

Frimpong, Fauna Atta; Akwaa-Sekyi, Ellis Kofi; Anyars, Ibrahim Suleman; Peprah-Yeboah, Akua; Sole, Ramon Saladrighes

Article

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Cogent Economics & Finance

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Suggested Citation: Frimpong, Fauna Atta; Akwaa-Sekyi, Ellis Kofi; Anyars, Ibrahim Suleman; Peprah-Yeboah, Akua; Sole, Ramon Saladrighes (2024) : Macroeconomic factors and venture capital market liquidity: evidence from Europe, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-19,
<https://doi.org/10.1080/23322039.2024.2401477>

This Version is available at:

<https://hdl.handle.net/10419/321599>

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To cite this article: Fauna Atta Frimpong, Ellis Kofi Akwaa-Sekyi, Ibrahim Suleman Anyars, Akua Peprah-Yeboah & Ramon Saladrighes Sole (2024) Macroeconomic factors and venture capital market liquidity: evidence from Europe*, Cogent Economics & Finance, 12:1, 2401477, DOI: [10.1080/23322039.2024.2401477](https://doi.org/10.1080/23322039.2024.2401477)

To link to this article: <https://doi.org/10.1080/23322039.2024.2401477>



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Macroeconomic factors and venture capital market liquidity: evidence from Europe*

Fauna Atta Frimpong^a , Ellis Kofi Akwaa-Sekyi^b , Ibrahim Suleman Anyars^c ,
Akua Peprah-Yeboah^b  and Ramon Saladrigues Sole^a 

^aDepartment of Business Administration, University of Lleida, Lleida, Spain; ^bDepartment of Accounting and Finance, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; ^cDepartment of Economics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

ABSTRACT

The relationship between macroeconomic factors and stock market liquidity is known but not the same can be said of macroeconomic factors and VC market liquidity. This study investigates whether there is a cointegration between macroeconomic factors and VC market liquidity and examines how macroeconomic factors affect VC market liquidity. We perform a panel fully modified OLS regression analysis after carrying out panel cointegration on a country-level dataset of 22 EU/EEA countries from 2000 to 2020. There is a long-run covariance between VC market liquidity and macroeconomic variables. Specifically, a 1% expansion in the size of the economy would lead to 0.652%, 0.927%, 0.661%, 0.723%, and 0.755% increase in VC market liquidity measured by exits through trade sales, IPOs, sales to PE firms, financial institution and MBOs, respectively. The European VC market is progressively increasing in liquidity as can be seen in the UK, France, and Germany. We report that as the size of the economy and money supply increases, VC market liquidity increases. Interest rate is significantly inversely related to VC market liquidity. The result is mostly significant for some exit strategies such as trade sales and IPOs. However, on the whole, inflation and unemployment do not significantly relate to VC market liquidity. This article has practical implications for venture capitalists and investors. It informs investors on which exit route has a significant relation with macroeconomic variables in Europe. The study effectively shows the aggregate impact of the macroeconomic conditions which is usually not the case with firm-level data.

IMPACT STATEMENT

In well-developed financial markets, the venture capital (VC) market complements the stock market in providing equity finance. However, the VC market remains underdeveloped even in Europe. This paper attempts to address this market failure by exploring the liquidity of the VC market and its relationship with macroeconomic variables to provide some assurances to market participants. To provide reasonable assurance of minimal losses during the exit stage of VC activities, the VC market in Europe may exit through IPOs, trade sales, Mezzanine financing, MBOs, and sales to private equity firms and financial institutions. We confirm a cointegration between macroeconomic factors and VC market liquidity. The study finds that as the size of the economy and money supply increases, VC market liquidity increases. Interest rate is significantly inversely related to VC market liquidity. Investors and potential investors need not worry about inflation and unemployment because they do not significantly affect VC market liquidity. The paper informs market participants that trade sales and IPOs are the most popular VC exit routes and for that matter, very liquid in Europe.

ARTICLE HISTORY

Received 25 January 2024
Revised 21 August 2024
Accepted 29 August 2024

KEYWORDS

VC market liquidity; VC exits; macroeconomic factors; cointegration; FMOLS

SUBJECTS

Finance; Economics; Business, Management and Accounting

CONTACT Ellis Kofi Akwaa-Sekyi  ekakwaa-sekyi@knust.edu.gh, el7teen@yahoo.com  Department of Accounting and Finance, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

*This paper is part of the thesis of the lead author and his supervisor. Even though this version approaches the research from a different perspective and therefore adopts a new methodology, some portions of the paper may be similar to the thesis.

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1. Introduction

Venture capital (hereafter VC) has driven innovation and entrepreneurial development, making an immense contribution to economic growth since the early 2000s (Pradhan et al., 2017). Thus, it has been the subject of scholarly debate over the past two decades, particularly in terms of how the challenges that confront the market can be addressed. To this end, the liquidity and exit strategies of VC are two areas of interest that have been on the radar of academic investigators (Franzoni et al., 2012).

Literature suggests a link between economic conditions and VC market liquidity and thus the ease of market exits. Cerutti et al. (2019) indicate that a liquid market allows investors to invest and withdraw their investment easily. An illiquid VC market poses serious concerns for industry players as it could limit the development of the market (Hege et al., 2009). Although both academia and practitioners acknowledge the interaction of economic and market liquidity factors to sustain continuous VC exits, a robust empirical investigation of the direction of causation between these variables appears lacking. This study attempts to close this gap in the literature by examining the influence of macroeconomic factors on VC market liquidity. In addition, this study investigates whether a long-run relationship exists between macroeconomic variables and VC market liquidity.

An important research stream shows that the development of VC markets is linked to macroeconomic factors such as GDP, labor market development, and stock market performance (e.g. Gompers & Lerner, 2000). An overlooked macroeconomic lever is monetary policy and, in particular, the level of interest rates set by central banks. Prior research in monetary economics shows that central bank rates affect consumption and asset prices (e.g. Gilchrist & Leahy, 2002), as well as entrepreneurship and economic growth (e.g. King & Levine, 1993; Shane, 1996). However, despite the direct association between interest rates and the cost of capital, entrepreneurial finance studies rarely consider monetary policies.

It is feared that the prevailing economic environment may not provide the necessary market conditions to facilitate VC exits in Europe, since the liquidity of the market has the potential to make it easy for investors to exit their investment without loss of value. Even though Venture capitalists (VCs) often adhere to rules that guide them in managing liquidity concerns, factors affecting the liquidity of the market and exits in Europe remain relatively unsettled due to limited studies.

This study draws inspiration from the work of Hege et al. (2009), who reported that low returns on VC investments pose a hindrance to a strong industry in Europe. They further revealed that the absence of attractive and liquid markets for VC exits, especially IPO, could be traceable to the relative lack of VC funding in Europe.

Macroeconomic factors play an essential role in determining the liquidity of a market, and Central bank monetary policies as well as government fiscal policies are significant determinants of market liquidity (Chowdhury et al., 2018). Liquidity appears to be the leading indicator of real economy according to Apergis et al. (2015) and is also thought to be a genuine predictor of future economic growth (Smimou, 2014). The illiquid nature of a market could be a rationale for recessions and market crashes (Jaccard, 2013). Therefore, this study attempts to examine the influence of macroeconomic factors on VC market liquidity and exits in Europe, thus contributing to the existing body of literature and bringing originality value.

In addition, because we have considered macroeconomic factors to observe their probable influence on VC exits, this article provides a thorough view of the set of factors that affect VC exits and the relationship that each factor shares with the exits in Europe. These findings will enable VCs to anticipate appropriate strategies to maintain adequate exit liquidity while incurring minimum losses in investments.

There are at least seven (7) exit strategies for European VC funds. While IPO and trade sale exits have been extensively researched (Dong et al., 2020) academic research has rarely focused on the remaining exits to comprehensively ascertain its liquidity or illiquidity in Europe from a macro perspective relative to macroeconomic factors. We focused on answering two questions in this study. First, is there a long-run relationship between macroeconomic factors and VC market liquidity in Europe? Second, how do the macroeconomic factors influence VC market liquidity?

