherwise, funding provides an appropriate protection against GDP growth inflections. The buffer is extremely effective, since the impact of shocks to GDP growth on the terminal contribution rates would decline by 50 to 90% (by 80 to 90% from the yardstick of average contribution rates) compared to the wait-and-see strategy.

Chart 9 – Evolution of the required financing of the pension system (funding and remaining PAYG) under alternative growth scenarios

As percentages of gross incomes



Sources: STATEC, IGSS, ILO, BCL calculations.

Table 5 – Average and terminal required financing under funding and the wait-and-see strategy

As percentages of gross incomes, between brackets: differences with respect to the baseline 3% GDP growth scenario

	Funding strategy		Wait-and-see strategy	
GDP growth	**Average 2008/'85**	**Rate in 2085**	**Average 2008/'85**	**Rate in 2085**
4.0%	25.7% (-0.3%)	23.5% (-0.5%)	26.9% (-4.0%)	30.8% (-4.9%)
3.0%	26.0%	24.0%	30.9%	35.7%
2.2%	26.7% (+0.7%)	25.8% (+1.8%)[31]	34.6% (+3.7%)	39.2% (+3.5%)

Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

This "shock absorber" property of the funding system as far as GDP growth is concerned is attributable to the "reserve dilution effect" already mentioned above and highlighted in Annex 4. The numerator of the reserve ratio increases with the overall surplus of the pension system, but the denominator – basically the wage bill – grows in line with inflation, the real wage and employment growth. Since real wage growth is assumed to be equal to productivity growth in the BCL pension model, which is a particularly reasonable assumption over a long-term horizon, the denominator increases in line with nominal GDP growth. Ceteris

[30] This difference may appear significant compared to the opposite 4% scenario. This is due to the 27% contribution cap, which is more tightening in the 2.2% growth case, where a larger prefunding would in principle be required. This contributes to increase the steady state, terminal financing rate. In spite of this bias, the 1.8% difference is well below the 3.5% difference observed under the wait-and-see strategy.

paribus, it therefore requires a lower overall surplus to maintain the reserve ratio at the same level when GDP growth is lower (see equations (6) and (7) in Annex 4). This favourable evolution will offset to a large extent the adverse impact on the steady state contribution rate of the evolution of the pension cost ratio, which is higher under the low growth scenario than under the alternative scenarios.

This can be illustrated based on formulae (3) and (4) in Annex 4. When rearranged, these equations yield $c = p + r * \frac{g-d}{1+g}$, where c is the equilibrium contribution rate, p the pension cost ratio, r the equilibrium reserve ratio compatible with the steady state and with the present value budget constraint, g the nominal growth rate and d the nominal return (namely 6.4% by assumption, namely 4.4% in real terms).

Lower GDP growth contributes to increase the contribution rate due to its adverse impact on the pension cost ratio p. However, this impact is mitigated by a decrease in the ratio $\frac{g-d}{1+g}$, as the numerator of this ratio is much more sensitive to g than the denominator. The equilibrium asset ratio r also tends to decrease when growth is lower, which further enhances the dampening effect.[31]

All in all, the steady state contribution rate increases (decreases) when GDP growth decelerates (accelerates) in the scenario depicted in Chart 9 and Table 5, but the net impact is far less pronounced than in the "non funded" situations owing to the favourable (adverse) impact of the asset dilution phenomenon. Most interestingly, this dampening factor is proportional to the reserve ratio r. In the extreme case where this ratio is equal to zero the asset dilution phenomenon is neutralised and the higher cost ratio induced by lower growth is no longer kept in check. The dilution effect even takes on the opposite sign when reserves turn negative – namely when the pension system incurs liabilities – which magnifies the adverse consequences of lower growth.

The impact of economic growth on the speed of the transition to funding also contributes to buffer growth inflexions. As explained in Annex 1, the speed of the transition is calculated in a separate way for resident and cross-border employees. Higher economic growth therefore implies larger inflows of cross-border workers in the BCL model. Since the average length of their carrier is relatively short, higher economic growth contributes to accelerate the transition of employees from PAYG to funding. This acceleration implies a lesser accumulation of assets at the beginning of the funding process, which contributes to increase social contributions in the steady state. Like the dilution effect, this factor alleviates the impact of GDP growth on the cost ratio, albeit to a lesser extent.[32]

The "shock absorber" nature of funding a very attractive feature in a small open country like Luxembourg, which is particularly vulnerable to idiosyncratic shocks and to financial market developments. In addition, the high surpluses and reserves inherent in funding would allow the authorities to address adverse shocks in a much more flexible manner than under tight budgetary constraints, as already explained above. The protecting nature of funding is therefore twofold.

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[31] The lower required equilibrium reserve ratio under the low growth scenario, which reinforces the "shock absorber" nature of funding, can be explained based on the present value budget constraint. The discount factor of future primary deficits is unchanged, since it is equal to the nominal rate of return (i.e. 4.4% plus 1.9% inflation by assumption). However, the discounted value of future primary deficits will decrease much more quickly under the low growth scenario, because they increase at a more moderate pace in such a context – both pensions and contributions indeed tend to increase in line with nominal GDP growth in the long term. This impact will outweigh the higher "steady state" primary deficit ratios inherent in the low growth scenario.

[32] The 27% cap on the total required financing contributes to dilute – but not to neutralise – this additional buffer. In this case, the accelerated transition of pensions to funding in case of higher economic growth leads to higher initial transfers to the Fund, in line with the quicker decline of the remaining PAYG cost (the initial transfers to the NF are indeed equal to 27% of gross incomes less this remaining cost).

3.4 Sensitivity analysis: yield on pension reserves and birth rates

The funding system is much less sensitive to GDP growth developments than alternative systems with lower reserves. However, the funding process presented above is of course conditional on a wide range of assumptions. The sensitivity of this process to two prominent risk factors, namely the average yield on reserves and demographic changes, is assessed in the following paragraphs.

