Cross-border Workers and Financial Instability: A Frequency Domain Causality Analysis Applied to the Luxembourg Financial Center

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Abstract

This paper aims to examine the causal relationship between workers (cross-border and resident workers) and financial instability in the Luxembourg financial center, using a Granger causality test in the frequency domain. The evidence shows that cross-border workers are more sensitive to financial shocks than resident workers. In addition to the causal relationship there is a "nonlinear" reaction: one smooth in the short term and a second more structural one in the long term.

Keywords

Frequency domain; Granger causality; Cross-border workers; Financial shocks

JEL

G01 ; J61

1. Introduction

The financial crisis of 2007 to 2009 highlighted the importance of understanding the effects that financial market conditions can have on the real economy and more particularly on the labor market. The consequences of the 2007-10 crisis were very significant in countries where the financial sector played a large part in the economy as in London, New York, Luxembourg and Dublin. Between the end of 2007 and the end of 2009, around 36,000 jobs were lost in the finance industry in New York City; this represents a loss of 12%. Alan Hevesi of the Office of the New York State Comptroller summarized this sensitivity of labor and GDP to the financial cycle in the following way: "When Wall Street does well, New York City and New York State do well" (Cappelle-Blancard, Tadjeddine, 2010).

In this article, we focus on the sensitivity of market labor to financial crises in Luxembourg. Luxembourg is a global financial center, specializing in banking, mutual funds and insurance. In November 2013, the total assets of Luxembourg's financial sector amounted to nearly 736 billion euros, more than 17 times the country's GDP. The sector is, by the volume of its assets, the largest in the eurozone if they are expressed as a percentage of GDP. The financial and insurance sector represented more than 28% of GDP in 2015, while it represented "only" 10% in Switzerland and 5% in France (OECD (2017)), and 10% of employment. The financial sector accounted for up to one third of GDP in 2006 and 2007. A country with an extreme specialization is dangerously exposed to financial shocks. Logically, the effect of the subprime crisis was significant in Luxembourg and the drop of real GDP in 2008-2009 amounted to 9.2% (Mathä et al. (2016)). But unlike New York, the rate of unemployment increased slightly from 4% in 2008 to 5.8% at the end of 2009; the maximum – 7.2% – was reached in 2014. The sensitivity of the labor market in Luxembourg to financial shocks seems to be a "nonlinear" relationship with two effects: one smooth in the short term and a second more structural one in the long term.

These findings lead us to examine the specificities of the labor market in Luxembourg.

Firstly, specialization in financial activities requires a highly skilled workforce. Mathä et al. (2016) noted that 55% of employees are considered highly skilled.

Secondly, Luxembourg is a small country which lacks in workforce and needs migrant workers. Mathä et al. (2016) remarked that Luxembourg is the EU country with the highest share of immigrants and only about one fifth of employees are Luxembourg nationals. In 2007, 55% of employees in Luxembourg were cross-border workers, living in France, Germany, and Belgium. Mathä et al. (2016) also noted that cross-border workers are overrepresented in temporary contracts and

internationally-oriented sectors (e.g. manufacturing, finance, business services and transportation). These sectors were the most exposed to the crisis.

Thirdly, the Luxembourg labor market is highly regulated by a tripartite social dialogue (including government, employers' and trade unions' representatives). The regulation affects wages and conditions to cut jobs. Because of this social dialogue, companies prefer to reduce working hours and not hire new workers rather than decrease workers' wages or lay people off (Mathä et al. (2016)).

These three specific features of the Luxembourg labor market are useful in suggesting explanations for the facts presented in graphs below. In the short term, companies try to keep their skilled workers as they foresee difficulties in recruiting new employees. Dismissals occur only when companies are severely affected by the long recession. But, during economic downturns, cross-border workers are at higher risk of losing their job than native workers. Much has been written analyzing the effects of recessions on migration, with the conclusion that migrants have a greater reaction to economic shocks such as recession than the resident population (Dustsmann et al. 2010 ; Findlay et al. 2010; Fromentin et al. 2017). Cross-border workers in Luxembourg could be a variable for adjustment of the labor market during financial crises. This thesis is consistent with the work on the persistence of the fragmentation of the labor market despite the desire for European integration (Pires et Nunes, 2018).

