

Louvain School of Management

Drivers of zombie firms: Evidence from regional disparities in Belgium

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Academic year 2025-2026
Dissertation for the master of Business Engineering
Master subject and focus: Sourcing and Procurement
Daytime schedule

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AKNOWLEDGEMENTS

I would like to express my deepest gratitude to my parents whose unwavering encouragements, confidence, and sacrifices have sustained me throughout my academic journey. Their constant support has been a continuous source of strength and motivation, without which this work would not have been possible.

I also wish to thank Norbert Mbeku, Elise Kumandja, Michel Jacobs, Zacharie Mwanja, Barthelemy Funga-Funga, Cécile Otshudi, Anuarite Bashizi, Aymar Nyenyezi, who have been like second parents to me here in Belgium. Their guidance, care, and belief in me have been invaluable, especially during the most challenging moments of this journey.

I am deeply grateful to Marieke Van Wulften, who over the past year has been both a mentor and a true friend, offering advice and constant encouragements.

My heartfelt thanks also go to Divine Lehani and Netty Badu for their prayers and spiritual encouragement, and to Thomas Speltiens and Déborah Muhanzi for their unwavering presence and support throughout this process.

More broadly, I would like to thank my friends and family. This work is a reminder that no achievement is ever the result of individual effort alone, but rather the product of collective support, shared faith, and mutual encouragements.

Finally I would like to express my sincere gratitude to my supervisor, Professor Paul Belleflamme, for his guidance, patience and constructive feedbacks.

Above all, I give thanks to God, whose grace, strength, and guidance made this journey possible. As it is written: “I can do all things through Christ who strengthens me”. (Philippians 4:13)

Table of Contents

INTRODUCTION	6
PART I: THEORIE AND HYPOTHESIS	9
CHAPTER 1: THEORATICAL FRAMEWORK	9
1.1. What is a Zombie Firm	9
1.1.1. Definition and conceptual framework	9
1.1.2. Global trends and statistics	10
1.2. Institutional determinants of firm survival	11
1.3. Strategic decisions and corporate governance	13
1.4. Sectorial dynamics and entrepreneurial ecosystem	15
1.5. Formation and detection	16
1.6. Solutions suggested in the literature	18
1.6.1. Firm-level recovery strategies	18
1.6.2. Government interventions	18
1.6.3. Macroeconomic regulatory measures	19
1.6.4. Human capital and corporate governance	19
1.6.5. Conditional support and innovation-oriented policies	20
CHAPTER 2: HYPOTHESES	21
2.1. First hypothesis	21
2.2. Second hypothesis	21
2.3. Third hypothesis	22
2.4. Fourth hypothesis	22
PART II: METHODOLOGY	23
CHAPTER 1: DATA AND SAMPLING	23
1.1. Data	23
1.2. Sample description	23
CHAPTER 2: OPERATIONALISATION OF VARIABLES	24
2.1. Dependent variables	24
2.2. Independent variables	25
2.3. Control Variables	26
PART III: ANALYSIS AND RESULTS	27
CHAPTER 1: FIRST HYPOTHESIS	27
CHAPTER 2: SECOND HYPOTHESIS	29
CHAPTER 3: THIRD HYPOTHESIS	30
CHAPTER 4: FOURTH HYPOTHESIS	32
PART IV: CONCLUSION	34

CHAPTER 1: SUMMARY OF RESULTS	34
CHAPTER 3: LIMITES OF THE THESIS	36
3.1. Defining zombie firms	36
3.2. Measuring Innovation	36
3.3. Industry-level aggregation and competition	36
3.4. Bel-first data	37
REFERENCES	39
APPENDIX	45
A. DATA SOURCE	45
B. REGRESSION RESULTS	45
I. Table I: H1 blended model regression results	45
II. Table II: H2 regression results	45
III. Table III: H3 regression results	45
IV. Table IV: H4 regression results	45
C. OTHER	45
I. List of bankruptcy reforms from (Altman et al., 2021)	46
II. Bureau Van Dijk (BVD) ownership concentration indicator from Researchgate (n.d)	47
III. List of supports in Wallonia from (Magerman et al., 2025)	48

INTRODUCTION

Over the last two decades, advanced economies have experienced a striking rise in zombie firms, companies that remain active despite being unable to generate sufficient operating profits to service their debt. These companies survive not because they are economically viable but because financial, institutional or political mechanisms prevent their exit. The growing prevalence of such firms has been widely documented in Japan, China, the United States and some countries in Europe. It is now being regarded as one important structural threat to productivity growth and capital reallocation (Caballero et al., 2008; Banerjee & Hofmann, 2018; McGowan et al, 2018).

Zombie firms are relevant because they distort the process of creative destruction¹. By continuing to operate despite low productivity, they trap capital and labour that could otherwise be used by more efficient firms, weaken competition, and slow down the diffusion of new technologies. OECD research show that industries with higher zombie shares exhibit lower productivity growth and weaker capital reallocation, which in turn reduces long-run economic growth (McGowan et al., 2018). In the context of a prolonged low interest rate, financial forbearance, and large scale public support following the COVID-19 and energy crisis, these concerns have become even more acute.

Belgium provides an interesting case for studying zombie firms; as it is a country with a highly developed economy, a strong welfare state, extensive public support to firms, and a decentralized regional governance structure. Furthermore, Belgium exhibits persistent economic divergence between its main regions, namely the ones of interest in this study: Flanders and Wallonia. Flanders is characterized by higher productivity, stronger export and international trade performance, and faster employment growth, while the growth in Wallonia does not differ much, it continues to lag behind despite large public transfers and support programs (Van Gompel & KBC Group, 2025). Yet little is known about whether zombie firms play a role in this divergence. In international databases, Belgium is treated as a single unit (De Jonghe et al., 2021), masking potentially large internal differences in how financial distress, firm survival and policy intervention interact across regions in the face of zombification.