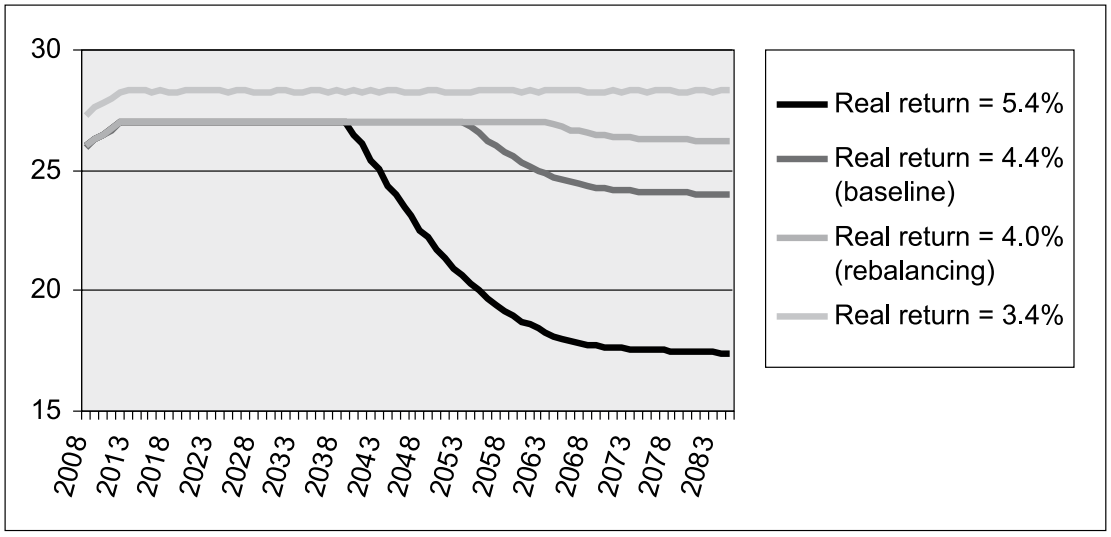
3.4.1. Sensitivity of the funding process to the choice of the benchmarks return rate

As explained in Annex 2, the benchmark real yield rate used in the projections is estimated in a rather conservative way. In spite of this downward bias, the baseline projection has been tested against two symmetric scenarios. Both scenarios are based on the very same hypotheses used in the baseline funding scenario depicted in Table 4, except the assumed real yield on reserves, which is set equal to respectively 5.4 and 3.4% instead of the baseline 4.4%. It should be kept in mind that a temporary departure from the benchmark would not alter the financial equilibrium of the pension system owing to the swap agreement between the pension system and the Treasury, as proposed by Modigniani and Muralidhar (2004). In addition, a departure confined to the short term would not change significantly the steady state equilibrium and therefore the related, long-term contribution rate. The two scenarios reviewed below presuppose a permanent drift away from the benchmark rate, which is far less likely than a temporary one.

A yield equal to 5.4%, namely approximately the yield used by Modigliani and Muralidhar (2004) in most of their projections centred on the United States, would of course ease the transition process. The steady state equilibrium contribution rate would converge to 17,4% of gross incomes, compared to 24% at present and also in the baseline funding scenario. The gap between primary pension expenditure and the contribution rate would grow to an unprecedented 12.5% of gross incomes at the end of the projection horizon, but it would be filled by extremely comfortable property incomes – they would amount to 37% of gross incomes or 15% of GDP, compared to respectively 25 and 10% in the baseline funding scenario. Property incomes would also ensure that reserves remain stable at more than 200% of GDP.

Chart 10 – Evolution of the required financing of the pension system (funding and remaining PAYG) under alternative return scenarios

As percentages of gross incomes



Sources: STATEC, IGSS, ILO, BCL calculations.

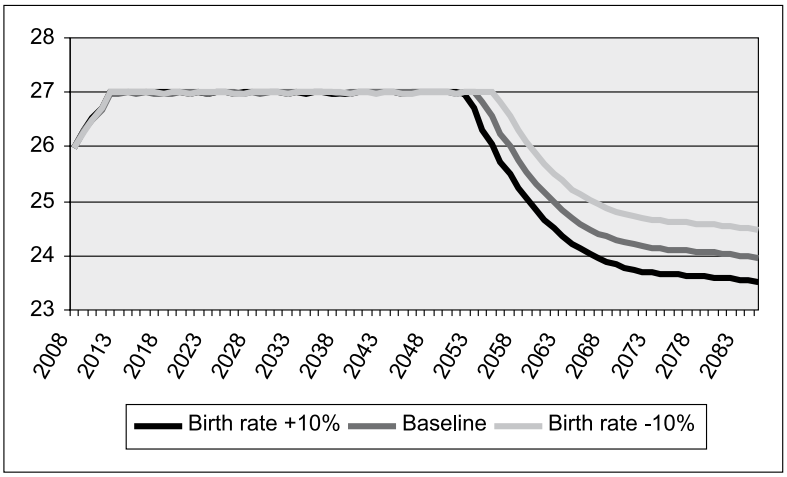
The evolution would of course be less favourable under the 3.4% real return scenario. In this case, the total required financing would have to reach 28.3% of gross wages all over the projection horizon, which means that the 27% cap would have to be lifted. All in all, however, the transition process still appears achievable and much more commendable than the wait-and-see strategy depicted in Chart 9, where the terminal contribution rate reached close to 36% in the 3% GDP growth scenario. In addition, a systematic, permanent decline in average returns of a significant magnitude is quite limited if the NF portfolio is properly diversified. Moreover, even in case such a permanent drift would occur, it could be addressed to a certain extent within the diversification strategy presented in Annex 2. This strategy relied on the rather conservative assumption that 35% of the NF portfolio would be invested in stocks, instead of 70% in the diversification strategy favoured by Modigliani and Muralidhar (2004). A downward drift in returns could be offset to a certain extent by adjusting the composition of the portfolio. In the context of this paper, the real average return would increase from 3.4 to 4.0% should the proportion of stocks be brought from 35 to 50%.[33] In such a case, the 27% cap would no longer be binding from 2065 onwards and the required financing would gradually converge to 26.2% of gross incomes at the end of the projection period. Finally, all the attractive patterns associated with funding, namely a high reserve ratio, comfortable surpluses and limited exposition to lower GDP growth, would be preserved even under the low return scenario with no asset rebalancing.

