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THE IMPACT OF THE EXCHANGE RATE ON LUXEMBOURG EQUITY FUNDS

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Abstract

The aim of this work is to investigate the impact of the exchange rate on Luxembourg equity funds. For this purpose, the dataset compiled by the Banque centrale du Luxembourg is used to exploit the detailed information on the currency composition of assets and liabilities and to deliver a statistical decomposition of the exchange rate valuation effect on both sides of the balance sheet. In addition, an econometric analysis relying on the International Capital Asset Pricing Model (ICAPM) is carried out to estimate the sensitivity of the Net Asset Value (NAV) to exchange rate movements. The main findings of the study are the following. (i) Equity funds in Luxembourg are highly internationalized as for the currency composition of their balance sheet, with 54% of non-euro denominated shares on the liability side, and 81% of non-euro denominated securities on the asset side at the end of June 2013. (ii) The currency composition of Luxembourg equity funds has changed since the onset of the financial crisis, with relatively more USD-denominated shares on the liability side and relatively more emerging markets currency-denominated securities on the asset side. (iii) This structural change in the currency composition of Luxembourg equity funds delivered a higher sensitivity of the NAV to exchange rate movements, in particular with respect to the emerging markets currencies. (iv) Despite this increased sensitivity to the exchange rate, stock market developments remain the most important driver for the activity of Luxembourg equity funds in the medium run. From this point of view, the EUR/USD exchange rate provided a natural hedging against stock market fluctuations during the crisis period, thereby mitigating the aggregate evolution of the NAV expressed in euro.

Keywords: Equity funds, risk analysis, ICAPM, fixed-effects model.

JEL classification: F30, G11, G23.

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Content

Résumé non-technique

Le développement de l'industrie des fonds d'investissement a constitué un élément majeur du paysage économique luxembourgeois depuis le milieu des années 1980. Le Luxembourg est ainsi devenu la deuxième place financière internationale pour la domiciliation de fonds et la première place financière internationale pour la distribution transfrontalière de parts d'OPC. De par cette dimension internationale, les fluctuations du taux de change peuvent exercer des effets importants sur l'activité des fonds d'investissement, avec des implications potentielles pour l'économie réelle et, plus particulièrement, les revenus fiscaux et la position extérieure du Grand-Duché.

Cet encadré s'attache à analyser l'impact des mouvements du taux de change sur la Valeur Nette d'Inventaire (VNI) des OPC actions domiciliés au Luxembourg, en insistant particulièrement sur les développements qui se sont produits depuis le début de la crise financière. À cet effet, les données compilées par la Banque centrale du Luxembourg sont utilisées, d'une part, pour exploiter le niveau d'information détaillé relatif à la composition en devises du bilan des OPC actions, et d'autre part, pour mesurer la contribution de l'effet de valorisation associé aux variations du taux de change dans l'évolution de la VNI. Une analyse économétrique basée sur le modèle ICAPM (*International Capital Asset Pricing Model*) est par ailleurs effectuée afin d'estimer la sensibilité de la VNI aux mouvements du taux de change, et apporter dans le même temps un éclairage sur les déterminants récents de l'activité des OPC actions.

Les principaux résultats obtenus dans cette étude sont les suivants. La composition en devises du bilan des OPC actions luxembourgeois affiche un degré élevé d'internationalisation, avec respectivement 54% et 81% des parts émises et des titres détenus libellés en devises étrangères à la fin du mois de juin 2013. L'analyse économétrique indique que les mouvements du taux de change exercent un impact significatif sur l'encours de la VNI exprimée en euros. Cette sensibilité s'est par ailleurs accrue depuis le début de la crise financière, en raison notamment de l'augmentation de l'exposition en devises des pays émergents. Dans l'ensemble, les fluctuations du marché boursier demeurent toutefois le principal déterminant de l'évolution de l'activité des OPC actions luxembourgeois à moyen terme. De ce point de vue, le taux de change de l'euro par rapport au dollar semble avoir exercé un effet de couverture naturelle contre les variations du marché boursier depuis la fin de l'année 2008, limitant ainsi les fluctuations de la VNI des OPC actions exprimée en euros et, ce faisant, le niveau des recettes générées par la taxe d'abonnement.

Non-technical summary

The growth of investment funds has been a salient feature of the Luxembourg economic landscape since the 1980s, with Luxembourg becoming the second international place for the domiciliation of investment funds after the US, and the first international platform for the cross-border distribution of mutual funds shares. Given the international dimension of the Luxembourg investment funds industry, exchange rate fluctuations may exert a sizeable effect on the activity of mutual funds, with potential implications for the real economy and, more specifically, fiscal revenues and the external position of the Grand-Duchy.

The aim of this study is to investigate the impact of the exchange rate on the Net Asset Value (NAV) of Luxembourg equity funds, focusing in particular on the developments observed since the onset of the financial crisis. For this purpose, the dataset compiled by the Banque centrale du Luxembourg is used to exploit the detailed information on the currency composition of equity funds and to deliver a statistical decomposition of the exchange rate valuation effect on both sides of the balance sheet. In addition, an econometric analysis relying on the International Capital Asset Pricing Model (ICAPM) is carried out to estimate the sensitivity of the NAV to exchange rate movements, and to provide at the same time a perspective on the recent determinants of the activity of Luxembourg equity funds.

The main findings of the study are the following. Equity funds in Luxembourg are highly internationalized as for the currency composition of their balance sheet, with 54% of non-euro denominated shares on the liability side, and 81% of non-euro denominated securities on the asset side at the end of June 2013. The econometric analysis reveals that movements in the exchange rate exert a significant impact on the NAV of equity funds expressed in euro. Moreover, this sensitivity increased since the onset of the financial crisis as a consequence of the increased exposure to emerging markets currencies. However, despite this increased sensitivity to the exchange rate, stock market developments remain the most important driver for the activity of Luxembourg equity funds in the medium run. From this point of view, the EUR/USD exchange rate provided a natural hedging against stock market fluctuations during the crisis period, thereby mitigating the aggregate evolution of the NAV expressed in euro and, consequently, the amount of revenues generated by the subscription tax.

1. Introduction

The growth of investment funds has been a salient feature of the Luxembourg economic landscape since the 1980s, with Luxembourg becoming the second international place for the domiciliation of investment funds after the US, and the first international platform for the cross-border distribution of mutual funds shares. Given the international dimension of the Luxembourg investment funds industry, exchange rate fluctuations may exert a sizeable effect on the activity of mutual funds, with potential implications for the real economy and, more specifically, fiscal revenues and the external position of the Grand-Duchy.

Several transmission channels are expected to take place with respect to the impact of exchange rate movements on the Net Asset Value (NAV) of Luxembourg mutual funds expressed in euro: (i) On the liability side of the balance sheet, a depreciation of the euro against a foreign currency mechanically translates into an increase in the NAV of mutual funds issuing shares in this currency. (ii) In addition, exchange rate valuation effects occur on the asset side of the balance sheet, directly, *via* a change in the domestic value of non-euro denominated securities, and indirectly, *via* the currency exposure of the security issuers comprising the portfolio. (iii) Finally, movements in the exchange rate of the euro may also impact the NAV of mutual funds through a transaction effect. Indeed, currency developments may lead investors to reconsider their portfolio allocation between euro- and non euro-denominated shares and assets, thereby affecting the net issuances of mutual funds[1].

The aim of this study is to investigate the impact of the exchange rate on the NAV of Luxembourg equity funds, focusing in particular on the developments observed since the onset of the financial crisis. For this purpose, the dataset compiled by the Banque centrale du Luxembourg (BCL) is used to exploit the detailed information on the currency composition of assets and liabilities and to deliver a statistical decomposition of the exchange rate valuation effect on both sides of the balance sheet. In addition, an econometric analysis relying on the International Capital Asset Pricing Model (ICAPM) is carried out to estimate the sensitivity of the NAV to exchange rate movements, and to provide at the same time a perspective on the recent determinants of the activity of Luxembourg equity funds.

