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WHAT DRIVES GROSS FLOWS IN EQUITY AND INVESTMENT FUND SHARES IN LUXEMBOURG?

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What Drives Gross Flows in Equity and Investment Fund Shares in Luxembourg?

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Abstract

The paper analyses gross portfolio investment flows in equity and investment fund shares (EIFS) in Luxembourg - a small open economy with a financial center - over the period 2002Q1-2016Q3. The statistical analysis shows that gross EIFS flows exhibit similar patterns over time amongst resident investors and non-resident investors. However, the volatility of EIFS flows instigated by non-resident investors is larger than the volatility of EIFS flows initiated by resident investors. The graphical analysis provides evidence that gross EIFS flows switch between positive and negative growth cycles whose durations vary over time, depending on macroeconomic, financial and geopolitical shocks at the global level. In particular, gross EIFS flows correlate positively with stock returns and negatively with risk/uncertainty measures at the global level. Sudden and sharp increases (decreases) in gross EIFS flows concur with periods of bullish (bearish) equity markets and low (heightened) risk aversion. Econometric tests show that gross EIFS flows (including extreme movements) are driven by macroeconomic and financial variables at the global level. Eventually, a prediction exercise suggests that it is difficult to forecast extreme movements in gross EIFS flows based on global macroeconomic and financial variables.

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Non-Technical Summary

The paper analyses gross investment flows in equity and investment fund shares (EIFS) in Luxembourg - a small open economy with a financial center - over the period 2002Q1-2016Q3. Gross flows cover gross inflows and gross outflows. Gross inflows are defined as the net purchases of domestic assets by foreign (*i.e.* non-resident) investors (IMF (2009)). If a majority of non-resident investors buy (sell) domestic assets, then gross inflows are positive (negative). Gross outflows are defined as the net purchases of foreign assets by domestic (*i.e.* resident) investors (IMF (2009)). If a majority of resident investors buy (sell) foreign assets, then gross outflows are positive (negative).

The paper carries out three analyses. A statistical analysis describes the statistical properties of gross EIFS flows. A graphical analysis identifies the main events and the potential drivers of gross EIFS flows. The econometric analysis tests the observations highlighted in the graphical analysis and undertakes a forecasting exercise of extreme movements in gross EIFS flows.

The paper highlights several results. The statistical analysis shows that gross EIFS flows exhibit similar patterns over time amongst resident investors and non-resident investors. However, the volatility of EIFS flows instigated by non-resident investors is larger than the volatility of EIFS flows initiated by resident investors. Moreover, gross EIFS flows correlate positively with stock price indices and negatively with risk/economic policy uncertainty measures related to advanced economies and emerging market economies. This suggests that stock prices and risk/economic policy uncertainty measures can be respectively conceived as an indicator of investors' expected return on equity investment and as a gauge for global risk aversion. This provides also evidence that the evolution of gross EIFS flows in Luxembourg may be potentially explained by a set of global factors rather than domestic factors.

The graphical analysis shows that gross EIFS flows switch between positive and negative growth cycle periods whose durations vary over time depending on shocks affecting the return/risk ratio associated to EIFS. Second, as EIFS flows initiated by non-resident investors are more volatile than EIFS flows instigated by resident investors, extreme movements in EIFS flows occur more frequently on the side of non-resident investors than on the side of resident investors. Third, given that gross EIFS flows correlate positively with stock prices and negatively with global risk aversion measures (such as the implied volatility index VIX), sudden and sharp increases (decreases) in gross EIFS flows likely occur during bullish (bearish) periods in equity markets, when investors' risk aversion is low (high). Fourth, extreme movements in gross EIFS flows can concur with one specific event (or shock) or with a set of events. The nature of events is multifaceted, covering economic, monetary, fiscal, financial, regulatory and geopolitical shocks. Moreover, the geographical provenance of events is worldwide so that gross EIFS flows are likely affected by global shocks, either stemming from advanced economies and/or emerging market economies.

The econometric analysis supports these results as it provides evidence of a significant relationship between EIFS flows, global stock prices, global risk aversion, global economic policy uncertainty measures and fundamentals that may have played an important role in shaping the evolution of EIFS flows over the period of analysis (in particular, global liquidity, global government spending, global interest rates and oil prices). A similar result prevails for extreme gross EIFS flows although relatively less compelling and more dependent upon the nature of extreme flows (*i.e.* whether a sudden and sharp increase/decrease in gross EIFS flows initiated by resident/non-resident investors). Eventually, a prediction exercise suggests that it is difficult to forecast extreme movements in gross EIFS flows, based on global macroeconomic and financial variables.

Résumé Non Technique

Le document analyse les flux bruts d'investissement de portefeuilles en actions et parts de fonds de placement (APFP) au Luxembourg - une petite économie ouverte dotée d'un centre financier - sur la période 2002T1-2016T3.

Les flux bruts couvrent les entrées brutes et les sorties brutes de capitaux. Les entrées brutes sont définies comme les achats nets d'actifs nationaux par des investisseurs étrangers (c'est-à-dire non-résidents) (FMI (2009)). Si la majorité des investisseurs non-résidents achètent (vendent) des actifs domestiques, les entrées brutes seront positives (négatives). Les sorties brutes sont définies comme les achats nets d'actifs étrangers par des investisseurs domestiques (c'est-à-dire résident) (FMI (2009)). Si la majorité des investisseurs résidents achètent (vendent) des actifs étrangers, les sorties brutes seront positives (négatives).

Le document entreprend trois analyses. Une analyse statistique décrit les propriétés statistiques des flux bruts d'APFP. Une analyse graphique identifie les principaux facteurs affectant les flux bruts d'APFP. L'analyse économétrique teste les observations mises en évidence dans l'analyse graphique et effectue un exercice de prévision des mouvements extrêmes de flux bruts d'APFP.

L'analyse statistique montre que les flux bruts d'APFP présentent des évolutions similaires entre investisseurs résidents et non-résidents. La volatilité des flux bruts d'APFP initiés par les investisseurs non-résidents est cependant supérieure à celle des flux bruts d'APFP initiés par les investisseurs résidents. Les flux bruts d'APFP présentent une corrélation positive avec les cours boursiers et une corrélation négative avec des mesures de risque ou d'incertitude propres aux économies avancées ou émergentes. Cela suggère que l'évolution des flux bruts d'APFP au Luxembourg peut être affectée par des chocs similaires en provenance du monde entier. Dans un tel contexte, les cours boursiers et des mesures d'aversion au risque (tel que l'indice de volatilité implicite VIX) peuvent être conçus respectivement comme une mesure de rendement attendu des investisseurs et de risque en ce qui concerne les investissements de portefeuille en APFP.

L'analyse graphique montre que les flux bruts d'APFP alternent entre des cycles de croissance positifs et négatifs dont la durée varie avec le temps et les chocs affectant le rapport rendement/risque associé à ce type d'investissement. Deuxièmement, étant donné que les flux bruts d'APFP des investisseurs non-résidents sont plus volatiles que les flux bruts des investisseurs résidents, on observe plus souvent de fortes et soudaines hausses (baisses) du côté des investisseurs non-résidents que du côté des investisseurs résidents. Troisièmement, les fortes et soudaines hausses (baisses) des flux bruts d'APFP se produisent plus vraisemblablement durant les périodes haussières (baissières) des marchés boursiers, lorsque l'aversion au risque des investisseurs diminue (augmente). Enfin, les mouvements extrêmes des flux bruts d'APFP peuvent correspondre à l'avènement d'un ou de plusieurs chocs. De tels chocs peuvent prendre différentes formes (économique, monétaire, budgétaire, financier, de réglementation ou géopolitique) et peuvent provenir d'économies avancées et/ou émergentes.

L'analyse économétrique confirme ces résultats. Elle montre en effet l'existence d'une relation significative entre les flux bruts d'APFP, les cours boursiers mondiaux, l'aversion pour le risque au niveau mondial, les mesures d'incertitude de la politique économique au niveau mondial et un certain nombre de variables macroéconomiques et financières qui jouent un rôle important dans la détermination des flux bruts d'APFP au cours de la période analysée (liquidité au niveau mondial, dépenses publiques au niveau mondial, taux d'intérêt mondiaux et prix du pétrole). Un résultat similaire prévaut pour les flux bruts extrêmes d'APFP, bien que plus dépendants de la nature des mouvements extrêmes (*i.e.* fortes et soudaines hausses/baisses dans les flux d'APFP initiées par les investisseurs résidents/non-résidents). Enfin, un exercice de prédiction des mouvements extrêmes de flux bruts d'APFP montre qu'il est difficile de prévoir de tels flux sur la base de variables macroéconomiques et financières à l'échelle mondiale.

1. Introduction

Luxembourg is a small open economy with a financial hub. A key feature of the Luxembourg economy is its substantial openness to international capital flows relative to the size of its economy as proxied by GDP (see infra). From a policy perspective, understanding the drivers of capital flows for financial centers is an important topic. Indeed, the literature shows that international capital flows can have substantial consequences on economic and financial stability (Calvo (1998), Reinhart and Reinhart (2008), Furceri *et al.* (2012), Tillman (2013), Pinar (2015)). On the one hand, international capital flows can provide important benefits to any economy, by contributing to its economic, financial and social development, often increasing structural growth and/or smoothing fluctuations in the real growth cycle. On the other hand, massive swings in international capital flows can also amplify economic and financial cycles, increase financial vulnerabilities and harm economic, financial and social development. This result holds for both advanced and emerging market economies (EMEs) and in particular for small open economies with a financial center (*e.g.* Mo and Pang (2008) for Hong Kong, Chow (2008) for Singapore, Pinar (2015) for Switzerland). Surprisingly, the literature does not offer any comprehensive analysis regarding international capital flows in Luxembourg.

Against this background, this paper analyses the evolution of gross capital flows in Luxembourg, a small open economy with a financial center. Gross flows regroup gross inflows and gross outflows. Gross inflows are defined as the net purchases of domestic assets by foreign (*i.e.* non-resident) investors (IMF (2009)). If a majority of non-resident investors buy (sell) domestic assets, then gross inflows are positive (negative). Gross outflows are defined as the net purchases of foreign assets by domestic (*i.e.* resident) investors (IMF (2009)). If a majority of resident investors buy (sell) foreign assets, then gross outflows are positive (negative). The analysis of gross flows allows investigating the behaviors of non-resident investors and resident investors separately. Indeed, non-resident and resident investors can be motivated by different factors and respond differently to various policies and shocks. Moreover, focusing on gross portfolio investment flows is more relevant from a policy perspective. Indeed, policymakers might react differently based on whether specific episodes of capital flow movements are instigated by domestic or foreign sources.

The paper focuses particularly on portfolio investment flows and especially on equity and investment fund share (EIFS) flows. The rationale underlying this choice is that Luxembourg presents the largest portfolio investment flows in term of GDP, across financial centers. Indeed, annual gross portfolio investment flows represent on average 830% of domestic GDP over the period 2000-2015 (Table 1)[1]. Concerning the different types of portfolio investments in Luxembourg, annual gross flows in equity and investment fund shares represent on average 507% of domestic GDP over the period 2002-2016, followed by gross flows in long-term debt securities (258% of domestic GDP) and short-term debt securities (20% of domestic GDP).

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[1] Table 1 presents the average amount of the ratio of gross portfolio investment flows (gross inflows + gross outflows)-to-GDP for OECD countries and financial centers over the period 2000-2015. Others financial centers included in the list of countries cover Hong-Kong, Macao and Singapore.

Table 1: Gross portfolio investment flows-to-GDP (average 2000-2015)

LU	IE	IC	HK	SG	NO	NL	PT	FI	UK	MO	FR	GR	ES	DK	AT	AU
830.0	103.7	48.1	28.7	21.3	19.6	16.7	15.2	14.5	13.2	12.3	12.3	12.1	11.8	11.7	11.4	11.1
SE	BE	CH	DE	EA	IT	US	CA	NZ	JP	SK	KR	HU	CZ	PL	MX	TK
9.9	9.0	8.4	8.1	7.4	6.6	6.2	5.8	5.7	5.3	4.4	3.8	3.3	3.0	2.9	2.4	2.0

Source: IMF BOP data for gross flows and World Bank for GDP. Period: 2000-2015. Figures are in percent.

To understand the full cycle of gross EIFS flows, the paper relies on the method by Forbes and Warnock (2012) and Pinar (2015). This method highlights four types of extreme episodes in gross EIFS flows: a surge, *i.e.* a sharp increase in gross EIFS inflows driven by non-resident investors; a stop, *i.e.* a sharp decrease in gross EIFS inflows instigated by non-resident investors; a flight, *i.e.* a sharp increase in gross EIFS outflows initiated by resident investors; a retrenchment, *i.e.* a sharp decrease in gross EIFS outflows driven by resident investors.

The paper makes several interesting contributions to the literature. The statistical analysis shows that gross EIFS outflows and gross EIFS inflows in Luxembourg exhibit similar patterns over time. However, the volatility of gross inflows initiated by non-resident investors is larger than the volatility of gross outflows instigated by resident investors. Moreover, according to the Jarque and Bera normality test (1987), the normal distribution does not suit gross inflows while it does for gross outflows. This can be explained by the sudden and dramatic negative gross inflows driven by non-resident investors in 2008Q4 during the unfolding of the subprime crisis. Gross EIFS flows correlate positively with stock price indices and negatively with risk/economic policy uncertainty measures related to advanced economies and EMEs. This suggests that the evolution of gross EIFS inflows and outflows in Luxembourg could be potentially explained by a similar set of global factors. In addition, this suggests that stock prices and risk/economic policy uncertainty measures can be respectively conceived as an indicator of investors' expected return on equity investment and as a gauge for global risk aversion.

The graphical analysis shows that gross EIFS flows alternate between positive and negative growth cycle periods whose durations vary over time depending on shocks affecting the return/risk ratio associated to EIFS. Second, as EIFS flows initiated by non-resident investors are more volatile than EIFS flows instigated by resident investors, extreme episodes in EIFS flows occur more frequently on the side of non-resident investors than on the side of resident investors. Third, given that gross EIFS flows correlate positively with stock prices and negatively with global risk aversion measures (such as the implied volatility index VIX), sudden and sharp increases (decreases) in gross EIFS flows likely occur during bullish (bearish) periods in equity markets, when investors' risk aversion is low (high). Fourth, extreme movements in gross EIFS flows can concur with one specific event (or shock) or with a set of events. The nature of events is multifaceted, covering economic, monetary, fiscal, financial, regulatory and geopolitical shocks. Moreover, the geographical provenance of events is worldwide, so that gross EIFS flows are likely affected by global shocks, either stemming from advanced economies and/or EMEs.

The econometric analysis supports these results. Indeed, estimations based on the Generalized Method of Moments (GMM) provide evidence of a significant relationship between gross EIFS flows, global stock prices, global risk aversion, global economic policy uncertainty measures and fundamentals that may have played an important role in shaping gross EIFS flows over the period of analysis (particularly global liquidity, global government spending, global interest rates and oil prices). The discrete modeling approach presents similar results for extreme gross EIFS flows, although relatively less compelling and more dependent upon the nature of

extreme episodes (whether stops/retrenchments or flights/surges). In particular, the econometric analysis shows that unconventional monetary policy measures implemented by central banks in the euro area, Japan, the United Kingdom and the United States contributed to have a positive effect on gross EIFS flows by reviving them and by limiting stops and retrenchments. This result is in line with the literature (Curcuru *et al.* (2015), Kiendrebeogo (2016)). Eventually, a prediction exercise based on the Receiver Operating Characteristics (ROC) method, suggests that it is difficult to forecast extreme movements in gross EIFS flows at h=1,2 quarters ahead based on global macroeconomic and financial variables.

The remainder of the paper is organized as follows. Section 2 defines gross EIFS flows and computes descriptive statistics. Section 3 looks for the potential factors that affected gross EIFS flows by performing a graphical analysis over the period 2002Q1-2016Q3. The graphical analysis identifies extreme episodes in gross EIFS flows and relates the evolution of gross EIFS flows to notable events. Based on the latter results, section 4 undertakes an econometric analysis to assess the impact of pre-determined factors on gross flows and on extreme gross flows. Section 5 implements a predictive exercise of extreme movements in gross EIFS flows based on global macroeconomic and financial variables. Section 6 concludes.

2. Statistical analysis

2.1 Definition

According to the IMF's Balance of Payments and International Investment Position Manual (2009, BPM6), equity and investment fund shares (EIFS) are financial assets that enter the category of portfolio investments[2], along with (short-term and long-term) debt securities. Compared to debt securities, EIFS have the distinguishing feature that the holders own a residual claim on the assets of the institutional unit that issued the instrument (BPM6, §5.19).

On the one hand, equity represents the owners' funds in the institutional unit. Contrary to debt securities, equity does not generally provide the owner with a right to a predetermined amount or an amount determined according to a fixed formula. Ownership of equity in legal entities is usually evidenced by shares, stocks, participations, depository receipts. Equity cover listed shares quoted in an exchange market (BPM6, §5.24) and unlisted shares (*e.g.* private equity) as well as other equity. Other equity is equity that is not in the form of securities (BPM6, §5.26). It can include equity in quasi-corporations, such as branches, trusts, limited liability and other partnerships, unincorporated funds, and notional units for ownership of real estate and other natural resources (BPM6, §5.26). The income of equity (other than investment fund shares) includes only distributed earnings (*i.e.* dividends).

On the other hand, an investment fund share is an equity security that entitles the owner to a portion of the net asset value of an investment fund. Investment funds (BPM6, §5.28) are collective investment undertakings through which investors pool funds for investment in financial or nonfinancial assets or both (*e.g.* debt securities, equity, commodity-linked investments, real estate, shares in other investment funds and structured assets (BPM6, §5.30)). These funds issue shares (if a corporate structure is used) or units (if a trust structure is used). Investment fund shares include money market fund shares, other investment fund shares together with insurance, pension and standardized guarantee (BPM6, §5.28). The income on investment fund shares includes both dividends and reinvested earnings (BPM6, §11.104).

2.2 Local patterns in gross EIFS flows

Chart 1 presents the evolution of gross EIFS flows in Luxembourg over the period 2002Q1-2016Q3. Outflows and inflows in gross EIFS share similar patterns. In other words, they tend to move in tandem. When resident investors buy (sell) foreign EIFS, non-resident investors buy (sell) domestic EIFS. The correlation between gross inflows and gross outflows amounts to 74% over the period. This result prevails throughout the sample period as the average one-year rolling window correlation amounts to 61%[3]. This suggests that non-resident and resident investors in EIFS may respond similarly to various shocks.

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[2] For a precise definition of EIFS, see IMF (2009) BPM6, "Equity and investment fund shares", p. 83-85.