Our article's main contribution is to propose an original econometric investigation of the frequency causality between cross-border workers and financial shocks in Luxembourg. The article evaluates the differential impact of shocks in the short term and long term on cross-border workers using spectral analysis.

The next section summarizes the methodology. In section 3, the data are briefly presented. Section 4 discusses the findings. The final section concludes the paper.

2. **Methodology**

To test for causality between the stock market and cross-border workers, we use frequency domain or spectral analysis (like Gómez-González *et al.* (2014) for example), building on Granger (1969), Geweke (1982) and Hosoya (1991), and developed by Breintung and Candelon (2006)[1]. The Granger causality at any frequency (ω) can be tested, using the spectral density of the "effect" variable, which is based on the moving-average representation of the VAR. The test can be used to determine

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[1] They impose linear restrictions on the autoregressive parameters in a vector autoregression (VAR) model.

whether a particular component of the "cause" variable at frequency ω is useful in predicting the component of the "effect" variable at the same frequency one period ahead (Tastan, 2015). Clearly, the strength and direction of the causality can be different for each frequency (short-run (temporary) and long-run (permanent) causality). This approach investigates whether the existence as well as the direction of causality is frequency-dependent, and it enables the identification of the exact lag length, regardless of the causality direction.

Based on the Breintung and Candelon (2006) methodology, we test the frequency causality between workers (cross-border workers and resident workers; $Work$ in the equation) and financial instability (Fin in the equation) in the following way:

$$\begin{cases} Work_t = \alpha_1 Work_{t-1} + \cdots + \alpha_p Work_{t-p} + \beta_1 Fin_{t-1} + \cdots + \beta_p Fin_{t-p} + \varepsilon_t \\ Fin_t = \alpha_1 Fin_{t-1} + \cdots + \alpha_p Fin_{t-p} + \beta_1 Work_{t-1} + \cdots + \beta_p Work_{t-p} + \varphi_t \end{cases}$$

3. Data description

We used monthly data between 1996M01 and 2017M09 (261 observations). Data about cross-border (C.B.) worker and resident flows (expressed as an annual change to take into account the seasonality of the labor market[2]) in Luxembourg were collected from STATEC[3]. The Euro Stoxx index and the Dow Jones index (expressed in logarithm) were collected from Yahoo Finance. In Figure 1, there appears to be a correlation between Euro Stoxx and flows of workers (particularly cross-border workers).

Fig. 1. Euro Stoxx, cross-border and resident workers

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[2] Like the Bureau of Labor Statistics (for example), we removed the influences of predictable seasonal patterns.
[3] The STATEC definition of the variable C.B. workers is "non-residents working on national territory".
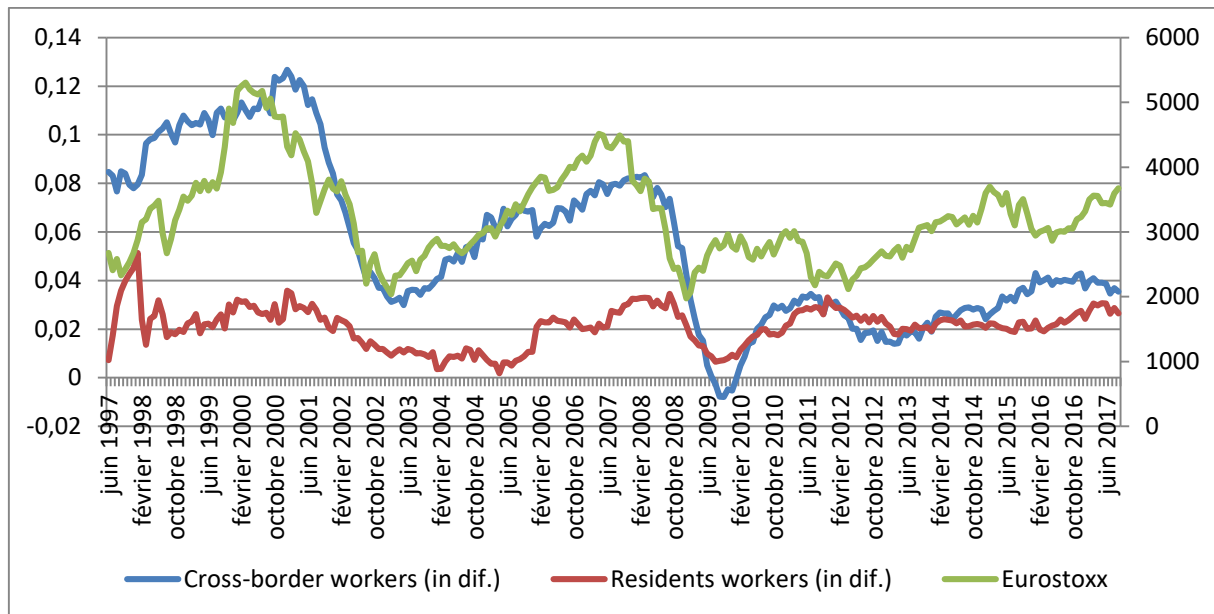
4. Results