These questions are important for practical and theoretical reasons. In practical terms, investors in the VC market prefer investing in an environment that provides them with the opportunity to easily exit

their investment as and when necessary and recover their investment as well as returns on their investments. Again, existing conditions that affect the liquidity or illiquidity of the VC market are crucial for understanding those conditions relative to macroeconomic factors. Furthermore, every VC contracting agreement requires the consideration of a preferred exit route for investment; therefore, this study points to an additional viable exit option for European VC investors. In addition to its practical importance, the above questions contribute to entrepreneurial finance research that seeks to understand the influence of macroeconomic factors on VC market liquidity (Yang, 2018).

This study contributes to the financial market liquidity discourse from the perspective of VC financing in Europe. We provide empirical evidence that interest, size of the economy, and money supply significantly affect VC market liquidity in the long-run. The contributions of this study are necessary because they help to address the aggregate impact of macroeconomic conditions, which is usually not the case with firm-level data.

The rest of the paper is organized as follows: literature review under various headings, methodologies, results, discussions, and conclusions.

2. Literature review and hypothesis development

2.1. Overview of venture capital exits

VC exit activities are surrogates for VC market liquidity and the economy in general (Chung et al., 2015). Their fundamental importance is exemplified by the influence of macroeconomic factors on required returns (Espenlaub et al., 2015; Félix et al., 2013) thus implying a suspected relation between market liquidity and macroeconomic performance (Chowdhury et al., 2018). Generally, the prevailing economic conditions in a country may influence the financial market, but little is known about this innovative equity financing market. Therefore, a better understanding of the relationship between economic conditions and the VC market could stimulate investor confidence and inform better capital market investment decisions because it is reported that in Spain, VC provides alternative innovative finance during the financial crisis (Frimpong et al., 2022).

Prior research on some macroeconomic variables and VC exits focuses on the US or Asian VC industry or regional blocks that aggregate the data and therefore do not tell what pertains to Europe (Espenlaub et al., 2015). Other studies conducted in Europe (Lahr & Mina, 2014) and the US (Nguyen & Vo, 2021) concentrate on the liquidity of investment assets and not market liquidity. Studies have revealed that macroeconomic factors are likely to impact VC exits. For example, Espenlaub et al. (2015) and Félix et al. (2013) find that macroeconomic factors are likely to impact cross-border exit activities. VC firms invest primarily with an exit plan spanning between 2 and 7 years, therefore, exit plays a critical role in a VC firm, as successful exit enables VC firms to develop (Humphery-Jenner & Suchard, 2013). Exiting comes in the form of divestment or liquidation, which are often considered the last and final stages of VC contracting relationships. There are exit strategies that VCs may consider before an investment is made in a firm; however, the most commonly used exits in Europe are IPO and trade sales (European IPO Report, 2020). These two exit strategies have been extensively studied in Europe, but little research has been done regarding the remaining exits available to European VC funds. This study examines the various exits available to European VC funds from a macro perspective, relative to macroeconomic indicators in Europe.

Cummings (2010) provides five principal VC exit strategies (IPO-where majority of the company's shares are sold to the public; acquisition exit-in which the entire company is bought or acquired by a third party; secondary sale-in which only the VC firm shares are sold to a third party while the entrepreneur maintains its shares; buyback, in which the entrepreneur buys back the shares held by the VC firm; and write-off, in which the VC firm decides to walk away from the investment. DeTienne and Chirico (2013) in line with previous studies, also provide a theoretical overview of exit strategies in the VC relationship. The authors report five probable exit strategies listed in order of preference for VCs. They include IPOs, acquisitions, secondary sales, buybacks, and write-offs. The VC process ends with an opportunity for the VCs to fully exit an investment by divesting all of its shares or partially exiting by selling a percentage of its shares. This is possible in instances where the conditions for divestment become

inevitable. Previous research indicates that successful and timely exits help in the recycling of VC funds for new investments (Esenlaub et al., 2015), improve the reputation of the VC firm (Useche & Pommet, 2021), and encourage fundraising activities of VC firms (Gemson & Annamalai, 2015). Schwenbacher (2008) on his part, presents evidence that supports the idea that an IPO as an exit route may be limited to the most promising ventures, while a trade sale seems to represent a more general exit route, that is, for both more and less promising ventures. He further suggests that, concerning exit choices, the likelihood of venture-backed companies going public is affected by the number of financing rounds, investment duration, and reporting requirements of the investee firm to VCs.

Guo et al. (2015) in their study provide evidence suggesting that start-ups backed by corporate VC funds remain in the VC contractual relationship for a longer period before exiting and receiving larger amounts than those backed by Independent VC funds. They further indicate that although a longer duration may lead to a higher likelihood of an exit through an acquisition, a larger investment increases the probability of an IPO exit. An earlier study by Esenlaub et al. (2015) investigates VC exits in domestic and cross-border investments by measuring the time from the date on which a VC firm invests in a given portfolio company to the date on which the VC firm exits this investment. They show that cross-border investments exit more quickly than domestic investments and that these differences can be explained by the impact of macro variables on the time of VC exit. These studies appear consistent with Bhattacharjee et al. (2009) study indicating that economic variables have both positive and negative influences on exiting activities.

Achleitner et al. (2012) provides an empirical analysis of private equity firms' decisions on exit channels for their portfolio firms in North America and Europe between 1995 and 2008. The authors find that secondary sale buyouts deliver rates of return that are equal to those achieved through public exits. They again report that portfolio companies with greater debt capacity are more likely to be sold through secondary buyouts and that increases in both the liquidity of debt markets and the amount of undrawn capital commitments to the private equity industry increase the probability of exit through secondary buyouts. Finally, Esenlaub et al. (2015) demonstrate that the common way for VCs to exit an investment is by staging their financing in several rounds, as it enables them to exit each financing round as and when it matures.

2.2. Scope of VC market liquidity

VC market liquidity allows VC firms to cash out some or all of their ownership shares in an investment (Frimpong et al., 2022; Schwenbacher, 2010). Evidence suggests that VCs adjust their investment decisions according to the liquidity conditions in IPO markets (Shuwaikh et al., 2024). In periods where the VC market appears illiquid, VCs invest more in high-tech and early-stage firms to defer exit requirements but would invest more in later stages when the market is deemed liquid (Esenlaub et al., 2015).

The theoretical support for this study is derived from liquidity risk theory for VC exiting activities. Liquidity risk theory refers to the potential difficulty a given financial asset, security, or commodity would have to quickly trade in the market without incurring a substantial loss (Acerbi & Scandolo, 2008). Esenlaub et al. (2015) consider liquidity risk as the risk of not being able to effectively exit, thus being forced either to remain much longer than expected in a VC contractual relationship or to sell shares at a high cut price. The discourse on VC market liquidity produces insights that explain the concept of not being able to effectively exit an investment (Foucault et al., 2013). Some authors see VC market liquidity as the possibility of exiting by either listing the company on a stock market, finding a strategic buyer, or the likelihood of being able to divest the cost of immediacy (Cumming et al., 2006; Proksch et al., 2016). We adopt an operational definition for VC market liquidity as the ease with which a VC recoups the investment, which implies the availability of several exit avenues, such as IPOs, trade sales, sales to financial institutions, sales to private equity firms, and MBO.

Some studies have articulated the role of liquidity in explaining fundraising, investment, and returns in the VC market (Cumming et al., 2011, 2006). According to Chowdhury et al. (2018), macroeconomic factors are related to stock market liquidity. Macroeconomic factors convey useful information that guides investment decision-making (Bondareva & Zatrochová, 2014). VC firms often adjust their investment decisions according to the prevailing conditions in IPO exit markets (Gompers et al., 2020;

Shuwaikh et al., 2024). Ma et al. (2018) report that stock market liquidity and trading activity for all stocks listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange between January 1995 and June 2016, increased when market returns were positive. Thus, a relationship between trading activities and market liquidity is established.