[3] The one-year rolling window correlation between gross EIFS inflows and gross EIFS outflows becomes negative only between 2007Q1 and 2007Q3.

Chart 1: Evolution of gross equity and investment fund shares flows in Luxembourg
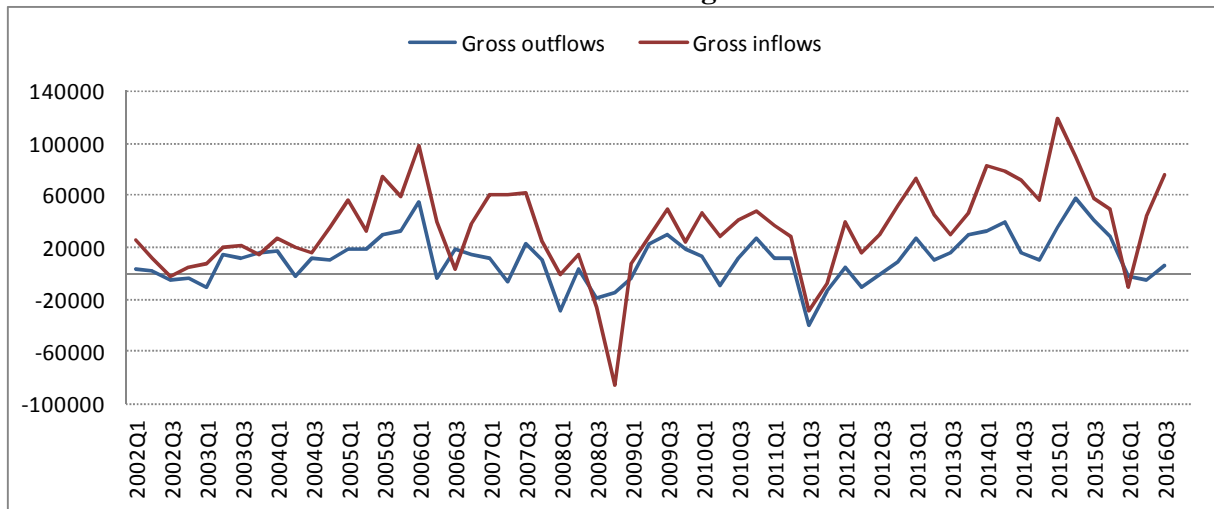
Source: BCL, Units: Millions of euros, Period: 2002Q1-2016Q3.

Over the period, the average amount of Gross EIFS flows is larger for non-resident investors (EUR34bn; Table 2) than for resident investors (EUR11bn; Table 2). The volatility of gross inflows initiated by non-resident investors is also larger than the volatility of gross outflows instigated by resident investors[4] (Table 2). This result prevails throughout the period as the one-year rolling window standard deviation of gross inflows lies always above the one for gross outflows, except for the period 2003Q2-2003Q4 (Chart 2).

Table 2: Simple statistics on Gross EIFS flows

EIFS	Gross outflows (resident ctp, assets)	Gross inflows (non-resident ctp, liabilities)
Mean	11021.72	34840.44
Median	11318.80	34676.85
Standard dev.	18437.60	33610.73
Skewness	-0.02	-0.52
Kurtosis	3.46	4.93
Normality	0.53	11.81
Probability	0.77	0.00

Source: BCL, The units for gross outflows and gross inflows are in millions of euros. Period: 2002Q1-2016Q3. The null hypothesis for the Jarque and Bera normality test (1987) is H_0: "*the series is normally distributed*".

Chart 2: One-year rolling window standard deviation
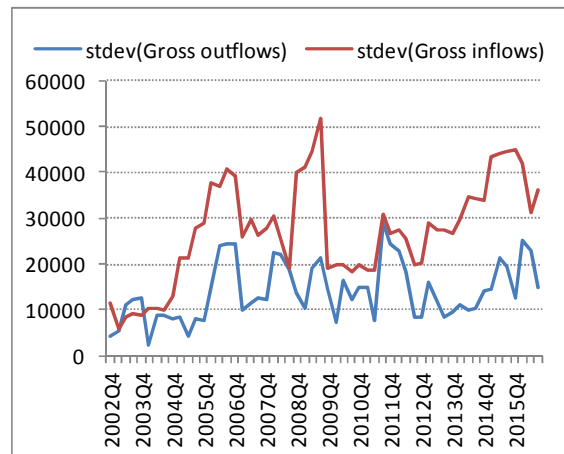
Source: BCL, Period: 2002Q1-2016Q3.

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[4] The paper implemented a right-tailed Fisher F-test (H_0: $\sigma^2_{gross\ inflows} / \sigma^2_{gross\ outflows} = 1$ *versus* H_1: $\sigma^2_{gross\ outflows} / \sigma^2_{gross\ inflows} > 1$) to check whether the standard deviations proper to gross EIFS inflows and gross EIFS outflows were significantly different. To take into account of the potential bias induced by outliers in gross EIFS flows, the test was also implemented on gross EIFS inflows-to-domestic GDP and gross EIFS outflows-to-domestic GDP. The F-tests showed that gross inflows are significantly more volatile than gross outflows. Results are available from the author upon request.

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The Jarque and Bera normality test (1987) rejects the normal distribution[5] for gross inflows initiated by non-resident investors, while it does not reject this hypothesis for gross outflows instigated by resident investors[6]. This can be explained by the sudden and dramatic negative gross inflows observed in 2008Q4 during the unfolding of the subprime crisis[7].

2.3 Gross EIFS flows, return and risk measures

Natural candidates to explain the evolution of gross EIFS flows are reward/risk measures pertaining to this class of asset (Forbes and Warnock (2012), Arias *et al*. (2013), Sarno *et al*. (2016)). Tables 3.1 and 3.2 compute the correlation between gross EIFS flows in Luxembourg and some return/risk measures. As to the return component, we consider the evolution of stock price indices in advanced economies and EMEs. Regarding risk, we consider the VIX, a measure of global risk perception in stock markets[8] and the Economic Policy Uncertainty Index (EPUI) put forward by Baker *et al.* (2015)[9] attached to several advanced economies and EMEs.

Table 3.1: Correlation between gross EIFS flows in Luxembourg and stock price indices for various countries

	Advanced economies												EMEs			
Gross flows	BE	CH	DE	EA	FR	HK	JP	LU	NL	SG	UK	US	BR	RU	IN	CN
ρ(outfl., ΔX)	0.54	0.55	0.53	0.55	0.58	0.44	0.52	0.46	0.53	0.41	0.49	0.45	0.33	0.47	0.44	0.33
ρ(infl., ΔX)	0.59	0.52	0.55	0.54	0.58	0.42	0.56	0.54	0.60	0.44	0.51	0.50	0.32	0.46	0.39	0.41
Cum. gross flows	BE	CH	DE	EA	FR	HK	JP	LU	NL	SG	UK	US	BR	RU	IN	CN
ρ(cum. outfl., X)	0.63	0.72	0.85	0.15	0.54	0.88	0.60	0.06	0.40	0.86	0.78	0.86	0.70	0.84	0.97	0.58
ρ (cum. infl., X)	0.57	0.68	0.83	0.07	0.47	0.87	0.55	0.02	0.34	0.87	0.78	0.87	0.68	0.81	0.97	0.54

Sources: BCL for gross flows; ECB-SDW, OECD and FRED for stock indices. Period: 2002Q1-2016Q3. The variable X in Table 3.1 represents stock price index proper to each considered country.

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[5] A variable that is normally distributed should feature a skewness equal to 0 and a kurtosis equal to 3.

[6] The Jarque and Bera normality test (1987) measures the difference of the skewness and kurtosis of the series with those from the normal distribution. Caution is still required when interpreting the statistical results given that the number of observation available for this analysis is relatively small (*i.e.* 59 observations over the period 2002Q1-2016Q3). With regard to this, Frain (2007) finds that the Jarque and Bera normality test (1987) can have low power in finite samples; notably when the sample size is lower or equal to 50 observations. Moreover, in order to reduce the potential bias implied by outliers in the distribution of gross EIFS flows, the Jarque and Bera normality test (1987) was also implemented on gross equity inflows-to-domestic GDP and on gross equity outflows-to-domestic GDP. Similar results were obtained. Results are available from the author upon request.

[7] Performing linear regression analysis requires that the residuals of the regression to be normally distributed in order to get exact inference about the estimates and standard errors of the estimated coefficients. Non-normality of the endogenous variable may imply that the residuals of the regression are not normally distributed. This is the case when the explanatory variables do not capture the non-normal phenomenon. Conversely, if the explanatory variables capture and allow understanding non-normality, then the residuals of the regression will be normally distributed. Here, the non-normal phenomenon can be explained by the extreme movements in gross inflows during the unfolding of the subprime crisis (2008Q4, see Chart 1). Indeed, when setting the value of gross inflows to zero in 2008Q4, the Jarque and Bera normality test (1987) does not reject anymore the normal distribution for gross inflows.

[8] The VIX is the CBOE Volatility Index, a measure of the implied volatility of S&P500 index options, calculated and published by the Chicago Board Options Exchange (CBOE). It is traditionally referred to as a gauge for investors' fear. The literature generally regards the VIX as a measure of global risk appetite in stock markets (Lo Duca (2012), Arias *et al*. (2013), Sarno *et al*. (2016)).

[9] For more information, see http://www.policyuncertainty.com/

Gross EIFS flows in Luxembourg - whether cumulated or not - correlate positively with stock price indices of advanced countries and EMEs (Table 3.1)[10]. They move in tandem with global stock prices. This suggests that the evolution of gross EIFS inflows and outflows in Luxembourg could likely be explained by a similar set of fundamentals and notably by global factors over the considered period. Hence, during boom (bust) phases in global stock markets, non-resident investors may increase (respectively, decrease) their net purchases of domestic assets and resident investors may increase (respectively, decrease) their net purchases of foreign assets. This result can be expected as stock prices can be conceived as a measure of investors' expected return on EIFS.

Table 3.2: Correlation between gross EIFS flows in Luxembourg, VIX and economic policy uncertainty indices for various countries

Gross flows	VIX	EPUI_global	EPUI_AU	EPUI_CA	EPUI_CL
ρ(outfl. LU, ΔX)	-0.32	-0.42	-0.41	-0.35	-0.15
ρ(infl. LU, ΔX)	-0.27	-0.35	-0.28	-0.36	-0.21
Gross flows	EPUI_IT	EPUI_NL	EPUI_SE	EPUI_SG	EPUI_UK
ρ(outfl. LU, ΔX)	-0.28	-0.28	-0.29	-0.46	-0.36
ρ(infl. LU, ΔX)	-0.24	-0.30	-0.22	-0.33	-0.24
Gross flows	EPUI_DE	EPUI_EA	EPUI_ES	EPUI_FR	EPUI_IE
ρ(outfl. LU, ΔX)	-0.29	-0.38	-0.23	-0.28	-0.13
ρ(infl. LU, ΔX)	-0.27	-0.30	-0.13	-0.23	-0.16
Gross flows	EPUI_US	EPUI_BR	EPUI_RU	EPUI_IN	EPUI_CN
ρ(outfl. LU, ΔX)	-0.34	-0.11	-0.31	-0.46	-0.19
ρ(infl. LU, ΔX)	-0.28	-0.11	-0.15	-0.39	-0.03

Sources: BCL for gross EIFS flows, FRED for VIX; http://www.policyuncertainty.com/ for the Economic Policy Uncertainty Index (EPUI). Period: 2002Q1-2016Q3. The variable X in Table 3.2 represents either the VIX or the EPUI proper to each considered country.

Gross EIFS flows in Luxembourg are negatively correlated with the VIX and the Economic Policy Uncertainty Index (Table 3.2) attached to advanced and emerging market economies. Thus, when global risk aversion and economic policy uncertainty increase (decrease) in advanced economies and EMEs, gross EIFS flows in Luxembourg would likely fall (increase). The latter observation supports the idea that gross EIFS inflows and outflows in Luxembourg are potentially explained by a similar set of global factors over the period of analysis.

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[10] In Table 3.1, the Luxembourg index features the lowest positive correlation for cumulated gross EIFS flows in Luxembourg. A possible explanation lies in the fact that due to the composition of the Luxembourg stock price index (in majority, companies with a relatively strong exposure on domestic rather than global activity), the Luxembourg stock price index may likely reflect more domestic conditions rather than global conditions. In turn, this suggests that gross EIFS flows in Luxembourg may be more likely affected by global factors rather than domestic factors.

3. Graphical analysis

3.1 Methodology

The graphical analysis aims at identifying the potential factors that drive gross EIFS flows in Luxembourg. To understand the full cycle of gross EIFS flows, the paper relies on the method put forward by Forbes and Warnock (2012) and later modified by Pinar (2015). This method highlights four types of extreme episodes in gross capital flows: a "*surge*", *i.e.* a sharp increase in gross EIFS inflows driven by non-resident investors; a "*stop*", *i.e.* a sharp decrease in gross EIFS inflows instigated by non-resident investors; a "*flight*", *i.e.* a sharp increase in gross EIFS outflows initiated by resident investors; a "*retrenchment*", *i.e.* a sharp decrease in gross EIFS outflows driven by resident investors[11].

To support the exercise, the graphical analysis relies on the evolution of return/risk measures associated to Gross EIFS flows. We consider the main stock price indices of advanced economies: Eurostoxx50 (SP_EA), Nikkei225 (SP_JP), FTSE100 (SP_UK), S&P500 (SP_US) and the VIX, respectively.

More importantly, the scope of the exercise consists in identifying a given pattern in gross EIFS flows and explaining it based on selected notable events that may have shaped the evolution of gross EIFS flows. By notable events, the paper refers to events that led to dramatic variations and/or that induced a trend reversal in gross EIFS flows and their associated reward/risk measures. Notable events are often given considerable attention by the economic and financial literature. As a result, such events are mainly drawn from the reading of the ECB's Financial Stability Reviews and Economic Bulletins[12]. The latter sources allow capturing key economic, financial and geopolitical events that may have driven gross EIFS flows and their associated reward/risk measures. In addition, when deemed necessary, the paper also resorts to complementary sources such as the IMF Financial Market Update, the IMF Global Financial Stability Report or specific Bulletins or Notes released by central banks[13]. We presume that such sources are widely distributed and read and do not reflect any vested or commercial interests. The graphical analysis also relies on potential events identified by earlier studies dealing with extreme gross capital flows movements (Pinar (2015)[14]) and financial market stress (Grimaldi (2010)[15]).

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[11] See Appendix B for a description of the method used to highlight extreme episodes in gross EIFS flows.

[12] The ECB Economic Bulletin is called the ECB Monthly Bulletin prior to January 2015.

[13] See Appendix C for more details regarding the sources.

[14] Pinar (2015) selected the following notable events in the analysis of extreme movements in gross capital flows for Switzerland: the collapse of Lehman Brothers (2008Q3), the Greece bailout (2010Q2) amid the EA sovereign debt crisis, the extended bailout of Greece (2011Q3) along with the US debt ceiling crisis, Bernanke's speech on tapering (2013Q2).

[15] Grimaldi (2010) identifies the following events that are concomitant with substantial increases in the financial stress index in Europe and the implied volatility of the Euro Stoxx 50 index (VSTOXX) : dot.com bubble burst (March 2000 - December 2000), 9/11 US terrorists attacks (September 2001 - November 2001), US corporate scandals (June 2002 - August 2002), Iraq war (March 2003 - May 2003), Madrid bombings (March 2004), heightened uncertainty/oil prices increases (June 2004 - December 2004), London bombings (July 2005), global financial crisis (August 2007 - June 2009).

In so doing, this methodology allows extracting general information along with selected notable events that shaped the direction of gross EIFS flows and their associated return/risk measures[16]. The output of this methodology is available in Tables C.1 to C.6 in Appendix C.

3.2 Main results

Chart 3 illustrates the evolution of gross EIFS flows and highlights their extreme movements along with notable events. According to the above methodology, the graphical analysis identifies different phases that characterize the evolution of gross EIFS flows over the period 2002Q1-2016Q3 (Table 4 and Chart 3).

a. Between 2002Q1 and 2003Q1, gross EIFS flows declined together with stock prices. Gross EIFS outflows became negative between 2002Q3 and 2003Q1 while gross EIFS inflows were negative in 2002Q3. The internet bubble burst, the September 11, 2001 terrorists' attacks[17] along with the discovery of a series of accounting irregularities in large US corporations (*e.g.* Arthur Andersen, Enron, Tyco, WorldCom's accounting and corporate fraud scandals)[18] may have contributed to undermine investors' confidence in equity markets and rein in EIFS investments. Public intervention aiming at reforming company accounting and improving investors' protection (*e.g.* Sarbanes-Oxley Act (July 2002)) may have helped to restore confidence in equity markets at the end of the period. Over this period, cumulated gross outflows (inflows) per quarter amounted to EUR -2.9bn (EUR 9.4bn). This means that Luxembourg investors were net sellers of foreign EIFS while non-resident investors were net buyers of domestic EIFS.

b. Over the period 2003Q2-2006Q1, gross EIFS flows displayed a positive growth cycle. During this period, stock prices rallied and risk aversion lowered. This could be explained by a strong recovery at the global level (notably in the US, UK and Japan) while growth in Europe was lackluster. The US notably experienced a sustained growth, propelled by strong consumption and investment (particularly in the real estate sector) and supported by an accommodative monetary policy and an expansionary fiscal policy, materialized by tax cuts and increases in military spending to finance the Iraq war. In fact, at that time, low interest rate

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[16] As the frequency of gross EIFS flows differs (*i.e.* lower since quarterly) from the frequency of events (at least daily frequency), it is difficult to analyze whether a specific event triggered a given behavior in gross EIFS flows and hence to carry out an event-study analysis properly speaking. Second, financial markets can be affected by a large amount of events that varies depending on their nature (*e.g.* monetary, fiscal, geopolitical, regulatory, *etc.*), magnitude and duration. More importantly, investors can react in different ways to a specific event. Behavioral finance theory teaches us that investors can (over)-react to meaningless events, not react at all to events considered as important, react without the occurrence of any important events (owing for example to short-term profit taking), focalize on specific events while ignoring others that occur at the same time (*e.g.* scapegoat theory (Bachetta and Van Wincoop (2005), Fratzscher *et al.* (2012)), react differently to similar events that happen through time or react with delay to a specific event. All in all, investors' reaction to a specific event is multi-faceted which renders the analysis between notable events and gross EIFS flows challenging. Due to these limits, the study can only provide evidence of concomitancy (or correlation) between notable events and gross EIFS flows and cannot analyze the causality between notable events and gross EIFS flows.

[17] ECB (2002), Monthly Bulletin, January 2002, p. 20; ECB (2004), Monthly Bulletin, "Box 2 Stock market reactions to the terrorist attacks in Madrid on 11 March 2004", April 2004, p. 24-25. See also Table C.1 in Appendix C.

