

**Luxembourg: Selected Issues—Prospects of the Financial Sector—  
Tax Harmonization and Asset Market Valuation**

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**Selected Issues**

**Prospects of the Financial Sector: Tax Harmonization and Asset Market Valuation**

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Approved by European I Department

May 14, 2002

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## I. INTRODUCTION AND SUMMARY

1. **What drives the development of Luxembourg's financial sector, which has grown dynamically and is now contributing about 22 percent to value added?** This question is particularly relevant in order to shed light on the sector's growth prospects in the face of a potential reduction of tax-related advantages, and the possibility that asset market valuation could increase at a lower rate in the future than in the past. The question is twofold. In a structural or long-term sense, are the driving elements tax and regulatory advantages (e.g., banking secrecy, the absence of a withholding tax on interest income and the absence of taxation of provisioning) or are other factors at play (e.g., the speedy application of EU directives in the financial field, the presence of a multilingual labor force, a favorable geographical position or simply the rapid development of the global financial industry)? In a cyclical or short- to medium-term sense, are the driving factors the real business cycle, interest rates, asset market valuations, or others?

2. **With respect to the long term, there is evidence that the tax and regulatory advantages that were important for the strong growth of the financial sector in the past have lost much of their relevance during recent years.** This evidence is limited and indirect. In the absence of sufficient microeconomic data and given the qualitative nature of many of the factors involved in the development of the sector, no formal test of this hypothesis was feasible. It is nonetheless consistent with a conceptual model of endogenous growth in which, by concentrating in one location, there has been scope for agglomeration economies in an internationally competitive environment reflected in factors such as learning by doing, suggesting that Luxembourg's banking sector may by now have accumulated know-how related advantages.

3. **Several observations support this finding:** Waves of bank arrivals responding to tax and regulatory changes (mainly in third countries) have not been observed recently; growth of the financial sector seems to have converged to the rates of growth of other major and older financial centers; entry of new banks—a strong positive influence on trend growth—has been very limited for several years; total factor productivity, that declined in the 1980s, has recovered in the 1990s; and there do not appear to be any discernible factors suggesting that the Luxembourg financial sector is not well positioned to face the challenges ahead.

4. **With respect to the short to medium term, the financial sector's performance is only weakly affected by the real business cycle, but significantly linked to developments in interest rates and asset market valuations, in line with the sector's role in maturity transformation and asset management.** Therefore, a slower rise in equity market valuation could slow down banking sector growth in the short to medium term. Bank revenues from interest margins are positively related to long-term interest rates and negatively related to short-term interest rates. Bank commission income is positively related to international equity markets. In both cases, a positive influence of euro-area real activity is only marginally significant.

5. **The paper is structured as follows.** Section II presents a short history of the development of the financial sector, highlighting the strong influence of tax and regulatory advantages for its past development; describes the structure of the banking sector today; and summarizes plans for harmonizing the taxation of cross-border interest income that could potentially challenge the future development of the sector. Section III explains the mechanisms of growth that may have been at work in Luxembourg's financial sector and discusses supporting evidence. The section presents a test of convergence of growth rates, and offers an estimation of a financial sector production function. Section IV investigates econometrically the factors driving the banking sector's revenues and relates the findings to the structural features of the banking sector. Section V concludes.

## II. BANKING SECTOR: HISTORY OF ARRIVALS, PRESENT FEATURES, AND CHALLENGES

### A. Short History of Bank Arrivals

6. **During the past forty years, Luxembourg's favorable framework of taxation and banking sector regulation attracted a considerable number of foreign banks and large amounts of customers' funds.**<sup>1</sup> Important elements of this framework have been banking secrecy, the absence of withholding tax on interest revenues, and the tax deductibility of provisions for banks.

7. **The role of regulatory and tax-related factors for the development of banking in Luxembourg can best be illustrated by an analysis of bank arrivals.** Banks did not enter Luxembourg in a smooth stream but rather in several waves. At least some of these waves were marked by the introduction of taxation and regulatory measures in third countries or by existing policies being felt more strongly under changed economic circumstances. By putting burdens on banking in these countries, these measures improved Luxembourg's attraction for banks. The waves of bank arrivals were:

- In the late 1960s, German banks wishing to participate in the euro markets set up affiliates in Luxembourg. This first wave was linked to both the US "regulation Q", leading to the establishment of eurodollar and eurobond markets in the 1960s when interest rates rose, and reserve requirements imposed by the Bundesbank on German banks holding foreign currency liabilities. In Luxembourg, the absence of such a requirement constituted a regulatory advantage.<sup>2</sup>

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<sup>1</sup> Huizinga and Nicodeme (2001) show empirically that international deposits are indeed tax-driven.

<sup>2</sup> Today, reserve requirements imposed by the ECB are uniform in the euro area. Market participants report that these requirements have not had a strong impact on Luxembourg's banking sector.

- In the early 1970s, Swiss banks began placing part of their customers' funds with subsidiaries in Luxembourg. These funds were then often invested in the euro-markets. Investing into this market via Luxembourg offered tax advantages and allowed Swiss banks to do business with the German banks that had arrived earlier.
- In the mid-1970s, US banks set up subsidiaries or branches in Luxembourg, mainly for private banking. Given bank secrecy and the absence of withholding taxes, investing in Luxembourg presented some advantages over investing in the US.
- In the late 1970s, Scandinavian banks arrived wishing to participate in international lending. In their home countries, these banks were forbidden to lend in foreign currencies.
- During the mid- and late 1980s, a fifth wave rolled in, linked to a shift towards private banking and asset management helped by banking secrecy and tax advantages.
- In the early to mid-1990s, a new wave of German banks settled, related to the (re)introduction of a withholding tax on interest income in Germany in 1992. As a result, a large amount of deposits left Germany for Luxembourg.

8. **While the specified tax-related and regulatory advantages have certainly helped the development of banking in Luxembourg, other factors have been important as well.** Among these were: quick adoption by the authorities of innovations in EU law that offered opportunities for the sector, such as the first EU directive on banking of 1981, the directives on free provision of financial services of 1988 and 1990, and the directive on uninhibited mobility of capital within the EU of 1990; effective supervision ascertaining stability, efficiency, and a high degree of observance of standards and codes; political stability; central geographic location; and a multilingual workforce.

### **B. Key Features of the Banking Sector**

9. **Banks hold about 43 percent of total Luxembourg financial sector assets.** As of December 2001, banking sector assets, held by a total of 189 banks, amounted to 33 times Luxembourg GDP. While bank assets have continued to grow in recent years, albeit at a slower pace than the average of the period 1980–2001, the number of banks has followed a declining path since the mid-1990s, partly reflecting a trend towards consolidation in European banking.

10. **Most banks are foreign-owned and serve mainly the non-domestic economy.** At end-2001, foreign-owned banks held about 94 percent of total bank assets, with subsidiaries of German, Belgian, and French banks recording the largest total bank asset shares. Domestic banks account for 6 percent of total bank assets.

11. **Over the years, banks have maintained a strong focus on interbank business.** Luxembourg's interbank market is the fourth largest in Europe. In bank balance sheets, assets due from banks accounted for between 50 and 60 percent of assets on average during the period 1980–2001, while liabilities due to banks consistently exceeded those due to non-banks.

12. **As a result of the large share of interbank business, Luxembourg banks show stronger liquidity and smaller net interest rate margins than banks in the neighboring countries and in other dynamic financial centers (Figure 1).**<sup>3</sup> These comparisons should, however, be used with care because they may be distorted by differences in accounting rules and other factors (e.g., see Vittas, 1991).