Cumming and Johan (2012) investigate the state of VC before and after the crisis to ascertain the challenge often faced by VC investors in their attempt to obtain liquidity through the preferred and most profitable exit routes even before the crisis began. The authors find that the difficulties faced by VC investors caused a reduction in the available amount of VC investment. They further report that the huge amount of funds that flowed into the industry drove down returns, causing knock-on effects on fundraising and investment activities (Cumming & Johan, 2012). VC performance exhibited traces of weakness, thus making it difficult for VCs to exit an investment and forcing some VCs to extend the traditional life of their investments even before the financial crisis (Cumming & Johan, 2012). The ability of an investor to exit an investment depends on market conditions and the exit opportunities available in the VC market (Bertoni & Groh, 2014). For an exit to be successful, market liquidity is essential, since investors may have to decide whether to invest further in promising ventures or to do otherwise. Studying the liquidity of the VC market in Europe appears to be an arduous task because of insufficient information, hence the need for this study.

2.3. Macroeconomic variables and VC market liquidity

Macroeconomic variables are external factors that influence VC market liquidity but are not under the control of VC firm management. Some of these factors are the size of the economy (GDP), interest rate, inflation rate, money supply, and unemployment rate. According to Brenner et al. (2009), financial instruments respond to macroeconomic news and the extent of the macroeconomic conditions could have a major effect on the VC market. A liquid VC market provides investors with the opportunity to easily exit their investment (Andrieu & Groh, 2021). In contrast, favorable economic environment is expected to provide the necessary conditions to facilitate successful exits (Cumming & Johan, 2008). The illiquid nature of the VC market poses a serious threat to VC investors, thus making it impossible for VC firms to exit their investment (Hege et al., 2009). It is clear from the deliberations above that a relationship exists between the macroeconomic environment and VC market liquidity, and therefore, we hypothesize that:

H₁: There is a long-run relation between macroeconomic variables and VC market liquidity

2.3.1. Size of the economy (GDP)

GDP is one of the most common indicators used to gauge the health of a nation's economy. It is perhaps the most closely watched and important economic indicator for economists and investors alike because it represents the total value of all goods and services produced by an economy over a specific period. As a measurement, it is often described as the calculation of the total size of an economy. Waqas et al. (2015) find a relationship between macroeconomic factors and VC activity. Another study by Groh et al. (2010) further confirmed that GDP is significantly related to VC activity. Additionally, Yang (2018) showed that GDP growth potentially increases the likelihood of IPO exit. We, therefore, postulate that VC investors may pay attention to GDP because a significant percentage change in GDP, either up or down, could have significant impact on market activities. In general, a bad economy usually means lower returns for investors, which could translate into lower liquidity. From these deliberations, we hypothesize the following:

H₂: The size of the economy (GDP) has a positive influence on VC market liquidity

2.3.2. Interest rate

Interest rates could encourage or discourage borrowing/spending, which usually impacts businesses and economic activities in a country. Fundraising and the supply of funds are sensitive to interest rate changes and benefit significantly from lower interest rates (Bellavitis et al., 2023; Gaspar et al., 2008). VC activity tends to slow down when interest rates rise, and VC firms may hedge their interest rate risk

accordingly (Ning et al., 2015). Some studies reveal that the level of interest rates can influence VC activity. For instance, Félix et al. (2013) study reports that factors such as interest rates are expected to influence demand for venture capital.

A high inflation rate shows an unstable economy and the presence of internal economic pressure (Dornbusch et al., 1990) and also reduces the real value of income in the local currency for investment (Buckley et al., 2007). Low inflation, on the other hand, indicates internal economic stability, improves the liquidity of the VC market, and facilitates exits (Shahbaz et al., 2016). For example, Bonini and Senem (2009) analyze the macro and political determinants of venture capital investments around the world and indicate that high price levels could potentially hinder VC investment. A high inflation rate decreases currency value and increases the vulnerability of the VC market and that could in turn affect exits which is an important decision in a VC contracting relationship. High inflation rates decrease currency value and increase the vulnerability of the VC market, which affects exits as an important decision in VC contracting relationships (Egilsson, 2020).

VC activities are very sensitive to interest rate changes; therefore, lower interest rates will positively influence exits. Therefore, we expect a negative relationship and formulate the following hypothesis:

H₃: The relationship between interest rate and VC market liquidity in Europe will be negative.

2.3.3. Inflation

Inflation is typically a broad measure, such as the overall increase in the prices of goods and services in a country. A high inflation rate shows an unstable economy and the presence of internal economic pressure (Dornbusch et al., 1990) and also reduces the real value of income in the local currency for investment (Buckley et al., 2007). Low inflation, on the other hand, indicates internal economic stability, improves the liquidity of the VC market, and facilitates exits (Chowdhury et al., 2018). For example, Bonini and Senem (2009) analyses the macro and political determinants of venture capital investments around the world and indicate that high price levels could potentially hinder VC investment. A high inflation rate decreases currency value and increases the vulnerability of the VC market and that could in turn affect exits which is an important decision in a VC contracting relationship. High inflation rates decrease currency value and increase the vulnerability of the VC market, which affects exits as an important decision in VC contracting relationships (Egilsson, 2020). Therefore, we expect high inflation to negatively affect VC market liquidity and exits, and therefore hypothesize as follows:

H₄: There is a negative relation between inflation and VC market liquidity

2.3.4. Money supply

An increase in money supply at low interest rates leads to an increase in cash balances and discourages investment. Bellavitis et al. (2023) indicate that increased fundraising activities are a direct response to lower interest rates in the financial market. The money that the financial institution utilizes for its daily operations is termed demand (Werner, 2014). When an economy overheats, central banks raise interest rates and take other contractionary measures to slow down, thereby discouraging investment and depressing asset prices (Dorman, 2014). During a recession, the central bank lowers rates and adds money and liquidity to the economy, thereby stimulating investment and consumption and having a generally positive impact on asset prices (Lavoie, 2010). Samargandi et al. (2020) report that equity market and money supply variables do not predict the contributions of financial development in each BRICS member in boosting economic growth in the other member countries. New money goes to the market mainly as investment credits. Therefore, an increase in the supply of money works by lowering interest rates, increasing investment, and putting more money in the hands of consumers, making them feel wealthier, which would in turn stimulate spending and cause VC market liquidity to increase which may translate into more exits in a resilient economy. If money supply continues to increase, more money would be available to investors and positively affect VC exit. We, therefore, hypothesize as follows:

H₅: An increase in money supply would positively affect VC market liquidity and vice versa

2.3.5. Unemployment

Bunyaratavej et al. (2008) find that investment provides net employment opportunities for people. Therefore, a high unemployment rate in an economy represents a weak or failing economy (Li, 2013). Félix et al. (2013) analyzed the determinants of VC activity using aggregate data from 23 European countries and found that the unemployment rate negatively influences the VC market. A well-functioning VC market may spur employment creation, even under perfectly flexible labor markets, because labor supply might react positively to improved and efficient market possibilities. High unemployment shuts economic growth and may hurt VC exit (Li, 2013). The higher the unemployment rate, the slower the economic recovery (Li, 2013). Unemployment may bring about innovation, which may lead to an increase in alternative financing, such as VC activities. In low-performing economies, VC firms may consider secondary market activities to remain liquid. Thus, higher unemployment may have the potential to increase VC activity. Therefore, we expect a mixed relationship between unemployment and VC market liquidity, and hypothesize as follows:

H₆: The unemployment rate has a mixed relationship with VC market liquidity.

3. Data and Methodology

This study explored the influence of macroeconomic factors on VC exit liquidity in Europe. The macroeconomic factors include the size of the economy (GDP), inflation, interest rate, unemployment rate, and money supply. We proxy VC market liquidity by the amount realized in VC exits, such as trade sales, IPO, write-offs, mezzanine/loans, MBO, sales to PE firms, and sales to financial institutions (Lahr & Mina, 2014). We argue that the speed at which a venture capitalist can recoup investments is a function of exit strategy. Hence, the VC exit strategy is synonymous with the liquidity of the market because some exit strategies affect the speed and value realized. We collected annual country-level data for 22 European countries over the period 2000 to 2020 from the Invest Europe, World Bank financial, and OECD databases. The selection was limited to data availability and belonging to EU/EEA membership. The analyses excluded countries with less than 10 years of data on the variables of interest, thus making the dataset an unbalanced panel. Although the data show an initial 448 observations in the descriptive statistics, the regressions use 382 observations.