The stationarity tests (Zivot et Andrews (1992), Perron (1997a, 1997b) and Lee et Strazicich (2004)[4]) show contradictory results. For sake of convenience, we suggest mixing I(0) and I(1) variables, as suggested by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996), by augmenting the vector autoregressive model (VAR) with one lag. The order of the VAR model is determined with AIC criterion. The conventional time-domain causality tests within the VAR framework show a unidirectional causality from stock market variables to "C.B. workers" and "Resident workers" and no evidence of a reverse effect[5].

Table 1. Pairwise Granger Causality Tests

| Null Hypothesis:	F-Stat	Prob.
Euro Stoxx ≠> C.B. workers	3.064	0.017
C.B. workers ≠> Euro Stoxx	0.438	0.780
Dow Jones ≠> C.B. workers	2.626	0.035
C.B. workers ≠> Dow Jones	1.438	0.221
Euro Stoxx ≠> Residents	3.782	0.005
Resident workers≠> Euro Stoxx	0.414	0.797
Dow Jones ≠> Residents	2.567	0.0387
Resident workers ≠> Dow Jones	0.959	0.430

Notes: This table tests the null hypothesis of no Granger causality. The degrees of freedom are determined by SIC.

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[4] The detailed results for the stationarity tests are available upon request.
[5] We get the same conclusions for resident workers.

Figures 2 to 5 show the results of performing a causality test between cross-border workers, resident workers and equity market variables (Euro Stoxx and Dow Jones) at the frequency domain. This methodology enables the decomposition of the causality test statistics into different frequencies. The causality measure between the series for all frequencies ($\omega \in (0, \pi)$) along with the 10% and 5% critical value is represented with a horizontal red and green (respectively) line. The frequency parameter (ω) is used to calculate the length of the period T measured in months (where $T = 2\pi/\omega$) and ω is compared to the 5% critical value of a x^2 distribution with 2 degrees of freedom (5.99). The frequency-domain causality test offers a broader view of the direction and strength of causality in different frequencies (like short-run and long-run causality). With monthly sampling frequency, the smallest observable periodicity is two months.

The Granger causality of the stock price index for cross-border workers and residents in Luxembourg is significant only at low frequencies (periodicities larger than 5 months). The Luxembourg labor market is resilient in the short term to equity shocks: financial fluctuations impact the cross-border workers only after five months. The sensitivity of the Luxembourg labor market also differs following a European equity shock and an American equity shock. There is no influence in the short term in the case of an American shock and the impact occurs later.
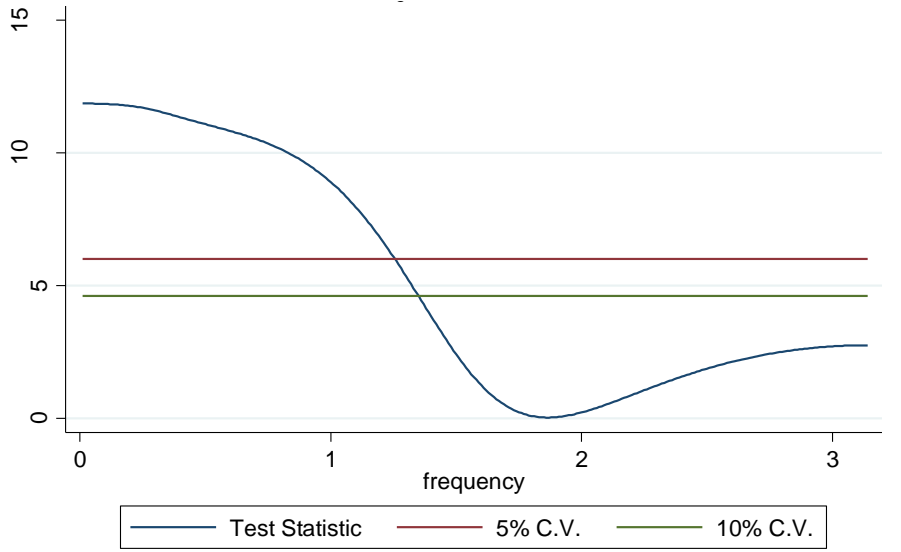