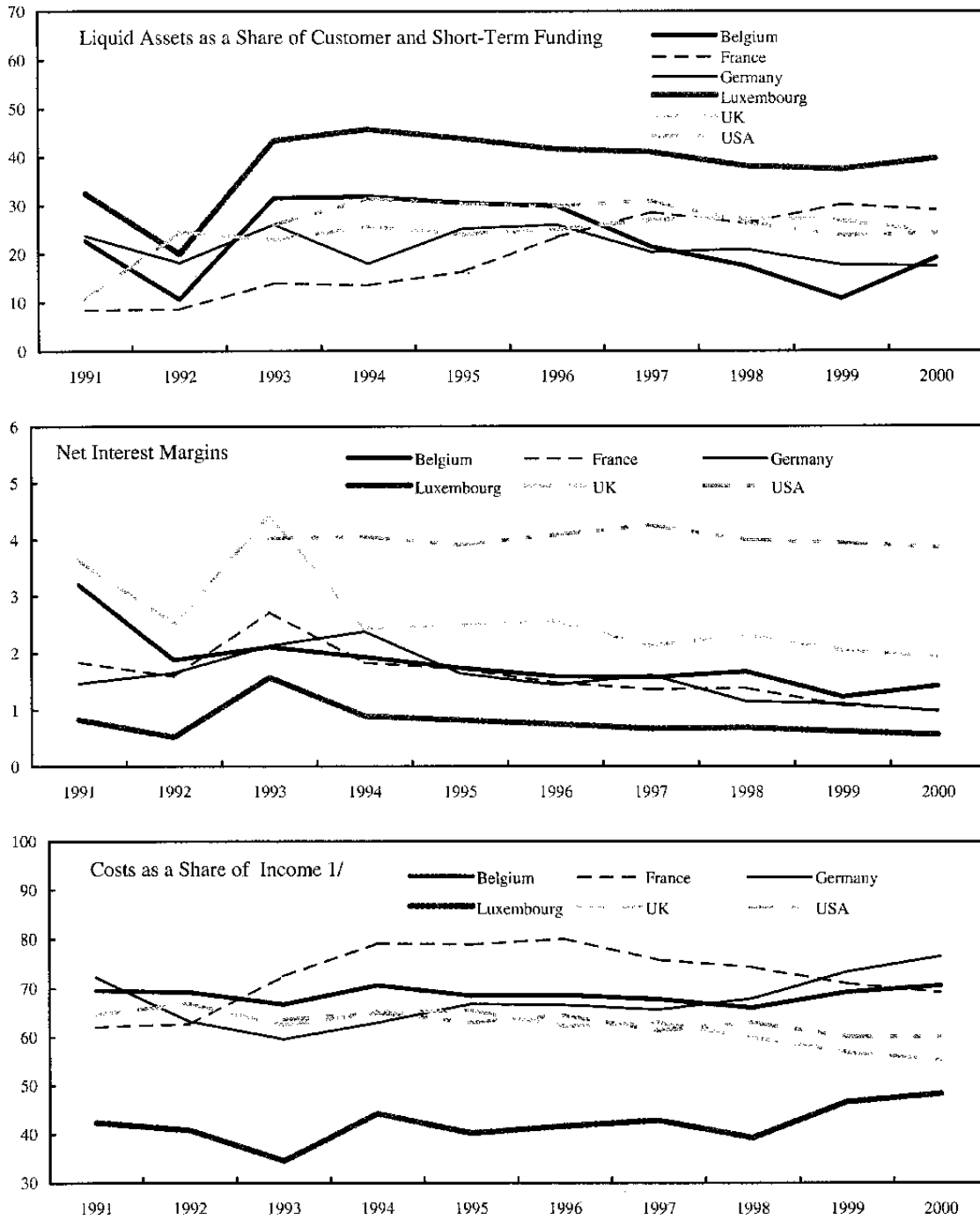
13. **After the decline of international syndicated lending in the early 1980s, Luxembourg banks moved from international syndicated lending into private banking and asset management while maintaining continuity in interbank activities.** The growing importance of private banking and asset management has led to a rising share of commission income in total income (Table 1).

	1980	1990	2001
Interest margin	736	2,335	4,412
Net income from commissions	62	389	2,824
Other net income	104	870	894
Gross income	902	3,594	8,130
Staff costs	201	702	1,806
Other expenditures	164	640	1,998
Result before provisions	537	2,252	4,326
Net provisions	213	1,584	505
Tax on income	164	196	828
Net profit	160	472	2,993

Source: Banque Centrale du Luxembourg.

<sup>3</sup> In the present context, net interest margins are defined as net interest income divided by total assets.

Figure 1. Luxembourg: Key Bank Balance Sheet Ratios  
(In Percent)



Source: BankScope.

1/ Overhead costs over net interest revenue and other operating income.



14. **The cost advantage of Luxembourg banks has narrowed in recent years, at least with respect to some of the comparator banks (Figure 1).** While country-specific circumstances such as the absence of large and costly branch networks have contributed to lower costs of banking in Luxembourg, good bank management may also have played its part. In a comparative study of the quality of bank management, Rouabah (2001) finds better bank management in Luxembourg than in most other European countries, whereas Altunbas et al. (2001) rank the quality of bank management in Luxembourg as average.<sup>4</sup> The reduction of the cost advantage of Luxembourg banks is clearest with respect to banks in the UK and US, where considerable restructuring has been carried out since the mid-1990s.

### **C. Challenges from Plans for International Tax Harmonization**

15. **Calls for closer cooperation in the area of taxing cross-border interest income have become louder in recent years.** The European Council stated at its Helsinki summit of December 1999 (unanimously and therefore with Luxembourg's support) that all citizens resident in a EU member state should pay taxes on all their savings income. Taking the decisions of the Helsinki summit one step further, the European Council decided during its Feira summit of June 2001 that a future Directive providing for the adoption of an information exchange network on cross-border capital income should be elaborated. The OECD has also started a (non-binding) dialogue about improving access to bank information for tax purposes. Further, the OECD has initiated a project concerning the identification and removal of "harmful" tax practices on a global scale. Note that Luxembourg has already taken first steps in the direction of closer cooperation on taxing cross-border interest income.<sup>5</sup>

16. **The content of the planned EU Directive is as follows:**

- The Directive, to be voted upon no later than December 31, 2002, shall provide for the establishment of an information network between EU member countries allowing effective taxation of intra-European cross-border capital income starting on January 1, 2010.

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<sup>4</sup> The differences between these two studies may be due to differences in methodology used. See Berger and Mester (1997) for a discussion of methodologies used for assessing banking efficiency.

<sup>5</sup> Being a signatory to the European Convention on Mutual Assistance in Criminal Matters of 1959, Parliament completed ratification of an additional tax-related protocol to the convention in October 2000. This will enable other countries that have also ratified the additional protocol to obtain information on suspected cases of infringements of tax laws more easily. Parliament has also ratified a Mutual Legal Assistance Treaty with the United States.

- During the transition period lasting from 2003 to 2009, member countries shall have the right to choose between participating in the information exchange system and applying a withholding tax.
- The minimum withholding tax rate to be applied during the transition period will be 15 percent from 2003 to 2005 and 20 percent from 2006 to 2009. Three quarters of the tax revenues will have to be transferred to the investor's country of residence, the remaining quarter can be kept by the country levying the tax.
- Luxembourg will participate in the information exchange only from 2010 on, and will therefore apply the withholding tax during the transition period. (This participation is, however, contingent on a series of preconditions, see below.) Austria and Belgium will also levy the withholding tax during the transition period. The other EU countries have stated their willingness to implement the information exchange system from 2003 on.
- Information sharing and withholding tax levying during the transition period shall apply to cross-border interest income only. During the transition period, they shall not apply to interest income from investment funds that have invested at least 60 percent of their assets in stocks. This threshold of 60 percent shall be increased to an as yet unknown level in 2010. Information sharing and withholding tax levying during the transition period shall also not apply to revenue from international bonds for which a prospectus was issued prior to March 1, 2001. Finally, they shall not apply to dividend payments.
- The EU commission shall enter into discussions with key non-EU financial centers (United States, Switzerland, Liechtenstein, Monaco, Andorra, and San Marino) with the aim of encouraging these centers to introduce measures "equivalent" to those of the planned directive.
- Relevant member countries (the UK and the Netherlands) shall assure that their associated and dependent territories (Channel Islands, Isle of Man, associated territories in the Caribbean) adopt equivalent measures as well.

**17. In April 1998, the OECD Council approved a report<sup>6</sup> on harmful tax competition, with abstentions from Luxembourg and Switzerland.<sup>7</sup> This report**

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<sup>6</sup> OECD (1998).