¹To account for the other variables that can explain VC exits, the model includes two control variables: political risk and capital gains taxes. The choice of control variables is informed by capital market theory, in which these variables and measures of financial economics are the most robust determinants of VC liquidity (see Table 1 for variable definitions and sources of data). Investors believe that government control can hurt or benefit them. This is especially true when a government elected into office will consistently be hostile to a sector, pushing down the market or causing it to run low (Bonini & Alkan, 2014). Again, political uncertainties generally reduce the market. Furthermore, lower taxes may influence market liquidity and impact exit possibilities (Da Rin et al., 2006). Taxes on income, profits, and capital gains are levied on the actual or presumptive net income of individuals; on the profits of corporations and enterprises; and capital gains, whether realized or not, on land, securities, and other assets. Excessive taxes on gains negatively affect VC market liquidity.

3.1. Variables

This section provides the economic motivation for the choice of the variables. Table 1 summarizes the definitions of the variables and their construction. Table 2 contains descriptive statistics for all variables used in the analysis.

3.2. Model specification

We employ panel cointegration and unit root tests before running the fully modified ordinary least squares (FMOLS). The study employed the STATA software for the analysis after mining the data in

Table 1. Summary of variable, expected relationship with dependent variable(s) and data source.

| Variable | Proxy/Measurement | Notation | Expected effect | Data Source |
|-------------------------------|--|-----------|-----------------|-------------------|
| Dependent Variables | | | | |
| Trade Sale | Total value of trade sale exits expressed in natural log | Tradesale | | Invest Europe |
| IPO | Total value of IPO exits expressed in natural log | IPO | | Invest Europe |
| Write-off | Total value of write-off exits expressed in natural log. | WRO | | Invest Europe |
| Mezzanine/loans | Total value of mezzanine/loans exits expressed in natural log. | Mezza | | Invest Europe |
| Sale to PE firm | Total value of sale to PE firm exits expressed in natural log. | SPEF | | Invest Europe |
| Sale to Financial Institution | Total value of sale to financial institution exits expressed in natural log. | STFI | | Invest Europe |
| MBO | Total value MBO exits expressed in natural log. | MBO | | Invest Europe |
| Independent Variables | | | | |
| Size of the economy (GDP) | GDP is the logarithm of annual GDP in Euros. | GDP | + | WDI of World Bank |
| Interest rate | Annual interest rate | INT | – | WDI of World Bank |
| Inflation | Annual percentage of inflation. | INF | –/+ | WDI of World Bank |
| Money supply | The logarithm of annual money supply in Euros. | MON | –/+ | WDI of World Bank |
| Unemployment | Annual unemployment rate | UNE | –/+ | WDI of World Bank |
| Control Variables | | | | |
| Political risk | | | | WDI of World Bank |
| Capital Gains Tax | | | | WDI of World Bank |

Table 2. Panel unit root test.

| Variables | Levin, Lin & Chu test | | ADF-Fisher Chi-square | | PP-Fisher Chi-square | |
|--------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|
| | Levels | 1 st Diff | Levels | 1 st Diff | Levels | 1 st Diff |
| Political Risk | –6.067*** | | 120.86*** | | 100.60*** | |
| Capital Gains Tax | –0.235 | 11.887*** | 78.500*** | 249.601*** | 56.47* | 265.440*** |
| LnSale to PE Fim | 10.51*** | | 150.2*** | | 181.72*** | |
| LnSale to Fin. Ins | 10.597*** | | 177.88*** | | 231.14*** | |
| LnMBO | –7.177*** | | 143.84*** | | 177.62*** | |
| LnMezzanine | –6.387*** | | 110.139*** | | 164.413*** | |
| LnTrade Sale | 1.548 | –27.251*** | 29.900 | 458.590*** | 37.311 | 458.801*** |
| LnIPO | 9.44** | | 135.00*** | | 156.23*** | |
| LnWrite-Off | –1.37643* | | 58.2015* | | 63.2327** | |
| LnGDP | –1.187 | 13.99*** | 58.90* | 222.06*** | 47.59 | 283.72*** |
| Interest rate | 1.17 | 12.46*** | 43.79 | 160.10** | 35.04 | 207.76*** |
| Unemployment | 3.028*** | | 74.77*** | | 21.62*** | |
| LnMoney Supply | 16.123 | –9.559*** | 3.996 | 222.75*** | 2.836 | 220.814*** |
| Inflation | 11.846** | | 165.464*** | | 160.934** | |

Excel. Panel cointegration allows for cross-sectional interdependence with different individual effects and deterministic trends (Streimikiene & Kasperowicz, 2016). To perform the FMOLS, we transformed the variables into logarithmic forms. We specify the equations for all the dependent variables as follows:

$$\ln(\text{TradeSale}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (1)$$

$$\ln(\text{IPO}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (2)$$

$$\ln(\text{Write-off}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (3)$$

$$\ln(\text{Mezzanine/loan}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (4)$$

$$\ln(\text{Sale to PE}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (5)$$

$$\ln(\text{Sale to Fin Inst}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (6)$$

$$\ln(\text{MBO}_i) = \alpha + \beta_1 \ln(\text{GDP}_{1i}) + \beta_2 \text{INF}_{2i} + \beta_3 \text{INT}_{3i} + \beta_4 \ln(\text{MON}_{4i}) + \beta_5 \text{UNEM}_{5i} + \beta_6 \text{CAP}_{6i} + \beta_7 \text{POL}_{7i} + \xi_i \quad (7)$$

In the model, index i ($i = 1, 2, \dots, 22$) specifies the countries, α specifies the constant term, β specifies the parameters to be estimated, and ξ specifies the error term. The notations used are listed in Table 1.

4. Analysis of results and discussion

4.1. Panel unit root tests

We performed a unit root test to check the stationarity of the variables. This avoids spurious regressions and ensures reliable and consistent estimates. We performed the following panel unit root tests: The Levin, Lin, and Chu test, ADF-Fisher Chi-square, and PP-Fisher Chi-square unit root tests. From Table 2, at least two of the three tests confirm the stationarity of the variables at Level $I(0)$. All the variables are stationary at the levels except for the size of the economy (lnGDP), interest rate, and capital gain tax. However, after converting the three variables by first difference and conducting unit root tests, these variables became stationary.

4.2. Descriptive statistics

The table of descriptive statistics captures the absolute values (in euros) of the exit strategies. From Table 3, trade sales have the highest mean of 364000; no wonder, it is the preferred exit route of most VC firms in Europe. However, the maximum single amount realized from VC exit was recorded using a Mezzanine (5200000). Write-off recorded the lowest mean exit amount (105000). Usually, write-off is a subordinate exit option plan, because VC investors end up losing significant amounts if they have to go by write-off. All the exit strategies comprising trade sales, IPO, write-offs, mezzanine, MBO, sales to PE firms, and sales to financial institutions have standard deviations higher than their means. This indicates that these variables had higher variability and were not normally distributed. For this and other reasons, the regression model uses the logarithmic form of market liquidity values. With the independent and control variables, apart from inflation, all other variables record lower standard deviations than their mean values. Usually, low standard deviation values indicate less variability, which ensures consistency.