[18] ECB (2002), Monthly Bulletin, November 2002, p. 22. Grimaldi (2010) p. 11. See also Table C.1 in Appendix C.

policies were a key driver of financial market developments[19]. In addition, US financial deregulation also contributed to fuel financial market developments, for example *via* the exemption of the "net capital rule" for large brokers-dealers in April 28, 2004 that permitted certain large investment banks (*e.g.* Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley) to increase dramatically their leverage to finance investments (notably mortgage-backed securities investments) over this period[20]. Risk aversion lowered for domestic and non-resident investors and confidence increased as cumulated gross outflows (inflows) increased to EUR 19.3bn (EUR 39.2bn) per quarter[21].

Over this period, gross inflows experienced three surges (2005Q1, 2005Q3 and 2006Q1) and gross outflows one flight (2006Q1). The surge in 2005Q1 concurred with an increase in global stock prices on account of positive economic data releases in the EA, Japan and the US, notably in the energy sector propelled by higher oil prices[22]. The surge in 2005Q3 was contemporaneous with an increase in global stock prices. The latter was potentially explained by positive data releases about corporate profitability in the US which offset investors' concerns about the impact of higher oil prices on the US economy, better economic outlook in Japan, while the rise in EA stock prices was explained by the cost cutting efforts by corporations given the prevalence of investors' concerns about EA economic prospects[23]. Moreover, the simultaneous surge and flight in 2006Q1 was concomitant with a strong increase in global stock markets, potentially explained by a weaker belief amongst investors about further US interest rate hikes, the release of positive and strong economic data and investors' expectations of continued robust corporate earnings growth in the EA, Japan and US[24].

Notice that the negative outflows in 2004Q2 concurred with investors' concerns about the real strength of the global economic recovery on the background of increasing oil prices and their expected impact on corporate profits and aggregate demand, along with the change in investors' expectations regarding the pace and timing of the US Federal Reserve's tightening cycle[25].

c. Between 2006Q2 and 2006Q3, gross EIFS flows shriveled down. Risk aversion rose slightly and global stock markets fell in May 2006. In fact, after the US Federal Reserve's monetary tightening of March 28 and May 10, 2006[26], investors feared potential further near-term interest rate hikes. Investors' nervousness was thus at that time notably explained by the

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[19] IMF (2003), Global Financial Stability Report, Global Financial Market Developments, September 2003, p. 7.

[20] Later, after the spark of the subprime crisis, several economists pointed to this exemption of the net capital rule as a potential cause that triggered the subprime crisis (*e.g.* Lo (2012)) although some of them warned about it at an earlier stage (Rajan (2005)).

[21] Despite some evidence by Grimaldi (2010) that the Madrid terrorist attacks of March 2014 increased financial stress in Europe, the impact on gross EIFS flows appears relatively muted.

[22] ECB (2005), Monthly Bulletin, March 2005, p. 33-34. See also Table C.1 in Appendix C.

[23] ECB (2005), Monthly Bulletin, September 2005, p. 33-35. See also Table C.1 in Appendix C. Despite some evidence by Grimaldi (2010) that the London terrorist attacks of July 2005 increased financial stress in Europe, the impact on gross EIFS flows appears relatively muted.

[24] ECB (2006), Monthly Bulletin, March 2006, p. 37. See also Table C.1 in Appendix C.

[25] IMF (2004), Financial Market Update, International Capital Markets Department, Global Markets Analysis Division, June 15, 2004, p. 1-2. See also Table C.1 in Appendix C. Grimaldi (2010) also pointed to heightened financial stress and the implied volatility of the Euro Stoxx 50 index over this period potentially due to heightened uncertainty and oil prices increases (June 2004 - December 2004).

[26] ECB (2006), Monthly Bulletin, June 2006, p. 33-36; ECB (2007), Monthly Bulletin, January 2007, p. 30. See also Table C.2 in Appendix C.

rise in US inflation expectations with the associated uncertainty among market participants about the future path of the US monetary policy. In addition, an upsurge in geopolitical tensions in the Middle East along with high and volatile dynamics in oil prices contributed to undermine investors' confidence[27]. Over this period, cumulated gross outflows (inflows) decreased to EUR 7.6bn (EUR 21.2bn) per quarter. Gross outflows (inflows) experienced a retrenchment (stop) in 2006Q2 (2006Q3).

d. Gross EIFS flows recovered between 2006Q4 and 2007Q1 along with equity prices on the background of a slight decrease in risk aversion. The rise in gross EIFS flows and in stock prices was supported by positive corporate earnings growth figures and favorable news concerning the global economic outlook, despite the rise in long-term interest rates and some market speculation that the US Federal Reserve could pursue a tighter monetary policy[28].

Notwithstanding this, the period includes a substantial fall in global equity prices at the end of February 2007 (Chart 3) potentially triggered by the Shanghai stock market bubble crash of February 28, 2007[29]. The latter occurred after rumors that Chinese economic authorities were going to raise interest rates in an attempt to curb inflation and limit speculative trading with borrowed money. The Shanghai Stock Exchange Composite Index tumbled 9% - the largest drop in 10 years - and led to major drops in worldwide stock markets (Chart 3). Despite this negative shock, no stops or retrenchments are identified in gross EIFS flows over this period. Rather, cumulated gross outflows (inflows) increased to EUR 12.9bn (EUR 49.3bn) per quarter.

e. The period 2007Q2-2009Q1 features a negative growth cycle in gross EIFS flows. This period includes the unfolding of the US subprime crisis. Global risk aversion as proxied by the VIX increased and peaked in 2008Q4. Indeed, starting from mid-2007, several banks reported heavy losses due to direct or indirect (subprime) mortgage exposure[30]. This led to an increase in risk aversion amongst private banks translated by diminished liquidity in the interbank market (Nov. 2007) as banks stopped lending to each other. The collapse of Bear Stearns (June 2007) and then Lehman Brothers (Sep. 2008)[31] and Washington Mutual (Sep. 2008) reinforced investors' loss of confidence. These factors were aggravated by concomitant financial events pertaining to the massive losses generated by the closure of Mr Kerviel's huge positions on a three trading days period by the Société Générale (Jan. 2008) and the fraudulous investment scheme by Mr Madoff (Dec. 2008). The appearance of the first financial and real economy consequences of the subprime crisis on European economies also contributed to erode investors' sentiment at that time.

Over this period, cumulated gross outflows (inflows) per quarter fell to EUR -4.5bn (EUR 6.8bn). Moreover, gross outflows experienced two retrenchments (2007Q2 and 2008Q1) while gross inflows experienced four stops (2007Q4, 2008Q1, 2008Q3 and 2008Q4); evidencing the severity of the financial crisis. The retrenchment of 2007Q2 matched with the huge losses on

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[27] ECB (2006), Monthly Bulletin, August 2006, p. 34. See also Table C.2 in Appendix C.

[28] ECB (2007), Monthly Bulletin, January 2007, p. 30 and ECB (2007), Monthly Bulletin, March 2007, p. 33. See also Table C.2 in Appendix C.

[29] ECB (2007), Monthly Bulletin, March 2007, p. 33. See also Table C.2 in Appendix C.

[30] These banks include notably: Bank of America, Barclays, Bear Stearns, BNP Paribas, Citigroup, Deutsche Bank, Fortis, Dexia, HSBC, IndyMac, Merrill Lynch, Natixis, Northern Rock, Société Générale, UBS, Wachovia, Wells Fargo, *etc.*

[31] Pinar (2015) also selected the collapse of Lehman Brothers (2008Q3) as a notable event in the analysis of extreme movements in gross capital flows for Switzerland.

mortgage exposures reported by UBS and Bear Stearns. The Bear Stearns bailout request for two subprime hedge funds in June 2007[32] induced a loss of confidence not solely on Bear Stearns but also on other banks exposed directly or indirectly to the subprime mortgage market. The stop in 2007Q4 concurred with the diminished liquidity in the interbank market (November 2007) due to heightened risk aversion amongst private banks. The simultaneous stop and retrenchment experienced in 2008Q1 were concomitant with increased pessimism among market participants about the global economic outlook[33] in a context where US and European banks announced large losses due to direct or indirect subprime mortgage market exposure. The stops in gross EIFS inflows in 2008Q3 and in 2008Q4 concurred with the collapse or bail-out of several major US financial institutions: Fannie Mae and Freddie Mac (on September 7, 2008), Lehman Brothers (on September 15, 2008), the multinational insurance corporation American International Group (AIG) (on September 17, 2008; at that time, the world's largest insurance company) and Washington Mutual (on September 25, 2008; then the US largest savings and loans company). Later, as European banks were also exposed directly or indirectly to subprime assets[34], the financial crisis then spread out to European countries. The stop in gross EIFS inflows in 2008Q4 is concomitant with a substantial fall in global equity prices reflecting increased market concerns about the stability of the global financial system and investors' concerns about the fallout from the ongoing crisis on the real economy[35].

Altogether, 2008Q4 saw the most important stop experienced by gross EIFS inflows over the sample period. The net sell-off of Luxembourg equities by non-resident investors was particularly important relative to the net sell-off of foreign equities by Luxembourg investors at that time. The strong concentration of stops and retrenchments suggests that during this period, investors liquidated foreign EIFS investment positions.

f. From 2009Q2 to 2010Q1, investments in EIFS recovered. The policy measures taken by central banks and by governments at the global level helped to restore confidence amongst investors and lowered risk aversion[36]. Equity prices recovered over this period and cumulated gross outflows (inflows) amounted to EUR 21.4bn (EUR 37.1bn) per quarter. Gross outflows experienced two successive flights in 2009Q2 and 2009Q3. This potentially reflected an expected recovery in the global economic outlook on the basis of positive macroeconomic data releases over these periods[37].

g. In 2010Q2, the recovery in gross EIFS flows came to a halt. Over this period, stock markets declined due to tensions in European sovereign bond markets, potentially caused by political instability in Greece[38]. In particular, markets were increasingly concerned about the implementation of the financial support package for Greece and the enforceability of the

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[32] ECB (2008), Research Bulletin, No 7, June 2008, p. 2. See also Table C.2 in Appendix C.

[33] ECB (2008), Monthly Bulletin, February 2008, p. 37-39. See also Table C.2 in Appendix C.

[34] According to Brown (2010), half of the securitized US assets, including mortgage backed securities had been sold to foreign (i.e. non-US) investors; most of them European investors. See Appendix C, Table C.2.

[35] ECB (2008), Monthly Bulletin, December 2008, p. 42. See also Table C.2 in Appendix C.

[36] ECB (2009), Monthly Bulletin, April 2009, p. 9, 13 and 14. See also Table C.3 in Appendix C.

[37] ECB (2009), Monthly Bulletin, June 2009 (p. 38) and September 2009 (p. 40). See also Table C.3 in Appendix C.

[38] ECB (2010), Monthly Bulletin, June 2010, p. 43. See also Table C.3 in Appendix C. Pinar (2015) also selected the bailout of Greece amid the EA sovereign debt crisis (2010Q2) as a notable event in the analysis of extreme movements in gross capital flows for Switzerland.

domestic austerity programs[39]. Investors feared a potential default on the Greek sovereign debt and likely contagion effects to other peripheral EA countries. Hence, between 2010Q1 and 2010Q2, gross flows decreased reflecting heightened risk aversion and subdued risk appetite by investors. While gross outflows became negative (EUR -8.9bn) in 2010Q2, gross inflows declined but remained positive (EUR 28.2bn)[40].

h. Between 2010Q3 and 2011Q2, gross EIFS flows were always positive. Over this period, risk aversion receded and stock prices rallied. The agreement of a bail-out for Greece (May 2010) is likely to have allayed financial stress experienced by the European sovereign bond market. In addition, the implementation of further QE respectively by the Bank of Japan (Oct. 2010) and by the US Federal Reserve (Nov. 2010) provided additional support to their respective economy. This contributed to lower investors' uncertainty regarding global economic prospects[41]. Over this period, cumulated gross outflows (inflows) increased to EUR 15.1bn (EUR 38.3bn) per quarter.

i. The period 2011Q3-2012Q3 is marked by a sudden reversal in the pattern of gross EIFS flows. Cumulated gross outflows (inflows) per quarter fell to EUR -11.7bn (EUR 9.8bn). This period saw a sharp drop in global stock prices that occurred in August 2011 affecting Asia, Europe, the Middle East and the US. This was notably explained by fears of contagion of the European sovereign debt crisis from Greece to peripheral countries (notably Spain and Italy), as well as concerns over France's then triple A rating[42]. Other negative factors further eroded investors' confidence, notably the slowdown of US economic growth and the US credit rating downgrade on August 5, 2011 by the rating agency Standard & Poor's[43] amid political discussions between the US government and the US Congress regarding the US debt ceiling. Altogether, these factors may have contributed to the global stock market fall of August 8, 2011 (dubbed as Black Monday)[44]. Over the specific period of 2011Q3, gross outflows (inflows) faced a retrenchment (stop), declining to EUR -39.4bn (EUR -28.3bn) per quarter.

Although not identified as a retrenchment, the negative gross EIFS outflows instigated by resident investors in 2012Q2 concurred with investors' concerns regarding financial stability in Spain and Cyprus. At that time, the fears concerning Spain focused on the release of a high budget deficit figures and the escalation of the banking crisis following the additional bail-out of Bankia (May 2012)[45] and the announcement of a European financial assistance programme for the recapitalization of Spanish banks (June 2012)[46]. The negative outflow was also concomitant

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[39] ECB (2010), Monthly Bulletin, May 2010, p. 43. See also Table C.3 in Appendix C.

[40] Notice that the US trillion-dollar stock market flash crash of May 6, 2010 did not seem to have any effect on gross EIFS flows as no extreme movement is detected over this period.

[41] ECB (2010), Monthly Bulletin, December 2010, p. 39 and ECB (2011), Monthly Bulletin, March 2011, p. 43. See also Table C.3 in Appendix C.

[42] See Table C.3 in Appendix C.

[43] ECB (2011), Monthly Bulletin, September 2011, p. 55.

[44] ECB (2011), Monthly Bulletin, Box 5: Financial Markets in early August 2011 and the ECB's Monetary Policy Measures, September 2011, p. 47-53. Pinar (2015) also selected the extended bailout of Greece along with the US debt ceiling crisis (2011Q3) as a notable event in the analysis of extreme movements in gross capital flows for Switzerland.

[45] ECB (2012), Monthly Bulletin, July 2012, p. 24-25. See also Banco de Espana, 2014, "ECB Action and the Spanish Economy during the First Fifteen Years of the Euro", Economic Bulletin, February 2014, p. 19. See also Table C.4 in Appendix C.

[46] ECB (2012), Monthly Bulletin, July 2012, p. 24-25. See also Appendix C, Table C.4.

with the Cypriot government's request of a bailout by the European Financial Stability Facility and the European Stability Mechanism. At that time, Cyprus was experiencing sovereign debt tensions after a sovereign downgrade by Fitch on June 25, 2012 in the wake of banking sector difficulties materialized by recapitalization needs of ailing Cypriot banks[47].

j. Between 2012Q4 and 2015Q2, gross EIFS flows displayed a positive growth cycle. Equity markets enjoyed a positive growth period as risk aversion lowered amongst investors. Cumulated gross outflows (inflows) increased substantially to EUR 25.6bn (EUR 67.8bn) per quarter. Gross inflows experienced four surges (2012Q4, 2013Q1, 2014Q1 and 2015Q1) while gross outflows experienced two flights (2013Q1 and 2015Q2). Investors seemed to have put a lot of weight on positive news affecting equity markets *i.e.* accommodative monetary and/or expansionist fiscal policy measures along with structural growth reforms implemented in major advanced economies (EA[48], Japan[49], UK and US[50]) throughout the period.

For example, the surge in 2012Q4 concurred with the OMT announcement by the ECB (Sep. 2012) and the US Federal Reserve's repeated forward guidance (Dec. 2012)[51]. The simultaneous surge and flight in 2013Q1 was concomitant with the resolution of the US fiscal cliff via the American Taxpayer Relief Act (Jan. 2013) and the announcement of a substantial recovery programme by Prime Minister Abe in Japan (Jan. 2013). In 2013Q2, gross EIFS flows decreased but remained positive (Chart 3). This can be explained by Mr. Bernanke speech about a likely tapering of asset purchases by the US Federal Reserve (May 2013)[52]. Similarly, the surge in 2014Q1 concurred with the resolution of the US fiscal cliff in the wake of the US Federal government shutdown and the US debt ceiling debate that took place during 2013Q4. Moreover, the surge of 2015Q1 (and the subsequent flight in 2015Q2) can be explained by the increase in investors' confidence following the QE announcement by the ECB in January 2015 and then its implementation in March 2015. Moreover, the decision to surrender banking secrecy in Luxembourg in January 2015 did not have a substantial impact (if any) on gross EIFS flows. This suggests that the dynamics of gross EIFS flows in Luxembourg are more likely explained by global rather than domestic factors.

It should be noticed that gross EIFS displayed short-run downward trends in 2014Q3 and 2014Q4, potentially triggered by negative events. The latter could pertain to the oil price slump throughout the period (2014Q3-2014Q4) and economic sanctions imposed on Russia (Apr. 2014)

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[47] See Central Bank of Cyprus (2012), Economic Bulletin, p. 9-11 and p. 50-53, December 2012. See Table C.4 in Appendix C.

[48] By order of appearance, ECB's LTRO2 (Feb. 2012), Greek bail-out agreement (Feb.-Mar. 2012), Mr. Draghi's speech "*whatever it takes to preserve the Euro*" (Jul. 2012), creation of the European Stability Mechanism (Sep. 2012), ECB's forward guidance (Jul. 2013), setting of the EU Single Supervisory Mechanism (Nov. 2013), ECB's ECB TLTRO1 (June 2014), ECB QE announcement (Jan. 2015) and its implementation (Mar. 2015).

[49] The case of Japan includes the Abenomics economic program implemented from 2013. This was based upon "three arrows" of monetary easing (first arrow), fiscal stimulus (second arrow) and structural reforms (third arrow) to encourage private investment. Specific policy measures include inflation targeting at a 2% annual rate, correction of the excessive yen appreciation, setting negative interest rates, radical quantitative easing, expansion of public investment, buying operations of construction bonds by the Bank of Japan (BoJ), *etc*.

[50] By order of appearance, US Federal Reserve's QE3 (Sep. 2012), US pass end-2012 fiscal cliff *via* the American Taxpayer Relief Act of 2012 (Jan. 2013), US pass end-2013 fiscal cliff (Jan. 2014), *etc*.

[51] ECB (2012), Monthly Bulletin, December 2012, p. 46. See Table C.4 in Appendix C.