<sup>7</sup> The OECD calls tax practices harmful if they "unfairly erode the tax bases of other countries and distort the location of capital and services. Such practices can also cause undesired shifts of part of the tax burden to less mobile tax bases, such as labor, property and consumption", see OECD (2000).

established a framework to counter the spread of harmful tax practices. In a follow-up report<sup>8</sup>, the OECD identified more than 60 potentially harmful tax regimes in its member countries, three of which were found in Luxembourg. It also lays out the procedures and a timeframe for elimination of these practices. Harmful practices are to be abolished by April 2003, with all benefits that taxpayers derive from such practices to be removed by December 31, 2005. As Luxembourg abstained from the vote on the initial (1998) report, it reserves the right not to remove harmful tax practices.

18. **Adoption of the planned EU Directive will result in a reduction of Luxembourg's tax-related advantages as a place for financial investment while the effects of the OECD project concerning the abolition of harmful tax practices cannot be established with certainty.** For parts of cross-border interest income originating in Luxembourg, the information exchange system envisaged by the planned EU Directive has the potential to lead to this income being subjected to the same income taxation as interest income originating in investors' home countries starting in 2010.

19. **A number of factors should, however, delay or limit the potential adverse effects of the removal of tax advantages on the financial sector:**

- Luxembourg and Austria have stated that they will approve the Directive only if third countries give satisfactory assurance that they will apply measures "equivalent" to those contained in the directive. But obtaining such assurances is by no means guaranteed.
- The EU Directive will allow Luxembourg's financial sector to keep part of its tax-related advantages during the transition period, and some tax advantages possibly permanently (e.g., the exemption of dividend income, which constitutes at present an advantage for example vis-à-vis Germany, where dividends are taxed).
- The multilateral nature of both initiatives should lead to other important financial centers also experiencing a reduction of tax-related advantages.

### III. FINANCIAL SECTOR PERFORMANCE: LONG-TERM DETERMINANTS

#### A. Conceptual Framework for Financial Sector Growth

20. **To assess more formally whether the Luxembourg financial sector might have become less dependent on tax and regulatory advantages because of accumulated know-how, it is useful to explore an endogenous growth model that captures the latter effect.** The Schumpeterian model developed by Aghion and Howitt (1999) offers such a framework

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<sup>8</sup> OECD (2000).

(see Box). The model formalizes the idea that the financial sector growth process could be characterized by *firm* (or internal, i.e., remunerated) learning by doing (LBD).

21. **The model suggests that an initial comparative advantage in terms of either non-policy or policy factors could have favored a hub of specialization, as the nascent Luxembourg financial industry incorporated *common knowledge* into new products and into better-quality products.** As time proceeded, workers in the specialized sector “learned by doing”, and developed new products and improved the “quality” of existing ones (quality includes customer relations).<sup>9</sup> This implies that although Luxembourg may have not enjoyed a conspicuously high ratio of research and development (R&D) to GDP, to the extent that that research has been available to all, it had a positive effect on the country’s trend growth rate.

22. **The model also suggests that if the labor force could quickly shift between sectors and to new product lines, the trend growth rate would increase.** In contrast, if the labor market were not flexible enough for the labor force to quickly shift between sectors, growth would only be possible via the influx of skilled foreign workers to the financial industry.<sup>10</sup>

23. **The endogenous growth model with LBD has a number of observational implications.** The main implications are that the long-run growth rate decreases with interest rates, with workers’ quit rate and with hiring costs, while it increases with R&D productivity, with patents flows, with the rate of entry of new firms and introduction of new products, with the exit flow of firms, with the rate of obsolescence of capital, and the rate of job separation. Similarly, the rate of unemployment increases with the rate of time preference, the rate of intertemporal substitution, and the rate at which workers quit for non-economic reasons.

24. **Unfortunately, these implications are difficult to test.** They are in terms of comparative statics across steady states (as opposed to dynamic behavior) and are, therefore, not directly amenable to easy statistical testing. Most importantly, the lack of reliable microdata makes it infeasible to simulate the model in order to see how well it describes the properties of the Luxembourg economy.

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<sup>9</sup> Although productivity in the sector benefits from general knowledge of the (largely) foreign workers hired by the financial sector in Luxembourg, the learning by doing is *internal* to the firm.

<sup>10</sup> Admittedly, even with a flexible labor market, an influx of foreign workers might occur. However, the growing importance of the influx of skilled foreign workers in the financial industry is a well-known feature of the Luxembourg economy that is consistent with the model.

**Box. A Schumpeterian Endogenous Growth Model with Learning  
by Doing and Innovations**

Aghion and Howitt's (1999) model of endogenous growth introduces heterogeneity in the process of innovations, i.e., innovative activity can be R&D or learning by doing (LBD). The model incorporates ideas by Romer (1986), Lucas (1988), Stokey (1988), and Lucas (1993). While R&D generates new products, LBD improves the quality of already invented goods. Both innovative activities are complementary. The model is an infinite-horizon continuous-time model with a constant mass of  $H$  skilled workers, each of which can engage in production or research.

There is one final consumption good and a continuum of intermediate goods. Individuals have intertemporally additive risk neutral preferences with a constant rate of time preference  $r$ . The mass of researchers is  $H^r$  and the flow of new products equals  $H^r \lambda^r$ , with  $\lambda^r$  equal to the exogenous rate of arrival of fundamental innovations. LBD takes place in each firm at a rate of  $\lambda^d x_a^{1-\nu}$  where  $\lambda^d$  is the productivity of LBD,  $0 < \nu < 1$ , and  $x_a$  is the labor input—the only input—used in the production of each intermediate good of age  $a$  under constant returns to scale. Each vintage of good is discounted at a rate  $0 < \alpha < 1$ . Finally, workers can move from producing an old product to producing a new product or to doing research at an exogenously given rate of skill upgrading,  $\sigma$ .

In this model, two relationships jointly determine the steady-state rate of growth and the amount of R&D relative to LBD. The first is a growth equation, which governs the evolution of general knowledge (freely available to all) and which determines growth as a function of the R&D/LBD mix. The second equation is an arbitrage equation and is the result of workers engaging in the most profitable activity, either R&D or LBD, depending on the growth rate  $g$ . It is important to note product quality improvement through LBD depends not on other firms' experience but on the experience of the firm producing the product.<sup>1</sup>

In a steady state, the economy grows at the rate of growth of general knowledge:

$$g = G \left( \lambda^r H^r, \frac{(\lambda^r)^\nu \lambda^d}{\sigma^\nu (1-\nu)} (H^r)^\nu (H - H^r)^{1-\nu} \right). \quad (B1)$$

Growth is a concave function  $G$  of the level of research  $H^r$  (figure B1) with a maximum at  $g^*$ , assuming that  $g^* < r$ . The arbitrage equation A is:

$$r + \sigma - g = \sigma \frac{\nu - \alpha}{1 - \nu + \alpha} \frac{H - H^r}{H^r}, \quad (B2)$$

which is positive on research and production workers if and only if the learning parameter  $(1-\nu) < (1-\alpha)$ . If the arbitrage curve A cuts the growth curve  $G$  to the left of  $H^*$ , the steady state is unique because A has a positive horizontal intercept and would cut  $G$  from below where  $G$  is increasing. Note that the interaction between  $G$  and A will not occur at the right of  $g^*$  ( $H^*$ ) because in the model

<sup>1</sup>Think of a fund manager who uses R&D knowledge available to all agents which is embodied in, say, a software that helps trading options on stocks. The fund manager derives a new synthetic product which quality is adapted to the needs of its clients via LBD.

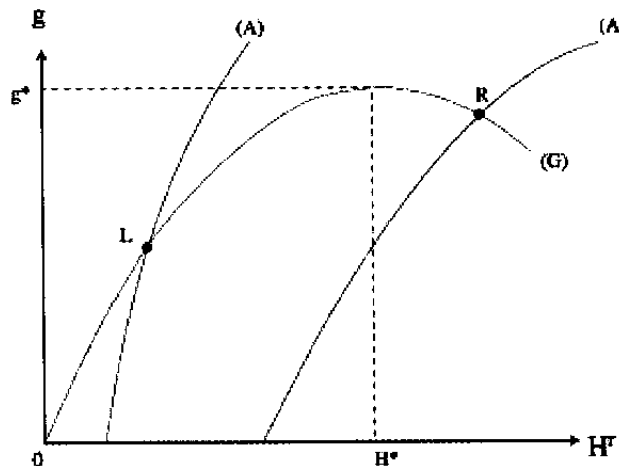
**Box. A Schumpeterian Endogenous Growth Model with Learning by Doing and Innovations (continued)**

each firm fully internalizes the quality-enhancing effects of its learning, i.e. only the firm that solves practical production problems benefits directly from that experience and raises the quality of its intermediate product. In other words, production workers appropriate at least part of the fruits of LBD, and so researchers will have to compensate them in a competitive equilibrium (this is the amount  $1-v$  in B2 as opposed to  $\alpha$ ).