4.3. Panel co-integration analysis

Table 4 presents the results of panel co-integration for the dependent variables. To execute FMOLS estimation, there is a need to establish long-term relationships among the variables. Table 4 shows seven hypotheses for panel cointegration, which include Panel (v-Stat, rho-Stat, PP-Stat, and ADF-Stat) and Group (rho-Stat, PP-Stat, and ADF-Stat). The results showed that all exit groups were cointegrated at a statistical significance of 1%. In summary, the panel (PP-Stat and ADF-Stat) and group (PP-Stat and ADF-

Table 3. Descriptive statistics.

| Variable | Obs | Mean | Std.Dev | Min | Max |
|-------------------------------|-----|----------|---------|-------|---------|
| Trade sale | 448 | 364000 | 654000 | 0 | 4420000 |
| IPO | 448 | 187000 | 447000 | 0 | 3710000 |
| Write-off | 448 | 105000 | 254000 | 0 | 2300000 |
| Mezzanine | 448 | 129000 | 422000 | 0 | 5200000 |
| Sale to PE firm | 448 | 304000 | 599000 | 0 | 3400000 |
| Sale to Financial institution | 448 | 66770.64 | 176000 | 0 | 1600000 |
| MBO | 409 | 65715.42 | 165000 | 0 | 2200000 |
| Size of economy | 462 | 13.266 | 1.447 | 10.05 | 17.38 |
| Unemployment rate | 462 | 7.758 | 4.315 | 1.8 | 27.5 |
| Inflation | 462 | 2.3 | 3.358 | -4.5 | 45.7 |
| Interest rate | 462 | 3.51 | 2.608 | -3.7 | 22.5 |
| Money supply | 462 | 5.831 | 1.395 | 2.129 | 11.685 |
| Political risk index | 440 | .814 | .454 | -4.7 | 1.76 |
| Capital gains tax | 455 | 25.051 | 9.034 | 10 | 49.66 |

Table 4. Panel cointegration results.

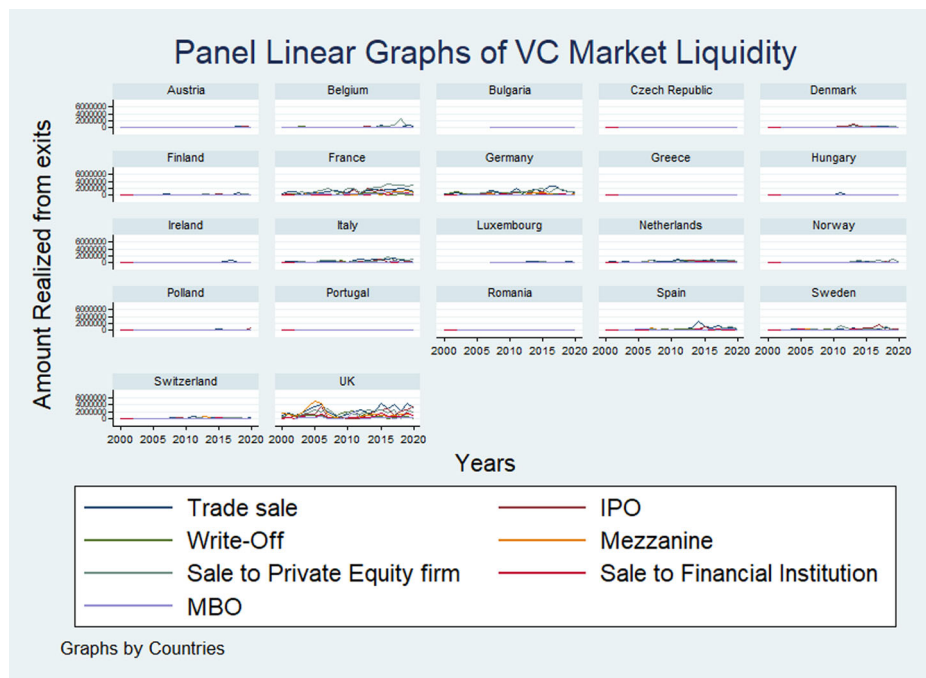
| Equation | Panel | | Group | |
|---------------------------------|------------|-------------|------------|------------|
| | PP-Stat | ADF-Stat | PP-Stat | ADF-Stat |
| LnTrade Sale | −9.3478*** | −10.4276*** | −8.1677*** | −9.0471*** |
| LnIPO | −7.908*** | −5.967*** | −14.49*** | −7.80*** |
| LnMBO | −12.55*** | −9.954*** | −17.11*** | −10.37** |
| LnWrite-Off | −5.893*** | −4.636*** | −12.43*** | −5.17*** |
| LnSale to Financial Institution | −16.36*** | −13.37*** | −24.80*** | −14.45** |
| LnSale to PE Firm | −11.36*** | −8.14*** | −18.11*** | −9.35*** |
| LnMezzanine | −17.16*** | −11.34*** | −23.88*** | −9.45*** |

Stat) confirm co-integration, while the panels (v-Stat and rho-Stat) and group (rho-Stat) report the contrary. The existence of cointegration implies that there is a long-run relationship between the variables for each exit group.

The long-run covariance between VC market liquidity and macroeconomic variables has rarely been researched. Few studies report the long-run relationship between macroeconomic variables and stock market liquidity in emerging markets, such as India (Debata & Mahakud, 2018; Naik & Reddy, 2021). We report the same long-run cointegration between all macroeconomic variables (interest rate, inflation, money supply, unemployment, and size of the economy) and the VC market liquidity. The European VC market informs market participants to be wary of macroeconomic policies because, in Spain, VC provides an alternative source of equity financing during a crisis (Frimpong et al., 2022).

4.4. The trend of VC market liquidity

Figure 1 shows a panel linear graph of VC market liquidity for the countries. The results indicate that VC exit activity is prevalent in countries such as the UK, France, Germany, Denmark, Italy, Switzerland, and Spain. This relatively reports low market liquidity within the European context, because VC investors are expected to easily exit their investment without loss in value. However, there is a progressive trend that indicates hope for the industry. In Figure 1, we report the trend of VC market liquidity by examining the value of transactions realized from VC exits in euros.

**Figure 1.** Panel Linear Graph on the Trend of VC Market Liquidity in Europe.

4.5. Panel fully modified OLS

This study employs the FMOLS approach after establishing cointegration among the variables. We choose FMOLS because OLS does not effectively address serial correlation and other endogeneity concerns of panel data. FMOLS is a cointegration regression with superiority in addressing both the within and between dimensions. Table 5 presents the results of the FMOLS estimation.

Table 5 shows the results for the long-run relationship between macroeconomic variables and VC market liquidity, which we measure using various exit options. The results indicate that the size of the economy (measured by the log of GDP) has a significant long-run effect on all variables for VC market liquidity, except write-off and mezzanine. Specifically, a 1% expansion in the size of the economy would lead to 0.652%, 0.927%, 0.661%, 0.723%, and 0.755% increase in trade sales, IPO, sale to PE firm, sale to financial institution and management buyout (MBO) respectively. The direction of the relationship is positive for all variables, which implies that as the size of the economy of European countries increases, VC market liquidity increases in a proportionate direction. This finding is consistent with our expectations of Groh et al. (2010). They report a significant positive relationship between GDP and VC activity. As the size of the economy increases, this is an indication of a good economic environment, which should encourage a favorable exit through trade sales, IPO, MBO, sales to PE firms, and sales to financial institutions. The relationship between the size of the economy and VC exit by write-off is not statistically significant because it is not the preferred exit option.

Interest rate has a significant negative effect at the 1% confidence interval for trade sales, sales to PE firms, and sales to financial institutions. At a 95% confidence interval, the interest rate is inversely related to IPO, write-off, and mezzanine, but has a 90% negative relation with MBO. Specifically, a 1% increase in interest rates would lead to a 0.437%, 0.542%, 0.443%, 0.496%, 0.633%, 0.551%, and 0.434% reduction in trade sales, IPO, write-off, Mezzanine, sale to PE firm, sales to financial institution, and MBO respectively. This means that all else being equal, as the interest rate increases, VC market liquidity decreases. Conversely, as the interest rate decreases, investors may want to switch from debt-to-equity financial instruments, because interest-bearing securities may not be attractive. This confirms the inverse relationship. This is inconsistent with the findings of Chen et al. (2021), whose study indicates that investors generally invest earlier (i.e., when price triggers are lower) if they can get more value from the deal, such as a lower required investment amount, but with the same percentage ownership, better industry prospects from a higher price growth rate, and lower market interest rates. Conversely, investors may delay investment given a higher option value, a greater investment amount required to cope with IPO cost-sharing, and a higher market-required return. This also runs in contrast to Minardi et al. (2019), who report that a favorable interest rate increases the probability of quick flips.