The main findings of the study are the following. (i) Equity funds in Luxembourg are highly internationalized as for the currency composition of their balance sheet, with 54% of non-euro denominated shares on the liability side, and 81% of non-euro denominated securities on the asset side at the end of June 2013. (ii) The econometric analysis reveals that movements in the exchange rate exert a significant impact on the NAV of equity funds expressed in euro. Moreover, this sensitivity increased since the onset of the financial crisis as a consequence of the increased exposure to emerging markets

[1] However, this effect should be fairly limited in the case of an international financial centre like Luxembourg as investors may switch across different subfunds within the same mutual (umbrella) fund issuing and investing in various currencies.

currencies. (iii) Despite this increased sensitivity to the exchange rate, stock market developments remain the most important driver for the activity of Luxembourg equity funds in the medium run. From this point of view, the EUR/USD exchange rate provided a natural hedging against stock market fluctuations during the crisis period, thereby mitigating the aggregate evolution of the NAV expressed in euro and, consequently, the amount of revenues generated by the subscription tax.

This paper is to some extent related to the empirical literature aimed at investigating the role of the exchange rate in the performance of investment funds and/or in the determinants of international portfolio equity flows. The former analysis adopts the microeconomic viewpoint of an asset manager and relies upon the theoretical framework of the ICAPM, thus pertaining to risk-adjusted return considerations in international equity funds (e.g. Detzler, 1999, Benson and Faff, 2003, Schmittmann, 2010). The latter analysis adopts a macroeconomic perspective and is more related to academic topics in international finance, in particular with respect to the portfolio balance model (e.g. Hau and Rey, 2004, 2006), as well as policy-making considerations regarding the drivers of financial integration and the potential destabilizing effects of push-pull factors (e.g. De Santis and Gérard, 2006, Fratzscher, 2011, IMF, 2011, ECB, 2012).

Another strand of the empirical literature investigates the currency composition on both sides of the international balance sheet and analyses the pass-through from exchange rate movements to the foreign financial position of countries, thus also adopting the macroeconomic viewpoint of a policy maker (e.g. Tille, 2003, Lane and Milesi-Ferretti, 2004, and Lane and Shambaugh, 2010). While Tille (2003) provides an accounting decomposition of the exchange rate effect in the evolution of the U.S. international investment position[2], Lane and Milesi-Ferretti (2005) and Lane and Shambaugh (2010) estimate the valuation impact of currency movements on the external adjustment process for a large set of countries. Notwithstanding the different context in which they are developed, these works are very similar to the problematic developed in this paper.

The structure of the paper is the following. To provide some background to the study, the second section presents the main stylized facts regarding the medium term evolution in the NAV of Luxembourg equity funds and the financial market environment that has driven this evolution. This section also investigates the currency composition of the balance sheet of Luxembourg equity funds and its main changes since the onset of the financial crisis. The third section provides an accounting framework from which a statistical decomposition of the contribution of currency movements to the valuation component of the NAV dynamics is extracted. The fourth and fifth section introduce the methodology of the econometric model used to estimate the sensitivity of Luxembourg equity funds to exchange rate movements and discuss the main results of the empirical analysis. Finally, the last section concludes and draws out some related questions for further analysis on this topic.

[2] The same kind of decomposition broken down into financial flows and valuation effects is provided for the euro area in ECB (2012).

2. Luxembourg equity funds: data and stylized facts

Since the adoption of the UCITS Directive in 1988, the size of the investment funds sector has grown rapidly, with Luxembourg becoming a central international platform for the cross-border distribution of shares (Lipper FMI, 2010). By the end of June 2013, 3 890 investment funds divided into 13 558 subfunds and totalizing a NAV of roughly 2 500 billions euro were domiciled in Luxembourg. Among this industry, equity funds, which are defined as investment funds primarily investing in shares and other equity, had assets under management of about 680 billions euro spread over 3 378 subfunds[3].

To provide some perspective to this study, this section briefly introduces some stylized facts regarding the Luxembourg equity funds industry. Overall, the impact of exchange rate movements depends on the currency composition of the balance sheet, and the co-movement between exchange rates and other financial returns (Tille, 2003, Lane and Milesi-Ferretti, 2005). Against this background, the medium term evolution of the NAV is first presented in the context of the main developments that have characterized the stock and foreign exchange markets, emphasizing in particular the financial environment during the crisis period. The balance sheet composition of Luxembourg equity funds is then investigated using the BCL database. Since the end of 2008, a new reporting has been introduced, investment funds being required to report detailed information on their assets and liabilities[4]. This statistical reporting is particularly useful to analyse the balance sheet structure of equity funds broken down by currency of issuance and investment.

2.1 Medium-term evolution of the NAV

Figure 1 relates the evolution of the NAV and the net issuance of shares for the Luxembourg equity funds industry since the end of 2001. The remaining Figures summarize the financial market environment that has driven this evolution. Figures 2 and 3 depict the developments of the main stock market indices and foreign exchange rates[5], while Figure 4 displays the VIX, a proxy for global risk aversion derived from option prices on the S&P 500 index.

[3] The database for the NAV of equity funds has been compiled from the O1.1 reports of the CSSF which are available at a monthly frequency. For the purpose of this study, exchange-traded funds (ETFs), private equity funds and funds of funds have been retrieved from the sample. This restricted subset of equity funds has been retained as a reference base to extract the subsequent data presented in this paper. Most of the funds concerned by the analysis have an umbrella-type, open-ended structure and are UCITS compliant. Summary information and statistics on Luxembourg equity funds are displayed in the Appendix.

[4] See e.g. ECB (2010), and Godfrey et al. (2010) for a detailed presentation of this reporting and its analytical interest.

[5] Figure 3 depicts the nominal effective exchange rate of the euro against 20 trading partners of the euro area and the bilateral nominal exchange rates of the euro against the US Dollar and the Japanese Yen. Given that exchange rates are quoted in terms of the units of foreign currency per euro, a rising index corresponds to an appreciation of the euro.

Figure 1: Net asset value and net issuance of shares (billions euro, Source: CSSF, BCL)

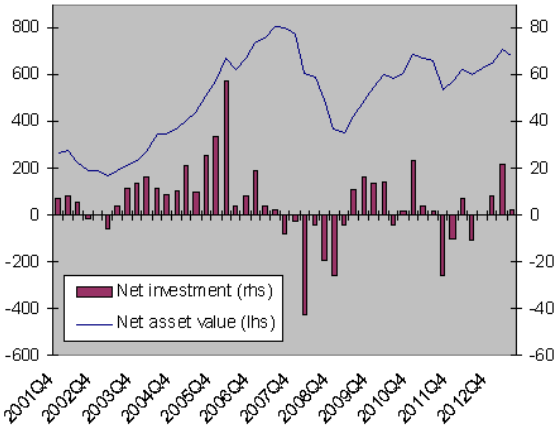


Figure 2: Major stock market indices (Dec. 2001 = 100, Source: Bloomberg)

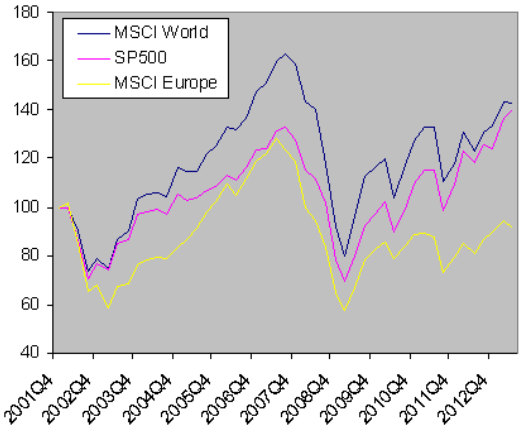


Figure 3: Evolution of the euro exchange rate (Dec. 2001 = 100, Source: ECB)