[52] Pinar (2015) also selected the Bernanke's speech on tapering (2013Q2) as a notable event in the analysis of extreme movements in gross capital flows for Switzerland.

following the Ukrainian geopolitical crisis (2014Q1-2017Q4)[53]. Another factor may relate to the Russian financial crisis (Dec. 2014) due to economic sanctions, falling oil prices (Apr. 2014) and the large depreciation of the ruble (Dec. 2014). Fragile economic prospects in the US and Europe may also have contributed to undermine investors' sentiment during this period[54,55].

k. Between 2015Q3 and 2016Q2, gross EIFS flows trended downwards. Over this period, stock markets were bearish and risk aversion increased slightly. Cumulated gross outflows (inflows) decreased to EUR 15.1bn (EUR 34.9bn) per quarter. In 2015, gross inflows experienced two stops (2015Q3 and 2015Q4). The latter may have been related to a worsening of market sentiment due to the US taper tantrum (May 2015)[56] and the Greek default on an IMF loan payment (June 2015)[57]. Other factors may relate to the Chinese stock market turbulences (from June 2015 to Feb. 2016)[58] in the wake of China's economic slowdown, the Renminbi devaluation (Aug. 2015)[59] and the collapse of oil prices during this period[60]. All these events participated to lower investors' confidence and potentially contributed to the stock market crash of 24 August 2015 labeled as "Black Monday"[61].

In 2016, though investors' confidence improved slightly, gross outflows experienced two retrenchments in 2016Q1 and 2016Q2 while gross inflows registered one stop in 2016Q2. These sharp and sudden falls in gross EIFS flows coincided with a series of events including the oil price slump and the Chinese economic slowdown that continued in the first half of 2016. In addition, investors were particularly concerned about the profitability of the European financial sector (particularly retail banks and insurance companies) in the context of a prolonged period of low (or negative) interest rates[62]. This set of negative events – along with the uncertainty pertaining to the UK's EU referendum (announced in Feb. 2016 and scheduled for June 23, 2016) contributed to the fall in global stock prices that occurred in February 2016. In addition, the simultaneous stop and retrenchment in 2016Q2 was concomitant with the global stock market crash of June 24, 2016 (labeled as "Black Friday") after the UK voted to leave the European Union[63].

l. In 2016Q3, gross EIFS flows increased. Risk aversion weakened, global stock markets experienced lower volatility and followed an upward trend. The policy measures implemented by the Bank of England (interest rate cut and QE expansion (Aug. 2016)) contributed to weather the immediate impact of the UK vote to exit the EU[64]. However, prospect of unforeseen shifts in market expectations relating to US monetary policy or inflation and heightened political

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[53] ECB (2014), Monthly Bulletin, June 2014, p. 42-43. See also Table C.5 in Appendix C.

[54] ECB (2014), Monthly Bulletin, November 2014, p. 37-38. ECB (2014), Monthly Bulletin, December 2014, p. 40 and p. 42. See also Table C.5 in Appendix C.

[55] Note that the US Treasury flash crash of October 2014 did not seem to have had any impact on gross EIFS flows.

[56] ECB (2013), Monthly Bulletin, Issue 8 p. 52, September 2013. See also Table C.5 in Appendix C.

[57] ECB (2015), Economic Bulletin, Issue 6, p. 11. See also Table C.6 in Appendix C.

[58] Note that the Chinese stock market turbulence began with the burst of the stock market bubble on 12 June 2015 and ended in early February 2016.

[59] ECB (2015), Economic Bulletin, Issue 6, p. 11. See also Table C.6 in Appendix C.

[60] ECB (2016), Economic Bulletin, Issue 1, p. 7. See also Table C.6 in Appendix C.

[61] ECB (2015), Economic Bulletin, Issue 6, p. 11. See also Table C.6 in Appendix C.

[62] ECB (2015), Financial Stability Review, November 2015, p. 48. ECB (2016), Economic Bulletin, Issue 5 / 2016, p. 6. ECB (2016), Financial Stability Review, May 2016, p. 58. See also Table C.6 in Appendix C.

[63] ECB (2016), Economic Bulletin, Issue 5 / 2016, p. 6. See also Table C.6 in Appendix C.

[64] ECB (2016), Economic Bulletin, Issue 8 / 2016, p. 5. See also Table C.6 in Appendix C.

uncertainties in advanced economies (notably concerning the consequences of the planned UK Brexit on the EU and the US elections) still weighed on stock markets in 2016Q3[65]. Cumulated gross outflows decreased to EUR 5.7bn per quarter while cumulated gross inflows increased to EUR 76.0bn.

Table 4: Cumulated gross flows by sub-periods

| | Periods | Length | Extreme movements | | Cumulated gross outflows (resident ctp, assets) | | Cumulated gross inflows (non-resident ctp, liabilities) | |
			Gross outflows (resident ctp, assets)	Gross inflows (non-resident ctp, liabilities)	Total over the period	Total per quarter	Total over the period	Total per quarter
a	2002Q1-2003Q1	5			-14685.84	-2937.17	47257.03	9451.41
b	2003Q2-2006Q1	12	1 flight	3 surges	232252.17	19354.35	471369.95	39280.83
c	2006Q2-2006Q3	2	1 retrenchment	1 stop	15239.96	7619.98	42495.56	21247.78
d	2006Q4-2007Q1	2			25974.58	12987.29	98651.56	49325.78
e	2007Q2-2009Q1	8	2 retrenchments	4 stops	-36243.99	-4530.50	54564.82	6820.60
f	2009Q2-2010Q1	4	2 flights		85740.92	21435.23	148703.54	37175.89
g	2010Q2	1			-8937.67	-8937.67	28225.50	28225.50
h	2010Q3-2011Q2	4			60794.45	15198.61	153440.62	38360.15
i	2011Q3-2012Q3	5	1 retrenchment	1 stop	-58874.62	-11774.92	49030.04	9806.01
j	2012Q4-2015Q2	11	2 flights	4 surges	282572.61	25688.42	746004.32	67818.57
k	2015Q3-2016Q2	4	2 retrenchments	3 stops	60733.34	15183.34	139799.58	34949.89
l	2016Q3-2016Q3	1			5715.85	5715.85	76043.64	76043.64

Source: BCL, Units: Millions of euros

Chart 3 presents the evolution of gross EIFS flows and highlights their extreme movements. It specifies notable events that occurred over these specific periods in line with the aforementioned analysis.

Altogether, several observations can be inferred from Chart 3 and the analysis above. First, gross EIFS flows switch between positive and negative growth cycle periods whose durations vary over time depending on shocks affecting the return/risk ratio associated to this class of portfolio investment. Second, as gross inflows are more volatile than gross outflows (section 2), surges/stops occur more frequently on the side of non-resident investors relative to flights/retrenchments on the side of resident investors. Third, as gross EIFS flows correlate positively with stock prices and negatively with the VIX (section 2), surges/flights (stops/retrenchments) likely occur during bullish (bearish) periods in stock markets, when investors' risk aversion is low (high). Fourth, extreme movements in Gross EIFS flows can concur with one specific event or with a set of events. The nature of events can be multifaceted, covering notably economic, monetary, fiscal, financial, regulatory and geopolitical shocks. Moreover, the geographical provenance of events is worldwide so that the evolution of Gross EIFS flows in Luxembourg are likely affected by global shocks rather than domestic ones[66].

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[65] ECB (2016), Financial Stability Review, November 2016, p. 46.
[66] Although this still needs to be confirmed by suited analytical tests (see section 4), this result is often highlighted in the literature (Sarno *et al*. (2016), Boero *et al*. (2016)).

Chart 3: Gross flows in equity and investment fund shares and selected notable events

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Left-side event boxes:
- Internet bubble burst, 11/09/2001 terrorists' attacks, US accounting scandals (02Q1-02Q4)
- US stock market crash - US interest rate hike, oil price surge and uncertainty about future US monetary policy path (05/2006)
- UBS and Bear Stearns mortgage losses (2007Q2)
- Diminished interbank market liquidity (11/2007)
- Kerviel positions closure (01/2008)
- Subprime crisis (07Q2-08Q4)
- Lehman Brothers bankruptcy (09/2008)
- EA GIIPS debt crisis I (2010Q2)
- US debt-ceiling crisis, US debt downgrade by S&P, GR extended bailout (2011Q3)
- EA GIIPS debt crisis II (2011Q3-2012Q3)
- Bernanke speech on tapering (05/2013)
- Global stock market crash due to Chinese stock market turbulences and Renminbi devaluation, uncertainty about QE exit, oil price slump (24/08/2015)
- Global stock price fall - low interest rate impact on the financial sector, falling oil prices and potential UK Brexit (02/2016)
- Black Friday stock market crash - UK Brexit (24/06/2016)

Right-side event boxes:
- Sarbanes–Oxley Act (07/2002)
- Buoyant US growth driven notably by consumption and real estate investment (at the expense of growing current account deficits) sustained by low interest rate policy (2003Q1-2006Q1)
- US financial deregulation allows investment banks to increase their leverage (04/2004)
- Bear Stearns rescue package (03/2008)
- US Treasury TARP (10/2008), US Federal Reserve TALF (03/2009), US Recovery and Reinvestment Act (02-03/2009), BoE QE1 (03/2009)
- Investors expect a turning point in the global crisis due to positive data release. (2009Q2-2009Q3)
- Draghi's speech on "whatever it takes to preserve the euro", ECB OMT (07-09/2012)
- EA debt crisis resolution, US Fed QE3, Abenomics announced (2012Q4-2013Q1)
- US fiscal cliff resolved, positive global economic outlook (12/2013-2014Q1)
- Bank of Japan Bazooka II (2014Q4)
- ECB QE announcement (01/2015) and implementation (03/2015)
- BoE response to Brexit (08/2016)

Left axis values: -100000, -80000, -60000, -40000, -20000, 0, 20000, 40000, 60000, 80000, 100000, 120000, 140000

Right axis values: 0, 50, 100, 150, 200, 250, 300

X-axis (quarters): 2002Q1, 2002Q2, 2002Q3, 2002Q4, 2003Q1, 2003Q2, 2003Q3, 2003Q4, 2004Q1, 2004Q2, 2004Q3, 2004Q4, 2005Q1, 2005Q2, 2005Q3, 2005Q4, 2006Q1, 2006Q2, 2006Q3, 2006Q4, 2007Q1, 2007Q2, 2007Q3, 2007Q4, 2008Q1, 2008Q2, 2008Q3, 2008Q4, 2009Q1, 2009Q2, 2009Q3, 2009Q4, 2010Q1, 2010Q2, 2010Q3, 2010Q4, 2011Q1, 2011Q2, 2011Q3, 2011Q4, 2012Q1, 2012Q2, 2012Q3, 2012Q4, 2013Q1, 2013Q2, 2013Q3, 2013Q4, 2014Q1, 2014Q2, 2014Q3, 2014Q4, 2015Q1, 2015Q2, 2015Q3, 2015Q4, 2016Q1, 2016Q2, 2016Q3, 2016Q4, 2017Q1

Legend: Gross outflows, Gross inflows, Flight, Retrenchment, Surge, Stop, SP_EA, SP_UK, SP_JP, SP_US, VIX

Region labels: a, b, c, d, e, f, g, h, i, j, k, l

4. Econometric analysis

4.1 Data and model specifications

The econometric analysis aims at testing the potential factors that affected gross EIFS flows (including their extreme movements) as highlighted in the graphical analysis. The literature on the modelling of portfolio capital flows usually relies on foreign and recipient country factors, known respectively as push and pull factors (Fratzscher (2011), Mercado and Park (2011), Soyoung *et al.* (2013), Cerrutti *et al.* (2015), Boero *et al.* (2016)). However, given the fact that Luxembourg is a small open economy, we expect that foreign (or push) factors may play a more important role than domestic (or pull) factors concerning the evolution of EIFS.

Regarding the explained variables, the paper follows the literature (Mercado and Park (2011), Soyoung *et al.* (2013), Cerrutti *et al.* (2015), Boero *et al.* (2016)) and defines the endogenous variable as the ratio of gross EIFS flows (whether inflows or outflows)-to-domestic GDP. This transformation would reduce the effect of outliers in the series of gross EIFS flows on the estimation output of the model[67] and particularly the impact of the large gross negative EIFS inflow that occurred in 2008Q4[68].

Regarding the explanatory variables, the paper considers two specifications. A first specification ("Model 1") assumes that stock prices include all the available information and especially the reaction of investors - whether rational or irrational - to news/shocks affecting equity markets. News/shocks pertain here to economic, monetary, fiscal, financial or geopolitical factors. As such, this specification simply regresses gross EIFS flows on stock prices plus a measure of global risk aversion (VIX in Model 1a) or of global economic policy uncertainty (global EPUI in Model 1b). Given the strong correlation existing between stock price indices, we limit the number of stock price indices to avoid as much as possible the curse of multicollinearity and its impact on the outcome of the models' estimation.

A second specification ("Model 2") considers that the correct reaction of investors to news/shocks can be approximated by parameters attached to a specific type of shock chosen and defined by the modeler and identified via a preliminary analysis and/or a literature survey. Due to multicollinearity issues and data availability, the second specification is as parsimonious[69] as possible and includes the main determinants of gross EIFS flows highlighted in the graphical

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[67] According to Grubbs (1969), an outlier is an observation that appears to deviate markedly from the other observations in a sample. Various methods are available in the literature to detect outliers (Hawkins (1980), Aggarwal (2016)). Outliers should be investigated carefully as they often contain valuable information about the data process under investigation. Before considering the possible elimination of outliers, it is necessary to understand why they appear. Of course, outliers are often bad data points. In any case, outliers introduce bias in the model parameter estimates and distort the power of statistical tests based on biased estimates. Outliers also contribute to increase the confidence intervals for the model parameters (Galeano and Pena (2013)).

[68] Other transformations exist in the literature. For example, Lo Duca (2012) expresses capital flows as percentages of assets under management. An alternative solution to reduce the effect of outliers in the series of gross EIFS flows would be to consider the aforementioned series in natural logarithms. As gross EIFS flows can be negative, logging the series would imply having missing values. A common technique for handling negative values is to add a constant value to the data prior to applying the log transformation. The transformation would therefore be *log*[(gross EIFS flows)+*a*]), where *a* is a constant. However this solution boils down to adding an arbitrary constant to the data. Hence the paper ruled out this transformation of gross EIFS flows with natural logarithms and relied on the ratio of gross EIFS flows-to-domestic GDP instead.

[69] Parsimonious models are simple models that explain an endogenous variable with a minimum number of predictors (or exogenous variables). As such, the model specification does not include variables that potentially cover the same information (for example, the VIX and the economic policy uncertainty index (EPUI)).

analysis (section 3) as well as those identified in the literature (Forbes and Warnoch (2012), Sarno *et al.* (2016)). Along these lines, Model 2 includes five main determinants: global risk aversion (in Model 2a) or global economic policy uncertainty (in Model 2b), global liquidity, global long-term interest rate, global government spending and oil prices.

Global risk aversion is proxied by the VIX, a measure of the implied volatility of S&P500 index options, calculated and published by the Chicago Board Options Exchange. The literature generally regards the VIX as a measure of global risk appetite in stock markets (Lo Duca (2012), Arias *et al.* (2013), Sarno *et al.* (2016)). Global economic uncertainty is proxied by the global Economic Policy Uncertainty Index (Baker *et al.* (2015)). Global liquidity is measured by the quarter-on-quarter growth rate of the sum of the ratios of monetary base-to-GDP for the euro area, Japan, United Kingdom and United States (as in Forbes and Warnoch (2012)). This allows considering the potential impact of unconventional monetary policy measures (UMPM) on gross EIFS flows notably after the unfolding of the global financial crisis of 2008. To proxy expectations about global economic prospects and future monetary policy paths, Model 2 includes the average rate on long-term (10-year) government bonds in the euro area, Japan, the United Kingdom and the United States (as in Forbes and Warnoch (2012)). As fiscal developments appeared to have played a key role on gross EIFS flows (section 3), Model 2 comprises the year-on-year growth rate of the ratio of total government spending-to-GDP for the euro area, Japan, United Kingdom and United States. In addition, given the importance of oil price dynamics highlighted in the graphical analysis, Model 2 considers the evolution of oil prices (the Brent)[70].

4.2 Gross EIFS flows

Following the literature on the determinants of capital flows (IMF (2007), Mercado and Park (2011), Soyoung *et al.* (2013), Arias *et al.* (2013)), Model 1 and Model 2 are estimated by the Generalized Method of Moments (GMM, Hansen (1982)) with the Newey-West (1987) estimator for the variance-covariance matrix to correct for potential heteroskedasticy or serial correlation in the residuals[71]. Indeed, the estimation of the aforementioned models by ordinary least squares (OLS) could produce biased estimates as they may suffer from an endogeneity bias where both the independent and dependent variables could influence each other[72]. To solve this problem, the literature traditionally relies on the generalized method of moments (GMM) that produces more efficient estimates. Under GMM estimation, the modeler must specify a list of instruments variables (IV) that are independent with the vector of residuals. For the instrument variables, the literature usually considers the lags of the independent variables. There must be at least as many instruments as there are parameters in the model. If there are more instruments than parameters, the modeler should make sure that the over-identifying moment conditions is rejected in which case the GMM estimation is valid. Over-identification can be tested via the Sargan (1958, 1975) and Hansen (1982) *J*-test.

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[70] See Table D in Appendix D for a detailed description of the series. At an earlier stage in the models' estimations, domestic variables (or pull factors) were also included but not retained in the final specification of the models due to their lack of explaining power (see *infra*).

[71] All variables entering Model 1 and Model 2 are seasonally adjusted and pass the Augmented Dickey-Fuller (1979), Phillips-Perron (1988) and the Kwiatkowski-Phillips-Schmidt-Shin (1992) stationarity tests. Results are available from the author upon request.

[72] For instance, there might be a two-way causality between gross EIFS flows and stock prices or between gross EIFS flows and oil prices or between gross EIFS flows and global liquidity, *etc.*

Tables 5.1 and 5.2 present the estimation output. For each specification, the *J*-test does not accept the over-identification condition (Tables 5.1 and 5.2); suggesting a valid estimation.

Diagnostic tests suggest that despite the fact that gross EIFS inflows are not normally distributed, the Jarque and Bera normality test (1987) does not reject the normal distribution for the residuals of the linear regressions, at a 95 percent confidence level. This means that explanatory variable allow to capture the non-normal phenomenon in gross EIFS outflows.

Turning to the interpretation of the coefficients[73], estimations show that global risk aversion (Model 1a) and global economic policy uncertainty (Model 1b) have a negative and significant impact on gross EIFS inflows and outflows. In addition, any increase in global equity prices is positively and significantly correlated with gross EIFS flows. This confirms the arguments mentioned in the graphical analysis.