Table 5. FMOLS for macroeconomic factors and VC market liquidity.

| | (1) LnTrade sale | (2) LnIPO | (3) LnWrite-off | (4) LnMezzanine | (5) LnSale to PE firm | (6) LnSale to Fin Inst | (7) LnMBO |
|----------------------|-------------------------|-------------------------|-----------------------|-------------------------|--------------------------|---------------------------|-----------------------|
| Size of Economy | 0.652*** (0.136) | 0.927*** (0.275) | 0.306 (0.263) | 0.125 (0.246) | 0.661** (0.224) | 0.723** (0.237) | 0.755** (0.277) |
| Unemployment rate | 0.0532 (0.0547) | 0.150 (0.111) | 0.255* (0.106) | 0.0547 (0.0992) | 0.0674 (0.0902) | 0.0683 (0.0953) | 0.232* (0.114) |
| Inflation | -0.0345 (0.0669) | -0.00305 (0.136) | 0.0186 (0.129) | -0.0687 (0.121) | -0.0446 (0.110) | -0.166 (0.117) | 0.182 (0.200) |
| Interest rate | -0.437*** (0.0842) | -0.542** (0.171) | -0.443** (0.163) | -0.496** (0.153) | -0.633*** (0.139) | -0.559*** (0.147) | -0.434* (0.178) |
| LnMoney supply | 0.522** (0.160) | 0.852** (0.325) | 0.861** (0.310) | 0.707* (0.291) | 0.563* (0.265) | 0.656* (0.280) | 0.467 (0.330) |
| Political risk index | 1.698*** (0.483) | 2.743** (0.980) | 2.641** (0.935) | 1.185 (0.878) | 0.597 (0.798) | -1.072 (0.844) | 2.067* (1.004) |
| Capital gains tax | 0.109*** (0.0199) | 0.129** (0.0403) | 0.155*** (0.0384) | 0.0753* (0.0361) | 0.110*** (0.0328) | 0.0561 (0.0347) | 0.0407 (0.0407) |
| linear | 0.00705*** (0.00140) | 0.00953*** (0.00283) | 0.00636* (0.00271) | 0.00987*** (0.00254) | 0.00957*** (0.00231) | 0.0122*** (0.00245) | 0.00765* (0.00300) |
| _cons | -5.574** (2.128) | -16.06*** (4.311) | -8.925* (4.115) | -1.292 (3.862) | -6.750 (3.512) | -8.817* (3.712) | -10.02* (4.366) |
| N | 425 | 425 | 425 | 425 | 425 | 424 | 406 |
| R ² | 0.414 | 0.343 | 0.284 | 0.234 | 0.275 | 0.298 | 0.213 |

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Moreover, money supply has a significant positive relationship with all market liquidity variables apart from MBO. Specifically, a 1% increase in interest rates would lead to a 0.522%, 0.852%, 0.861%, 0.707%, 0.563%, and 0.656% increase in $\ln\text{Trade}$, $\ln\text{IPO}$, $\ln\text{WriteOff}$, Mezzanine , $\ln\text{SaleToPEFirm}$, and $\ln\text{SaleToFinInst}$, respectively. Although the level of significance is within the 90% to 95% confidence interval, there is consistency in the direction of the relationship between money supply and VC market liquidity. This finding is inconsistent with Samargandi et al. (2020) indicating that equity market and money supply variables do not predict the contributions of financial development thus boosting economic growth. Ordinarily, an increase in the money supply should stimulate growth, which should enhance financial market liquidity. However, this finding is inconsistent with the theoretical sense that increasing the money supply will stimulate the desire to engage in productive investment activities, including VCs who would rather want to keep their investments rather than exit, especially when the investee firm performs better.

However, the inflation rate has a positive and insignificant impact on write-offs and MBO. During the period of rising inflation, the real value of financial assets diminishes. This makes it costly to hold financial assets. Again, the situation triggers a shift from holding equity to debt instruments, especially when central banks raise interest rates. Thus, VCs may prefer exiting, confirming the positive relationship between inflation and market liquidity. However, it is negatively related to the other exit options but not significant. This is probably due to the disincentive of selling out investor interest because the effect of inflation on the value of financial assets will be low when inflation is high. This situation causes a reduction in the trading of VC market instruments.

Unemployment has a positive relationship with all VC market liquidity variables but is only significant (90%) with write-off and MBO. Specifically, a 1% increase in the unemployment rate would lead to a 0.255% and 0.232% increase in write-off and MBO, respectively. In the event of high unemployment, VC investors may consider participating in the secondary market as liquid. This situation results in the positive relationship reported in this study. Unsurprisingly, unemployment was positively related to write-offs. Unemployment negatively affects economic activities, which may limit the possibility of the VC realizing the full anticipated proceeds from exits, a situation that may warrant a write-off option. The same positive relation is reported of the relationship between unemployment and IPO exit which is contrary to our expectation because high unemployment should all other things equal leads to reduced IPO activities.

The control variables have some significance concerning market liquidity. The political risk index is statistically significant for trade sales, IPOs, write-offs, and MBO. The results indicate a positive relationship with VC market liquidity. Specifically, a 1% increase in political risk would lead to a 1.698%, 2.745%, 2.641%, and 2.067%, increase in $\ln\text{Trade}$, $\ln\text{IPO}$, $\ln\text{WriteOff}$, and $\ln\text{MBO}$, respectively. This is probably because, when investors suspect high political risk in a country, they may wish to sell their investments, thereby increasing VC exit activities through trade sales, IPO, write-offs, or MBO. Capital gains taxes significantly increase VC market liquidity. The results showed significant increases in trade sales activities, IPO, write-offs, sales to PE firms, and mezzanine exit options. Specifically, a 1% increase in capital gain tax would lead to a 0.109%, 0.029%, 0.155%, 0.0572%, and 0.110% increase in $\ln\text{Trade}$, $\ln\text{IPO}$, $\ln\text{WriteOff}$, Mezzanine , and $\ln\text{SaleToPEFirm}$, respectively. This is contrary to our expectations because it is envisaged that capital gains tax should disincentivize VC market liquidity.

Table 5 reports a variable named 'linear' in the regression. It is an estimation technique in FMOLS (in Stata) suggesting that the estimation technique for the model is a linear technique instead of a quadratic equation.

4.6. Further analysis

Due to the government's involvement in VC activities in Europe, we introduce two variables; fund of funds and government agencies. Fund of funds is a public VC fund through the European Investment Fund (EIF) and National Promotional Institutions (NPIs) fund. According to a new report by Invest Europe 2023, government agencies contributed 37% (4.2bn) of the 11.2bn euros of funds raised from 16% (2.8bn) of the previous year. As a result of differences in government involvement in various countries,

Table 6. FE and RE models for macroeconomic factors and VC market liquidity.