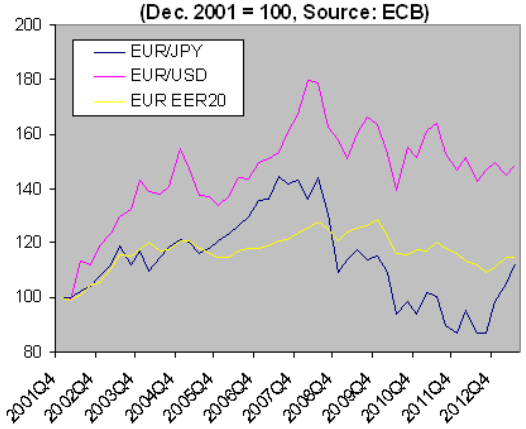
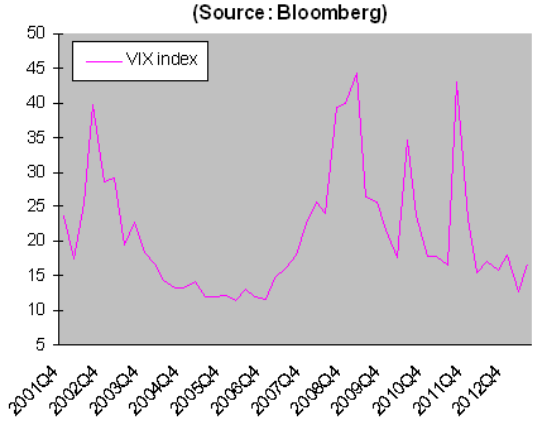


Figure 4: Risk aversion (Source: Bloomberg)



Overall, the co-movement between stock market indices and the NAV of equity funds is very striking during the whole period under review. The favourable developments in the stock markets between 2003 and 2007 largely contributed to the increased activity of equity funds, both from the point of view of valuation effects and net positive inflows. At the same time, the exchange rate of the euro evolved along a rising trend which, accordingly, negatively impacted the NAV of equity funds.

After the turning point in Summer 2007, which is associated to the onset of the financial crisis, the NAV of Luxembourg equity funds started to decline, along with the fall of stock market indices. Equity funds have been particularly affected by the financial crisis which led to an environment of growing uncertainty and risk aversion and, correspondingly, to a flight-to-safety behaviour favourable to government bonds. As a matter of fact, the reduction in the NAV accelerated during the year 2008 in the context of sizeable redemptions reflecting investor's concerns regarding the intensification of the tensions in the financial system.

After reaching a trough in March 2009, the NAV of equity funds recovered and engaged into a rising trend against the background of an improvement in financial conditions and the real economy. However, this dynamics came to a halt with the euro area sovereign debt crisis, which became a driving force in the evolution of stock markets from Spring 2010. Rising hopes about an improvement in the macroeconomic environment and unconventional monetary policy measures of the central banks, in particular the introduction of the Outright Monetary Transaction (OMT) programme by the ECB in September 2012, which significantly reduced the tail risk for the euro area, finally provided a stimulus to the development of equity funds, with investors searching for yield in a low interest rate environment. The NAV of Luxembourg equity funds thereby recovered until May 2013, with about 30 billions euro of net positive inflows registered during the first months of the year, before the Federal Reserve created market uncertainty by hinting a possible slowdown in Quantitative Easing.

During the crisis period, exchange rate developments provided an overall support to the NAV evolution of Luxembourg equity funds, the euro being characterized by a slightly depreciating trend against other major currencies. However, and more specifically, the market regime became clearly dominated by a risk-on risk-off asset allocation environment which materialized into an increased positive co-movement between the stock market and the euro exchange rate. Figures 5 and 6, which display the correlation coefficient of the euro against the world MSCI and the VIX over a 5-year rolling window, clearly illustrate the transition to such a regime.

Figure 5: 5-year correlation between the euro exchange rate and the world MSCI

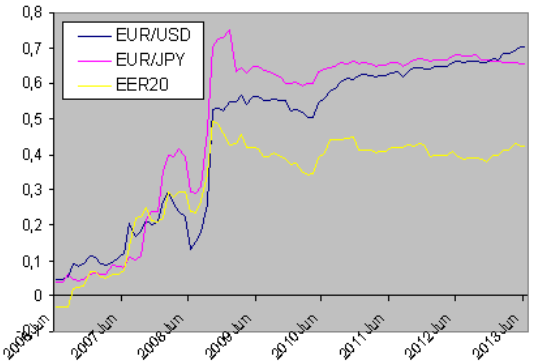
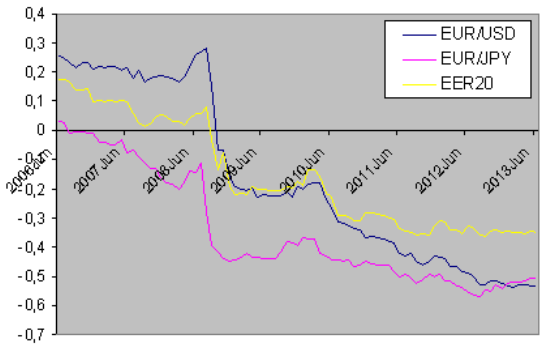


Figure 6: 5-year correlation between the euro exchange rate and the VIX



Source: Bloomberg, ECB, Authors' calculations

The risk-on risk-off asset allocation environment prevailing during the crisis period has important implications for the analysis of the exchange rate impact. Indeed, within such a market regime, movements in the exchange rate of the euro provide a natural hedging against stock market fluctuations for the Luxembourg equity funds industry as a whole, by mitigating valuation and transaction effects arising from stock prices developments. The underlying explanation of this phenomenon is the following.

In this environment, an increase (decrease) in the VIX, the proxy used to identify the relevant risk-on risk-off episodes, translates into both a fall (rise) of stock prices and a depreciation (appreciation) of the euro against safe-haven currencies, including the US dollar (USD) and the Japanese Yen (JPY). Indeed, in a market regime dominated by risk aversion and macroeconomic uncertainty, risk-off episodes, such as the ones associated with the spikes in the VIX corresponding to the Lehman failure and the intensification of the euro area sovereign debt crisis, are accompanied by a sell-off in existing risky positions, including a reversal of carry trade operations and a shift out of equities to high-quality liquid assets, principally US and Japanese bonds (JP Morgan, 2011). This situation generates a decrease in the NAV of equity funds driven by both net redemptions of shares and the fall of stock prices. At the same time, these behaviours result into a net buying of USD and JPY, thereby leading to their appreciation against the common currency, which in turn tends to offset the initial decline in the activity of Luxembourg equity funds, the latter being ultimately expressed in euro. At the opposite, when risk is perceived as low (*risk-on episodes*), investors tend to engage in higher-risk investments and into carry-trade activities, which translates into a rise of equity markets and a simultaneous depreciation of safe haven currencies against the currencies of other developed and emerging markets. In this case, the positive impact of valuation and transaction effects arising from stock market developments is mitigated by the appreciation of the euro, which hence exerts a dampening effect on the NAV evolution of Luxembourg equity funds.

This natural hedging effect of the exchange rate on the aggregate NAV of Luxembourg equity funds will be further emphasized in the empirical part of this work. Before turning to this analysis, some stylized facts regarding the balance sheet composition of Luxembourg equity funds are first presented to complete the descriptive background of the study.