In addition, estimations show that global risk aversion (Model 2a) and global economic policy uncertainty (Model 2b) correlate negatively and significantly with gross EIFS inflows and outflows. The coefficients attached to global liquidity are positive and significant. This suggests that gross EIFS inflows and outflows benefited from the intervention of central banks via the implementation of unconventional monetary policy measures[74]. In the majority of cases, global government spending features a positive and significant coefficient with gross EIFS outflows[75]. Global interest rates correlate negatively and significantly with gross EIFS flows. Thus, any increase in long-run interest rates at the global level would rein in gross EIFS inflows and outflows. This could suggest a portfolio rebalancing effect from equity to bonds as the reward on long-run debt securities increases (other things being equal). In addition, the coefficients attached to oil prices are positive and significant. Thus, any increase in oil prices would lead to an increase in gross EIFS inflows and outflows. In this case, an increase in oil prices could suggest a recovery in global demand and thus more risk appetite and more investment in equities by investors[76]. Altogether, the estimation output support the results highlighted in the graphical analysis[77,78].

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[73] Caution is still required when interpreting the statistical results given that the number of observation available for this analysis is relatively small (*i.e.* 59 observations over the period 2002Q1-2016Q3).

[74] Other authors provide similar evidence in the literature (Curcuru *et al.* (2015), Kiendrebeogo (2016)).

[75] Except for gross inflows, where the growth rate in global government spending has a significant and negative impact on gross EIFS inflows in Model 2b.

[76] Another suggestion relate to the fact that a fall in oil prices induce fewer revenues that accrue to oil-exporting countries and may thus have induced less capital outflows from these economies.

[77] Notice that the model specifications (Model 1 and Model 2) presented in Table 5.1 do not include any lagged dependent variable in the set of explanatory variables. Indeed, when included, the coefficient attached to the latter variable was not significant. Results are available from the author upon request. This means that the persistence in gross EIFS flows is captured by the chosen set of explanatory variables.

[78] Following Forbes and Warnoch (2012), the paper also tested for the impact of domestic variables (or pull factors) in Model 1 and Model 2. To capture domestic factors, the paper included subsequently the following domestic variables in the model specification: the quarter-on-quarter growth rate of Luxembourg real GDP, the Luxembourg stock price index (considered in logarithms and in first difference), the cycle component of the Luxembourg real GDP (retrieved *via* a Hodrick-Prescott filter with smoothing parameter $\lambda=1600$) and the ratio of Luxembourg public debt-to-GDP. Only the Luxembourg stock price index turned out significant for Model 2; not for Model 1 (results are available from the author upon request). This suggests that in Model 1, the global stock price index is more informative about the dynamics of gross EIFS flows than the Luxembourg stock price index. Turning to the significance of the Luxembourg stock price index in Model 2, this may be explained by the fact that the latter domestic financial variable experiences larger volatility compared to other global variables included in Model 2 and as such this domestic financial variable adds significant explanatory power to explain (volatile) gross EIFS flows. Altogether, these results confirm the arguments mentioned in the graphical analysis that foreign variables (or push

factors) are the main drivers of gross EIFS flows in Luxembourg; not domestic variables (or pull factors). Similar evidence is found in the literature (Sarno *et al.* (2016), Boero *et al.* (2016)). As a result, Table 5.1 does not include any domestic variable.

Table 5.1: Gross EIFS flows

Variables	Gross EIFS outflows/GDP$_t^{LU}$ (resident ctp, assets)		Gross EIFS inflows/GDP$_t^{LU}$ (non-resident ctp, liabilities)		Gross EIFS outflows/GDP$_t^{LU}$ (resident ctp, assets)		Gross EIFS inflows/GDP$_t^{LU}$ (non-resident ctp, liabilities)	
	Model 1a	Model 1b	Model 1a	Model 1b	Model 2a	Model 2b	Model 2a	Model 2b
Constant	5.65 (0.00)	8.79 (0.00)	15.87 (0.00)	10.67 (0.01)	15.52 (0.00)	35.45 (0.00)	30.18 (0.00)	60.37 (0.00)
Global risk aversion $log(VIX_t)$	-1.58 (0.08)	X	-4.34 (0.00)	X	-4.33 (0.00)	X	-8.23 (0.00)	X
Global economic policy uncertainty $log(EPUI_t^{global})$	X	-1.68 (0.01)	X	-1.62 (0.09)	X	-6.04 (0.00)	X	-10.01 (0.00)
Global stock price index $log(SP_t/SP_{t-1})$	0.10 (0.00)	0.12 (0.00)	0.18 (0.00)	0.30 (0.00)	X	X	X	X
Global liquidity $log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$	X	X	X	X	12.91 (0.05)	9.44 (0.00)	8.29 (0.09)	6.12 (0.06)
Global government spending $log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$	X	X	X	X	16.16 (0.05)	6.17 (0.05)	20.17 (0.01)	-14.55 (0.00)
Global interest rate i_t^{10y}	X	X	X	X	-0.71 (0.00)	-2.26 (0.00)	-1.09 (0.00)	-3.74 (0.00)
Oil prices $log(OP_t/OP_{t-1})$	X	X	X	X	3.34×10^{-2} (0.01)	3.00×10^{-2} (0.00)	4.99×10^{-2} (0.00)	6.33×10^{-2} (0.00)
Diagnostic tests								
Adjusted R2	38.05	38.75	58.16	44.51	28.48	51.43	48.93	59.65
J-Stat (Sargan-Hansen J-test; H$_0$: No over-identification - valid estimation)	2.90 (0.57)	4.29 (0.36)	5.30 (0.25)	6.38 (0.17)	9.54 (0.57)	7.91 (0.54)	11.64 (0.70)	9.53 (0.48)
Normality test (Jarque and Bera (1980) test; H$_0$: Normal residuals)	1.31 (0.51)	5.85 (0.05)	3.26 (0.19)	1.64 (0.43)	0.27 (0.87)	0.67 (0.71)	3.80 (0.14)	0.24 (0.88)

Sources: see Appendix D. NB: P-values are mentioned in parentheses. Period: 2002Q1-2016Q3.

4.3 Extreme movements in gross EIFS flows

To gauge the role of the aforementioned macroeconomic and financial variables in the conditional probability of having an extreme movement in gross EIFS flows, we estimate the following binary choice model:

$$Prob(dummy_t^{EIFS}=1) = F(X_tB) \tag{1}$$

Where $dummy_t^{EIFS}$ is a dummy variable that takes the value of 1 (0 otherwise) if gross EIFS flows are experiencing an extreme movement (*i.e.* whether a retrenchment, a stop, a stop and a retrenchment, a flight, a surge, a flight and a surge); X_t is a vector of exogenous variables that potentially affect extreme movements in gross EIFS flows and B is the vector of coefficients attached to each exogenous variables, including the constant. We consider the same set of exogenous variables and test the same models as above (*i.e.* Model 1 and Model 2).

The appropriate methodology to estimate the binary choice model is determined by the distribution of the cumulative distribution function, $F(.)$. As episodes of extreme movements in gross EIFS flows occur irregularly over the sample, we follow Forbes and Warnoch (2012) and consider a complementary logarithmic (or cloglog or gompit) function. The model is estimated by Maximum Likelihood. The variance-covariance matrix is computed based on the Huber (1967) and White (1980) method. Tables 5.2 and 5.3 present the estimation output[79].

Concerning stops/retrenchments, Model 1 shows that a fall in global stock prices is positively associated with retrenchments and/or stops as highlighted in the graphical analysis. The coefficients attached to global risk aversion and to global economic policy uncertainty are not significant.

Model 2 complements the analysis by showing that any increase in global risk aversion and in global economic policy uncertainty correlates positively with retrenchments and/or stops. The magnitude of the coefficient increases for the case of simultaneous stops and retrenchments. This suggests that the former episodes occur in periods of heightened global risk aversion and global economic policy uncertainty, as suggested by the graphical analysis.

Moreover, the coefficients related to global long-run interest rates are positive and significant only for Model 2b. In this case, an increase in long-run interest rates at the global level is associated with a fall in gross EIFS flows. Indeed, any rise in long-term interest rates would increase the expected future cost of financing and translate into a decrease in the discounted value of expected future corporate earnings. Global liquidity correlates negatively and significantly only with retrenchments and with both stops and retrenchments when Model2b is considered. This suggests that unconventional monetary policy measures contributed to lower the occurrence of retrenchments and simultaneous stops and retrenchments in gross EIFS flows. In addition, oil prices correlate negatively and significantly with stops or with simultaneous stops and retrenchments when considering Model 2b. Global government spending is not significant in explaining either stops or retrenchments.

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[79] Caution is still required when interpreting the statistical results given that the number of observation available for this analysis is relatively small (*i.e.* 59 observations over the period 2002Q1-2016Q3).

Table 5.2: Extreme movements in gross EIFS flows: stops and retrenchments

Variables	Gross outflows (resident ctp, assets) Retrenchment				Gross inflows (non-resident ctp, liabilities) Stop				Gross flows Stop and retrenchment			
Specification	Model 1a	Model 1b	Model 2a	Model 2b	Model 1a	Model 1b	Model 2a	Model 2b	Model 1a	Model 1b	Model 2a	Model 2b
Constant	3.45 (0.30)	-0.49 (0.82)	-4.86 (0.03)	-8.96 (0.04)	3.29 (0.26)	-1.53 (0.49)	-7.43 (0.00)	-10.12 (0.04)	3.49 (0.05)	-6.88 (0.06)	-10.19 (0.00)	-20.34 (0.00)
Global risk aversion $log(VIX_t)$	-1.46 (0.21)	X	1.20 (0.09)	X	-1.29 (0.21)	X	1.98 (0.02)	X	-1.70 (0.18)	X	3.18 (0.01)	X
Global economic policy uncertainty $log(EPUI_t^{global})$	X	-0.05 (0.91)	X	1.39 (0.07)	X	0.23 (0.61)	X	1.60 (0.07)	X	1.14 (0.11)	X	3.42 (0.00)
Global stock price index $log(SP_t/SP_{t-1})$	-0.10 (0.06)	-0.05 (0.09)	X	X	-0.22 (0.00)	-0.16 (0.00)	X	X	-0.17 (0.01)	-0.08 (0.00)	X	X
Global liquidity $log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$	X	X	-6.89 (0.06)	-7.10 (0.05)	X	X	-4.14 (0.26)	-3.32 (0.27)	X	X	-4.72 (0.22)	-7.92 (0.05)
Global government spending $log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$	X	X	-9.27 (0.16)	-5.22 (0.36)	X	X	-7.40 (0.45)	-0.14 (0.98)	X	X	-19.16 (0.08)	-12.91 (0.12)
Global interest rate i_t^{10y}	X	X	0.26 (0.71)	0.66 (0.06)	X	X	-0.42 (0.13)	0.78 (0.07)	X	X	-0.16 (0.70)	1.09 (0.02)
Oil prices $log(OP_t/OP_{t-1})$	X	X	1.36x10⁻³ (0.90)	1.59x10⁻³ (0.86)	X	X	-0.04 (0.01)	-0.04 (0.00)	X	X	-2.83x10⁻³ (0.22)	-0.03 (0.05)
McFadden **R**-squared	13.42	8.88	15.82	16.29	38.48	36.41	26.36	22.43	38.74	39.78	35.95	35.02
Log-likelihood	-15.77	-16.59	-15.10	-15.02	-15.25	-15.76	-16.90	-17.80	-6.91	-6.79	-7.14	-7.24

Sources: see Appendix D. NB: For stops/retrenchments, the dependent variable is a dummy variable that takes values (0;1) indicating respectively, if there is a retrenchment, a stop or both. Period: 2002Q1-2016Q3.

Table 5.3: Extreme movements in gross EIFS flows: surges and flights

Variables	Gross outflows (resident ctp, assets) Flight				Gross inflows (non-resident ctp, liabilities) Surge				Gross flows Flight and surge			
Specification	Model 1a	Model 1b	Model 2a	Model 2b	Model 1a	Model 1b	Model 2a	Model 2b	Model 1a	Model 1b	Model 2a	Model 2b
Constant	-0.48 (0.83)	-1.60 (0.46)	17.47 (0.08)	15.23 (0.04)	4.59 (0.03)	0.16 (0.94)	25.14 (0.01)	13.26 (0.09)	25.51 (0.05)	-0.67 (0.84)	20.24 (0.06)	3.05 (0.52)
Global risk aversion $log(VIX_t)$	-0.47 (0.58)	X	-5.73 (0.08)	X	-1.98 (0.01)	X	-8.18 (0.01)	X	-15.72 (0.05)	X	-8.40 (0.04)	X
Global economic policy uncertainty $log(EPUI_t^{global})$	X	-0.02 (0.96)	X	-2.64 (0.06)	X	0.22 (0.66)	X	-2.37 (0.08)	X	-0.28 (0.71)	X	-0.90 (0.35)
Global stock price index $log(SP_t/SP_{t-1})$	0.22 (0.01)	0.20 (0.01)	X	X	0.07 (0.18)	0.07 (0.09)	X	X	2.03 (0.07)	0.16 (0.06)	X	X
Global liquidity $log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$	X	X	15.15 (0.00)	10.36 (0.01)	X	X	9.29 (0.07)	2.71 (0.47)	X	X	-0.19 (0.96)	-1.40 (0.56)
Global government spending $log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$	X	X	39.14 (0.14)	2.48 (0.77)	X	X	52.88 (0.03)	4.59 (0.52)	X	X	-69.33 (0.20)	-39.33 (0.04)
Global interest rate i_t^{10y}	X	X	-1.26 (0.03)	-1.66 (0.00)	X	X	-1.33 (0.05)	-1.14 (0.07)	X	X	-0.16 (0.77)	-0.17 (0.53)
Oil prices $log(OP_t/OP_{t-1})$	X	X	0.06 (0.03)	0.07 (0.00)	X	X	1.51×10^{-5} (0.99)	0.01 (0.39)	X	X	0.04 (0.22)	0.01 (0.21)
McFadden R-squared	37.12	36.63	31.16	41.09	18.90	9.03	33.46	15.95	68.17	25.64	43.17	18.23
Log-likelihood	-10.15	-10.23	-8.67	-9.38	-16.29	-18.27	-13.16	-16.62	-2.65	-6.21	-4.69	-6.76

Sources: see Appendix D. NB: For surges/flights, the dependent variable is a dummy variable that takes values (0;1) indicating respectively, if there is a flight, a surge or both. Period: 2002Q1-2016Q3.

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Regarding surges/flights (Table 5.3), Model 1 shows that in the majority of cases, an increase in global stock prices correlates positively with surges and/or flights. For the majority of cases, global risk aversion turns out negative and significant. The evidence is less compelling with global economic policy uncertainty as the coefficient attached to this variable is not significant in Model 1.

Model 2 shows that, in the majority of cases, any increase in global risk aversion and in global economic policy uncertainty correlates negatively with surges and/or flights. Moreover, any increase in long-run interest rates at the global level decreases the probability of a flight or a surge in gross EIFS flows (but not for simultaneous flights and surges). This result is expected as any increase in the reward on long-run debt securities would potentially trigger a portfolio rebalancing effect from equity to bonds (other things being equal). Global liquidity (respectively, oil prices) correlates positively (negatively) and significantly only for flights at a 95 percent confidence level. Moreover, significance tests are more mitigated regarding global government spending.

Altogether, although less compelling than for gross EIFS flows and perhaps more dependent upon the nature of extreme episodes (whether stops/retrenchments or flights/surges), the econometric results on extreme EIFS flows provide nevertheless evidence in favor of the results highlighted in the graphical analysis[80].

5. Prediction exercise

This section analyses whether extreme movements in gross EIFS flows can be predicted based on the chosen set of fundamental variables. It focuses exclusively on extreme movements in gross EIFS flows, given their importance from a financial stability perspective (Forbes and Warnoch (2012), Lo Duca (2012), Pinar (2015)). The prediction exercise relies on the ROC procedure (Peterson *et al.* (1953)) and computes the Area Under Receiving Operating Characteristic (AUROC). The AUROC has been extensively used in the literature to assess the predictive power of early warning indicators for crisis episodes (Drehman and Juselius (2013), Ferrari *et al.* (2015)). As commonly assumed in the literature, an AUROC equal to one indicates that the predictor variable perfectly forecasts extreme movements in gross EIFS flows. If a predictor provides an AUROC equal to 0.5, its predictive power is equivalent to that of tossing a coin. The predicted variable is a dummy variable that takes on value 1 (0 otherwise) if gross EIFS flows experience an extreme movement (*i.e.* whether a retrenchment, a stop, a stop and a

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[80] As for the GMM estimation, the paper also tested for the impact of domestic variables in Model 1 and Model 2 for extreme movements in gross EIFS flows in the discrete choice model. To capture domestic factors, the paper included subsequently the following domestic variables in the model specification: the quarter-on-quarter growth rate of Luxembourg real GDP, the Luxembourg stock price index (considered in logarithms and in first difference), the cycle component of the Luxembourg real GDP (retrieved via a Hodrick-Prescott filter with smoothing parameter $\lambda=1600$) and the ratio of Luxembourg public debt-to-GDP. The majority of domestic variables were not significant (results are available from the author upon request) for Model 1 and Model 2. The significance of only a minority of domestic variables should be interpreted with caution as domestic variables can themselves be affected by foreign shocks. This argument is even more relevant since Luxembourg is a small open economy with a financial centre; hence sensitive to external shocks. The estimation output also provides some evidence in favor of this argument. Indeed, when including domestic variables in the model, some global explanatory variables became not significant and/or changed sign. This implies multicollinearity between global variables and domestic variables. In other words, domestic variables could be omitted from the specification as they can bring similar information as global variables.

retrenchment, a flight, a surge, a flight and a surge). The predictor variables are the ones defined above and used in the models' estimations[81]: global risk aversion (VIX), global economic policy uncertainty (global EPUI), global stock price index, global liquidity, global government spending, global long-run interest rate and oil prices. Forecasting horizons h span time t to t-2 quarters (h=0,1,2).

Tables 6.1 and 6.2 present the univariate non-parametric ROC results[82] by reporting the AUROC. The tables also mention the probability that the predictor variable provides significant predictive power of extreme movements in gross EIFS flows (in brackets) along with the critical value of the considered variable for which the predictive power is maximized (in squared brackets and mentioned only when the AUROC is significantly greater than 50%).

Results show that despite the fact that extreme movements in Gross EIFS flows correlate with the chosen set of fundamentals (section 4), the majority of the fundamentals do not have any predictive power of extreme movements in gross EIFS flows at h=1,2 periods ahead (Tables 6.1 and 6.2).