3.4.2. Sensitivity of the funding process to demographic variables: the birth rate

The baseline funding scenario is very sensitive to the evolution of the pension cost ratio, which is itself conditional on the various assumptions presented in Chapter 1. The impact of macroeconomic developments has already been analysed in depth in section 3.3. To a certain extent, socio-demographic variables were already analysed on this occasion. By construction, economic growth indeed directly affects the (residual) number of cross-border workers, whose age profile is quite similar to the age composition of immigrants. The last sensitivity analysis carried out in this paper is devoted to the incidence of birth rates on the baseline funding scenario. Higher (lower) birth rates should in principle ease (complicate) the transition process, since they would lower (increase) the cost ratio.

Chart 11 – Evolution of the required financing rate under two alternative demographic scenarios

As percentages of gross incomes



Sources: STATEC, IGSS, ILO, BCL calculations.

[33] By assumption, real returns on stocks and risk-free assets would both decline by 1% compared to the assumptions made in Annex 2 and would therefore reach 6 and 2%, respectively. The average real return would therefore equal 3.4% for the 35 (stocks)/65% (risk-free) portfolio and 4.0% for the 50/50% portfolio.

The impact of two alternative paths for the birth rate is synthesised in Chart 11. The first path consists in an increase in the birth rate by 10% all over the projection horizon compared to the baseline scenario. The second one rests on a symmetric 10% decline. The sign of the impact on the contribution rate is in line with intuition, but all in all the magnitude of the impact is quite limited, for two reasons. First, the 10% adjustment imposed at the beginning of the projection horizon will not have a decisive impact on the long-term budgetary situation of the pension system. For instance, additional births in 2008 will have a positive impact on the working age population in the midst of the projection horizon, but they will also give way to new pension expenditure from about 2065 onwards. Second, the projection is conducted on the assumption that economic growth is kept unchanged with respect to the baseline scenario (i.e. 3% GDP growth a year). Under this assumption, the favourable impact of higher birth rates on the resident working force will be marched by an offsetting adjustment of the inflow of cross-border workers – which is the residual variable in the model. A relaxation of the unchanged GDP growth hypothesis would not have a large impact on the budgetary situation of the pension system, however. As explained in section 3.3, GDP growth inflexions do not have a strong impact on the long-term equilibrium of the system under funding.

Concluding remarks

The Luxembourg private sector pension system is at crossroads. On the one hand, the current budgetary situation of the system appears extremely favourable. On the other hand, projections based on reasonable assumptions suggest that the pension regime is not sustainable over a long-term horizon. Under the baseline BCL projection, the private regime would incur liabilities equal to about 160% of GDP in 2085. The corresponding figure would amount to 49% of GDP in 2050 in the projections carried out in IGSS (2006) conditionally on a 3% growth rate.

The primary objective of the paper was to assess the extent to which a solution proposed by Modigliani and Muralidhar (2004), where pensioners are gradually transferred from PAYG to a public fund, is suitable to the Luxembourg situation, characterised inter alia by large inflows of cross-border workers. A baseline funding scenario designed in this paper in a stepwise manner and under reasonable return assumptions illustrates how fruitful such a solution could be in the Luxembourg case. In the steady state, the baseline funding scenario would lead to very comfortable reserves and budgetary surpluses with no cost in terms of long-term, equilibrium contribution rates. These very favourable results would be achieved in spite of a continuously increasing pension cost ratio due to ageing and to the gradual retirement of large contingents of cross-border workers. Owing to these very comfortable budgetary indicators, the Luxembourg general government considered as a whole (i.e. the central government, social security and local governments) would ceteris paribus be in position to record surpluses, as was the case over the 1990-2003 period (except in 1992). The Luxembourg authorities would therefore be able to react in a much more flexible way to adverse economic events, without incurring the risk of breaching the 3% deficit reference value embedded in a protocol of the Treaty Establishing the European Community. Another particularly attractive feature of funding – especially in the context of a small and very open economy – is that it would mitigate in an effective way the impact on the pension regime of adverse GDP growth developments.

Prefunding is required In order to reap this wide range of benefits. Such a frontloading strategy seems to be within the grasp of Luxembourg, which could resort to a variety of measures. The baseline funding projection presented in the paper serves an illustrative purpose and a wide range of prefunding measures could of course be considered. This projection is based on the illustrative assumptions that (i) the joint contribution of employees, employers and the central government would reach 27% of gross incomes before the actuarial equilibrium is reached – this could be achieved via higher central government transfers to the pension system, via alternative tax resources or through higher employee and employers contributions

with ad hoc adjustments in order not to detract from wage competitiveness – and (ii) the indexation of pensions to real wage developments would be suspended from 2007 to 2017. The latter measure would not erode the purchasing power of pensions, as benefits would still be adjusted to price developments all over the projection horizon. The wage replacement ratio would decrease over the 2007-2017 period, but it would still be much higher than in the neighbouring countries. Moreover the baseline prefunding solution would retain the very same pension formula that is currently applied in Luxembourg. Finally, this scenario would preserve intergenerational fairness, whereas a wait-and-see strategy under the current system would strongly penalise the future generations of pensioners. The baseline funding scenario also requires a more dynamic asset diversification strategy. The virtuous interaction between prefunding and higher returns on assets is indeed the very distinctive feature of this scenario.

The sensitivity analysis revealed that the baseline funding scenario is reasonably resilient to alternative return or demographic assumptions. However, even the funding system would have to be monitored in a continuous way. Like the present system, it is of course not immune from all adverse external shocks. For instance, periodic rebalancing of the investment strategy may have to be considered.

While there are transition costs to be incurred in order to ensure convergence of the private sector pension regime to a more stable funded system that is less vulnerable to adverse economic shocks, the danger of doing nothing is that the system will remain unstable and costs will be dramatically higher for future generations. Hence, while the problem may not appear to be immediate, doing nothing in not an option as it will pass on to our children the higher cost of fixing the system.