| Variables | lnMBO | IPO | MEZZ | LnSPEF | LnSFIs | LnTS | W/O |
|----------------|-------------------------|-------------------------|--------------------------|------------------------|------------------------|-------------------------|-------------------------|
| Capital Gain | 0.016 (0.015) | 0.0003 (0.025) | 0.061* (0.034) | 0.042 (0.044) | 0.060 (0.072) | 0.011 (0.012) | 0.096*** (0.033) |
| UE | 0.034 (0.026) | 0.087* (0.045) | 0.020 (0.047) | −0.030 (0.081) | −0.053 (0.108) | 0.026 (0.020) | 0.235*** (0.052) |
| PR | −0.195 (0.305) | −0.058 (0.479) | −0.063 (0.418) | −2.381** (0.890) | −1.908* (1.002) | −0.047 (0.247) | 1.959*** (0.632) |
| FUNDS | 1.37E-07* (1.56E-07) | 1.99E-07* (1.13E-07) | 1.89E-07** (9.39E-08) | 1.13E-07 (1.89E-07) | 8.14E-08 (1.35E-08) | 2.04E-08 (5.03E-08) | −2.16E-07 (1.71E-07) |
| INFL | 0.115*** (0.063) | −0.021 (0.065) | −0.020 (0.050) | −0.196** (0.084) | −0.050 (0.050) | 0.005 (0.036) | 0.053 (0.0729) |
| INTR | −0.149*** (0.042) | −0.232*** (0.056) | −0.139* (0.072) | −0.286* (0.120) | −0.240** (0.114) | −0.227*** (0.031) | −0.161** (0.077) |
| GOVAG | 1.46E-08 (2.09E-07) | −5.17E-08 (1.65E-07) | 2.45E-07* (1.43E-07) | 1.23E-07 (2.58E-07) | 1.04E-08 (1.98E-07) | 1.19E-07* (7.11E-08) | 4.8E-07** (2.12E-07) |
| GDP | 0.074 (0.176) | −0.308 (0.190) | −0.144 (0.211) | −0.059 (0.249) | 0.326 (0.347) | 0.083 (0.103) | −0.1607 (0.220) |
| R ² | 07180 | 0.7774 | 0.0309 | 0.8930 | 0.5727 | 0.7619 | |
| N | 407 | 426 | 426 | 426 | 425 | 426 | |

we adopt the fixed effect (FE) and random effect (RE) models to provide further analyses of the relationship that exists between these variables. We use STATA software for these further analyses.

The panel fixed effect model (8) and random effects model (9) are specified below to follow:

$$VC_{it} = \beta_{1i} + \beta_2 CG_{it} + \beta_3 UN_{it} + \beta_4 PR_{it} + \beta_5 FF_{it} + \beta_6 INFL_{it} + \beta_7 INTR_{it} + \beta_8 GOVAG_{it} + \beta_9 SizeofEco_{it} + \varepsilon_{it}. \quad (8)$$

$$VC_{it} = \alpha_1 + \alpha_2 CG_{it} + \alpha_3 UN_{it} + \alpha_4 PR_{it} + \alpha_5 FF_{it} + \alpha_6 INFL_{it} + \alpha_7 INTR_{it} + \alpha_8 GOVAG_{it} + \alpha_9 SizeofEco_{it} + \mu_i + \varepsilon_{it}. \quad (9)$$

β_{1i} is assumed to vary among the independent variables and capture the individual-specific fixed effect whereas $\beta_2, \beta_3, \beta_4, \beta_5$, and β_6 are assumed to be fixed for all individuals. All changes in the behavior of the individuals are assumed to be incorporated in β_{1i} , which is called individual heterogeneity. β_{1i} is also called the fixed effects. These individual intercepts included are to control for individual-specific and time-invariant characteristics. The parameters $\beta_2, \beta_3, \beta_4, \beta_5$ and β_6 for the independent variables. The fixed effect model best suits panels that are short and wide. Hence, given that my panel is short (2000–2020) and wide (22 countries), the fixed effect model is the best and most appropriate model for this study.

In equation (9), we present the random effect model as some of the preliminary tests support this method of estimation. The random effect model is used when the unobserved individual-specific characteristics are assumed to be uncorrelated with the independent variables. This allows the individual-specific effects to be treated as random variables drawn from a larger population. RE model is efficient when this assumption holds because they employ both within-entity and between-entity variation.

μ_i represents the random effect, capturing the individual-specific deviation from the overall intercept, α .

The choice of both the FE and RE over the FMOLS for further analysis is to cater to individual unique country characteristics in government involvement in VC activities which might unduly bias the equation. The results for further analysis can be seen in Table 6.

From Table 6, the introduction of the government involvement variables does not significantly improve the original model. Fund of funds and government agencies show significantly weak relations when VC firms exit through IPO, Mezzanine financing, trade sales, MBO, and write-offs. However, consistent with the original model, interest rate shows a significant relation with almost all the exit methods.

Table 6 presents a further (robustness or sensitivity) analysis of the relationship between VC market liquidity and the independent variables. The various relationships between the VC market liquidity variables and their respective independent variables are undertaken considering the preliminary tests for choosing either the FE or RE method of estimations (see Table 6). From the results, only trade sales, sales to financial institutions, and MBO are positively impacted by the size of the economy, as indicated by the lnGDP. However, lnGDP has no significant impact on any of the other VC market liquidity exits.

Table 7. Redundant fixed effect and random effect tests.

| Dependent Variable | Chi-Square Statistic | | Probability | |
|--------------------|----------------------|---------|-------------|--------|
| | FE | RE | FE | RE |
| MBO | 25.4204 | 13.2356 | 0.0000 | 0.1040 |
| IPO | 324.7381 | 20.5414 | 0.0000 | 0.0085 |
| TRADE | 258.0305 | 26.2975 | 0.0000 | 0.0009 |
| LnSale to PE firm | 249.6392 | 13.5522 | 0.0000 | 0.0942 |
| LnSale to Fin Inst | 237.3774 | 15.6375 | 0.0000 | 0.0479 |
| MEZZ | 353.5233 | 13.9356 | 0.0000 | 0.0835 |

Interest rate has a significant negative impact on the liquidity of the entire venture capital market. Specifically, an increase in interest rate would cause about 0.149%, 0.323%, 0.139%, 0.286%, 0.240%, 0.227%, and 0.161% in MBO, IPO, MEZZ, SPEF, SFIs, TS, and W/O respectively. This implies that VC market liquidity falls when interest rates rise, all other things being equal. On the other hand, investors may wish to move from debt to equity financial instruments when interest rates drop since interest-bearing securities might not be as appealing.

The inflation rate has a positive but insignificant impact on MBO, indicating that venture capitalists may prefer to exit, supporting the positive relationship between inflation and market liquidity. It is, however, significantly negatively related to LnSPEF, most likely because selling out investor interest is discouraged when inflation is high because the effect of inflation on the value of financial assets is reduced, which results in a decrease in trading of VC market instruments. Additionally, the effect of inflation on all other VC liquidity markets is negligible.

All VC market liquidity variables have a positive relationship with unemployment, however, this relationship is only significant with write-offs and IPOs. To stay liquid in the event of significant unemployment, venture capitalists might think about taking part in the secondary market. A favourable association, as reported in this study, will arise from such a circumstance. The favourable relationship between unemployment and write-offs is not surprising. Because unemployment will hurt economic activity, it may be harder for venture capital firms to realize all of the money they had hoped to from exits, which could be a case for the write-off option. The association between unemployment and IPO exit is also claimed to be positively correlated, which defies our hypothesis because high unemployment should, in theory, result in fewer IPO operations.

The control variables show some significance with market liquidity. The political risk index is statistically significant with LnSPEF, LnSFIs, and W/O. The result demonstrates a positive relation with the first two VC market liquidity and a negative relation with the write-off. This suggests that all other things being equal, a 1% increase in sales to PE firms and sales to FI firms would cause VC market exits to increase by 2.381% and 1.908%, respectively; similarly, a 1% increase in write-offs would cause VC market exits to decrease by 1.959%. This is likely because, in cases where investors suspect high political risk in a nation, they may wish to sell off their investments, increasing VC market exit activities through trade sales, LnSPE firms LnSFI firms, and write-offs.

Capital gains tax significantly increases VC market liquidity. The result shows significant increases in trade sale activities, write-offs, and Mezzanine exit options. This is contrary to our expectations because it is envisaged that capital gains tax should disincentivize VC market liquidity.

Fund of funds has a positive effect on all the exits except write-off which shows a negative effect. The results further show that fund of funds has significant positive effects on IPO and MBO only. This implies that an increase in investments in other funds by Fund of funds would cause an increase in VC market liquidity through MBO and IPO.