2.2 The aggregate balance sheet

Table 1 presents the main items of the aggregate balance sheet of Luxembourg equity funds and its evolution since the end of 2008. The following information is worth taking into account.

(i) As expected, equity funds mostly invest in shares and other equity, which constitute the bulk of their asset portfolio. At the end of June 2013, this category amounted for 616.1 billions euro over a total asset of 714.7 billions euro. Investment funds shares /units, including MMF shares/units, and securities other than shares stood respectively at 19.0 and 17.6 billions euro. The remaining of the assets was made up of deposits and loan claims, financial derivatives and other non-financial assets. On the liability side, shares issued accounted for 95.2% of total liabilities, with the residual items including loans and deposits received, financial derivatives and other non-financial liabilities.

Table 1: Aggregate balance sheet of Luxembourg equity funds
(Outstanding amounts at the end of the period, billions euro)

	2008Q4	2009Q4	2010Q4	2011Q4	2012Q4	2013Q2
Assets						
Deposits and loan claims	20.3	21.0	29.1	28.3	28.1	31.8
Securities other than shares	12.8	13.6	15.2	18.9	18.5	17.6
Shares and other equity	325.6	496.2	626.9	514.0	586.6	616.1
Issued by euro area residents	83.8	116.2	119.2	93.9	110.2	120.7
Issued by non-euro area residents	241.8	380.0	507.7	420.1	476.3	495.4
Investment funds shares/units (including MMF shares)	6.6	10.8	15.6	14.8	18.0	19.0
Other assets	13.3	12.6	11.3	11.3	11.0	16.9
Financial derivatives	10.3	11.7	12.6	10.1	10.6	13.3
Liabilities						
Loans and deposits received	2.9	2.6	3.3	5.5	5.3	6.3
Investment funds shares/units issued	367.9	544.6	688.5	571.9	649.1	680.5
Other liabilities	9.8	11.1	10.2	12.2	11.2	17.4
Financial derivatives	8.2	7.7	8.6	7.8	7.2	10.5
Total Assets/liabilities	388.8	566.0	710.6	597.5	672.8	714.7

Source: BCL

(ii) Equity funds in Luxembourg are highly internationalized, with a share of non-euro area assets reaching more than 80% of the portfolio of shares and other equity at the end of June 2013. Overall, during the period under review, the proportion of shares and other equity issued by non-euro area residents has significantly increased, reflecting in particular a portfolio shift toward emerging countries as well as important valuation effects on this class of assets. This major change in the portfolio composition of equity funds since the onset of the financial crisis has important implications for our problematic, given that it may imply a higher sensitivity of the NAV to exchange rate movements *via* the asset side of the balance sheet.

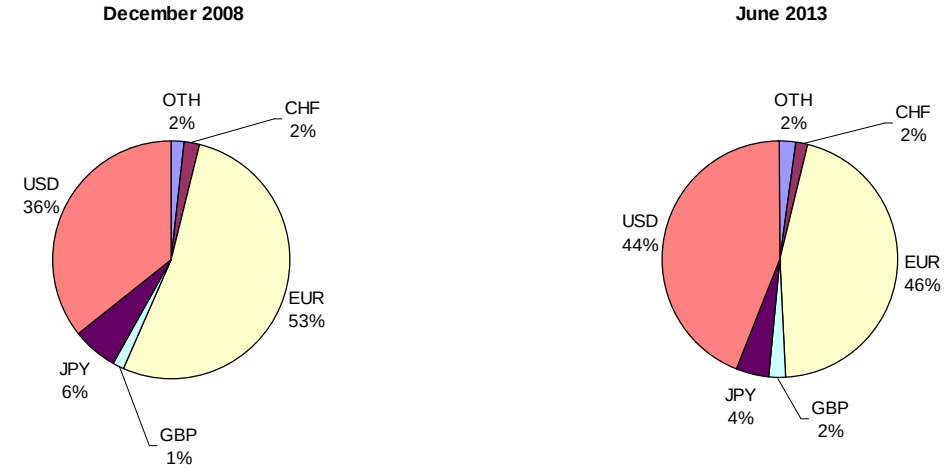
(iii) Finally, the amount of financial derivatives, which primarily include forwards and futures contracts aimed at hedging foreign currency risk, is quite low in comparison with the size of the foreign assets portfolio. This finding confirms the existing literature which suggests that foreign exchange risk in international equity portfolio is mostly unhedged[6] (e.g. Solnik, 1991, Hau and Rey, 2006). However, given that the current reporting does not provide enough detailed information on the composition of financial derivatives, net positions may be reported for some subfunds, thus biasing downward the true currency hedge ratio.

[6] Some of the results obtained in the literature indicate that currency management of a global equity portfolio only provides very modest risk-reduction benefits (Labarge, 2010). Several justifications have been put forward to support these results: (a) a diversified portfolio in different currencies already provides a natural hedging against foreign exchange risk, (b) a long-term position on a foreign investment should be naturally hedged given that exchange rates usually follow a mean reverting process, (c) market incompleteness affect the cost/benefit of taking positions in currency derivatives.

2.3 The currency composition of assets and liabilities

Figures 7 and 8 display the currency composition of the asset portfolio and shares issued by Luxembourg equity funds[7]. The high level of currency diversification of the balance sheet is very striking, with 54% of non-euro denominated shares on the liability side, and 81% of non-euro denominated securities on the asset side at the end of June 2013. In addition, it clearly appears that the importance of the euro (and, to a lesser extent, the Japanese Yen) has significantly decreased over the period under review. On the liability side, this movement took place against an increase in the proportion of shares issued in USD (from 36% to 44%). On the asset side, the share of securities denominated in emerging market currencies and in US dollar has substantially increased (respectively from 22% to 28% and from 29% to 33%).

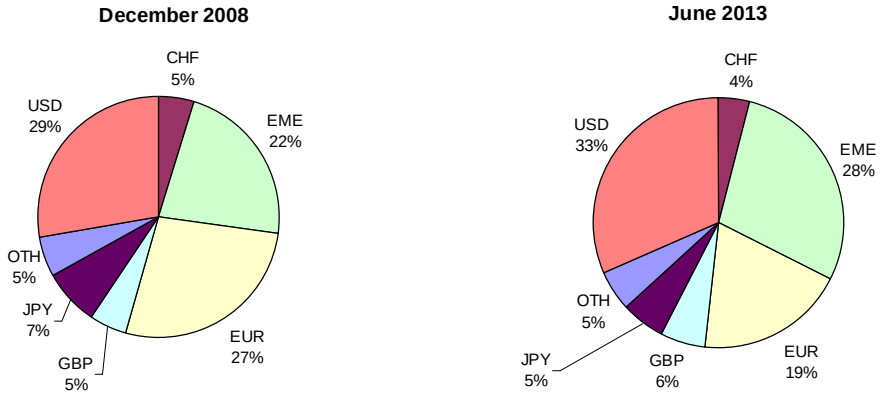
Figure 7: Net asset value broken down by currency of issuance



Source: BCL

[7] EUR, USD, JPY, CHF, GBP, EME and OTH respectively stand for the euro, the US dollar, the Japanese Yen, the Swiss Franc, the Pound Sterling, the emerging markets currencies and the other currencies. The list of emerging countries comprises countries included in the MSCI emerging markets index (as of June 2013), plus Hong-Kong and Singapour.