Annex 1 – Calculation of the transition speed to the New Fund

The speed with which pensions will be transferred from the current PAYG regime to the funding system is of paramount importance, since it directly impacts the magnitude of the asset accumulation process at the beginning of the projection period. The percentage of pensions transferred has been calculated for residents and cross-border workers in a separate way. In addition, specific calculations or assumptions have been made for all pension categories, namely old age, disability and survival pensions (orphans and widows) and for each gender in a separate way. The transition rate is therefore inferred for six (twelve if genders are considered) subcategories, in accordance with the following steps:

- The number of pensions and the average pension all over the 2005-2085 period are identified for each subcategory, using the BCL pension model.
- The inflow of new pensioners from 2008 onwards is then approximated for the abovementioned categories for each age cohort. First, for each year of the 2008-2085 horizon, changes in the number of pensioners is extracted from the pension model. The figures are then corrected for the impact of mortality. This ensures that the inferred numbers of new pensioners are fully consistent with the BCL pension model.
- The cumulated number of new pensioners (i.e. the persons who will get retired in 2008 or thereafter) is calculated all over the 2008-2085 horizon. For each vintage (year when pensioners will get retired), the number of pensioners is calculated all over this time horizon, taking into account the impact of mortality. For instance, the number of pensioners from the 2008 vintage is equal to the inflow of new pensioners in 2008 (see the previous bullet point). The number of pensioners from the same 2008 vintage in 2009 is equal to this figure, minus the number of persons who died in 2009, and the same calculation in done for the rest of the projection horizon. The same calculation is done for each of the 2009 to 2085 vintages.
- The number of pensioners in each vintage (calculated all over the 2008-2085 period) is then multiplied by the average pension for the vintage. The resulting amounts are adjusted in order to take into account the split of their pension benefits into the two pension systems (i.e. PAYG and NF). It is indeed assumed that pensions are transferred to the NF on a pro rata basis, depending on the relative weight in the carrier of contributory incomes earned from 1 January 2008 onwards – as the pension reform would by assumption be implemented from this date. This means that assuming a 40-year career, the future pension benefits of employees who joined the insured population in December 1990 would be split between the PAYG system and the NF regime. 42.5% (i.e. 17/40) would remain under the PAYG system. The remaining benefits would be paid by the NF. Pensions would by assumption be calculated in exactly the same way in the NF – which would be a defined benefit scheme – and in the PAYG system. The transition speed would be higher the shorter the average duration of the career, thus the quicker transition process for cross-border workers. Their assumed career is shorter than for residents at the beginning of the transition process, but in line with the pension model, it is assumed that the duration of their career will gradually converge to the duration assumed for resident employees.
- The resulting amounts are summed up across all vintages for each year of the projection horizon. The 2085 amounts are calibrated in order to be equal to the total amount of pensions projected for this year in the pension model. The cumulated percentage of pensions transferred to the NF is then calculated all over the 2008-2085 period. The respective annual amounts (also adjusted with the 2085 calibration coefficient) are divided by the corresponding total amount of pension benefits projected by the model.
- This calculation process is carried out in full for four categories, namely old age and disability pensions for residents and also for cross-border workers, based on the respective age profiles of new pensioners,

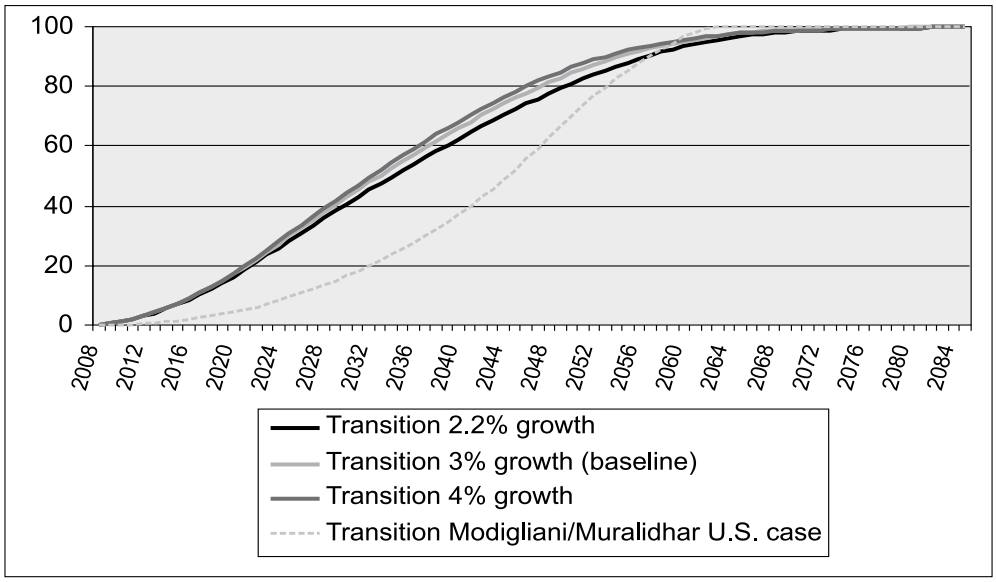
average pensions and average durations of careers. The transition coefficients for survival pensions are assumed equal to the corresponding coefficients inferred for old age pensions. Survival coefficients for men (women) are brought in line with old age coefficients for women (men).

- The weighted sum of the transition vectors derived for each subcategory is then calculated. The weight depends on the proportion of pension benefits channelled to the different categories in the current pension system. The resulting aggregated vector of transition coefficients appears in columns 6. of the funding tables presented in the paper.

The transition coefficients inferred in this way are in line with the specificities of the Luxembourg pension system and the profile of present and future pensioners. In addition, the coefficients adjust in a flexible way to changes in the exogenous assumptions made in the projections. For instance, higher economic growth, which will result in a higher number of "residual" cross-border workers, will translate in higher transition coefficients – thus in a faster transition process – because of the lower average duration of the career of cross-border workers assumed at the beginning of the projection period. Due to these peculiarities, the transition would be quicker in the Luxembourg case than assumed in the simulation made by Modigliani and Muralidhar (2004), as illustrated in the chart below. This will lead to a lesser accumulation of assets in the transition period and therefore to higher steady state contribution rates.