In figure B1, growth and the level of research are increasing in  $\lambda^r$  or  $\lambda^d$  because they shift the curve G up without affecting A, and growth and the level of research are increasing in H as they shift the curve G up and the curve A to the right. Growth and the level of research are decreasing in  $r$  as they shift A to the left without affecting G. Finally, growth and the level of research are increasing in  $\sigma$  and  $v$  as they shift A to the right. Growth response to the interest rate is as in other Schumpeterian models in that an increase in interest rates reduces research and growth. Increases in LBD productivity  $\lambda^d$  raise growth because they enhance the total present value to be shared by researchers and production workers (as they are engaged in complementary activities). Growth increases because R&D is more forward looking than LBD as it is aimed at capturing the rent of future products.

It is also clear that as  $\sigma$  (upgrading) occurs, there is an increased flow of workers into new products which enhances the profitability of R&D. Because the G curve is upward sloping at the steady-state point, this will also increase growth. As in Lucas (1993), adaptability increases growth, although in contrast to Lucas this effect is not because adaptability increases aggregate LBD but because it increases the steady-state mass of researchers and LBD is not only external to firms in the model.

Figure B1: A Schumpeterian Endogenous Growth Model with Learning by Doing and Innovations



25. **Therefore, only a partial correlation test of three implications of the model could be performed, which suggests some limited support for the model and the view that Luxembourg has become less dependent on tax and regulatory advantages in recent times.** In the period 1970–2000, there is some evidence that the trend growth rate of the financial sector value added is strongly positively correlated with the entry of new banks and the rate of jobs creation. The correlations are 59 percent and 48 percent, respectively. Both are significant at the 95 percent level and carry the right sign. In contrast, the correlation with short-term interest rates (-21 percent), although negative as expected, is not significant.

### **B. Financial Sector Developments in International Perspective**

26. **Luxembourg’s financial sector growth in terms of bank assets has been within the range of that of two other dynamic financial centers, but there has been a process of convergence recently (Table 2).** During 1980–2001, when measured by total assets denominated in national currencies, Luxembourg banks grew quicker than United States banks but slower than United Kingdom banks. However, asset growth in Luxembourg seems to have fallen to levels that are roughly equal to those of the other countries during the 1990s.<sup>11</sup> Thus, there seems to be a tendency to convergence.

27. **Formal testing supports the hypothesis that growth rates in Luxembourg’s financial sector are converging to the growth rates of relatively older financial sectors.** There is evidence that bank assets in the United States, the United Kingdom, and Luxembourg are cointegrated. Unit root tests on bank assets in the three countries show that, in the period 1980–2001, non-stationarity cannot be rejected for the level of all variables (Table A1).<sup>12</sup> In contrast, changes in all variables, except in United States bank assets, are stationary. Given the latter result, a test of non-stationarity when there is the possibility of a break in the intercept and/or the slope of the series is applied to *changes* in bank assets in the United States.<sup>13</sup> This test confirms that the level of bank assets in the United States is indeed non-stationary, but also indicates that there is a significant break in *changes* in bank assets in the United States in 1989 or 1990 (Table A2). Finally, the Johansen-Juselius test for

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<sup>11</sup> This would be an analogous situation to the one described in the endogenous growth literature as *conditional convergence* (e.g., Barro and Sala-i-Martin, 1995): the country with a lower level of income per capita must have a higher growth rate of output per capita for the two countries’ levels of output to converge.

<sup>12</sup> The unit-root test used is the modified Dickey-Fuller t-test (DFGLS) proposed by Elliott, Rothenberg, and Stock (1996). This test is a point-optimal invariant test which has substantially improved power when an unknown mean or trend is present in the data. The alternative model includes a constant and a linear time trend.

<sup>13</sup> As indicated by Perron (1997), unit root tests are biased towards the null of no stationarity when the series has a break in the intercept and/or the slope.

cointegration—correcting for small-sample biases following Cheung and Lai, (1993)—accepts the hypothesis of one cointegrating vector at the 90 percent confidence level (see  $\lambda$ max statistic in Table A3).<sup>14</sup>

Table 2. Luxembourg: Total Bank Assets in Luxembourg, United Kingdom and United States, 1980–2001					
	Luxembourg		United Kingdom		United States
	(In billions of U.S. dollars)	(In billions of Luxembourg francs) 2/	(In billions of U.S. dollars)	(In billions of sterling)	(In billions of U.S. dollars)
1980	133.9	3,917.0	631.7	271.8	1,496.9
1990	374.2	12,480.0	2,160.5	1,211.0	3,250.6
1995	622.9	18,373.7	2,695.3	1,707.9	4,086.5
2001	647.2	29,085.1	4,196.1	2,905.4	6,296.9
Average Annual Growth (In percent)					
1980–2001	7.8	10.0	9.4	11.9	7.1
1980–1990	10.8	12.3	13.1	16.1	8.1
1990–2001	5.1	8.0	6.2	8.3	6.2
1995–2001	0.6	8.0	7.7	9.3	7.5

Sources: Banque Centrale du Luxembourg, Board of Governors of the United States Federal Reserve Bank, IFS, and OECD.

1/ Data for Luxembourg refer to commercial banks and savings banks. Data for the UK comprise assets of banks authorized under the Banking Act of 1987 and, starting in 1987, building societies. Data for the U.S. refer to commercial banks.

2/ Data for recent years provided by the authorities in euro were converted into LUF using the constant conversion rate of 40.3399 francs per euro.

3/ Data provided in Luxembourg francs, in euros or in pounds sterling were converted into U.S. dollars using market exchange rates.

### C. Financial Sector Production Function and Total Factor Productivity

28. **This section estimates a production function and time-varying total factor productivity (TFP) in the Luxembourg financial industry using a Cobb-Douglas**

<sup>14</sup> The model uses two lags. The residuals are normal and show no serial correlation. The  $\chi^2$  test for weak exogeneity shows that there are two common trends, i.e., the United Kingdom and the Luxembourg bank assets. The model is identified. Although the trace statistic is not significant at the 90 percent confidence level after the small sample bias correction, Enders (1995), p. 393, recommends using the  $\lambda$ max statistics in case of disparity between it and the trace as the former has a sharper alternative hypothesis.



**technology.**<sup>15</sup> The estimation follows the production approach and uses the Kalman filter.<sup>16</sup> The series of value added, capital stock, and labor compensation in the financial sector were provided by Statec, the Luxembourg official statistical agency. Figure 2 shows the levels of the series.