Figure 8: Asset portfolio broken down by currency of investment[8]



Source: BCL

To complete the picture, the following Table displays a matrix with the currency composition of the asset portfolio for the main issuing currencies[9]. Overall, equity funds issuing shares in USD invest the bulk of their money into assets denominated in emerging markets currencies (EME) and, to a lesser extent, in USD (respectively 44.3% and 41.1% at the end of June 2013). Shares issued in euro are mostly invested in assets denominated in euro (38.0% at the end of June 2013) but display a higher currency diversification of their corresponding asset portfolio, with the respective proportion of assets denominated in USD, in emerging markets currencies, in GBP and in CHF being respectively at 23.7%, 13.8%, 8.8% and 5.8% at the end of June 2013. Finally, shares issued in Japanese Yen are mainly invested in assets denominated in JPY, in emerging market currencies and in USD (respectively 52.6%, 21.5% and 16.4% of the asset portfolio at the end of June 2013).

[8] The detailed currency composition of the asset portfolio of Luxembourg equity funds is displayed in the Appendix.

[9] Given that some subfunds issue shares in several currencies, the currency composition of the asset portfolio broken down by currency of issuance has been proxied, by applying the proportion of shares issued for each currency to the whole asset portfolio.

Table 2: Currency composition of the asset portfolio broken down by currency of issuance (%)

CURRENCY OF ISSUANCE	200812	CURRENCY OF INVESTMENT							Total amount issued
		EUR	USD	JPY	CHF	GBP	OTH	EME	(billions euro)
	EUR	46.4	21.5	4.5	6.1	6.4	4.2	10.9	*192.0*
	USD	5.5	38.9	3.3	1.4	2.2	5.6	43.1	*133.6*
	JPY	17.1	18.6	50.3	0.9	6.8	1.8	4.5	*23.6*
	CHF	16.3	22.6	7.1	44.2	3.3	3.0	3.5	*7.7*
	GBP	11.9	33.4	6.6	2.9	26.4	3.1	15.7	*5.2*
	OTH	12.5	6.7	21.4	1.5	1.5	39.3	17.1	*5.7*
	Total amount invested (billions euro)	*94.4*	*96.1*	*25.7*	*16.1*	*17.5*	*17.7*	*77.3*	

CURRENCY OF ISSUANCE	201306	CURRENCY OF INVESTMENT							Total amount issued
		EUR	USD	JPY	CHF	GBP	OTH	EME	(billions euro)
	EUR	38.0	23.7	4.0	5.8	8.8	5.9	13.8	*307.3*
	USD	3.8	41.1	2.1	1.4	2.9	4.5	44.3	*301.3*
	JPY	5.4	16.4	52.6	0.2	1.3	2.6	21.5	*30.2*
	CHF	15.8	25.5	4.6	39.0	3.1	3.3	8.6	*11.7*
	GBP	13.0	37.8	5.0	4.0	18.2	4.3	17.8	*15.2*
	OTH	10.0	22.8	9.5	1.2	2.1	25.0	29.4	*14.8*
	Total amount invested (billions euro)	*126.2*	*206.2*	*35.0*	*26.4*	*38.1*	*35.8*	*185*	

Source: BCL

Overall, the currency home bias is quite obvious in the asset portfolio of equity funds, with shares issued in a given currency being relatively more invested in the same currency, except for the GBP which is relatively more invested in USD. In addition, during the period under review, and independently of the currency of issuance, shares issued by Luxembourg equity funds have increasingly been invested in assets denominated in emerging market currencies. This change in the currency composition of the asset portfolio has important consequences for the sensitivity of Luxembourg equity funds to exchange rate movements, given that the increased emerging countries exposure implies a higher currency mismatch in the balance sheet.

This section described the financial market environment surrounding the NAV evolution of Luxembourg equity funds and provided some stylized facts regarding the currency composition of their balance sheet. Against this background, the next sections empirically investigate the influence of the exchange rate on the NAV dynamics using both a statistical and an econometric approach.

3. Statistical decomposition of the exchange rate valuation effect

The aim of this section is to provide an accounting decomposition of the NAV evolution of Luxembourg equity funds, in order to quantify the exchange rate valuation effect and to identify the contribution of each currency on both the asset side and the liability side of the balance sheet.

3.1 The conceptual framework

From an accounting point of view, the change in the NAV between period t-1 and t can be written as:

$$(1) \qquad NAV_t - NAV_{t-1} = TRA_t + VAL_t,$$

where TRA_t corresponds to the net issuance of shares (i.e. transactions), and VAL_t to the revaluation of existing shares.

In turn, this identity can be rewritten as:

$$(2) \qquad NAV_t - NAV_{t-1} = TRA_t + VAL^P_t + VAL^{FX}_t,$$

where VAL^P_t corresponds to the component of revaluation that relates to a shift in share prices (i.e. the price valuation effect), and VAL^{FX}_t to the component of revaluation that relates to currency movements (i.e. the exchange rate valuation effect).

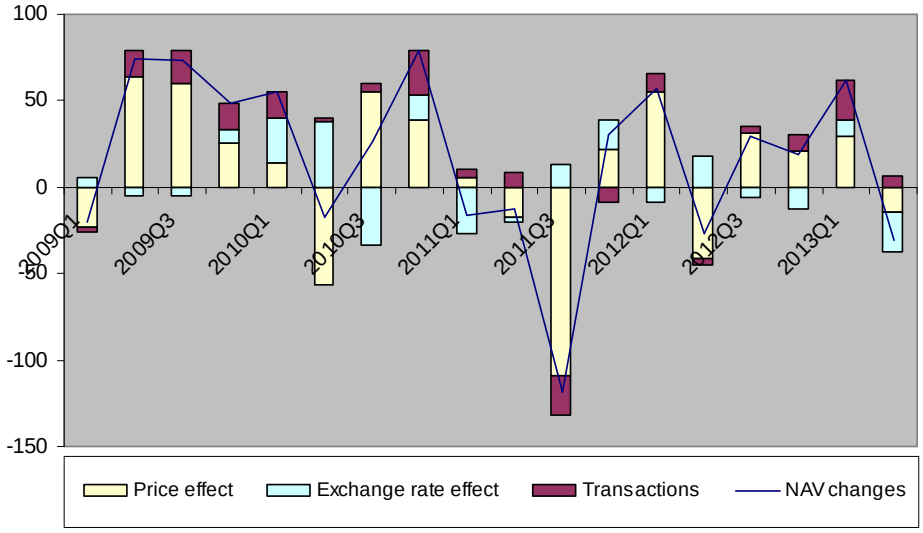
Since the end of 2008, the statistical reporting of the BCL allows for a decomposition of the NAV evolution between net transactions, price valuation effects and exchange rate valuation effects. However, the available measure of the latter is only based on the liability side of the balance sheet. As such, it does not reveal the complete contribution of the exchange rate valuation channel, since it does not take into account the impact of the exchange rate on the value of the asset portfolio. This makes it difficult to determine with precision the size of the exchange rate effect given that part of it is included in the price effect on the liability side of the balance sheet. To overcome this problem, the exchange rate effect has been proxied for the asset portfolio of equity funds and added to the exchange rate effect extracted from the NAV evolution[10].

[10] The following methodology has been applied to proxy the exchange rate effect on the asset side of the balance sheet. The price effect on the liability side has been decomposed into a price effect and an exchange rate effect on the asset side, the latter corresponding to the exchange rate effect between the currency of issuance and the currency of investment. Once extracted from the Security-by-Security database, this exchange rate effect on the asset side has been added to the exchange rate effect on the liability side to obtain the total exchange rate effect.

3.2 Main results

To get a general idea of the importance played by the exchange rate, the following graph displays the decomposition in the NAV evolution of equity funds between transactions and valuation effects, the latter being itself decomposed into a price effect corresponding to the capital gains and losses on the existing portfolio, and an exchange rate effect including both the asset side and the liability side of the balance sheet.