Chart A1.1 – Proportion of benefits transferred to the New Fund

As percentages of total pension benefits



Sources: STATEC, IGSS, ILO, Modigliani and Muralidhar (2004), BCL calculations.

Annex 2 – Choice of the benchmark real rate of return on NF assets

Modigliani and Muralidhar (2004) base their funding projections on the assumption that the average real return on the assets of the pension system would be in the range 5-5.5%. They demonstrate in Chapter 5 that return series over the 1926-2000 period bear out this assumption in the U.S. According to Modigliani and Muralidhar, pre-tax returns on corporate capital before taxes, which is the appropriate measure in the funding context, would reach 8 to 8.5%. They also mention Poterba (1998), who argued "the pre-tax return on capital in the corporate non-financial sector has averaged 8.5 percent over the 1959-1996 period". Since their benchmark portfolio consists in equities for 70% and risk-free assets for the remaining 30%, their average return equal to 5-5.5% is considered quite reasonable.

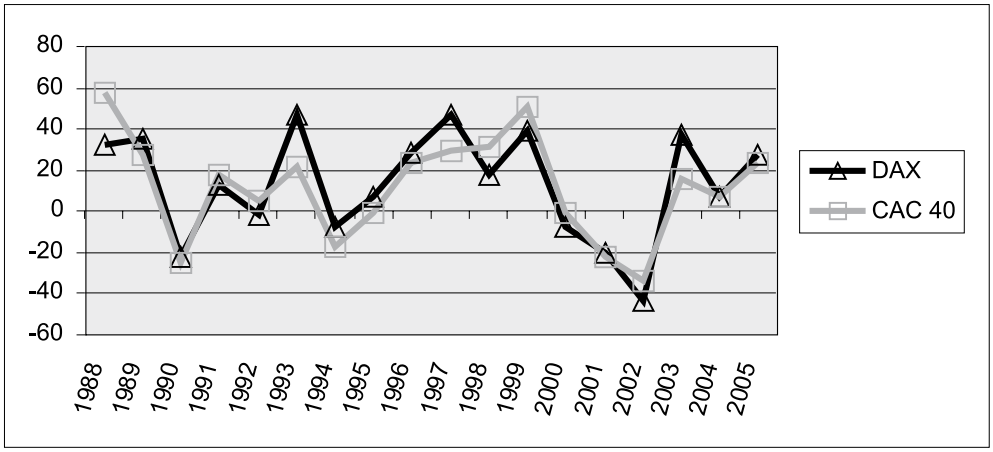
The benchmark assumption made in this paper is more conservative. In order to comply with congruence, it is assumed that NF assets would be primarily invested in European equities, whose average return might be below the 8-8.5% range considered by Modigliani and Muralidhar in the U.S. case. It is assumed in the paper is that the average pre-tax return on European equity would be equal to 7%, namely the middle of the aforementioned 8-8.5% range minus 1.3%, i.e. the differential between the U.S. and European real rate of return on equities estimated in IMF (2000). It is further assumed that the real, risk-free interest rate would reach 3%. According to Bundesbank data on 10-year government bonds and on inflation over the 1973-2005 period, the average real interest rate on these bonds reached 3.4% once the outlier years 1984 to 1990 – characterised by very high real interest rates – are disregarded. The portfolio allocation is much more conservative than the 70/30% benchmark portfolio of Modigliani and Muralidhar, since equities are confined to 35% of total pension assets throughout the projection horizon. The implicit return is therefore equal to 4.4% all over the 2008-2085 projection period (=7%*0.35+3.0%*0.65). Although stock markets real rate of return are subject to substantial variation from year to year, the volatility of returns tends to decline considerably over longer time horizons.

The congruence assumption is quite conservative and is used in order not to inflate the benchmark return used in the projections. A more diversified investment policy would be more appropriate over a long period, as it would contribute to increase returns without a commensurate increase in risks over such a long investment horizon. In addition, financial instruments such as strategic currency hedging make it possible to further alleviate risks with potentially higher yields. For a description of strategic currency hedging, see Muralidhar, Prajogi and van der Wouden (2000). It should finally be mentioned that the assets of the Government Pension Fund in Norway are invested in a very diversified way. As of 31 December 2005, only 53% of assets were invested in Europe – including the UK, Denmark, Switzerland and Sweden – and 6% in Asia/Oceania. The Americas and Africa accounted for the rest.

Several pieces of evidence also suggest that the return assumptions made in the paper are reasonable. First, as illustrated in the Chart below, the (nominal) return on European equities was in line with – or even above – the assumed 7% real return over the 1988-2005 period. Second, the Government Pension Fund in Norway achieved a real rate of return equal to 4.5% from 1997 to 2005 after deduction for inflation and management costs.[34] At the end of 2005, equities represented 42% of the total assets at market value of the Fund.

Chart A2.1 – Nominal returns on European equities

As percentages



Average nominal return DAX: 9.8%. CAC 40: 9.0%.
Average real return DAX: 8.2%. CAC 40: 6.8% (after correction for the respective changes in the harmonised indexes of consumer prices).

[34] See Government Pension Fund (2005).