The model, with all variables in logs, is:

$$Y_t = A_t + \alpha K_t + \beta L_t + e_t \quad (1)$$

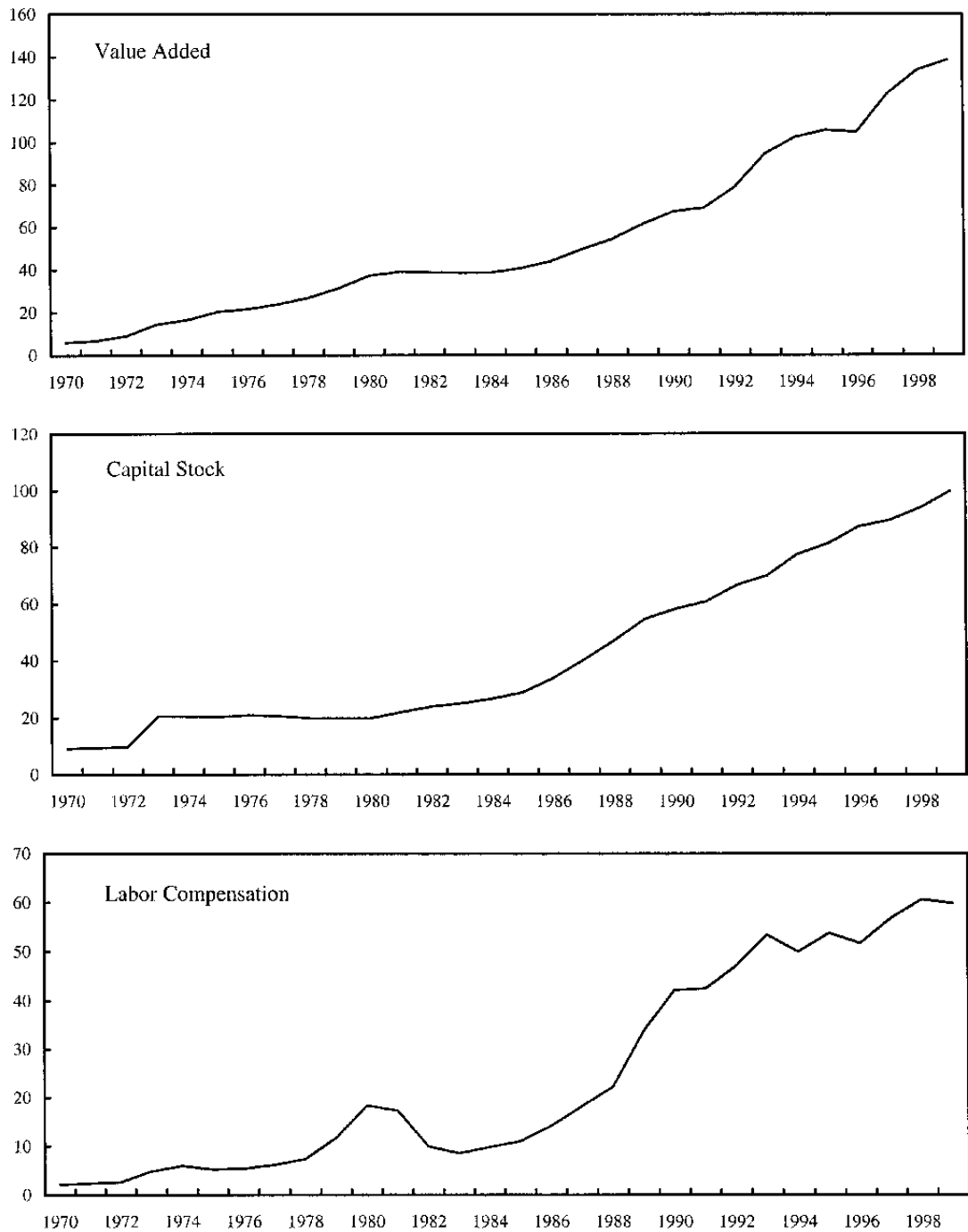
where the variables are value added in the financial industry, TFP, capital, labor, and a white noise residual, respectively. The subscript  $t$  in TFP indicates that it is allowed to vary over time.

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<sup>15</sup> Frequently encountered arguments against the use of time series models for studying growth (and estimating total factor productivity) are that the quality of the data is low, and that the sample period normally available is too short (Temple, 1999). A related argument is that researchers need to include long lags of the regressors in the estimation in order to prevent short-run business-cycle effects driving long-run correlations. Although data availability is certainly a challenge in the case of Luxembourg, the criticism of time-series analysis is somewhat exaggerated. The alternative to time-series analysis is to use cross-section or panel econometrics. These translate in practice into the use of 5-10 year averages of annual data. This approach has problems of its own as there is growing evidence that business cycles are not necessarily symmetric or synchronous (Nadal-De Simone, 2001); thus, averages may alter the statistical properties of the series. Another problem is the calculation of *growth* rates using the first and the last output or income per capita values of the series in *levels*, either of which can be very far, and at different distances from what is being measured, i.e., the trend path of output. The use of growth rates obtained after regressing the whole of the output or income per capita series on a constant and a trend is not better in terms of proper measurement of trend growth as it assumes that the trend in output is stationary rather than stochastic. All these issues are also relevant when estimating production functions.

<sup>16</sup> An alternative approach is the intermediation approach such as adopted, for instance, by Rouabah (2001) for a study on Luxembourg and a set of five other industrial countries. While the production approach assumes that financial institutions provide transaction and information services using only their physical capital and labor, the intermediation approach incorporates the institutions' financing costs among the costs of providing their services.

Figure 2. Luxembourg: Financial Sector Production Function Data  
(Billions of Luxembourg Francs)



Source: STATEC.

29. **The fact that unit root tests suggest that value added in the financial sector is non-stationary and that capital and labor are stationary poses a statistical and economic challenge.** According to the unit root test reported in Table A1, value added in the financial sector and the capital stock are integrated of order one while labor compensation is trend stationary (Table A1).<sup>17</sup> However, the level of the capital stock series has a significant break in the intercept and/or the slope in 1982 or 1983, suggesting that the capital stock series may be stationary (Table A2).

30. **Therefore, the estimation of a production function for the financial sector requires the specification of a production function in which TFP is integrated of order one.** This would suggest that TFP is non-stationary; shocks to TFP impart persistence to the industry value added. In contrast, while factors of production follow a stationary time trend, they are not subject to permanent shocks. This will be the working hypothesis adopted for the estimation.<sup>18</sup> Thus, the estimation of the model assumes that  $A_t$  follows the random walk process:

$$A_t = A_{t-1} + v_t \quad (2)$$

where  $v_t$  is white noise. The model of equations (1)-(2) in its state-space form is identified.<sup>19</sup>

31. **The model was estimated in state-space form using the Kalman filter (Table A4).** The estimation was not subject to the restriction that returns to scale are constant (i.e., that the sum of the coefficients on capital and labor equals one). The variance of the output equation (1) is not significant while the variance of TFP and the parameters  $\alpha$  and  $\beta$  are statistically different from zero. The results of the Kolmogorov test on serial correlation show, however, that there is some serial correlation in the level but not the squares of the standardized forecast errors.<sup>20</sup>

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<sup>17</sup> The alternative is a constant and a linear time trend.

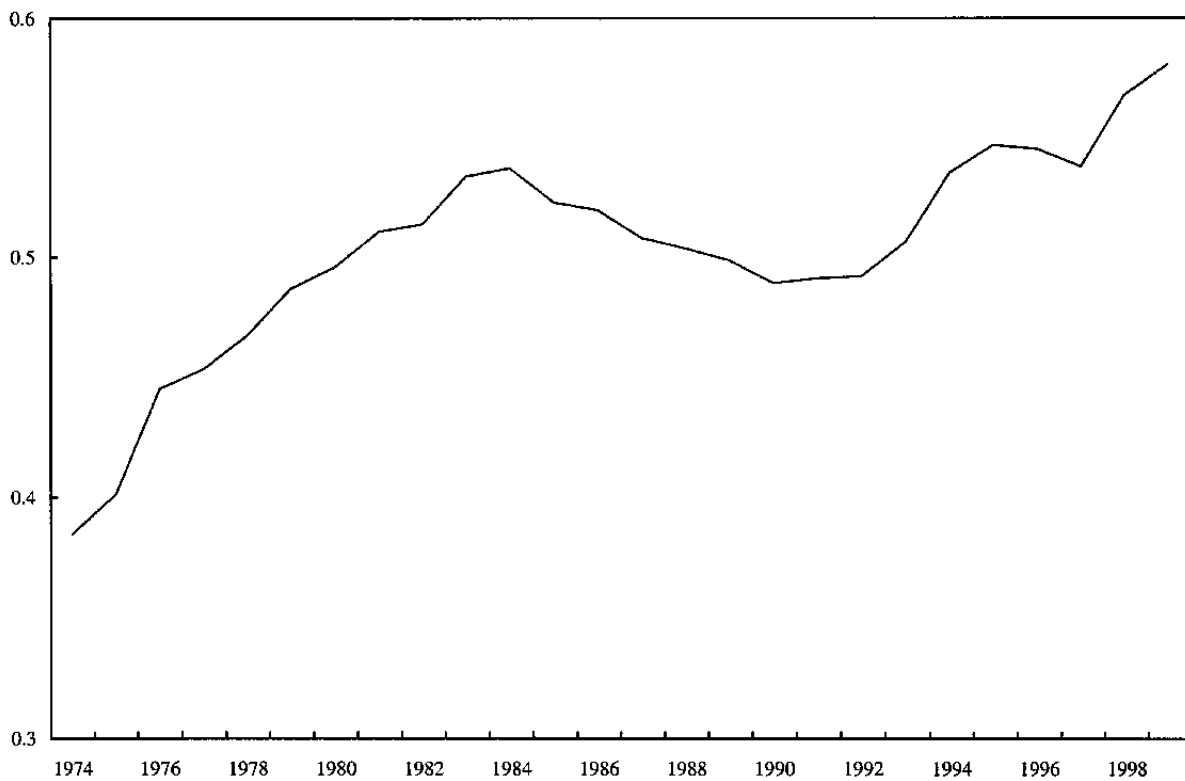
<sup>18</sup> Most observers would agree with the view that TFP is non-stationary of order one.