Figure 9: Decomposition in the NAV evolution (billions euro)



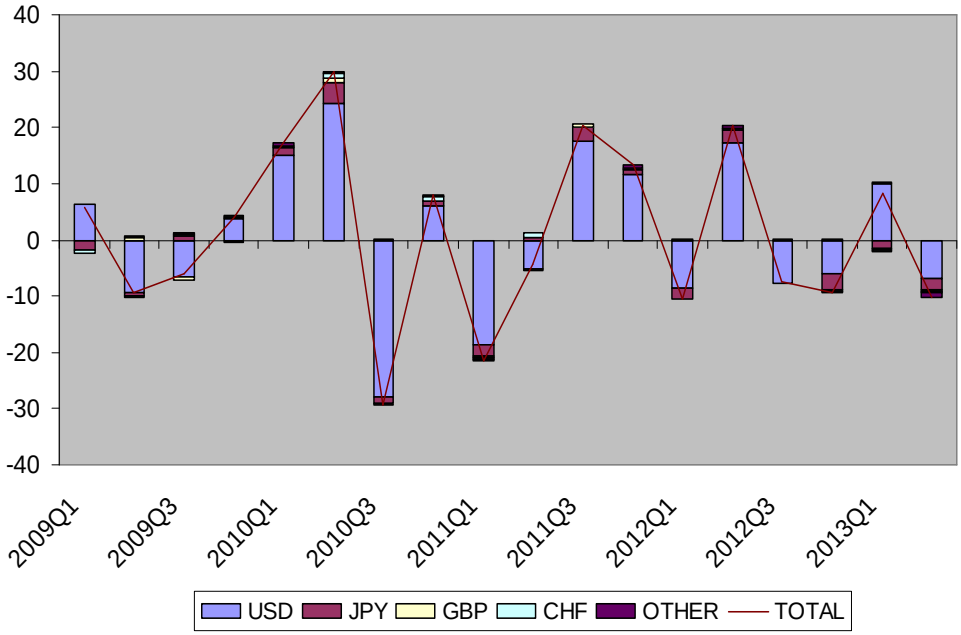
Source: BCL

Overall, the price effect played a predominant role in the NAV evolution over the period under review, with more than half of the 312.6 billions euro increase recorded being explained by stock market developments. From an accounting point of view, movements in the exchange rate of the euro have only contributed to about 10% of the NAV increase since 2009. However, this modest contribution reflects the absence of a significant trend in the depreciation of the euro, thus concealing the importance of exchange rate movements for short-run developments in the NAV. Indeed, in absolute terms, the relative contribution of the exchange rate valuation effect amounted to almost 25% of the NAV fluctuations during the crisis period. In addition, exchange rate movements appear to have provided a natural hedging against stock market developments, by mitigating the impact of the price and the transaction effects on the activity of Luxembourg equity funds.

To complete the picture, the exchange rate effect on the liability side of the balance sheet is broken down by currency of issuance. As implied by Figure 10, the EUR/USD and, to a lesser extent, the EUR/YEN exchange rates appear to be the main drivers of the exchange rate effect on the liability side, with an absolute contribution to the latter reaching respectively 83% and 11%. It is also worth noting that, for almost every period,

the exchange rate effect of the different currencies has the same sign, thereby reflecting the positive market correlation across the currencies used for the issuance of shares.

Figure 10: Decomposition of the exchange rate effect broken down by currency of issuance (billions euro)

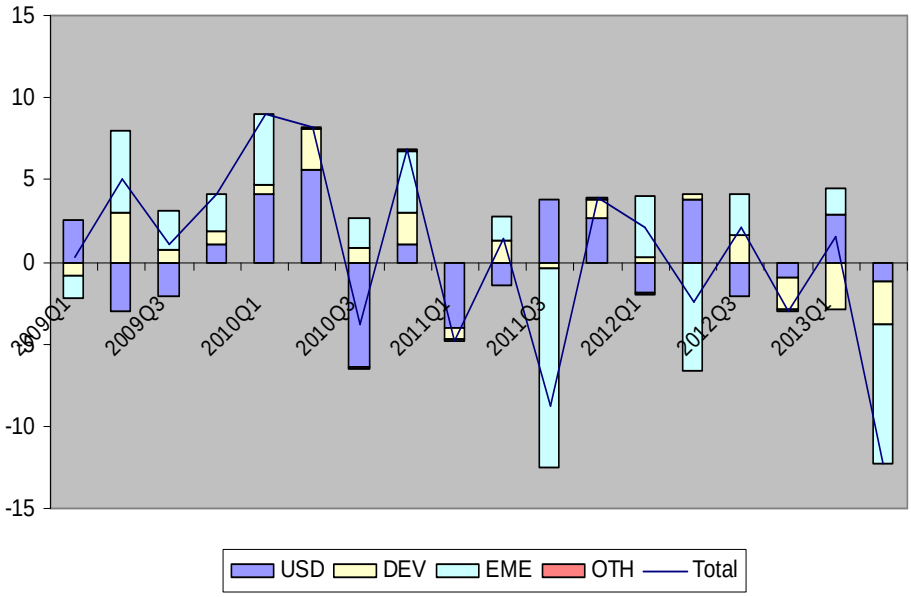


Source: BCL

In the same perspective, the exchange rate effect broken down by currency of investment is displayed in Figure 11[11]. The exchange rate valuation effect appears to be more muted on the asset side, reflecting the currency diversification of the portfolio of Luxembourg equity funds, as well as the existing currency home bias reported in the balance sheets. Over the period under review, exchange rate valuation effects on USD- and EME-denominated securities clearly appear to have most significantly contributed to the NAV fluctuations on the asset side of the balance sheet, with a respective contribution to the latter reaching about 38% and 41% in absolute terms.

[11] DEV includes the CHF, GBP, JPY, CAD, AUD, DKK, ILS, NOK, NZD, SEK and the EUR. The contribution of the euro reflects the exchange rate impact of euro-denominated assets corresponding to shares issued in a foreign currency. However, this impact should disappear for the overall exchange rate effect given that this exchange rate effect on the asset side should be fully offset by the opposite exchange rate effect on the liability side.

Figure 11: Decomposition of the exchange rate effect broken dow by currency of investment (billions euro)



Source: BCL

The above decomposition provides a good indication regarding the importance of currency movements for the NAV evolution, in particular with respect to the EUR/USD exchange rate. However, this statistical evaluation of the exchange rate effect is based on a purely accounting approach and as such, it does not take into account changes in the value of the firms comprising the asset portfolio as well as potential rebalancing effects arising from currency movements. The estimation of a model may thus provide a better approximation of the exchange rate effect, delivering at the same time a framework for analysing the NAV dynamics of Luxembourg equity funds.

4. Presentation of the empirical model

The empirical model used to analyse the impact of the exchange rate on the NAV of Luxembourg equity funds directly relates to the International Capital Asset Pricing Model (ICAPM). The ICAPM extends the domestic CAPM to an international context, with the world market portfolio replacing the domestic market portfolio, and the exchange rate risk being added in the specification.

The ICAPM-based regression is adapted to the context of the present study. Rather than using the stock return of a specific firm or the performance of a specific investment fund, the NAV of Luxembourg equity funds is used as the dependent variable in the estimate. As a consequence, additional explanatory variables are included to the baseline ICAPM in order to take into account the transaction effect embedded in the NAV evolution.

4.1 The structure of the econometric model

The baseline model used for the regression analysis is the following:

(3) $$nav_t = \alpha + \beta x_t + \varepsilon_t$$

where nav_t represents the aggregate NAV of Luxembourg equity funds, x is a vector of explanatory variables including the world AC MSCI, the EUR/USD exchange rate, the EME/USD exchange rate and the VIX, β is a vector comprising the sensitivity coefficients to risk factors, and ε_t is an i.i.d. disturbance error term. All the variables included in the model are expressed in first log-difference.