Annex 3 – Detailed results of the projections related to the impact of growth inflexions

Table A 3.1 – Baseline funding scenario in case of a 4% GDP growth rate

As percentages of gross incomes, unless stated otherwise

	NF contributions	Property income NF	Pensions paid by NF	NF balance	Pension reserves	% of pensions transferred to NF	Cost ratio	Of which cost PAYG pensions	Total required financing	Transition cost
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	6.0	4.0	0.0	10.0	72.8	0.2	20.1	20.0	26.0	5.9
2009	6.7	4.4	0.1	10.9	79.5	0.6	19.8	19.6	26.3	6.5
2010	7.3	4.8	0.2	11.9	86.8	1.3	19.5	19.2	26.5	7.0
2011	7.9	5.3	0.4	12.8	94.6	2.1	19.2	18.8	26.7	7.5
2012	8.7	5.7	0.6	13.8	103.0	3.1	18.9	18.3	27.0	8.1
2013	9.2	6.2	0.8	14.6	111.8	4.3	18.6	17.8	27.0	8.4
2014	9.7	6.8	1.1	15.4	120.8	5.8	18.4	17.3	27.0	8.6
2015	10.2	7.3	1.3	16.2	130.2	7.4	18.2	16.8	27.0	8.9
2016	10.7	7.9	1.6	17.0	139.8	9.1	17.9	16.3	27.0	9.1
2017	11.2	8.5	1.9	17.7	149.6	10.9	17.7	15.8	27.0	9.3
2018	11.7	9.1	2.3	18.5	159.8	12.9	17.5	15.3	27.0	9.5
2019	11.7	9.7	2.7	18.7	169.5	15.0	18.0	15.3	27.0	9.0
2020	12.3	10.3	3.1	19.5	179.5	17.5	17.8	14.7	27.0	9.2
2021	12.3	10.9	3.7	19.5	188.9	20.0	18.4	14.7	27.0	8.6
2022	12.9	11.5	4.1	20.2	198.6	22.6	18.3	14.1	27.0	8.7
2023	12.9	12.0	4.8	20.2	207.8	25.2	18.8	14.1	27.0	8.2
2024	13.5	12.6	5.2	20.9	217.1	28.0	18.7	13.5	27.0	8.3
2025	13.6	13.2	6.0	20.8	225.7	30.8	19.4	13.4	27.0	7.6
2026	14.2	13.7	6.5	21.4	234.6	33.5	19.3	12.8	27.0	7.7
2027	14.3	14.2	7.2	21.3	242.8	36.3	20.0	12.7	27.0	7.0
2028	14.9	14.7	7.7	21.9	251.1	38.9	19.9	12.1	27.0	7.2
2029	15.0	15.2	8.5	21.7	258.9	41.5	20.5	12.0	27.0	6.5
2030	15.6	15.7	9.0	22.3	266.9	44.2	20.4	11.3	27.0	6.6
2035	17.7	17.9	12.3	23.3	302.5	56.8	21.7	9.4	27.0	5.4
2040	20.1	19.9	14.9	25.1	334.8	68.2	21.8	6.9	27.0	5.2
2045	22.1	21.8	17.7	26.2	365.2	78.4	22.6	4.9	27.0	4.4
2050	23.5	23.6	19.5	27.6	394.7	86.2	22.6	3.1	26.6	4.0
2055	23.5	25.1	21.6	27.0	417.2	92.0	23.5	1.9	25.4	1.9
2060	23.5	26.1	22.4	27.2	433.4	95.7	23.4	1.0	24.5	1.1
2065	23.5	26.8	23.6	26.7	444.4	97.8	24.2	0.5	24.0	0.0
2070	23.5	27.3	23.8	27.1	452.6	98.8	24.1	0.3	23.8	0.0
2075	23.5	27.7	24.7	26.5	458.1	99.2	24.9	0.2	23.7	0.0
2080	23.5	27.9	24.8	26.7	461.5	99.6	24.9	0.1	23.6	0.0
2081	23.5	28.0	25.3	26.1	461.6	99.7	25.4	0.1	23.6	0.0
2082	23.5	28.0	25.0	26.5	462.1	99.7	25.0	0.1	23.6	0.0
2083	23.5	28.0	25.5	26.0	462.0	99.8	25.6	0.0	23.6	0.0
2084	23.5	28.0	25.1	26.4	462.3	99.9	25.2	0.0	23.5	0.0
2085	23.5	28.0	25.7	25.8	462.1	100.0	25.7	0.0	23.5	0.0

Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

Table A 3.2 – Baseline funding scenario in case of a 2.2% GDP growth rate

As percentages of gross incomes, unless stated otherwise

	NF contri-butions	Property income NF	Pensions paid by NF	NF balance	Pension reserves	% of pensions transferred to NF	Cost ratio	Of which cost PAYG pensions	Total required financing	Transition cost
	1.	2.	3. =6.*7.	4.=1.+2.-3.	5.	6.	7.	8.	9.=1.+8.	10.=9.-7.
2008	5.7	4.1	0.0	9.8	73.4	0.2	20.3	20.3	26.0	5.7
2009	6.2	4.5	0.1	10.5	80.7	0.6	20.3	20.1	26.3	6.0
2010	6.6	5.0	0.2	11.3	88.4	1.2	20.2	20.0	26.5	6.3
2011	6.9	5.4	0.4	12.0	96.5	2.0	20.2	19.8	26.7	6.5
2012	7.5	5.9	0.6	12.8	105.2	3.0	20.1	19.5	27.0	6.9
2013	7.7	6.5	0.8	13.3	114.1	4.1	20.1	19.3	27.0	6.9
2014	8.0	7.0	1.1	13.9	123.2	5.5	20.1	19.0	27.0	6.9
2015	8.3	7.6	1.4	14.4	132.6	6.9	20.1	18.7	27.0	6.9
2016	8.6	8.2	1.7	15.0	142.2	8.5	20.1	18.4	27.0	6.9
2017	8.9	8.8	2.1	15.6	152.0	10.3	20.2	18.1	27.0	6.8
2018	9.2	9.4	2.4	16.1	162.0	12.1	20.2	17.8	27.0	6.8
2019	8.9	10.0	3.0	15.9	171.4	14.1	21.0	18.1	27.0	5.9
2020	9.3	10.6	3.4	16.4	181.0	16.3	21.1	17.7	27.0	5.9
2021	9.1	11.2	4.1	16.1	189.9	18.7	22.0	17.9	27.0	5.0
2022	9.5	11.7	4.7	16.5	198.9	21.0	22.2	17.5	27.0	4.8
2023	9.3	12.3	5.4	16.1	207.2	23.5	23.2	17.7	27.0	3.8
2024	9.7	12.8	6.0	16.5	215.6	25.9	23.3	17.3	27.0	3.7
2025	9.5	13.3	7.0	15.9	223.1	28.5	24.4	17.5	27.0	2.6
2026	10.0	13.8	7.6	16.1	230.5	30.9	24.6	17.0	27.0	2.4
2027	9.8	14.2	8.6	15.5	237.1	33.4	25.7	17.1	27.0	1.2
2028	10.4	14.6	9.3	15.7	243.6	35.8	25.9	16.6	27.0	1.1
2029	10.3	15.0	10.3	15.0	249.2	38.1	27.0	16.7	27.0	0.0
2030	10.9	15.4	11.0	15.2	254.8	40.6	27.1	16.1	27.0	0.0
2035	12.4	16.7	15.7	13.5	274.2	51.8	30.2	14.6	27.0	0.0
2040	15.3	17.4	19.5	13.2	284.5	62.4	31.3	11.8	27.0	0.0
2045	17.9	17.8	23.6	12.2	289.5	72.3	32.6	9.0	27.0	0.0
2050	20.8	18.0	26.1	12.8	293.6	80.9	32.3	6.2	27.0	0.0
2055	23.1	18.3	29.0	12.4	298.0	88.1	33.0	3.9	27.0	0.0
2060	24.9	18.6	30.2	13.3	303.3	93.3	32.3	2.1	27.0	0.0
2065	25.8	19.0	31.8	13.0	308.6	96.8	32.8	1.1	26.9	0.0
2070	25.8	19.2	31.7	13.4	312.9	98.5	32.2	0.5	26.3	0.0
2075	25.8	19.4	32.7	12.6	315.2	99.2	32.9	0.3	26.1	0.0
2080	25.8	19.5	32.3	13.1	316.8	99.5	32.4	0.1	26.0	0.0
2081	25.8	19.5	32.9	12.4	316.6	99.6	33.0	0.1	25.9	0.0
2082	25.8	19.5	32.3	13.0	317.0	99.7	32.4	0.1	25.9	0.0
2083	25.8	19.5	33.0	12.4	316.8	99.8	33.1	0.1	25.9	0.0
2084	25.8	19.5	32.4	13.0	317.2	99.9	32.4	0.0	25.9	0.0
2085	25.8	19.6	33.0	12.3	316.9	100.0	33.0	0.0	25.8	0.0