<sup>19</sup> The criterion for local identification is that the information matrix be non singular in a neighborhood of the estimated parameters (Rothenberg, 1971). In no case was there any difficulty inverting the matrix of the second derivatives of the log likelihood function. Global identification was done checking the features of the state-space representation of the model, as suggested by Burmeister et al. (1986).

<sup>20</sup> If the reason for serial correlation is the endogeneity of the regressors, the use of lagged capital and lagged labor should help (Temple, 1999). However, using up to lag two of capital and labor did not reduce serial correlation. The use of detrended capital and labor did not change the results significantly either. It is likely that the source of serial correlation is the omission of a proxy for some form of LBD, or another form of human capital.

32. **The results of the estimation suggest that the level of TFP increased rapidly between the mid-1970s and the mid-1980s, and that after the slump experienced in the second half of the 1980s, it recovered strongly (Figure 3).**<sup>21</sup> The recovery of TFP in the 1990s has to be qualified, however. While TFP grew at an average annual rate of 2.25 percent in the first half of the 1990s, it slowed to 1.50 percent between 1996 and 1999 largely for cyclical reasons. Overall, TFP growth in the financial sector has been consistent with accumulation of know-how within financial institutions as defined in the model framework used in this paper.

Figure 3. Luxembourg: Smoothed Time-Varying Total Factor Productivity



Sources: STATEC, and IMF staff estimates.

<sup>21</sup> The estimates of TFP are smoothed, i.e., the estimates use all the information available in the sample. In contrast to the filtered estimates, smoothed estimates provide more accurate inference.

33. **The results also show that the industry operates under decreasing returns to scale.**<sup>22</sup> The sum of the estimated parameters of capital and labor do not add up to one, thus implying decreasing returns to scale.<sup>23</sup> This result is broadly consistent with the results of Rouabah (2001) who found that only the first quartile of banks in terms of size operate under increasing returns to scale while the smaller banks seem to be subject to decreasing returns to scale.

34. **Value added and TFP are cointegrated.** The estimation of the production function assumed that value added and TFP were cointegrated. It is thus important to test whether the estimated TFP is indeed cointegrated with value added. The results strongly reject no cointegration in favor of one cointegrating vector (Table A3). This is true using either the trace or the  $\lambda_{max}$  statistics.<sup>24</sup> This result provides some comfort as to the internal consistency of the approach followed for estimation.

35. **The estimates seem consistent with the conceptual endogenous growth model described earlier.** The Luxembourg financial sector grew rapidly during the second half of the 1970s and the first half of the 1980s as LBD capitalized on the institutional-policy advantages of the country in an internationally competitive market. As the sector gained market share and matured, the relative importance of capital and labor in the production process started to increase, although the sector still operates under decreasing returns to scale. A next step would be to build a proxy for LBD, or some form of human capital, and integrate it into the estimation to check the robustness of the results.

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<sup>22</sup> Note that if a single variable, say the capital stock, is measured with error, its coefficient will be biased toward zero. If several variables are measured with error, biases may go in either direction.

<sup>23</sup> The model described in the Box has some effects that make the average rate of growth of the economy higher than optimal (e.g., the private firm does not internalize the loss to the previous monopolist caused by its innovation), and other effects that make the average growth rate of the economy lower than optimal (e.g., the firm does not internalize that the benefits to the next innovation will continue for ever). Thus, the *laissez-faire* average growth rate may be more or less than the optimal growth rate (Aghion and Howitt, 1999). This implies that endogenous growth does not necessarily require increasing returns to scale as it is the case in models with external economies of scale.

<sup>24</sup> The 90 percent confidence values have been corrected for the small-sample bias using Cheung and Lai (1993). The model was estimated using 1 lag. The residuals are normal and show no serial correlation. The model is identified.

#### **IV. BANKING SECTOR PERFORMANCE: SHORT- TO MEDIUM-RUN DETERMINANTS**

36. **This section analyzes how Luxembourg bank revenues respond to the business cycle, interest rates and stock market valuation.** Its aim is to learn how the European business cycle, important European interest rates, and international asset market trends have affected the revenues of Luxembourg's banking system starting in the early 1990s.

37. **It concludes that revenues are sensitive to interest rates and asset market valuation, while being less sensitive to the real business cycle.** More precisely,

- revenues from interest margins are linked to interest rates of neighboring countries. When long-term interest rates rise, revenues from interest rate margins rise as well, and when short-term interest rates increase, revenues from interest rate margins shrink. In addition, there is some evidence of a positive impact of euro area real activity on revenues from interest margins;
- commission income is positively related to major international stock market indices. Further, the data lend limited support to the hypothesis that euro area real activity has a positive effect on commission income.

38. **Conceptually, banks' revenues are sensitive to the business cycle and to interest rates through bank intermediation and to asset market valuation through asset management.** The business cycle could determine bank revenues through its influence on the number of bankable projects and on loan quality, leading to an increase of bank revenues in cyclical upswings. However, a large share of interbank activity, as in the case of Luxembourg, can to some degree act as a shield against business cycle effects on bank revenues. Interest rates could influence bank revenues when bank intermediation is characterized by unhedged maturity transformation. When market interest rates change, even for a constant slope of the yield curve, the effects are felt more quickly on the liability side than on the asset side because the liability side is characterized by a shorter average maturity. Therefore, if interest rates increase, bank revenues from intermediation will tend to fall, and vice versa. Further, for similar reasons, revenues may be affected when the slope of the yield curve changes. Financial asset prices could determine banks' revenues through their influence on commission income. Some commissions are directly proportional to the net value of the assets concerned. Others are linked to the number of investment funds and investment fund accounts managed. As these numbers are thought to move in line with asset prices, they could create an additional link between asset prices and commission income.

### Explaining revenues from interest margins<sup>25</sup>

39. **Revenues from interest margins were considered to be a function of Luxembourg bank assets, euro area real activity, and long- and short-term European interest rates.** This relationship can be written in a general form as:

$$IRM = f(AST, GDP, LIR, SIR)$$

Table A5 identifies the series, their sources, their units and the methods used for seasonal adjustment. All data are quarterly and cover the period 1991 Q1 to 2001 Q3.<sup>26</sup>

40. **OLS-regression results suggest that an upward movement in long-term interest rates raises banks' revenues from interest margins, whereas an increase in short-term interest rates lowers them.** The result of regressing interest margins on assets, the differenced real activity indicator, long-term interest rates, and differenced short-term interest rates is:<sup>27</sup>

$$IRM = -6.572 + 0.764 AST + 5.614 \Delta GDP + 0.063 LIR - 0.098 \Delta SIR$$

(-2.50)      (5.15)      (1.56)      (2.61)      (-2.47)

$$\bar{R}^2 = 0.54; DW = 1.93; LM1: \chi^2_{(1)} = 2.45 (0.12); LM4: \chi^2_{(4)} = 9.16 (0.06)$$

In the estimation result, t-values are reported in parentheses below estimated parameters (first row) and p-values in parentheses following residuals analysis test statistics (second row). The estimated parameters associated with assets and interest rates have the expected signs and are statistically significant. The differenced real activity indicator also has the expected sign but, with a t-value of 1.56 and a corresponding p-value of 0.13 (not shown), it is only marginally significant. The residuals of this regression can be considered acceptable, as they do not exhibit serial correlation at the first lag or the first four lags. Removal of differenced GDP from this regression yielded residuals that appeared autocorrelated over the first four lags so that it was kept in spite of its only marginal significance.