Fig. 2. "Euro Stoxx" Granger causes "C.B. workers" within (0.00, 1.25) frequency bands, corresponding to wave lengths beginning at 5.02 months. The figure indicates that the null hypothesis of no causality is rejected when ω < 1.25 (5 months).

Figure 3. Dow Jones → Cross-border workers
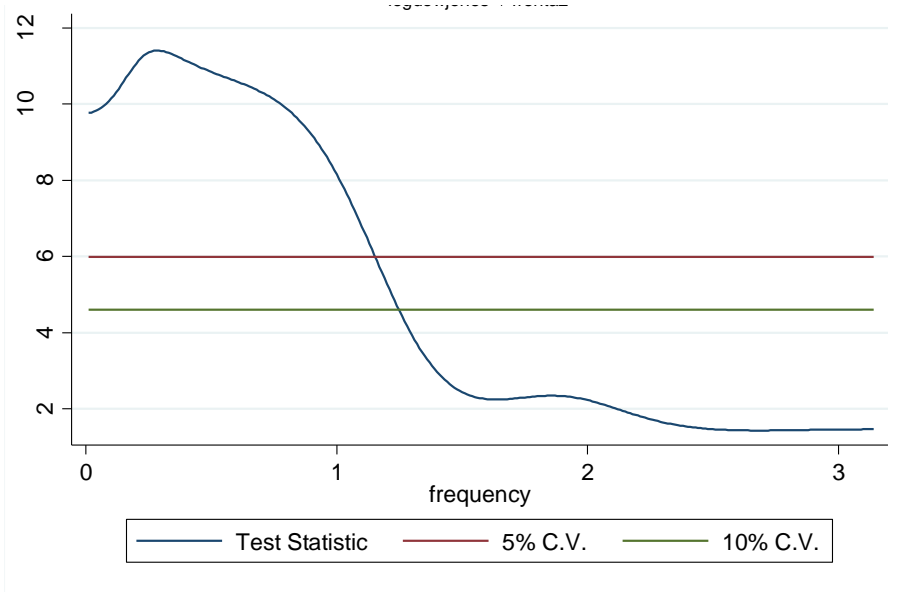
Fig. 3: "Dow Jones" Granger causes "C.B. workers" within (0.00, 1.16), corresponding approximatively to 5.41 months.
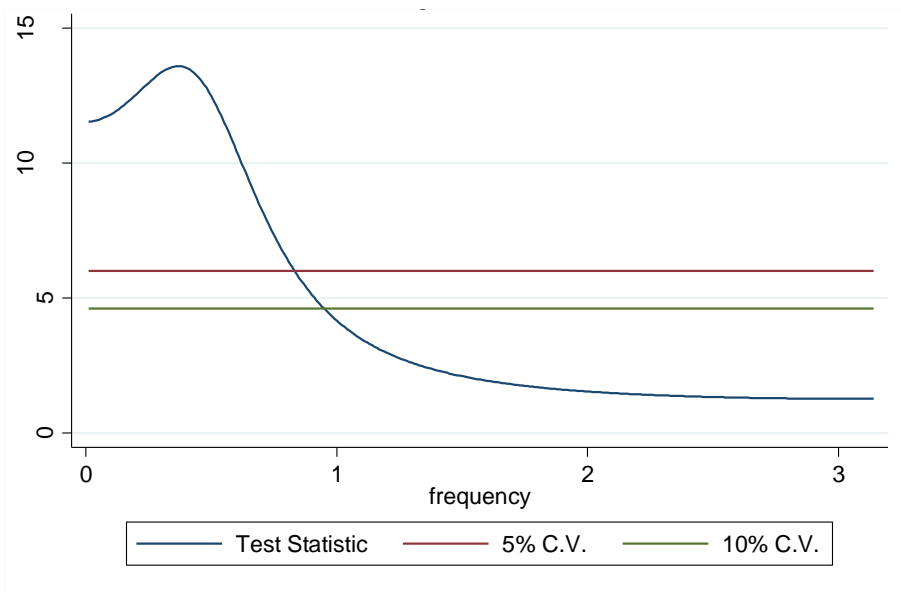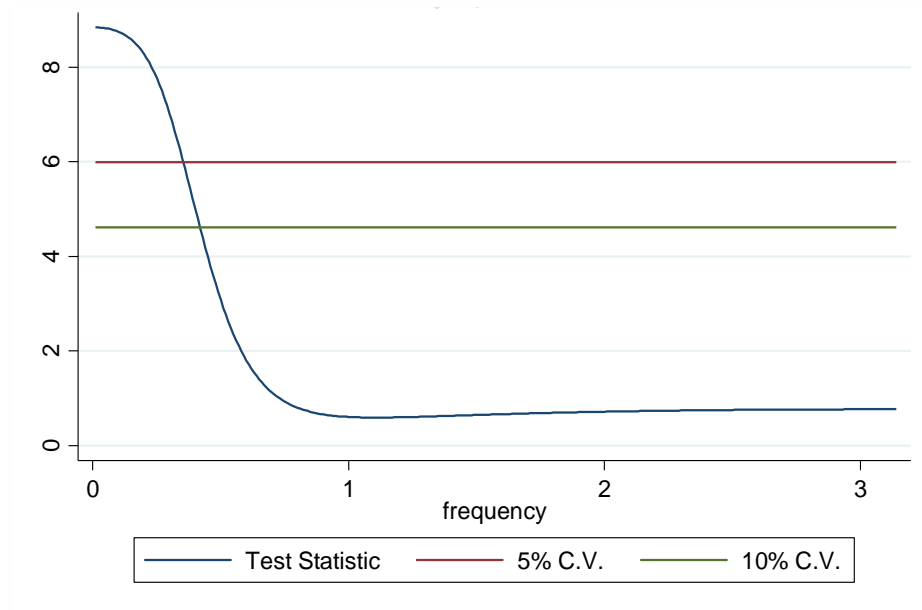
Fig. 4 and 5 The null hypothesis of no causality (respectively "Euro Stoxx" and "Resident workers"; "Dow Jones" and "Resident workers") is rejected when $\omega < 0.84$ (7.5 months) and $\omega < 0.37$ (17 months). Concerning the reverse causality, the null hypothesis is not rejected (in all cases).