Sources: STATEC, IGSS, ILO, BCL calculations. Based on Modigliani and Muralidhar (2004).

Annex 4 – Analytical appendix the present value budget constraint and the steady state equilibrium

The primary objective of this appendix is to demonstrate that the asset ratios and balances compatible with the present value budget constraint (PVBC) are strictly identical to the steady state level of these ratios and balances, and that the transition path to funding presented in Table 4 above is fully compatible with long-term sustainability and the actuarial equilibrium of the private sector pension regime. The equilibriums presented in the paper indeed fulfil two constraints. First, they give way to an asset ratio that is at the same time stable over the long-term and compatible with the PVBC. As shown below (see equations (3) and (4)), the magnitude of the asset ratio depends in a quite linear way on the "targeted" primary balance. The lower the "targeted" primary balance of the pension system (thus the higher the primary deficit), the higher the equilibrium asset ratio. Second, the primary balance – and therefore the contribution rate – must be high enough to ensure a sufficient accumulation of assets during the transition period. This guarantees that the equilibrium reserve ratio will be reached after the transition period has elapsed. The first constraint could be complied with even under a low "steady state" contribution rate c. However, this would require a large accumulation of assets in the transition period and therefore high contribution rates during this period in order to satisfy the second constraint. Such a dichotomy in the evolution of contribution rates is rejected in the paper, where contributions are converging to their steady state level in a "gentle" way over the projection period.

A4.1. Asset ratio compatible with the present value budget constraint

The present value budget constraint with a no-Ponzi game restriction could be written as follows:

$$R_t = \sum_{j=1}^{\infty} \frac{(P-C)_{t+j}}{(1+d)^j} \tag{1}$$

Where R_t is the outstanding amount of reserves in year *t*, P the level of pension (and assimilated) expenditure, C the amount of social contributions flowing to the private sector pension system and d the nominal rate of return (i.e. 6.4% in the baseline projection). The PVBC states that the amount of reserves in year t should be equal to the present value of all future primary deficits of the pension system. If this level of reserves is reached, the future primary gaps will be closed owing to the generated property incomes.

Dividing (1) by It, namely by the amount of gross contributory incomes – basically the wage bill –in year *t*, equation (1) becomes:

$$r_t = \sum_{j=1}^{\infty} (p-c)_{t+j} * \left[\frac{1+g}{1+d}\right]^j \tag{2}$$

where *g* is the annual and nominal rate of growth of gross contributory incomes (and also of GDP if the real growth of wages is in line with productivity).

The explanation for equation (2) is the following: $\frac{(P-C)_{t+1}}{I_t}$ is equal to $\frac{(P-C)_{t+1}}{I_{t+1}} * (1+g)$ or $(p-c)_{t+1} * (1+g)$, where $(p-c)_{t+1}$ is the ratio of the primary deficit to gross incomes. More generally, for all successive terms, $\frac{(P-C)_{t+j}}{I_t} = (p-c)_{t+j} * (1+g)^j$.

Equation (2) could be interpreted as the sum of the terms of a geometric progression. By definition, the sum of such a progression is equal to

$$Sum = \frac{a_n * q - a_1}{q - 1},$$

where a_n is the last term of a geometric progression, a_1 the first one and q the progression factor. The q factor extracted from equation (2) is $\frac{1+g}{1+d}$. If g<d, a_n is equal to zero in the situation depicted in (2), because the geometric progression goes to infinity in this specific case. The general formula for geometric progressions can therefore be rewritten $Sum = \frac{a_1}{1-q}$.

Since $a_1 = (p-c)_{t+1} * \frac{1+g}{1+d}$ in our specific case, (2) could read as follows:

$$r_t = (p-c)_{t+1} * \frac{1+g}{1+d} * \frac{1+d}{d-g} = (p-c)_{t+1} * \frac{1+g}{d-g}$$

or, since the primary deficit ratio is by assumption constant from 2085 to infinity:

$$r^{PVBC} = (p-c) * \frac{1+g}{d-g} \qquad (3)$$

where g and d could be expressed either in real or in nominal terms (the inflation factor indeed cancels out in the formula).