The results show that GOVAG has positive effects on all exits under consideration except IPO which had a negative effect. It, however, has significant positive effects on MEZZ, InTS, and InW/O. This implies an increased investment in the VC market by the government agencies through sovereign funds, European Investment Fund, and National Promotional Institutions Funds would improve the market's liquidity through MEZZ, trade sales, and possibly control the number of write-offs in European VC market. The increase in trade sales and other exits in Europe is in line with the Invest Europe 2023 report confirming government agencies' significant contribution to fundraising activities in Europe. It further

corroborates trade sale exit as the most common exit route for European Venture Capitalists which account for almost 40% of the exits in Europe (SVC Report, 2023).

4.7. Redundant fixed effects test and Hausman specification tests

We used the Hausman specification and redundant fixed effect tests to choose the best panel data model for efficiently assessing the connection between the dependent and independent variables. The fixed effects model and the random-effects model can be chosen using the Hausman specification test, and the fixed effects model and the pooling least squares model can be chosen using the redundant fixed effects test. Pooling least squares was ranked worse than the fixed effects model when the redundant effects model was applied.

In order to examine the correlations and get the best estimates, the fixed-effect model is used to all equations. This increases the consistency and reliability of the estimates and outcomes. The results report that the POLS is rejected for all equations in favour of the FE at a 1% significance level. Similarly, the decision between the fixed effects model and the random effects model is advised by the Hausman specification test. At a 1% significance level, the null hypothesis of random effects is rejected in light of Table 7's findings.

5. Conclusion

This study examines whether long-run relationships exist between macroeconomic factors and VC market liquidity. We also investigate whether macroeconomic factors affect VC exits. Using country-level data for 22 European countries from 2000–2020 in panel cointegration and panel FMOLS, we provide evidence of a long-run relationship between macroeconomic factors and VC market liquidity. VC market liquidity shows a progressively increasing trend in exit activities. Specifically, we report a significant effect of the size of the economy, inflation, interest rate, money supply, and unemployment on VC market liquidity at least 5% significance levels. Thus, a 1% expansion in the size of the economy would lead to a 0.652%, 0.927%, 0.661%, 0.723%, and 0.755% increase in trade sales, IPO, sale to PE firms, sale to financial institutions, and MBO, respectively. In addition, a 1% increase in interest rates would lead to a 0.437%, 0.542%, 0.443%, 0.496%, 0.633%, 0.551%, and 0.434% reduction in trade sales, IPO, write-offs, Mezzanine, sale to PE firm, sale to financial institution and MBO, respectively. Moreover, a 1% increase in interest rates would lead to a 0.522%, 0.852%, 0.861%, 0.707%, 0.563%, and 0.656% increase in trade sales, IPO, write-off, Mezzanine, sale to PE firm, and sale to financial institution, respectively.

Furthermore, a 1% increase in political risk would lead to a 1.698%, 2.745%, 2.641%, and 2.067%, increase in trade sales, IPO, write-off, and MBO respectively. Finally, a 1% increase in the unemployment rate would lead to a 0.255% and 0.232% increase in write-off and MBO, respectively. Consistently, we report that the size of the economy and money supply have a significant positive relationship with VC market liquidity. Interest rates have a significant inverse relationship with VC market liquidity in the long run. However, inflation and unemployment have no significant relationship with VC market liquidity. Consistent with the European VC market, macroeconomic factors significantly affect trade sales and IPO exits. Write-off remains an unfavorable exit option and does not generally support VC market liquidity because it results in a loss of value. Ideally, VCs may want to exit through IPOs, but the European situation portrays a different picture. Exiting via write-offs is a less preferred option because it results in an amount below the expected value. The findings have implications for the need to intensify VC activities in Europe compared to their counterparts in the US. This study makes theoretical and practical contributions to research on the VC industry. Future studies could consider how VC fund management responds to macroeconomic changes in Europe at the micro level.

Note

1. The countries include Austria, Belgium, Bulgaria, Czech Republic, Denmark, France, Finland, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, and United Kingdom.

Disclosure statement

No potential conflict of interest was reported by the author(s);

Author contributions

Fauna Atta Frimpong: Conceptualization, design, literature review, data mining, drafting of manuscript: 30%; Ellis Kofi Akwaa-Sekyi: Methodology, data scrutiny, analysis, writing of manuscript: 20%; Ibrahim Suleman Anyars: Methodology, analysis and interpretation: 20%; Akua Peprah-Yeboah: Literature review, proofreading and finalizing of write-up: 15%; Ramon Saladrighes Sole: Refining the conceptualization, proofreading, finalizing and approval: 15%.

Funding

We declare that there was no funding received for this paper.

About the authors

Dr. Fauna Atta Frimpong received his B. A degree in Publishing Studies, from the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana in (2004), his Master of Business Administration (Banking & Finance) degree from the same university in (2008), and his Ph.D. in Law and Business Administration (Finance) from University of Lleida, Lleida, Spain in (2021). He is presently a lecturer and an independent researcher of Corporate and Entrepreneurial Finance, in Lleida, Spain. His research interests include but are not limited to Venture Capital Financing, Entrepreneurial Finance, Entrepreneurship, and Financial Intermediation.

Dr. Ellis Kofi Akwaa-Sekyi holds a Ph.D. in Law and Business Administration (Banking and Finance option) from the University of Lleida, Spain. He is a lecturer at Kwame Nkrumah University of Science and Technology (Dept. of Accounting and Finance at the KNUST School of Business). He is an associate researcher at the University of Lleida, Spain, the University of Bari (Aldo Moro), Italy and the University of Vaasa, Finland. Ellis Akwaa-Sekyi has graduated with an MSc in Microfinance and an MPhil in Banking and Finance from the University of Cape Coast, Ghana, and Kwame Nkrumah University of Science and Technology, Ghana respectively. He has presented at international conferences and published in corporate governance, risk management, internal controls, microfinance, and sports. Ellis is a certified peer reviewer for several journals including Cogent Economics and Finance, Journal of African Business, Cogent Business and Management, Journal of Financial Reporting, and Intangible Capital. MR. IBRAHIM SULEMAN ANYARS (ibrahimanyarssuleman2@gmail.com), Kwame Nkrumah University of Science and Technology, Department of Economics, Kumasi, Ghana.

Suleman Ibrahim Anyars holds B. A and Master's in Economics from Kwame Nkrumah University of Science., Kumasi. He is also a Chartered Financial Economist and Chartered Energy Economist from the Global Academy of Financial Management (GAFM), USA. He is a tutor at a Senior High School in the Ashanti Region, Ghana, and an instructor for the Professional course in the Association of Certified Chartered Economists (ACCE) under GAFM, USA. He teaches Economics and Government at the SHS and Econometrics, Financial Economics, and Risk Management. Economic Policy Analysis and Investment for the ACCE program. His research interests include macroeconomics, financial economics, energy economics, international, and monetary economics, and economic policy analysis.

Dr. Mrs. Akua Peprah-Yeboah holds PhD in Accounting and lectures at the Accounting and Finance Department of KNUST School of Business, KNUST-Kumasi, Ghana. She has published and presented at international conferences. She teaches Cost and Management Accounting and Financial Accounting. Her research focus includes but is not limited to Corporate Social Responsibility Accounting, Climate Change Accounting and Finance, and Corporate Governance. She loves the quantitative approach to research.

Ramon Saladrighes Solo is an economist who has worked with financial accounting and entrepreneurship. He was vice-rector of quality and planning and is now an economic coordinator at the University of Lleida. Dr. Saladrighes manages a corporate-sponsored professorship in entrepreneurship, the "Càtedra Santander d'Emprenedoria Universitària."

ORCID

Fauna Atta Frimpong  <http://orcid.org/0000-0002-2575-8657>
 Ellis Kofi Akwaa-Sekyi  <http://orcid.org/0000-0002-9497-568X>
 Ibrahim Suleman Anyars  <http://orcid.org/0000-0002-5764-1170>
 Akua Peprah-Yeboah  <http://orcid.org/0000-0003-1227-0019>
 Ramon Saladrighes Sole  <http://orcid.org/0000-0003-3987-2511>

Data availability statement

The data for this study is available upon request.

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