41. **Alternative regressions using the cyclical components of the euro area real activity indicator and of long-term interest rates did not yield satisfactory results.** A modified Hodrick-Prescott procedure was used to split real activity and short-term interest

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<sup>25</sup> Here and in the remainder of the paper, revenues from interest margins (or short: interest margins) are defined as the difference of interest payments received and interest payments made.

<sup>26</sup> Most data were found to be non-stationary, see Table A1.

<sup>27</sup> Cointegration analysis of these five variables could not find a sufficient number of cointegrating relationships.

rates into trends and cyclical components. Subsequent regressions of interest rate margins on assets, the cyclical components of GDP, the long-term interest rate, the short-term interest rate and the cyclical components of the stock market index failed to produce a satisfactory outcome.

### Explaining commission income

42. **Commission income was postulated as a function of assets, euro area real activity and international stock market valuation.** This relationship can be expressed as:

$$COM = f(AST, GDP, SMI)$$

However, a cointegrating relationship could be found only between commissions, the real activity indicator and stock market indices (Table A3). See Table A5 for identification of the data used.

43. **The estimated cointegration relationship suggests that an increase in euro area economic activity and an increase in stock market valuation have positive effects on commission income of Luxembourg banks.** This relationship is:

$$COM = 1.497GDP + 0.905SMI + \varepsilon,$$

where  $\varepsilon$  represents a stationary error term.<sup>28</sup> The parameters of both euro area real activity and the stock market indicator have the expected positive signs.

44. **The estimate of the cointegrating relationship should, however, be used with caution.** First, a likelihood ratio test failed to reject the hypothesis that the estimated coefficients of GDP and SMI were different from zero and that GDP and SMI could be excluded from the long-run relationship. Note, however, that this contradicts the earlier finding of the presence of a cointegrating relationship and may be due to collinearity between the three variables. Second, subsequent attempts to fit a single equation equilibrium correction model to the data using the Phillips-Loretan (1991) approach failed to produce econometrically satisfactory results.

45. **Finally, the cyclical component of commissions is clearly related to the cyclical part of stock market indices (Figure 4).** In particular, a cyclical upswing of the stock indices leads to an upswing of commission income. The regression result is:

$$COMCY = -1.406 + 2.517 SMICY + \varepsilon$$

(-0.23)      (5.81)

$$\bar{R}^2 = 0.44; DW = 1.77; LM1: \chi^2_{(1)} = 0.179 (0.67); LM4: \chi^2_{(4)} = 2.92 (0.57)$$

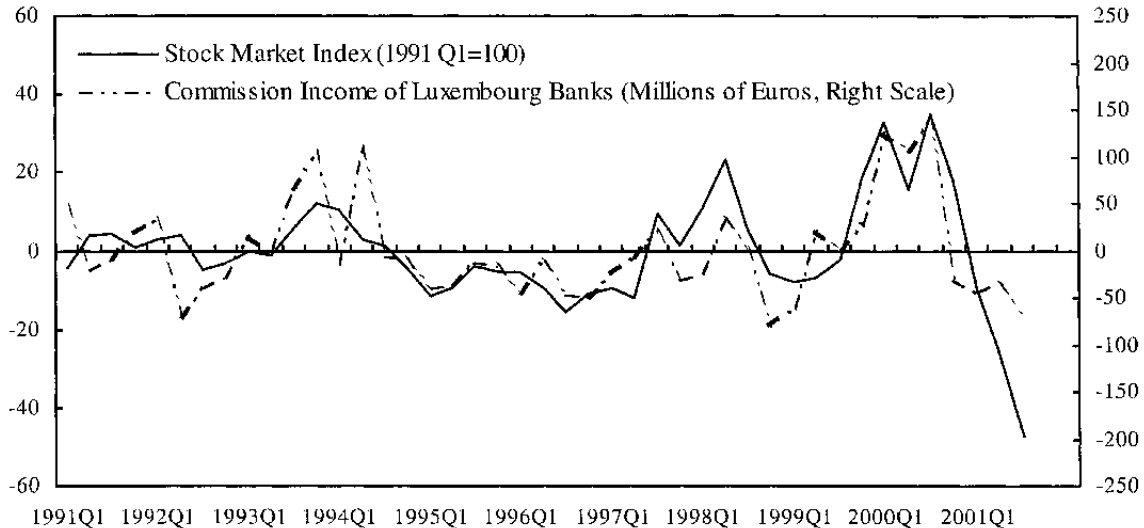
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<sup>28</sup> Due to the non-stationarity of the time series under consideration, t-values do not apply.



The estimated parameter associated with the stock market cycle is clearly significant. The residuals of the regression are not autocorrelated. The positive correlation strengthens in about 1995.

Figure 4. Luxembourg: Cyclical Components of Stock Market Index and Commission Income



Sources: Banque Centrale du Luxembourg; WEFA; and Fund staff calculations.

## V. CONCLUDING REMARKS

46. **Luxembourg's financial sector is facing a potential reduction of tax-related advantages, and a possibly significant slowdown in the growth of asset market valuation.** To shed light on the prospects of the sector in front of these challenges, this study sought to answer two questions: In a structural sense, to what extent are the main factors driving the development of the financial sector tax and regulatory advantages (e.g., banking secrecy, the absence of a withholding tax on interest income and the absence of taxation of provisioning) or other factors (e.g., the speedy application of EU directives in the financial field, the presence of a multilingual labor force, a favorable geographical position or simply the rapid development of the global financial industry)? And, in a cyclical sense, what are the respective roles of real activity, interest rates, asset market valuations, or other factors?

47. **With respect to structural factors, there is qualified evidence that the tax and regulatory advantages that were important for the strong growth of the financial sector in the past, have lost much of their relevance during recent years.** Conceptually, by concentrating in one location, there has been scope for agglomeration economies in an internationally competitive environment, reflected in factors such as learning by doing, suggesting that Luxembourg's banking sector may by now have accumulated know-how

related advantages. While this concept could not be tested formally, the sum of the following evidence nonetheless lends it considerable, if indirect, support:

- The rapid growth of the financial sector in the 1970s and 1980s has slowed somewhat in the 1990s, though it remains high, and seems to have converged to the rates of growth of other major and older financial centers.
- In recent years, continued high growth has not been based on the arrival of new banks in response to tax and regulatory advantages. On the contrary, the spate of mergers in the international financial sector and the attendant decline in the rate of entry of banks in Luxembourg have constituted a drag on growth, as there is evidence that trend growth in financial sector value added in Luxembourg has been strongly positively correlated with the entry of new banks.
- Total factor productivity is estimated to have recovered strongly in the 1990s after a slump that started in the mid-1980s. The recovery of TFP has to be qualified, however. While TFP grew at an average annual rate of 2.25 percent in the first half of the 1990s, it slowed to 1.50 percent between 1996 and 1999, largely for cyclical reasons. Overall, as defined in the model framework used in this paper, TFP growth in the financial sector has been consistent with accumulation of know-how within financial institutions.
- There appear to be no specific impediments to the ongoing development of the financial sector. In particular, there is no reason why the sector would not continue to build on existing non-tax and non-regulatory advantages (e.g., skills and location).

**48. With respect to medium- and short-term issues, the performance of the financial sector was found to be significantly dependent on asset market valuation—implying that a slower rise in asset market valuation could lead to slower growth of the sector—though interest rate margins and, to a lesser extent, real activity also play a role.**

- Bank revenues from interest margins are positively related to long-term interest rates and negatively related to short-term interest rates. A positive influence of euro area real activity is only marginally significant.
- Bank commission income is positively related to international equity markets. Again, a positive link from euro area real activity to commission income is more tenuous.
- While bank commission income is furthermore strongly influenced by stock market cycles, no cyclical determinants of bank revenues from interest margins could be found.