Equation (3) makes it clear that the asset ratio compatible with the PVBC is positive provided that d (the return) is higher than g (the rate of economic growth). Furthermore, there is no equilibrium if d is equal to *g*. In normal circumstances, namely if *d>g*, the asset ratio will be positive and proportional to the primary deficit ratio observed in the longer term. There are several asset ratios r^{PVBC} compatible with the PVBC, depending on the long-term primary deficit – basically on the chosen contribution rate c. However, it should be borne in mind that a higher future primary deficit ratio also requires more substantial reserves, which presupposes a larger prefunding effort. A zero asset ratio is also a possible equilibrium, but such a solution requires that the contribution rate c be kept equal to the pension cost ratio p.

A4.2. Asset ratio in the steady state equilibrium

It is of paramount importance for the NF to reach the steady state equilibrium, where property incomes will be sufficient to ensure that the asset level remains stable.

By definition, $R_t = R_{t-1} * (1+d) - (P-C)$ or, after division by I_t, $r_t = r_{t-1} * \frac{1+d}{1+g} - (p-c)$.

Since $r_{t-1} * \frac{1+d}{1+g} = r_{t-1} + r_{t-1} * \frac{d-g}{1+g}$, this equation can be rewritten

$$r_t - r_{t-1} = r_{t-1} * \frac{d-g}{1+g} - (p-c)$$

By definition, in the steady state $r_t - r_{t-1} = 0$ (required stability of the asset ratio) and $r_{t-1} = \bar{r}$, namely the stable, steady state asset ratio. Therefore $\boxed{\bar{r} = (p-c) * \frac{1+g}{d-g}}$ (4)

The steady state equilibrium $\bar{r}$ is therefore strictly equal to the asset ratio r^{PVBC}. This is a crucial property. It indeed means that the stabilisation of asset ratios at the end of the projection horizon and even beyond is an appropriate target, compatible with the PVBC over the long-term and therefore with the actuarial equilibrium of the pension regime. This target ensures a smooth continuum between the asset ratios at the end of the projection horizon and the steady state equilibrium.

A4.3. Overall balances compatible with the PVBC and the steady state equilibrium

Balance and asset ratio have to stabilise in tandem in the steady state. This equilibrium is also compatible with the PVBC as defined in A4.1.

By definition, the overall balance $B_t = d * R_{t-1} - (P - C)$, namely property incomes minus the primary deficit of the pension system. Alternatively,

$b_t = d * \frac{R_{t-1}}{I_t} - (p-c)$, where b_t is the ratio of the overall balance to gross incomes.

Since $\frac{R_{t-1}}{I_t} = \frac{R_{t-1}}{I_{t-1}} * \frac{1}{1+g} = \frac{r_{t-1}}{1+g}$, then $b_t = \frac{d}{1+g} * r_{t-1} - (p-c)$ (5)

In the PVBC equilibrium, replacing r_{t-1} by r^{PVBC} and substituting into (5) the expression

$(p-c) = r^{PVBC} * \frac{d-g}{1+g}$, namely (3) rearranged, one gets:

$\boxed{b^{PVBC} = \frac{g}{1+g} * r^{PVBC}}$ (6)

b^{PVBC} is the overall balance compatible with the PVBC equilibrium and with the reserve ratio r^{PVBC}.

Likewise, in the steady state equilibrium, substituting (4) into (5) and replacing r_{t-1} by $\bar{r}$ gives

$\boxed{\bar{b} = \frac{g}{1+g} * \bar{r}}$ (7)

The equilibrium balance ratio is proportional to the equilibrium asset ratio. In addition, for a given equilibrium asset ratio, the required balance is more demanding the higher the rate of economic growth. This is due to the "asset dilution effect" of economic growth mentioned in the paper, which contributes to alleviate the vulnerability of the funding system to adverse inflexions in GDP growth (see section 3.3).

A4.4. Quantification under the baseline funding scenario

Under the baseline funding scenario depicted in Table 4 the contribution rate is calibrated in order to ensure that there will be a strict continuum between the budgetary indicators projected at the very end of the projection horizon on the one hand and the equilibrium level of the same indicators on the other hand. This ensures that the scenario is fully sustainable over the long-term or, stated otherwise, that there is no underfunding at the end of the projection period. The contribution rate c is set on the assumption that the

primary balance will become constant at the average level projected for 2084-2085 over the long-term. The average cost ratio over the two-year period 2084 -2085 is considered because the pension cost ratio is somewhat inflated in 2085 due to the advent of a 2-year indexation to real wages. Averaging 2085 with a year where no indexation will take place ensures that this bias is removed.

In the baseline funding scenario, the constant contribution rate to the NF that guarantees a transition to the long-term equilibrium (reserves compatible with future primary deficits and with the steady state equilibrium), namely c, is equal to 24.0%. The average pension cost ratio projected for 2084 and 2085 is equal to $\frac{(29.4\% + 30.1\%)}{2}$ = or 29.8% of gross incomes. The long-term primary deficit (p-c) is in turn equal to 5.8% of gross incomes. Since by assumption d=6.42% in nominal terms (and 4,4% in real terms) and g=4.96% (3.0% in real terms), equation (3) or indifferently (4) above gives the following equilibrium level of assets:

$r = (p - c) * \frac{1 + g}{d - g} = 5.8 * \frac{1.0496}{0.0642 - 0.0496}$ = 416% of gross incomes or 165% of GDP.

In line with equations (6) and (7) the corresponding equilibrium overall balance is equal to

$b = \frac{g}{1 + g} * r = \frac{0.0496}{1.0496} * 416 =$ 19.7% of gross incomes or 8.0% of GDP.

The equilibrium characterised by the conjunction of 5.8% primary deficit, 19.7% overall balance and 416% reserves is exactly the situation that would prevail at the end of the projection horizon in the baseline funding scenario (see Table 4, average 2084-2085). This illustrates that the transition path to funding proposed in this scenario is fully compatible with long-term sustainability and the actuarial equilibrium of the pension system.

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