The model is first estimated with a standard OLS regression using aggregate monthly data covering the sample 2001:7 to 2013:6. The same model is then estimated on two sub-samples, namely 2001:7 to 2007:12 and 2009:1 to 2013:6, to check for a structural change in the sensitivity of Luxembourg equity funds to the different risk factors during the crisis period.

In addition, to exploit the rich structure of the dataset compiled by the BCL and to increase the degrees of freedom of the regression, a fixed-effect model is estimated using a balanced panel dataset of monthly investment funds level data over the period 2009:1 to 2013:6. Small funds with less than 100 millions euro of assets under management are excluded from the sample retained for the analysis. Moreover, in order to have a stable sample of subfunds with a continuous reporting, the analysis is limited to the crisis period.

The fixed-effect model used for the regression analysis is the following:

(4) $$nav_{it} = \alpha + \beta x_{it} + \mu_i + \varepsilon_{it}$$

where nav_i represents the first log-difference of the net asset value of subfund i, and x contains the abovementioned vector of explanatory variables. μ_i is an unobservable investment funds-specific effect and ε_{it} is an idiosyncratic disturbance term. All the regressions include fixed effects to account for any investment funds-specific factors not identified by the other explanatory variables (e.g. the managerial skills). Thus, the fixed-effects model allows the intercept term in the regression model to differ across entities but not over time, while all of the slope estimates are fixed both cross-sectionally and over time.

4.2 The explanatory variables

The vector of explanatory variables includes the following macroeconomic time series: (i) the MSCI all country world, to proxy the market risk, (ii) the nominal EUR/USD and EME/USD exchange rates, to proxy the exchange rate risk, and (iii) the VIX, to proxy the risk aversion of investors[12].

In order to determine the most appropriate stock market index, a number of alternatives have been considered to reflect the international portfolio diversification of Luxembourg equity funds. Given that it is representative of a diverse number of countries, the *Morgan Stanley Capital International all country world index* (MSCI AC world) for end-of-month prices expressed in local currency provides a natural benchmark for this analysis. This market capitalisation weighted index including both developed and emerging markets is consequently used to proxy the market risk of Luxembourg equity funds.

Similarly, the exchange rate exposure of the NAV should be assessed against an exchange rate index that is representative of the currency composition of the balance sheet of Luxembourg equity funds. From this point of view, the effective exchange rate of the euro is not appropriate given that it is a weighted measure of the change in the value of the euro taking into account a basket of currencies of the euro area trading partners. Rather than creating a composite exchange rate as in Lane and Milesi-Ferretti (2005), the following exchange rates have been retained in the parsimonious model. Given their predominant share on both the asset side and the liability side of the balance sheet, the nominal EUR/USD and EME/USD exchange rates at the end of each month are used in the regression to proxy the exchange rate risk of Luxembourg equity funds[13].

Finally, the VIX index, which is derived from option prices on the S&P 500, is used as a proxy for global risk aversion. This measure of expected future stock market volatility is included in the model in order to take into account the transaction component in the NAV evolution, beyond the impact of stock market and exchange rate movements on the flows to and from equity funds. According to the existing literature aimed at investigating the determinants of portfolio flows (e.g. De Santis and Gérard, 2006, Fratzscher, 2011, IMF, 2011, ECB, 2012), additional explanatory variables have been included in the model such as the volatility of the exchange rate, the world inflation rate, the world industrial production growth or the term structure of interest rates. However, these variables were not statistically significant and have been dropped from the analysis to get a parsimonious model.

[12] All the data come from Bloomberg, except the NAV which is produced internally using the O1.1 reports of the CSSF. Summary statistics of the variables are presented in the Appendix.

[13] A positive EUR/USD exchange rate return corresponds to an appreciation of the euro relative to the US dollar, while a positive EME/USD exchange rate return corresponds to an appreciation of the emerging markets composite exchange rate relative to the US dollar. The EME/USD composite exchange rate is computed by using the weighted market capitalisation of the countries included in the MSCI emerging markets index (as for June 2013), plus Hong-Kong and Singapore.

5. Results from the empirical analysis

5.1 Main results

The main results of the regression analysis are provided in the following Table. Robust (HAC) standard errors are reported in parenthesis below the coefficients. All regressions include a constant term whose estimates are not reported. A dummy has been introduced for the month 2004:4 to control for a statistical outlier in the NAV series, and for the months 2010:6 and 2011:11 which correspond respectively to the onset and the intensification of the euro area sovereign debt crisis.

Table 3: Main results of the regression analysis

	OLS (2001:7-2013:6)	OLS (2001:7-2007:12)	OLS (2009:1-2013:6)	Fixed-effect model (2009:1-2013:6)
MSCI AC World	1.079***	1.069***	0.941***	0.972***
	(0.066)	(0.082)	(0.063)	(0.021)
EUR/USD	-0.718***	-0.751***	-0.749***	-0.805***
	(0.047)	(0.075)	(0.053)	(0.026)
EME/USD	0.737***	0.740***	0.891***	1.077***
	(0.132)	(0.174)	(0.152)	(0.060)
VIX	-0.032***	-0.034***	-0.038***	-0.020***
	(0.005)	(0.009)	(0.009)	(0.003)
Nb of Obs.	143	77	54	49 184
Adj. R squared	0.91	0.92	0.94	0.15

*** indicates statistical significance at the 1% confidence level

The following results are worth mentioning:

(i) The standard OLS model accounts for more than 90% of the NAV fluctuations of Luxembourg equity funds during the whole period. In addition, all the coefficients have the expected sign and are statistically significant at the 1% level. Overall, the results obtained for the crisis period are robust to panel data techniques, but the associated standard deviations of the estimated coefficients are lower.

(ii) According to the results obtained from the baseline regression, a 1% increase in the MSCI all country world translates into a 1.1% rise in the NAV of Luxembourg equity funds. The sensitivity of the activity to exchange rate movements is quite elevated, thereby reflecting the high level of currency diversification on both the asset side and the liability side of the balance sheet. More specifically, a 1% increase in the EUR/USD

exchange rate is associated with a -0.72% change in the NAV, while a 1% increase in the EME/USD exchange rate is associated with a +0.74% change in the NAV.

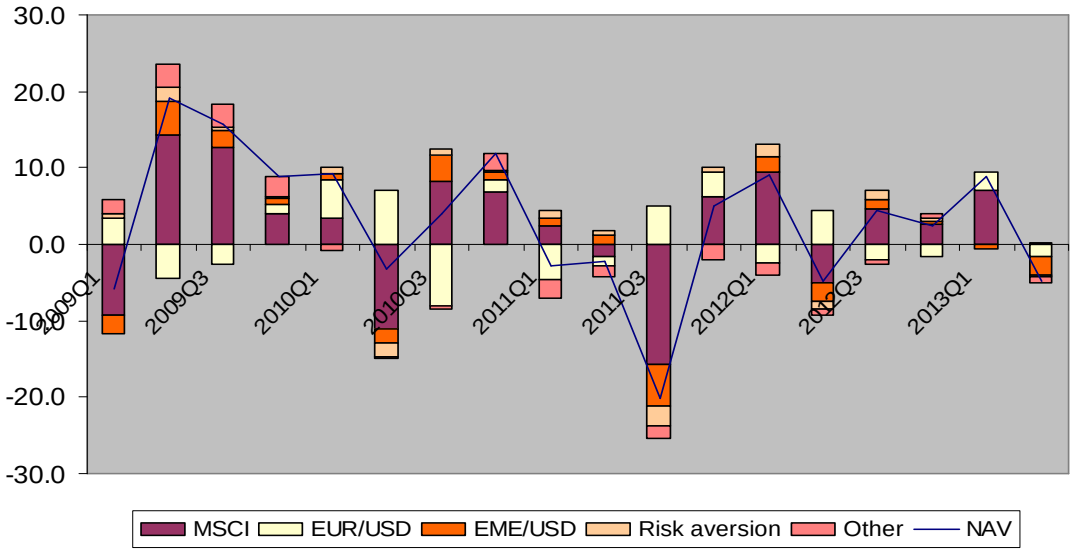
(iii) Overall, the change in the portfolio composition of the balance sheet delivered a higher sensitivity of the NAV to the EME/USD exchange rate during the crisis period, with the associated coefficient rising from 0.74% to 0.89% across the two subperiods used for the regression. In the same vein, the econometric results suggest a lower sensitivity of the NAV to the MSCI all country world. This result is relatively intuitive against the background of an increased exposure to emerging countries, the importance of the latter being relatively low in this market capitalisation weighted index[14].