Finally, like Gradojevic (2012), we examined the spectral causal interactions and the robustness of the results[6] with respect to the time period. The database was divided in two: before January 2010 (168 observations) and after January 2010 (93 observations), to analyze the interactions during a period marked by financial crises and during a quieter period[7]. For cross-border workers, the null hypothesis of no causality (respectively before and after 2010) is rejected when $\omega < 1.14$ (5.5 months) and when $\omega < 0.70$ (9 months). Before 2010, the null hypothesis of no causality for residents is rejected when $\omega < 0.78$ (8 months), and after 2010, the null hypothesis cannot be rejected. The causal impact of the stock market index on cross-border workers and residents in Luxembourg remains unidirectional[8]. Therefore, these results are in line with the previous conclusions and we note that the effect occurs more quickly in times of financial instability, and especially for cross-border workers.

5. Conclusion

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[6] We also get almost similar results using CAC40 and DAX variables.
[7] January 2010 marks the end of the decline of cross-border workers (see Fig. 1).
[8] The conventional time-domain causality test presents the same conclusions.

The goal of this study was to investigate the causality relationship between equity prices and a segmented labor market in an international financial center. The case of Luxembourg is very relevant because of the extreme specialization in banking and the financial industry and because of the significance of cross-border workers. Our main findings confirm the differential impact of an equity shock on cross-border and resident workers and the existence of a non-significant impact in the short term and a significant impact in the long term. We also noted a different causality relationship following a European or an American equity shock.

All of the preceding findings complement the current debate about the fragmented European labor market and the real effects of financial instability.

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