Regarding stops/retrenchments (Table 6.1), some fundamentals (global risk aversion, global economic policy uncertainty and global stock prices) present a significant predictive power but often only at time t (*i.e.* for h=0). This is the case respectively for stops and for simultaneous stops/retrenchments supporting the fact that stops and retrenchments likely correlate with increases in global risk aversion, heightened global economic policy uncertainty and falls in stock prices. The ROC procedure suggests that when the VIX (respectively, the global EPUI) increases above a critical threshold equal to 20.57 (117.23), an episode of stops and retrenchments may happen over the sample period. Similarly, when global stock prices decreases below a critical threshold equal to -5.44%, an episode of simultaneous stops and retrenchments may materialize over the period. In addition, the ROC procedure attaches significant predictive power to stops at h=1 period ahead only for the global stock price index.

For flights/surges (Table 6.2), global risk aversion, global stock price index and oil prices present significant predictive power of specific extreme movement episodes in gross EIFS flows at h=0. Thus, when the VIX decreases below 17.23 (14.36), an episode of surge (simultaneous flights and surges) may occur. Similarly, the probability of observing episodes of flights and simultaneous flights and surges increases as global stock prices grows faster than 6.18%. This result concurs with the fact that flights/retrenchments likely occur in periods of bullish stock markets (sections 3 and 4). Moreover, the ROC procedure attaches significant predictive power of flights at h=2 period ahead only for the VIX. This suggests that long periods of low risk aversion are a pre-requisite for the appearance of surges in gross EIFS flows as highlighted in the graphical analysis (section 3).

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[81] Testing a larger set of predictors goes beyond the scope of this paper and is left for further research work.

[82] The advantage of the non-parametric method is that it makes no assumption on the distribution of test values in extreme/no extreme episodes in gross EIFS flows. Parametric methods could also be used for the ROC procedure. However, the latter necessitates that the statistical distribution of test values in extreme/no extreme episodes is known and follow a normal distribution. In the latter case, binormal distribution is commonly used by the literature (Hanley (1988), Park *et al*. (2004), Vardhan and Sameera (2012), De Zea *et al*. (2014)).

Altogether, the prediction exercise suggests that it is difficult to forecast extreme movements in gross EIFS flows at h periods ahead (h=1,2) based on global macroeconomic and financial variables[83]. This result can be expected as predicting gross EIFS flows boils down to guessing not solely future shocks, but also investors' reactions to a given shock[84].

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[83] One could perhaps only nowcast extreme movements in gross EIFS flows given the lag between the release of some fundamentals (available at higher frequencies, such as the VIX) and the publication of gross EIFS flows data. This exercise goes beyond the scope of this paper and is left for further work.

[84] More importantly, caution is still required when interpreting the results put forward by the ROC method (notably regarding the predictive power attached to a minority of variables at h periods ahead). Indeed, in the ROC prediction exercise, extreme movements in gross EIFS flows are determined *ex post*. A more relevant exercise would be to implement the ROC analysis on real-time data so that extreme movements in EIFS flows are determined *ex ante* (see Gadea and Perez-Quiros (2015)).

Table 6.1: ROC results: gross EIFS flows, risk aversion and economic policy uncertainty

Variables	Gross outflows (resident ctp, assets) Retrenchment			Gross inflows (non-resident ctp, liabilities) Stop			Gross flows Stop and retrenchment		
	h=2	*h=1*	*h=0*	*h=0*	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*
Global risk aversion VIX_t	42.46 (0.53)	41.26 (0.46)	58.53 (0.51)	74.92 (0.01) [16.75]	58.68 (0.43)	48.00 (0.85)	83.70 (0.02) [20.57]	60.00 (0.57)	63.70 (0.44)
Global economic policy uncertainty $EPUI_t^{global}$	35.91 (0.21)	34.92 (0.17)	59.72 (0.45)	64.24 (0.19)	40.45 (0.35)	39.17 (0.28)	83.33 (0.02) [117.23]	38.88 (0.48)	51.85 (0.91)
Global stock price index $\log(SP_t/SP_{t-1})$	45.83 (0.73)	53.76 (0.77)	67.65 (0.17)	87.32 (0.00) [-2.30]	73.07 (0.02) [-2.30]	48.86 (0.91)	92.59 (0.00) [-5.44]	62.22 (0.49)	59.25 (0.60)
Global liquidity $\log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$	45.23 (0.70)	38.69 (0.33)	42.88 (0.56)	60.96 (0.32)	65.24 (0.16)	53.27 (0.76)	46.59 (0.84)	50.00 (1.00)	68.51 (0.29)
Global government spending $\log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$	34.32 (0.159)	42.65 (0.54)	51.19 (0.92)	56.41 (0.56)	52.99 (0.78)	37.89 (0.22)	42.59 (0.65)	44.07 (0.72)	26.66 (0.07)
Global interest rate i_t^{10y}	50.79 (0.95)	50.39 (0.97)	51.19 (0.92)	50.42 (0.96)	57.69 (0.48)	53.70 (0.73)	37.77 (0.43)	46.29 (0.82)	52.59 (0.88)
Oil prices $\log(OP_t/OP_{t-1})$	33.73 (0.14)	44.84 (0.67)	62.10 (0.35)	28.63 (0.01)	59.11 (0.40)	65.24 (0.16)	33.33 (0.25)	57.77 (0.66)	56.66 (0.71)

Sources: see Appendix D. NB: For stops/retrenchments, the dependent variable is a dummy variable that takes values (0;1) indicating respectively, if there is a retrenchment, a stop or both.

Table 6.2: ROC results: gross EIFS flows, risk aversion and economic policy uncertainty

Variables	Gross outflows (resident ctp, assets) Flight			Gross inflows (non-resident ctp, liabilities) Surge			Gross flows Flight and surge		
	$h=2$	$h=1$	$h=0$	$h=2$	$h=1$	$h=0$	$h=2$	$h=1$	$h=0$
Global risk aversion VIX_t	40.93 (0.48)	35.81 (0.24)	50.93 (0.94)	70.03 (0.09) [16.75]	68.46 (0.12)	75.08 (0.03) [17.23]	73.91 (0.25)	67.93 (0.40)	83.69 (0.06) [14.36]
Global economic policy uncertainty $EPUI_t^{global}$	30.69 (0.08)	41.16 (0.49)	56.97 (0.62)	51.74 (0.88)	48.60 (0.90)	56.62 (0.58)	46.73 (0.87)	44.56 (0.78)	54.34 (0.84)
Global stock price index $\log(SP_t/SP_{t-1})$	39.76 (0.42)	54.41 (0.75)	85.11 0.00 [6.18]	48.08 (0.87)	59.75 (0.42)	67.77 (0.14)	73.36 (0.26)	55.97 (0.78)	89.13 (0.01) [6.18]
Global liquidity $\log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$	61.86 (0.40)	62.09 (0.39)	56.19 (0.66)	54.18 (0.73)	31.01 (0.06)	36.78 (0.22)	58.15 (0.70)	30.97 (0.26)	20.55 (0.02)
Global government spending $\log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$	63.25 (0.35)	69.30 (0.16)	47.90 (0.87)	51.21 (0.91)	44.42 (0.63)	42.50 (0.51)	39.67 (0.59)	64.67 (0.50)	22.28 (0.04)
Global interest rate i_t^{10y}	35.34 (0.22)	34.41 (0.19)	41.86 (0.53)	41.98 (0.48)	38.85 (0.31)	39.02 (0.32)	36.41 (0.46)	40.21 (0.61)	46.73 (0.87)
Oil prices $\log(OP_t/OP_{t-1})$	28.60 (0.05)	30.69 (0.09)	78.13 (0.03) [0.98]	53.31 (0.78)	33.79 (0.12)	48.78 (0.91)	67.39 (0.42)	28.80 (0.19)	59.78 (0.65)

Sources: see Appendix D. NB: For surges/flights, the dependent variable is a dummy variable that takes values (0;1) indicating respectively, if there is a flight, a surge or both.

6. Conclusions

This paper analyses gross portfolio investment flows in equity and investment fund shares (EIFS) in Luxembourg - a small open economy with a financial center - over the period 2002Q1-2016Q3. To understand the full cycle of gross EIFS flows, the paper relies notably on the method by Forbes and Warnock (2012) and Pinar (2015) that identifies extreme episodes in gross inflows and outflows (surges, stops, flights, retrenchments).

The paper makes several interesting contributions to the literature. The statistical analysis shows that gross EIFS outflows and gross EIFS inflows exhibit similar patterns over time. However, the volatility of gross inflows initiated by non-resident investors is larger than the volatility of gross outflows instigated by resident investors. Moreover, according to the Jarque and Bera normality test (1987), the normal distribution does not suit gross inflows while it does for gross outflows. This can be explained by the sudden and dramatic negative gross inflows driven by non-resident investors in 2008Q4 during the unfolding of the subprime crisis. Gross EIFS flows correlate positively with stock price indices and negatively with risk/economic policy uncertainty measures related to advanced and emerging economies. This suggests that the evolution of gross EIFS inflows and outflows in Luxembourg could potentially be explained by a similar set of global factors. Moreover, this suggests that stock prices and risk/economic policy uncertainty measures can be respectively conceived as an indicator of investors' expected return on equity investment and as a gauge for global risk aversion.

The graphical analysis shows that gross EIFS flows switch between positive and negative growth cycle periods whose durations vary over time depending on shocks affecting the return/risk ratio associated to EIFS. Second, as EIFS flows initiated by non-resident investors are more volatile than EIFS flows instigated by resident investors, extreme episodes in EIFS flows occur more frequently on the side of non-resident investors than on the side of resident investors. Third, given that gross EIFS flows correlate positively with stock prices and negatively with global risk aversion measures (such as the implied volatility index VIX), sudden and sharp increases (decreases) in gross EIFS flows likely occur during bullish (bearish) periods in equity markets, when investors' risk aversion is low (high). Fourth, extreme movements in gross EIFS flows can occur with one specific event or with a set of events. The nature of events is multifaceted, covering economic, monetary, fiscal, financial, regulatory and geopolitical shocks. Moreover, the geographical provenance of events is worldwide, so that gross EIFS flows are likely affected by global shocks, either stemming from advanced economies and/or EMEs.

The econometric analysis supports these results. Indeed, GMM estimations provide evidence of a significant relationship between gross EIFS flows, global stock prices, global risk aversion, global economic policy uncertainty measures and fundamentals that may have played an important role in shaping gross EIFS flows over the period of analysis (notably global liquidity, global government spending, global interest rates and oil prices). The discrete modeling approach provides similar results for extreme gross EIFS flows although relatively less compelling and more dependent upon the nature of extreme episodes (whether stops/retrenchments or flights/surges). In particular, the econometric analysis shows that unconventional monetary policy measures implemented by central banks in the euro area, Japan, the United Kingdom and the United States contributed to have a positive effect on gross EIFS flows by reviving them and by limiting stops and retrenchments. This result is in line with the literature (Curcuru *et al.* (2015), Kiendrebeogo (2016)). A prediction exercise based on the ROC

method suggests that it is difficult to forecast extreme movements in gross EIFS flows at h=1,2 quarters ahead based on global macroeconomic and financial variables.

Altogether, the different analyses carried out in this paper suggest that it is possible to understand the evolution of gross EIFS flows. Far from being affected by irrational exuberance, gross EIFS flows in Luxembourg - and in particular extreme movements in gross EIFS flows – can be explained by economic, monetary, fiscal, financial, regulatory and geopolitical events occurring at the global level.

Having provided some insights about the drivers of gross EIFS flow dynamics in Luxembourg, the paper also hints at several potential future research works. A first exercise could consist in nowcasting extreme movements in gross EIFS flows, given that the paper shows that it is difficult to forecast gross EIFS flows and due to the existence of a lag between the release of some fundamentals (available at higher frequencies, such as the VIX and stock prices) and the release of gross EIFS flows data. In addition, and perhaps more importantly, further work is needed to understand the impact of gross EIFS flows (and potentially other types of capital flows) on the real economy of Luxembourg (in particular, concerning the added value in the financial sector, the employment level, *etc*.). As the paper highlights that gross EIFS flows tend to alternate between positive and negative growth cycle periods, an interesting exercise could consist in modeling gross EIFS flows within a Markov switching framework featuring two regimes: one for high-growth periods and the second one for low-growth periods. The output from the Markov switching model - and notably the smoothed probabilities - could then be compared to the periods identified in the graphical analysis of this paper.

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Appendix

A. Definitions

Chart A presents the evolution of the different types of portfolio investment flows for Luxembourg. Over the period 2002-2016, annual gross flows in EIFS represent on average 459% of GDP, followed by annual gross flows in long-term debt securities (242% of GDP) and by annual gross flows in short-term debt securities (19% of GDP).

Chart A: Ratio of gross portfolio investment flows-to-domestic GDP in Luxembourg
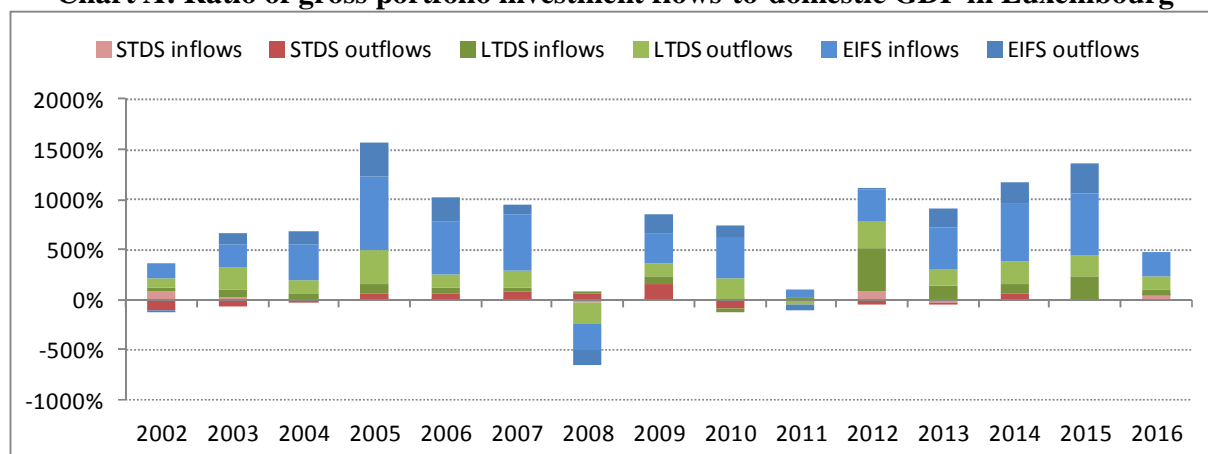
NB: Source: BCL, STATEC. Period: 2002-2016. Gross flows are defined as the sum of inflows and outflows. STDS: short term debt securities; LTDS: long term debt securities and EIFS: equity and investment fund shares.

B. Computation of extreme movements in gross EIFS flows

Following Forbes and Warnoch (2012) and Pinar (2015), this paper uses a one-sided Hodrick-Prescott filter (Stock and Watson (1999)) with a recursive window to calculate the smoothed levels of gross EIFS flows. A recursive window allows for all information up to each point in time to be used to calculate the underlying trend of the data. Thus, the trend is smooth, but no historical information is lost. Furthermore, the paper calculates the standard deviation of EIFS flows by using a rolling window of 12 quarters. This window corresponds to the last 3 years, which is sufficiently long enough to determine the recent volatility trends and is sufficiently short to avoid having the crisis period overshadow the post-crisis period for too long. The "normal" range of capital flows in each quarter is then defined as the current level of the Hodrick-Prescott trend plus/minus one time the recent standard deviation.

C. Sources for the graphical analysis

Tables C.1 to C.6 present general information along with selected notable events (in bold) that shaped the direction of gross EIFS flows and their associated return/risk measures in equity markets over the period 2002Q1-2016Q3. The paper relies on the economic and financial literature and specifically on the following source: ECB Monthly Bulletin/Economic Bulletin (notably the section "Equity markets"), ECB Financial Stability Review, IMF Financial Market Update, IMF Global Financial Stability Report. Other sources include also the timeline of the

crisis provided by the Federal Reserve Bank of Saint Louis[85] or specific information provided on websites of central banks or financial literature (*e.g.* Financial Times) when deemed necessary.