(iv) Finally, the VIX is statistically significant during both the pre-crisis and the crisis period, while the estimated OLS coefficient becomes slightly higher after 2009, thereby illustrating the increased risk aversion of investors during the crisis period. This result confirms the relevance of the risk-on risk-off analytical framework and the importance of the VIX for taking into account the transaction component in the NAV evolution of Luxembourg equity funds.

5.2 Historical decomposition

The contribution of each factor to the quarterly evolution of the NAV of Luxembourg equity funds since the beginning of the crisis is displayed in the following Figure, using the results obtained from the regression model. The contribution of each factor is computed by multiplying the value of the factor by the estimated β coefficient for each month and then cumulating over the reference quarter.

Figure 12: Factor contribution to the NAV evolution of Luxembourg equity funds (%)



[14] At the end of 2012, emerging markets weighted for only 13% of the MSCI all country world index.

Overall, during the period under review, stock market fluctuations have played a dominant role in the NAV evolution. In comparison, risk aversion seems to have exerted a more limited impact, reflecting important movements in the VIX, such as the ones registered during the quarters associated with the onset and the intensification of the sovereign debt crisis (2010Q2 and 2011Q3). As a matter of fact, these risk-off episodes translated into significant net outflows from Luxembourg equity funds. Fluctuations in the exchange rate of the euro have also exerted a non-negligible impact on the activity of Luxembourg equity funds. More specifically, the evolution of the emerging market currencies has globally accentuated the effects of the stock market on the NAV evolution, while the contribution of the EUR/USD exchange rate has generally been of the opposite sign, thereby mirroring the positive correlation between the world market index and the exchange rate of the euro against the dollar observed during the crisis period. This compensation effect illustrates the natural hedging role played by the EUR/USD exchange rate against stock market fluctuations for the Luxembourg equity funds industry as a whole.

6. Conclusion

To conclude, the analysis developed in this paper suggests an elevated sensitivity of the NAV of Luxembourg equity funds to exchange rate movements. This elevated sensitivity reflects the international currency composition on both the asset side and the liability side of the balance sheet.

The impact of the exchange rate has been investigated using both a statistical and an econometric approach. In particular, a parsimonious regression model including the MSCI all country world, the EUR/USD exchange rate, the EME/USD exchange rate and the VIX proved to deliver a good empirical framework for analysing the NAV dynamics of Luxembourg equity funds. The results obtained from this empirical estimate indicate that the sensitivity of the NAV to movements in emerging markets currencies has increased since the beginning of the crisis, reflecting the portfolio movements observed during this period. At the same time, and more importantly, movements in the EUR/USD exchange rate have provided a natural hedging effect against stock market developments, thus limiting the fluctuations in the aggregate NAV of Luxembourg equity funds expressed in euro.

Overall, the impact of exchange rate movements depends on the currency composition on both sides of the balance sheet, and the co-movement between exchange rates and other financial returns. From this point of view, the impact of the exchange rate on the NAV of Luxembourg equity funds is expected to change in the forthcoming future with the transition to a new market regime characterised by a changing correlation between the EUR/USD and the stock market, and an already engaged retrenchment of investors from emerging countries, arising in particular from the tapering of the Federal Reserve's Quantitative Easing programme. Against this background, the estimate of a time varying model based on the Kalman filter might represent a natural extension of this work.

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Appendix 1: Descriptive data on Luxembourg equity funds

Number of subfunds	*Aggregate NAV (billions euro)*	*Mean*	*Standard deviation*	*Market share of the 5% largest subfunds (%)*
3378	680.6	0.2	0.6	44.7

Breakdown of the NAV by structure (billions euro)		*Breakdown of the NAV by legal framework (billions euro)*		
Open-end funds	Closed-end funds	Part 1	Part 2	SIF
680.2	0.4	609.5	24.9	46.2

Source: BCL, CSSF

Appendix 2: Currency composition of the asset portfolio of Luxembourg equity funds (June 2013, billions euro)

Currency of investment	Currency Code	Outstanding amount	Currency of investment	Currency Code	Outstanding amount
US Dollar	USD	206.2	Norwegian Krone	NOK	2.6
Euro	EUR	126.2	Zloty	PLN	2.0
Pound Sterling	GBP	38.1	Chilean Peso	CLP	1.7
Yen	JPY	35.0	Naira	NGN	1.2
Hong Kong Dollar	HKD	28.5	Pakistan Rupee	PKR	0.8
Switzerland Franc	CHF	26.4	Forint	HUF	0.8
Brazilian Real	BRL	20.5	New Israeli Shekel	ILS	0.7
Indian Rupee	INR	18.9	Colombian Peso	COP	0.6
Yuan Renminbi	CNY	18.5	Qatari Rial	QAR	0.6
Won	KRW	15.4	Nuevo Sol	PEN	0.4
New Taiwan Dollar	TWD	12.3	UAE Dirham	AED	0.5
Russian Ruble	RUB	11.2	Czech Koruna	CZK	0.5
Baht	THB	11.1	Kenyan Shilling	KES	0.4
Canadian Dollar	CAD	8.9	Sri Lanka Rupee	LKR	0.4
Rupiah	IDR	8.1	Egyptian Pound	EGP	0.3
Swedish Krona	SEK	7.6	New Romanian Leu	RON	0.3
Mexican Peso	MXN	7.4	Tenge	KZT	0.2
Australian Dollar	AUD	7.0	Kina	PGK	0.2
Singapore Dollar	SGD	7.0	New Zealand Dollar	NZD	0.1
Rand	ZAR	6.1	Kuwaiti Dinar	KWD	0.1
Malaysian Ringgit	MYR	5.6	Dong	VND	0.1
Danish Krone	DKK	4.4	Argentine Peso	ARS	0.1
Turkish Lira	TRY	4.3	Other Currencies		0.7
Philippine Peso	PHP	2.7			

Source: BCL

Appendix 3: Presentation of the variables used in the econometric model

Summary statistics (2001:7 - 2013:6)

	Mean	Standard error	Minimum	Maximum
Net Asset Value	0.0062	0.0578	-0.1898	0.2275
MSCI World AC	0.0011	0.0443	-0.1868	0.0973
EUR/USD	0.0030	0.0313	-0.1144	0.0894
EME/USD	0.0007	0.0137	-0.0583	0.0279
VIX	-0.0009	0.1814	-0.3851	0.6458

All the variables are expressed in first-log difference

Correlation matrix (2001:7 - 2013:6)

	NAV	MSCI World AC	EUR/USD	EME/USD	VIX
NAV	1.000				
MSCI World AC	0.839	1.000			
EUR/USD	-0.027	0.310	1.000		
EME/USD	0.491	0.690	0.651	1.000	
VIX	-0.577	-0.720	-0.229	-0.534	1.000

All the variables are expressed in first-log difference

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