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Table A1. Luxembourg: Selected Data: Elliot, Rothenberg, and Stock Test for Unit Roots Statistics for $\rho = 0$					
Series	Period	Levels		Changes	
		Lags <sup>1</sup>	DFGLS <sup>2</sup>	Lags <sup>1</sup>	DFGLS <sup>2</sup>
Financial sector value added	1970-1999	1	-2.27	1	-3.48**
Financial Sector Capital stock	1970-1999	1	-2.68	1	-7.62**
Financial Sector Labor	1970-1999	1	-3.89**	...	n.a.
USA banks assets <sup>3</sup>	1980-2001	1	-1.76	1	-1.63
UK bank assets	1980-2001	1	-1.41	1	-2.99**
Luxembourg bank assets	1980-2001	1	-2.07	1	-2.84**
Total factor productivity <sup>4</sup>	1970-1999	1	-0.95	1	-2.19*
Luxembourg bank profits	91Q1-01Q3	1	-3.83**	...	n.a.
Luxembourg bank assets	91Q1-01Q3	3	-3.57**	...	n.a.
Euro-area real GDP	91Q1-01Q3	2	-3.13*	...	n.a.
Average of Belgian, French and German long-term interest rates	91Q1-01Q3	1	-3.19*	...	n.a.
Average of Belgian, French and German short-term interest rates	91Q1-01Q3	1	-1.63	1	-2.61**
Long-term /short-term interest rate differential	91Q1-01Q3	2	-2.97*	...	n.a.
Average of international stock market indices	91Q1-01Q3	1	-1.36	1	-2.38**
Luxembourg bank revenues from interest margins	91Q1-01Q3	1	-4.55**	...	n.a.
Luxembourg bank commission income	91Q1-01Q3	1	-2.70	1	-5.70**

Source: Fund staff calculations.

<sup>1</sup>Lags are determined according to the Schwarz information criterion and checking that the residuals are white noise.

<sup>2</sup>The DFGLS test has a null of a unit root with a constant and a linear time trend. The 5 percent critical value is -2.89 and the 1 percent critical value is -3.48. Rejection at the 5 percent level is marked by one asterisk (\*), rejection at the 1 percent level by two asterisks (\*\*).

<sup>3</sup>The second difference of USA bank assets has a DFGLS test of -4.37 for a null of a constant and a linear time trend strongly, rejecting the null of a unit root process.

<sup>4</sup>The DFGLS test has a null of no constant and no linear time trend as this is the data generating process estimated. The 5 percent and the 1 percent critical values are -1.95 and -2.58, respectively.

Table A2. Luxembourg: Bank Assets and Capital Stock: Perron's (1997) Unit Root Test <sup>1</sup> (1990-1999)						
Variable	$T_b^2$	$K^3$	$\hat{\alpha}$	$t_{\hat{\alpha}}$	$\hat{\theta}$	$t_{\hat{\theta}}$
U. S. banks assets	1985	5	0.004	-4.80	1.08	0.53
	1992	0				
Changes U.S. bank assets	1989	5	-0.76	-8.42*	-1.64	-5.81*
	1990	3				
Luxembourg capital stock	1983	2	-0.19	-8.03*	-0.07	-7.84*
	1982	2				

Source: Fund staff calculations.

<sup>1</sup>This is model 2 in Perron (1997) which allows for a change in the intercept and in the slope.

<sup>2</sup>The first  $T_b$  is the value that minimizes the t-statistic for testing  $\alpha = 1$  and the second  $T_b$  is the value chosen to minimize the t-statistic on the change in the slope.

<sup>3</sup>Lags  $K$  are chosen following the Schwarz criterion and checking that residuals are white noise.

Table A3. Luxembourg: Selected Data: Johansen-Juselius Test for Cointegration							
I. US, UK, and Luxembourg Bank Assets							
Eigenvalues	$\lambda_{\max}$	Trace	$H_0: r=$	$\lambda_{\max}^1$ 90 percent critical value	Trace <sup>1</sup> 90 percent critical value	Lags	Residuals analysis: <sup>2</sup>
0.684	23.05*	31.87*	0	18.34	36.58	2	Normality $\sim \chi_6^2 = 1.32$ (0.98)
0.306	7.30	8.82	1	14.52	18.23		LM1 $\sim \chi_9^2 = 3.35$ (0.95)
0.073	1.52	1.52	2	3.71	3.71		LM4 $\sim \chi_9^2 = 4.18$ (0.90)
II. Financial Sector Value Added and Total Factor Productivity							
Eigenvalues	$\lambda_{\max}$	Trace	$H_0: r=$	$\lambda_{\max}^1$ 90 percent critical value	Trace <sup>1</sup> 90 percent critical value	Lags	Residuals analysis: <sup>2</sup>
0.586	22.03*	22.08*	0	12.52	15.72	1	Normality $\sim \chi_4^2 = 1.51$ (0.83)
0.0	0.0	0.0	1	3.20	3.20		LM1 $\sim \chi_4^2 = 6.47$ (0.17)
							LM4 $\sim \chi_4^2 = 2.43$ (0.66)
III. Commission Income, Real Activity Indicator, and Stock Market Indices							
Eigenvalues	$\lambda_{\max}$	Trace	$H_0: r=$	$\lambda_{\max}^1$ 90 percent critical value	Trace <sup>1</sup> 90 percent critical value	Lags	Residuals analysis: <sup>2</sup>
0.5588	30.21*	51.66*	0	23.03	45.92	6	Normality $\sim \chi_6^2 = 3.235$ (0.78)
0.3762	17.46	21.45	1	18.23	22.89		LM1 $\sim \chi_9^2 = 7.347$ (0.60)
0.1022	3.99	3.99	2	4.66	4.66		LM4 $\sim \chi_9^2 = 13.670$ (0.13)
Source: Fund staff calculations.							
<sup>1</sup> The 90 percent critical values are corrected for small sample bias using Cheung and Lai (1993). The model includes a drift term in the variables but not in the cointegration space.							
<sup>2</sup> The normality test is a multivariate version of the Shenton-Bowman test for normality for individual time series; the LM1 and LM4 are the Lagrange multiplier tests; p-values in parentheses.							

Table A4. Luxembourg: Production Function Parameter Estimates (Time-Varying Total Factor Productivity)		
Variables	Estimates	Standard Errors
$\sigma_e$	0.000	0.004
$\sigma_v$	0.033*	0.005
$\alpha$	0.239*	0.070
$\beta$	0.451*	0.191
Log likelihood function value: 51.92		
Residuals analysis: Kolmogorov–Smirnov <sup>1</sup>		
Standardized forecast errors: 0.43*		
Squared standardized forecast errors: 0.23		
Source: Fund staff calculations.		
<sup>1</sup> This is a Durbin cumulated periodogram test for serial correlation. The 10 percent rejection limit is 0.31.		



Table A5. Luxembourg: Data Used in Section IV

Variable Name in Text	VariableDescription	Identifier	Source	Unit	Seasonal Adjustment
Profits	Profits before provisions	PRF	BCL	Millions of LUF	X11, multiplicative
Assets	Total assets	AST	BCL	Millions of LUF	X11, multiplicative
GDP, activity indicator	Euro-area 12 GDP (in constant prices of 1995)	GDP	Eurostat	Millions of LUF	X11, multiplicative
Long-term interest rates	Arithmetic average of long term government bond yields in Belgium, France and Germany	LIR	OECD	Percent per annum	X11, multiplicative
Short-term interest rates	Arithmetic average of Belgian, French and German short term interest rates; starting in 1991 Q1, Eurozone short term interest rate	SIR	OECD	Percent per annum	X11, multiplicative
Interest rate differential	Difference between arithmetic averages of Belgian, French and German long-term and short-term interest rates	IRD (=LIR-SIR)	Fund staff calculations	Percent per annum	X11, additive
Stock market valuation/ stock market indices	Arithmetic average of DAX (Germany), FT500 (UK), S&P 500 (USA), each normalized by 1991 Q1 = 100	SMI	WEFA	Index, 1991 Q1 = 100	X11, multiplicative
(Revenues from) Interest margins	Revenues from interest margins	IRM	BCL	Millions of euro	Moving average, multiplicative
Commissions	Commission income	COM	BCL	Millions of euro	Moving average, multiplicative