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[85] https://www.stlouisfed.org/financial-crisis/full-timeline

Table C.1: Gross EIFS flows and notable events

Overview	Period	out	in	Selected notable events
a — Aftermaths of the internet bubble burst and the 11/09/2001 terrorists' attacks, US accounting scandals	2002Q1	3.50	25.84	US accounting scandals: Enron (10/2001); Afghanistan war (03/2002); Following stock market turbulences prompted by the September 11 2001 events, global stock markets stabilized in 2002Q1.While market participants seemed to become more optimistic about the prospects for economic growth, uncertainty remained about the strength of the recovery. In addition, ongoing concerns about US corporate governance and the accounting practices adopted by listed companies for the disclosure of their earnings seemed to undermined investors' confidence (2002Q1, ECB MB 03/2002)
	2002Q2	1.81	11.72	US accounting scandals: Arthur Andersen LLP court conviction (06/2002); Uncertainty about global economic recovery and renewed concerns about US corporate profits tended to had an adverse influence on global stock prices in 2002Q2 (2002Q2: ECB 06/2002)
	2002Q3	-5.56	-2.33	US accounting scandals: Worldcom (07/2002); Sarbanes–Oxley Act (07/2002); EU accounting scandal: Vivendi Universal financial troubles (07/2002); Against the background of weak corporate profit reports and continuing concerns about the reliability of financial accounting information (notably in the US), global stock price indices declined substantially (2002Q3: ECB MB 07/2002)
	2002Q4	-3.57	4.93	US accounting scandals: Tyco (11/2002); Increases in EA and US stock prices took place against a background of better than expected quarterly corporate earnings announcements of and some data releases perceived by market participants as indicating an improved economic outlook, especially in the US. The JP stock market was more volatile due to market concerns about financial fragility and continued uncertainty surrounding the resolution of the problem of non-performing bank loans (2002Q4, ECB MB 12/2002)
	2003Q1	-10.86	7.09	Iraq war begins (03/2003, Grimaldi (2010)); Mixed economic data release, greater uncertainty about global economic prospects and growing nervousness among market participants about intensified geopolitical tensions and the prospects of a war in Iraq (2003Q1; ECB MB 03/2003)
b — Buoyant US, UK and JP economy (US growth driven by investment – notably in the housing sector - and consumption at the expense of growing current-account deficits) sustained by low interest rate policy; Lacklustre EA recovery; China strong export-driven growth; Oil price surge	2003Q2	14.58	19.40	As a result of the early 2000s recession, as well as the jobless recovery that followed, US unemployment peaks at 6.3%, the highest since April 1994 (04/2003); US Jobs and Growth Tax Relief Reconciliation Act of 2003 – Bush government tax cuts (05/2003); EA and US stock markets were supported by the end of major combat operations in Iraq (announced by the Bush government in May 2003), better-than-expected corporate earnings announcements and the decline in bond yields (2003Q2; ECB MB 06/2003)
	2003Q3	11.14	21.25	Improved economic data and corporate earnings in the EA, US and JP contributed to increase optimism among market participants regarding the global economic outlook and the global recovery (2003Q3; ECB MB 09/2003)
	2003Q4	15.52	14.25	EU accounting scandal: Parmalat (12/2003); Positive macroeconomic data release in the US and EA improved investors' confidence in the US and EA stock markets while the JP stock market suffered from the appreciation of the yen and its impact on the JP export industry (2003Q4: ECB MB 12/2003)
	2004Q1	16.59	27.33	Madrid terrorist attacks (03/2014, ECB MB Box 2, p. 24-25, 04/2004 and Grimaldi (2010)); Global stock prices have increased reflecting improved corporate profitability, the decline in long-term real interest rates and abating stock market uncertainty (2004Q1; ECB MB 03/2004)
	2004Q2	-2.26	19.80	US financial deregulation – Exemption of the net capital rule allows 5 large broker-dealers (Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley) to increase their leverage (04/2004); Investors' concerns about the real strength of the global economic recovery on the background of increasing oil prices and their expected impact on corporate profits and aggregate demand and the expectations changing for the pace and timing of the US tightening cycle (2004Q2, ECB MB 06/2004, Grimaldi (2010))
	2004Q3	11.32	15.27	Countervailing global factors pertaining to weaker macroeconomic data releases than expected by the market, the perceived impact of high oil prices on future economic growth and the decrease in long-term interest rates (2004Q3: ECB MB 09/2004)
	2004Q4	10.81	34.68	Positive economic figures, despite the increase in oil prices supported investors' confidence in global stock markets (2004Q4: ECB MB 12/2004)
	2005Q1	18.17	56.28	EA GSP debate and amendment (03/2005); Positive economic figures and lower uncertainty supported global stock markets (2005Q1; ECB MB 03/2005)
	2005Q2	18.85	33.10	Rejection of the EU constitution referendum by France (05/2005) and Netherlands (06/2005); EA and US stock prices supported by strong corporate earnings and lower long-term bond yields ; JP stock prices undermined by heightened political tensions in East Asia (ECB MB 06/2005)
	2005Q3	30.01	73.77	London terrorists attacks (07/2005, Grimaldi (2010)); Oil price surge due to unprecedented Atlantic hurricane season (08/2016); Strong corporate profitability in the US offset investors' concerns about the impact of higher oil prices and supported US stock prices; better economic outlook in Japan boosted JP stock prices; the rise in EA stock prices is explained by the cost cutting efforts from corporations given the prevalence of investors' concerns about EA economic prospects (2005Q3; ECB MB 09/2005)
	2005Q4	33.16	58.86	Temporary fall in oil prices dampen market concerns about the adverse economic impact of high oil prices and better global outlook improves investors' confidence (2005Q4: ECB MB 12/2005)
	2006Q1	54.37	97.39	Investors view the slowdown in US GDP growth as a salutary sign that the Fed's rate hikes have achieved their aim and will be ending soon (02/2016); Strong economic data and expectations of continued robust corporate earnings growth supported global stock markets (2006Q1; ECB MB 03/2006)

NB: EUR billions for EIFS. NB: For gross outflows, surges (stops) are in green (red). For gross inflows, flights (retrenchments) are in green (red). Abbreviations: GSP: Growth and Stability Pact.

Table C.2: Gross EIFS flows and notable events

	Overview	Period	out	in	Selected notable events
c	May 2006 US stock market crash due to high oil prices and US interest rates uncertainty	2006Q2	-3.67	39.72	US monetary tightening (03-05/2006); May 2006 global stock market crash due to investors' nervousness about the rise in US inflation expectations, higher oil prices and the associated uncertainty about further near-term interest rate increases by the US Federal Reserve (05/2006, ECB MB 06/2006)
		2006Q3	18.91	2.77	Amaranth Advisers hedge fund failure (09/2006); Aftermaths of May 2006 global stock market crash (2006Q3); Upsurge in geopolitical tensions in the Middle East, mixed survey-based data releases on business confidence and high and volatile oil prices exert downward pressure on EA stock prices (2016Q3, ECB MB 09/2006 and ECB FSR 06/2007 p. 10)
d	Recovery period	2006Q4	13.88	38.61	Bush government tax cuts on investment gains, stock dividends, real estate (10/2006); Lower uncertainty concerning geopolitical risks, inflation developments and the future path of US monetary policy rates contributed to improve investors' confidence in stock markets (2006Q4; ECB MB 12/2006)
		2007Q1	12.10	60.05	February 27, 2007 Shanghai stock market bubble crash inducing major drops in worldwide stock markets (02/2007); Global stock markets experienced a prolonged rise due to rapid growth in corporate earnings, but then declined sharply at the end of February. This fall may have been triggered by the Chinese stock market crash, compounded by market uncertainty about the shorter-term outlook for economic growth in the US in an environment of increased risk aversion and uncertainty among global investors (2007Q1, ECB MB 03/2007)
		2007Q2	-6.86	59.96	UBS announces heavy losses in the US subprime mortgage sector (04/2007); Bear Stearns reports big losses on soured subprime mortgage investments (05-06/2007); EA and US stock prices have risen markedly despite a significant rise in long-term bond yields due to the early June 2007 bond market turmoil which induced temporary sharp losses in major stock markets. The overall stock price increases in 2007Q2 has taken place in an environment of better than expected earnings growth, strong merger and acquisition activity and increased risk appetite among investors following the global stock market turmoil of end-February 2007 (2007Q2, ECB MB 06/2007).
		2007Q3	22.92	61.31	Bear Stearns bail-out due to mortgage (subprime) market losses (06/2007); Several institutions (IndyMac, Wachovia, BNP Paribas) report heavy losses due to (subprime) mortgage exposure (07/2007); IndyMac bankruptcy (07/2007); Northern Rock bail-out (09/2007); Between May 2007 and August 2007, global equity markets witnessed a marked correction as investors became increasingly concerned about financial risks associated with tensions in the US sub-prime mortgage market, which triggered a broader reassessment of credit risks and heightened risk aversion (2007Q3, ECB MB 09/2007). In September 2007, global stock prices stabilized as the mortgage credit concerns eased somewhat. In the EA, strong actual and expected profitability provided ongoing support to stock prices (09/2007, ECB MB 10/2007)
		2007Q4	9.98	24.52	Diminished liquidity in the interbank market (11/2007); Fed TAF (12/2007); Several banks (Deutsche Bank, Fannie Mae, etc.) report heavy losses due to (subprime) mortgage exposure (2007Q4); Intensified concerns about the financial and economic implications of the US sub-prime mortgage crisis resurfaced, prompting a renewed correction in stock prices. (2007Q4, ECB MB 12/2007)
e	Subprime crisis	2008Q1	-29.36	-0.30	Société Générale closes out Kerviel's huge positions on a three days trading (01/2008); Fed TSLF and PDCF (03/2008); Bear Stearns is bailed out by the Federal Reserve bank of New York and sold to JP Morgan Chase (03/2008); Several banks (Barclays, Bank of America, HSBC, Wells Fargo, Natixis, Société Générale, etc.) report heavy losses due to (subprime) mortgage exposure (2008Q1); Global equity prices experienced pronounced fluctuations and declined significantly overall, as concerns regarding the financial and economic implications of the US subprime mortgage crisis intensified (2008Q1, ECB MB 03/2008)
		2008Q2	3.56	14.18	Several banks (Citigroup, UBS, Merrill Lynch, Fortis, etc.) impacted by (subprime) mortgage market losses cut jobs (04/2008); Global stock prices rebounded strongly, mainly on account of a renewed increase in investors' risk appetite and improved risk perceptions that offset the downward pressure exerted by higher long-term interest rates. Stock prices were supported by investors' more favorable risk perceptions and attitudes against the background of the Bear Stearns rescue package of mid-March 2008. A more optimistic outlook for corporate earnings supported the US market. Conversely, in the EA, where financial corporate earnings dropped significantly the above-average performance of shares in the oil and gas sector could explain the recovery in EA stock prices. (2008Q2, ECB MB 06/2008)
		2008Q3	-18.73	-26.33	Freddie Mac and Fannie Mae US federal government take-over (07/09/2008); Lehman Brothers' bankruptcy after having announced a record loss of USD3.2 billion (15/09/2008, Pinar (2015)); AIG, the world's largest insurance company, taken over by federal government (17/09/2009); Fed AMLF (09/2008); Washington Mutual bankruptcy (25/09/2008); Ireland financial crisis starts with Anglo Irish bank losses (09/2008); Paulson and Bernanke ask for a USD700billion bill bailout to help US ailing banks (10/2008); Global stock prices have declined significantly, mainly on account of renewed market concerns not only about the financial sector but also about the outlook for the world economy and the rapid increase in commodity prices (2008Q3 ECB MB 09/2008)
		2008Q4	-14.54	-86.52	US Treasury TARP (10/2008); Fed MMIFF and CPFF (10/2008); ECB FRFA (10/2008); Fed QE1 (12/2008); Madoff investment scandal (12/2008); Iceland financial crisis (2008Q4); Ireland financial crisis (2008Q4); FDIC deposit insurance increase (10/2008); Fed forward guidance 1 (16/12/2008); Global equity price fell substantially; reflecting increased market concerns about the health of the banking sector and the stability of the financial system. Concerns about the fallout from the ongoing crisis on the real economy also weighed heavily on equity valuations (2008Q4, ECB MB 12/2008)

NB: EUR billions for EIFS. For gross outflows, surges (stops) are in dark green (dark red). For gross inflows, flights (retrenchments) are in dark green (dark red). Abbreviations: TAF: Term Auction Facility; TSLF: Term Securities Lending Facility; PDCF: Primary Dealer Credit Facility; AMLF: Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility; TARP: Troubled Asset Relief Program; MMIFF: Money Market Investor Funding Facility; CPFF: Commercial Paper Funding Facility; FRFA: Fixed Rate Full Allotment; QE: Quantitative Easing.

Table C.3: Gross EIFS flows and notable events

	Overview	Period	out	in	Selected notable events
e	Subprime crisis	2009Q1	-3.22	7.74	**US Treasury CPP (01-02/2009)**; American Recovery and Reinvestment Act of 2009 (02/2009); American International Group (AIG) bail-out (03/2009); **Fed TALF (03/2009)**; Several banks (Royal Bank of Scotland) report heavy losses due to (subprime) mortgage sector (01/2009); **BoE QE1 announcement (05/03/2009)**; IE sovereign bond rating downgraded (2009Q1); Fed forward guidance 2 (18/03/2009); Major stock markets around the world continued their downward trends between January 2009 and mid-February 2009. Heightened risk aversion among investors was triggered by bleak prospects for the global economy, as well as by renewed concerns about the health of the banking sector (2009Q1, ECB MB 03/2009) However, between mid-February 2009 and March 2009, global stock prices were supported by the US Treasury's announcement of its "Public-Private Partnership Investment Program", which investors perceived as good news and declining real interest rates in a context of sharp further declines in the earnings of listed companies and uncertainty surrounding the depth and length of the recession on either side of the Atlantic (2009Q1, ECB MB 04/2009)
f	Monetary (conventional and unconventional) and fiscal stimulus helped restore investors' confidence from subprime crisis.	2009Q2	23.41	28.46	ECB LTRO1 (09/2009); ECB CBPP (05/2009); IE sovereign bond rating downgraded (2009Q2); Global equity prices increased substantially, reflecting increased risk appetite among investors triggered by a growing market perception that a turning point in the global crisis was approaching. The latter was supported by incoming data generally pointing towards stronger financial market conditions, a sharp upward revision to corporate earnings expectations and a pick-up in business and household confidence which nonetheless remained at low levels **(2009Q2, ECB MB 06/2009)**
		2009Q3	30.37	48.77	Fed forward guidance 3 (09/08/2009); Major stock markets continued their upward trend that started in early March 2009; reflecting rising risk appetite driven by changes in market sentiment, with many market participants revising upwards their growth prospects for the world economy over the coming quarters. In particular, EA financial sector equities experienced strong gains potentially explained by a reflection of a more positive market assessment of the capitalization of EA banks and thus of their ability to withstand the current economic slowdown but also by favorable income statements reported by EA banks in 2009Q2 **(2009Q3, ECB MB 09/2009)**
		2009Q4	18.70	24.47	GR/PT/ES sovereign credit rating downgrade (2009Q4); The upward trend underlying developments in EA stock market prices that started in March 2009 weakened after mid-October 2009. Market concerns about the strength of the recovery and the fragility of the financial sector appeared to be the driving forces behind recent developments (2009Q4, ECB MB 12/2009)
		2010Q1	13.27	47.01	Worries about Europe sovereign bond market reach a fever pitch. Investors fear Greece might default on its national debt and trigger a domino-effect of defaults in PT, IE, IT and ES (02/2010); Despite improvements in EA and US corporate earnings per share, EA and US stock prices increased modestly. In particular, investors' risk appetite lowered in EA equities due to intensifying market concerns about the outlook for public finances in a number of peripheral European countries. (2010Q1, ECB MB 03/2010)
g	EA debt crisis I (GIIPS sovereign rating downgraded and bailout requests)	2010Q2	-8.94	28.23	**GR credit rating downgraded and requests for bailout (04/2010, Pinar (2015))**; GR international bailout agreement (05/2010); US trillion-dollar stock market flash crash (06/05/2010); PT sovereign bond rating downgraded (05/2016); EA and US stock prices declined as a result of the intensification of the sovereign debt situation in the EA (notably the Greek fiscal crisis) and the effective strength of the global economic recovery (2010Q2, ECB MB 06/2010).
h	Recovery period	2010Q3	10.98	41.37	Bernanke talks about QE2 stimulus in Jackson Hole (27/08/2010); Global stock markets recovered but remained volatile. Positive news stemmed from the easing of the Greek sovereign debt crisis in May 2010, the publication of the EU-wide bank stress tests and the revised proposals for financial regulation on both sides of the Atlantic. Negative news related to a fragile short-term outlook for the global economy, particularly the US economy. (2010Q3, ECB MB 09/2010)
		2010Q4	26.94	47.40	BoJ QE2 (10/2010); Fed QE2 (11/2010); IE sovereign bond rating downgraded (2010Q4); EA and US stock prices increased but remained volatile while JP stock prices experienced a strong increase. EA stock markets were supported by robust actual and expected corporate earnings growth and overall positive macroeconomic news in a context of renewed tensions in EA sovereign debt markets. In particular, concerns about the exposure of EA banks to sovereign debt holdings had a negative impact on bank stock prices. US stock markets were supported by mixed, but overall positive, economic news, especially regarding listed corporations' earnings. At the same time, investors' uncertainty about the sustainability of the US recovery and changing expectations about the extent, nature and effectiveness of QE measures by the Federal Reserve System may have weighed negatively on stock market valuations (2010Q4, ECB MB 12/2010)
		2011Q1	11.42	36.75	Tōhoku earthquake and tsunami – Fukushima disaster (03/2011); GR/PT/IE credit rating downgrade (2011Q1); EA and US stock prices increased on the back of improved economic outlook on both sides of the Atlantic, as well as profit announcements that were better than expected. Political tensions in Northern Africa and the Middle East in February 2011 and the uncertainties surrounding the economic damage caused by the devastating earthquake in Japan countered these positive developments somewhat (2010Q4, ECB MB 03/2011)
		2011Q2	11.45	27.91	GR/PT/IT/IE credit rating downgraded (2011Q2); EA and US stock prices declined overall, reflecting concerns about the strength of the world economy and the re-intensification of tensions in certain EA sovereign debt markets (2011Q2, ECB MB 06/2011)

NB: EUR billions for EIFS. For gross outflows, surges (stops) are in dark green (dark red). Abbreviations: CPP: Capital Purchase Program; TALF: Term Asset-Backed Securities Loan Facility; LTRO: liquidity-providing longer-term refinancing operations; CBPP: Covered Bond Purchase Program.

Table C.4: Gross EIFS flows and notable events

Overview	Period	out	in	Selected notable events
	2011Q3	-39.44	-28.34	**Greece extended bailout: 4th austerity package passed by Greek Parliament (29/06/2011, Pinar (2015)**; **US debt downgrade by S&P (05/08/2011)**; Fed forward guidance 4 (09/08/2011) and Operation Twist announcement (21/09/2011); **2011 US debt-ceiling crisis debate (2011Q3)**; ES/IT/GR/PT credit rating downgrade (2011Q3). EA and US stock prices declined due to downward revision of expectations regarding global economic growth. In addition, substantial tensions related to the EA sovereign debt crisis and the downgrading of US sovereign debt contributed to a decline in investor risk appetite. Meanwhile, actual and expected growth of earnings per share decreased (2011Q3, ECB MB 09/2011)
	2011Q4	-13.24	-7.87	BoE QE2 (10/2011); ECB CBPP2 (11/2011); ES/IT/IE/PT credit rating downgraded (2011Q4); EA stock prices declined (due to the EA sovereign debt crisis and its potential impact on EA banks via their exposure to sovereign debt of peripheral countries and weak economic data release). EA stock prices were notably undermined by market sentiment following the surprise announcement by the Greek Prime Minister of a vote of confidence on the Greek government and a Greek referendum and the expectation of a potential spreading of the crisis both to larger and to higher-rated EA countries. US stock prices rose due to better than expected economic data release while JP stock prices fell. Towards the end of 2011Q4, global stock prices increased sharply as the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, the Federal Reserve and the Swiss National Bank announced coordinated actions to enhance their capacity to provide liquidity support to the global financial system in order to ease strains in financial markets. (2011Q4, ECB MB 12/2011)
i: US sovereign debt ceiling debate, US debt downgrade and EA debt crisis II	2012Q1	4.98	39.47	Fed forward guidance 5 (25/01/2012); ECB LTRO2 (02/2012); Greek bail-out agreement (02-03/2012); GR credit rating downgrade (2012Q1); US stock prices rose sharply supported by better than expected macro data releases. EA stock prices rose in January and February 2012 due to renewed hopes of a durable solution to the sovereign debt crisis in the EA (via the completion of the Greek debt restructuring) despite the creditworthiness downgrade of several EA sovereigns and key financial entities by major rating agencies over this period and weak earnings reports. An easing of funding conditions via the Eurosystem's second three-year LTRO also seems to have supported EA equity markets. In March 2012, EA stock prices declined due to data releases pointing to a weakening short-term economic outlook (2012Q1, ECB MB 03/2012 and 04/2012)
	2012Q2	-10.18	16.39	Bankia bailout by Spanish government (05/2012); Spain's financial sector and public finances concerns and European financial support package announcement (06/2012); Cyprus bailout request from EFSF/ESM after experiencing sovereign debt tensions owing the recapitalization needs of Cypriot ailing banks (06/2012); Between April and May 2012, stock prices declined in the EA, JP, UK and US. Share prices were affected by further signs of a deceleration in global economic activity and a loss in confidence, as well as increasing perceptions of sovereign and corporate default risks within the EA and their likely effects on the global financial market. In June 2012, global stock prices recovered due to prospects of political initiatives to strengthen EA financial stability and a continuation of US accommodative monetary policy initiatives. On the other hand, data releases pointing to some deterioration in the short-term economic outlook continued to weigh on global stock prices (2012Q2, ECB MB 06/2012 and 07/2012)
	2012Q3	-1.00	29.37	BoE QE3 (07/2012); **Draghi speech "whatever it takes to preserve the euro" (07/2012)**; **Fed QE3 (09/2012)**; EU European Stability Mechanism creation (09/2012); Confidence vote for Greek Prime Minister Papandreou as an indicator of where the European situation was leading (07/2012); **ECB OMT announcement (09/2012)**; **Fed forward guidance 6 (13/09/2012)**; Stock prices increased in the EA, JP, UK and US; supported by political initiatives to strengthen financial stability in the EA, the outcome of the Greek elections and statements from EA policy-makers regarding their commitment to take the necessary steps to resolve the EA sovereign crisis. In particular, financial stock prices in the EA recorded large increases following the ECB's announcement of the modalities for undertaking OMTs and the German court ruling on the ESM. The expectations of further monetary stimulus in the US, China and the EA contributed also to this stimulus in equity prices. (2012Q3, ECB MB 09/2012 and 10/2012)
j: Unconventional monetary measures and fiscal stimulus (EA, JP, UK, US)	2012Q4	9.20	52.47	US fiscal cliff (12/2012); France credit rating downgrade (11/2012); Cyprus bailout agreement (11/2012); **Abe's election and recovery programme announced (12/2012)**; **Fed forward guidance 7 (12/12/2012)**; EA and US stock prices rose strongly, following the ECB's OMTs announcement and the announcement of further monetary stimulus in the US. The positive market sentiment in the EA mainly reflected steps towards the **resolution of the EA debt crisis, such as political initiatives to strengthen financial stability through a banking union, advances in the restructuring of the Spanish banking sector and an agreement on Greece's bailout programme.** The downgrades of Spain (by Standard & Poor's in October 2012) and France (by Moody's in November 2012) had only a limited impact on the EA stock markets, as they had been broadly expected by market participants. In the US, the looming "fiscal cliff" weighed negatively on stock prices, particularly in the two months to early December 2012. In both economic areas, stock prices in the financial sector outperformed those in the non-financial sector over this period. (2012Q4, ECB MB 12/2012)
	2013Q1	27.23	73.44	**US pass fiscal cliff via the American Taxpayer Relief Act of 2012 (01/2013)**; **Japan Abenomics economic strategy announced (01/2013)**; Abe's second arrow (fiscal stimulus) approved (01/2013); In an economic environment of weak growth dynamics, EA stock prices increased due to political advances made towards resolving the sovereign debt crisis. Positive US stock price developments were primarily driven by the temporary agreement on the fiscal cliff and the debt ceiling. JP stock prices rose strongly amid market expectations of changes in economic and monetary policies after the December 2012 elections. (2013Q1, ECB MB 03/2013)

NB: EUR billions for EIFS. For gross outflows, surges (stops) are in dark green (dark red). For gross inflows, flights (retrenchments) are in dark green (dark red). Abbreviations: CBPP: Covered Bond Purchase Program; LTRO: liquidity-providing longer-term refinancing operations; EFSF: European Financial Stability Facility; ESM: European Stability Mechanism; OMT: Outright Monetary Transactions.

Table C.5: Gross EIFS flows and notable events

Overview	Period	out	in	Selected notable events
	2013Q2	9.68	44.71	BoJ QE3 - Kuroda Bazooka - Abe's first arrow (04/2013); **Bernanke speech about Fed's likely tapering and induced taper tantrum (05/2013, Pinar (2015))**: In an economic environment of weak growth dynamics, positive developments in EA stock price were primarily driven by diminishing domestic uncertainties and by low yields on other assets such as bonds. Developments in Cyprus weighed on EA stock prices, notably in the banking sector. US stock prices were supported by signs of a pick-up in economic activity and by company earnings developing slightly better than expected. Political agreement to postpone spending cuts until the end of September 2013 and the Federal Reserve System's decision to maintain its asset purchase programme and to reiterate its forward guidance had a positive impact on market sentiment. JP stock prices continued to rise sharply after the announcement of new monetary policy measures by the Bank of Japan and the rapid depreciation of the yen. In June 2013, EA and US equity prices declined as a result of the financial market uncertainty relating to expectations of an immediate tapering-off of bond purchases by the US Federal Reserve. (2013Q2, ECB MB 04/2013, 05/2013, 06/2013 and 07/2013)
	2013Q3	15.99	30.26	**ECB forward guidance 1** (04/07/2013); Stock prices increased in the EA, JP, UK and US. EA and US stock prices were supported by the prospects of a diplomatic solution to the conflict in Syria, as well as by reduced expectations of a near-term withdrawal of monetary policy accommodation in the US. The Federal Reserve System's announcement that it would continue with the current pace of asset purchases confirmed those expectations on 18 September 2013. EA equity prices benefited from the Governing Council's communication on forward guidance on key ECB interest rates. Stock price indices in most EMEs displayed large declines as a result of market participants' concerns about possible consequences for emerging economies of the cessation of unconventional monetary policies, particularly in the United States. (2013Q3, ECB MB 09/2013 and 10/2013)
j Unconventional monetary measures and fiscal stimulus (EA, JP, UK, US)	2013Q4	30.16	46.53	2013 US Federal government shutdown and US debt-ceiling debate (10/2013); Fed decision to gradually taper its asset purchases (12/2013); EA and US stock markets were supported by positive economic data releases and market expectations of a likely delay in the Federal Reserve System's QE tapering and its decision to gradually taper its asset purchases. **Stock price rises were, however, partly reversed in October 2013 due to the US debt ceiling deadlock in the context of the partial government shutdown**, before the rise in prices resumed after an agreement on the debt ceiling was reached. EA stock markets were supported somewhat by stronger than expected macroeconomic announcements at the beginning of the review period, while macroeconomic announcements were mixed at the end of the period. (2013Q4, ECB MB 12/2013 and 01/2014)
	2014Q1	32.15	82.65	Oil price slump (01-12/2014); **US pass fiscal cliff (01/2014)**; **Fed forward guidance 8 (19/03/2014)**; EA and US stock market developments were influenced mainly by possible early profit-taking ahead and by the turbulence in several emerging market economies. In addition, the US FOMC decision of March 2014 to further scale down the purchasing of assets may also have weighed on equity markets and the geopolitical tensions arising from the Ukrainian crisis weighed on stock markets. Aside from these episodes, the general continuation of the trend of broadly rising equity prices observed in recent months reflects investors' decreasing risk aversion and a favorable economic outlook. (2014Q1, ECB MB 02/2014, 03/2014 and 04/2014)
	2014Q2	40.07	79.08	EA stock prices increased in April/May 2014 on account of generally positive earnings data and some signs of a rebound in economic activity and then declined in June 2014 against a background of mixed economic data and heightened geopolitical tensions in Ukraine. US equity prices rose against a background of improving economic data for the US and a positive reaction from equity markets to the June 2014 FOMC meeting, when it was reaffirmed that the highly accommodative monetary policy stance is considered appropriate. JP equity prices rose due to improving economic data and a continued commitment by the Bank of Japan to maintain the accommodative monetary policy stance. (2014Q2, ECB MB 06/2014 and 07/2014)
	2014Q3	15.45	71.20	ECB TLTRO1 (06/2014); Oil price slump (Q3/2014); Russia economic sanctions (04/2014); EA and US stock prices exhibited volatile movements over the review period influenced by evolving geopolitical tensions in Ukraine and some mixed economic data across economic areas. The Federal Reserve's decision to further reduce the pace of its asset purchases by USD 10 billion was expected and did not have a significant impact on stock prices. The EA banking stock prices seemed to weather well negative news about the solvency of specific institutions during the review period and to continue benefiting from the assessment of bank balance sheets associated with the launch of the European banking union. JP stock prices increased over this period. (2014Q3, ECB MB 09/2014 and 10/2014)
	2014Q4	10.31	56.89	US Treasury "flash crash" (10/2014); EU Single Supervisory Mechanism (11/2014); **BoJ Unprecedented Monetary Stimulus Program – Kuroda's Bazooka Part II (10-12/2014)**; Oil price slump (Q4/2014); Russia financial crisis (12/2014); ECB ABSPP and CBPP3 (10/2014); Fed forward guidance 9 (29/10/2014 & 17/12/2014); EA, US and JP stock prices exhibited volatile movements influenced by some mixed economic data across economic areas and general market uncertainty about global growth. EA stock prices increased overall, due to a recovery in the last part of the review period. US stock prices also recorded a net gain, supported by positive US economic data releases. JP equity prices increased sharply following the decision by the Bank of Japan to considerably expand its monetary easing. (2014Q4, ECB MB 12/2014)

NB: EUR billions for EIFS. For gross outflows, surges (stops) are in dark green (dark red). For gross inflows, flights (retrenchments) are in dark green (dark red). Abbreviations: ABSPP: Asset-Backed Securities Purchase Program; CBPP: Covered Bond Purchase Program.

Table C.6: Gross EIFS flows and notable events

	Overview	Period	out	in	Selected notable events
j	Unconventional monetary measures and fiscal stimulus (EA, JP, UK, US)	2015Q1	35.10	119.54	Unexpected SNB abandons cap on EUR/CHF (01/2015); Ending of banking secrecy in Luxembourg (01/2015); ECB QE announcement (03/2015); EA stock prices increased significantly thereby outperforming US and JP stock markets. **Most of the gains in the EA were recorded immediately after the announcement of the ECB's Asset Purchasing Programme (APP) in March 2015** which led to a decline in the expected future cost of financing, and thus had a positive effect on the discounted value of expected future corporate earnings. In late February the fact that the Eurogroup agreed to extend Greece's financial assistance programme also helped to increase the appetite for risk. (2015Q1, ECB EB 1/2015 2/2015 and 3/2015)
		2015Q2	57.23	89.23	**Greek default on an International Monetary Fund loan payment (30/06/2015)**; Bund sell-off (05/2015); EA and US stock prices rose. That strong performance coincided with the decline in EA sovereign yields, which led to a decline in the expected future cost of financing and an increase in the discounted value of expected future corporate earnings. However, the uncertainty that surrounded the outcome of the Greek bail-out referendum in to accept the bailout conditions proposed jointly by the European Commission, the IMF and the ECB temporarily weigh on EA stock markets in late June 2015 (2015Q2, ECB EB 4/2015 and 5/2015)
k	China economic slowdown, oil price slump, uncertainty from QE exit strategy, UK Brexit	2015Q3	40.88	58.00	**Chinese stock market turbulences (06/2015); China Renminbi devaluation (08/2015); Black Monday global stock market crash (24/08/2015):** France credit rating downgrade (09/2015); **Raising concerns about the oil price slump (2015Q3);** Global equity markets witnessed a broad-based fall in prices and sharp spikes in measures of volatility amid growing concerns regarding the global growth outlook. **In early July 2015, developments in Greece weigh on EA stock prices.** Moreover, an unexpected yuan devaluation in August 2015 triggered a slide in global equity markets that gathered significant pace following the release of the weakest PMI report for China in over six years and a substantial correction in Chinese equities in August 2016, which reverberated globally. In addition, a combination of factors including falling oil prices, declining world trade and expectations of US rate increases weigh also on global stock prices (2015Q3, ECB EB 6/2015 and ECB FSR Nov. 2015)
		2015Q4	27.78	48.70	ECB stimulus package announcement that fell short of financial market expectations (03/12/2015); **Chinese stock market turbulences (2015Q4):** Global stock prices gradually improved between October and November 2015 following a period of strong volatility linked to developments in China. The improvement in EA stock prices was supported by market expectations of more monetary policy stimulus in the EA. Those expectations of further monetary policy easing led to significant declines in sovereign bond yields across EA countries. However, global equity prices declined significantly in December 2015 and increasing uncertainty related to developments in China and a sharp reduction in the oil price. (2015Q4, ECB EB 8/2015 and 1/2016)
		2016Q1	-2.19	-11.25	**China economic slowdown (01/2016); Oil price slump (01/2016);** BoJ negative rate policy (01/2016); **ECB TLTRO2 (03/2016); Uncertainty relative to the UK's EU referendum (2016Q1); Chinese stock market turbulences (2016Q1);** Concerns about the profitability of European financial sector (notably retail banks and insurance companies) in the context of a prolonged period of low (or negative) interest rates (2016Q1); Global equity prices declined significantly amid increasing uncertainty related to developments in China, uncertainty regarding the UK's EU referendum, a sharp reduction in the oil price and worsened global macro outlook (notably in EMEs). Such declines has been tempered by considerable policy accommodation, in particular the ongoing monetary policy stimulus of major central banks (both conventional in the form of low policy rates and unconventional in the form of negative rates and/or asset purchase programmes) (2016Q1, ECB EB 2/2016, 3/2016 and ECB FSR May 2016)
		2016Q2	-5.74	44.34	**Uncertainty relative to the UK's EU referendum and UK Brexit (06/2016); Black Friday stock market crash (24/06/2016);** EA and US equity prices experienced high volatility and declined following the outcome of the UK referendum on EU membership as political uncertainty in the European Union increased, notably concerning the willingness to push through growth-enhancing structural reforms going forward. Such declines has been tempered by considerable policy accommodation, in particular the ongoing monetary policy stimulus of major central banks (2016Q2, ECB EB 5/2016 and ECB FSR May 2016 and Nov. 2016)
l		2016Q3	5.72	76.04	**BoE cut interest rates and expands QE to ward off Brexit effects (08/2016);** EA and global stock markets experienced lower volatility and hence weathered well the immediate impact of the UK vote to leave the EU potentially helped by an environment of accommodative monetary policy. However, prospect of unforeseen shifts in market expectations relating to US monetary policy or inflation and heightened political uncertainties in advanced economies (notably concerning the consequences of the UK Brexit on the EU and the US elections) weigh on stock markets (2016Q3, ECB EB 8/2016 and 1/2017 and ECB FSR Nov. 2016)
		2016Q4	X	X	Trump election's temporary uncertainty (11/2016); Fed's interest rate hike (12/2016); Berlin terrorists attacks (12/2016); Italian bank Monte Paschi bail-out (12/2016); Trump election (12/2016); EA and global stock markets remained relatively calm and improved slightly, against the backdrop of timid improvements in the global economic and inflation outlook, mainly fuelled by developments in the US economy, a steepening of the yield curve and a reported perception among market participants of a less stringent finalization of the Basel III framework. (2016Q4, ECB EB 7/2016, 8/2016 and ECB FSR Nov. 2016)

NB: EUR billions for EIFS. For gross outflows, surges (stops) are in dark green (dark red). For gross inflows, flights (retrenchments) are in dark green (dark red).

D. Data

Table D specifies the series used in the paper.

Table D: Data

Variable		Source	Mnemonic	Transformation
Gross EIFS inflows	$\dfrac{EIFS_t^{in}}{GDP_t^{LU}}$	BCL STATEC	Table 07.06 http://www.statistiques.public.lu/fr/economie-finances/index.html	Ratio: $EIFS_t^{in}/GDP_t^{LU}$
Gross EIFS outflows	$\dfrac{EIFS_t^{out}}{GDP_t^{LU}}$	BCL STATEC	Table 07.06 http://www.statistiques.public.lu/fr/economie-finances/index.html	Ratio: $EIFS_t^{out}/GDP_t^{LU}$
Global risk aversion	VIX_t	FRED	VIXCLS	Log: $log(VIX_t)$
Global economic policy uncertainty	$EPUI_t^{global}$	http://www.policyuncertainty.com/	$EPUI_t^{global}$	Log: $log(EPUI_t^{global})$
Global stock price index	SP_t	Bloomberg	MSCI World Developed	Log-difference: $log(SP_t/SP_{t-1})$
Global liquidity	$M0_t^{EA}/GDP_t^{EA}$	ECB-SDW/FRED	ILM.M.U2.C.LT00001.Z5.EUR/EUNNGDP	$\dfrac{M0_t}{GDP_t} = \sum_{k=1}^{4} \dfrac{GDP_t^k \times M0_t}{\sum_{k=1}^{4} GDP_t^k}$
	$M0_t^{JP}/GDP_t^{JP}$	BoJ; FRED	http://www.boj.or.jp/en/statistics/boj/other/mb/index.htm/ ; JPNNGDP	
	$M0_t^{UK}/GDP_t^{UK}$	FRED;FRED	MBM0UKM/UKNGDP	
	$M0_t^{US}/GDP_t^{US}$	FRED;FRED	BOGMBASE;GDP	Log-difference: $log(M0_t/GDP_t/M0_{t-1}/GDP_{t-1})$
Global government spending	GSP_t^{EA}/GDP_t^{EA}	Eurostat	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gov_10a_main&lang=en	$\dfrac{GSP_t}{GDP_t} = \sum_{k=1}^{4} \dfrac{GDP_t^k \times GSP_t^k}{\sum_{k=1}^{4} GDP_t^k}$
	GSP_t^{JP}/GDP_t^{JP}	OECD	https://data.oecd.org/gga/general-government-spending.htm	
	GSP_t^{UK}/GDP_t^{UK}	Eurostat	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gov_10a_main&lang=en	
	GSP_t^{US}/GDP_t^{US}	FRED; FRED	GEXPND;GDP	Log-difference: $log(GSP_t/GDP_t/GSP_{t-4}/GDP_{t-4})$
Global interest rate	i_t^{EA}	ECB-SDW	FM.M.U2.EUR.4F.BB.U2_10Y.YLD	*Average:* $i_t^{10y} = (1/4)*(i_t^{EA}+i_t^{JP}+i_t^{UK}+i_t^{US})$
	i_t^{JP}	Eurostat	Economy and finance/Interest rates/Long-term interest rates/Government bond yields – 10years maturity	
	i_t^{UK}	FRED	IRLTLT01GBM156N	
	i_t^{US}	FRED	DGS10	
Oil prices (Brent)	OP_t	FRED	DCOILBRENTEU	Log-difference: $log(OP_t/OP_{t-1})$

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