This thesis addresses these differences by asking the following research question:

¹ A concept in economics that describes a process in which the old is replaced with the new. This mostly references innovations.

What explains regional disparities between zombie firm prevalence and recovery between Flanders and Wallonia in Belgium, and how are these differences reflected at the industry level in terms of innovation?

This question is relevant for two reasons; first, it shifts the zombie firm literature from a national to a subnational level, allowing the role of regional institutions and policies to be studied within a single country, in which the impact and causes of zombification could considerably diverge.

Secondly, it goes beyond a simple prevalence by distinguishing between zombie incidence, zombie persistence and innovation effects, thereby linking financial distress to long term economic dynamics that include more than quantitative figures.

To answer this question, a panel of firm level information from Bel-First database is used, which provides detailed financial, balance sheet and subsidy information for Belgian firms over multiple years. Zombie firms are initially identified using the standard interest coverage ratio criterion, following Banerjee and Hofmann (2018) and McGowan et al (2018), afterwards using additional criteria discussed in the text. The empirical strategy combines panel regressions with fixed effects and dynamic persistence models to test four hypotheses. These examine: (i) the ability to predict zombie status from financial variables; (ii) whether zombie prevalence differs between Flanders and Wallonia; (iii) whether industry-level zombie congestion affects innovation by healthy firms and (iv) whether public subsidies influence the persistence of zombie firms differently across the two regions.

The main findings reveal nuanced pictures. First, zombie firms are not randomly distributed across Belgium, firms located in Wallonia are more likely to be zombies than comparable firms in Flanders, even after controlling for size, leverage, and macroeconomic conditions. This indicates that regional factors play a fundamental role in shaping financial distress.

Second, public subsidies are strongly associated with zombie persistence, confirming what is emphasized in the literature. However, surprisingly this effect is stronger in Flanders than in Wallonia, hinting that how public support is designed and implemented matters more than how much is spent.

Third, industry-level zombie congestion does not significantly reduce firm innovative capabilities once firm competences are controlled. This gives clues on how innovations appears to be driven in the two regions.

Together, these results imply that Belgium's regional divergence is not simply a story of too many subsidies allocated to one region for example, but of structural differences in firm governance and in the way public support interacts with financial discipline across regions. Zombie firms matter because of persistence and misallocation, but their effects are more limited than often assumed.

The remainder of this thesis is structured as follows:

Part 1 reviews the literature on zombie firms, their trends, and their environment; and derives the hypothesis tested in the empirical analysis.

Part 2 describes the data, variables and empirical strategy.

Part 3 presents the results for each hypothesis and provides detailed economic evidence. With a discussion on the findings in light of the existing theory and policy debates.

Part 4 concludes by summarizing the contributions of the thesis and outlines the implications for Belgian economic policy and limitations future research on the same topic.

PART I: THEORIE AND HYPOTHESIS

CHAPTER 1: THEORITICAL FRAMEWORK

1.1. What is a Zombie Firm

1.1.1. Definition and conceptual framework

The term *Zombie* in an economic context was first introduced by Kane (1987), who describes zombie savings and loan institutions as “institutional corpses” capable of financial movement and engaging in harmful behaviours. These entities disrupt financial markets by consuming resources from viable competitors, thereby spreading zombification across the system.

Zombification here refers to the process through which distressed and unprofitable firms remain in the market, surviving through continued external support, despite the lack of capacity to cover their own (Banerjee & Hofmann, 2020).

Zombie firms emerge primarily from market disruptions and resource misallocation. They absorb financial resources that would otherwise support healthy firms, reducing overall market efficiency and creating significant economic challenges (Wang & Zhu, 2020). This crowding-out effect is not uniform; it varies across ownership structures, industries, capital-labour intensity, and regional levels of marketization. For example, state owned firms benefit from preferential credit deepening the displacement of more productive firms (Faccio, 2006). Industries that rely on heavy capital find themselves with limited credit access for healthy firms, as zombie firms occupy large majority of physical capital and collateral (Peek & Rosengren, 2005). Industry characteristics also matter because in a highly capital-intensive industries, suppressed prices and tied up financial resources by zombie firms reduce investment in other companies (Caballero et al., 2008).

Research on zombie firms has accelerated since 2018, driven by the aftermath of the 2008 global financial crisis and the economic disruption cause by the COVID-19 pandemic (Zoller-Rydzek & Keller, 2020). Initially focused on Japan’s prolonged stagnation (Caballero et al., 2008), the literature expanded to encompass Europe, China, and the OECD economies, with China and the United States dominating recent studies (Blažková et al., 2025).

Conceptually, a zombie firm is generally understood as a company unable to meet its interest obligations and potentially insolvent, yet surviving due to exceptional market conditions and support from financial institutions, equity investors, or governments. Although no universally accepted definition exists, many studies rely on interest coverage ratios as key criterion for measuring zombification (Altmann et al., 2024; Banerjee and Hofmann, 2018). However, this

approach has limitations: it can only be overly aggressive, lending to inflated estimates caused by zombification. Moreover, lenders often provide cheap credit to zombie firms, enabling them to maintain interest coverage ratios above one despite minimal cash flows, which introduces systemic bias into ratio-based measures (Altman et al., 2024).

Zombie firms benefit disproportionately from low-cost financing and preferential access to high-quality credit, often at the expense of non-zombie firms with stronger growth potential (Wang & Zhu, 2020). This dynamic reduces profitability for healthy firms (Caballero et al., 2008) and transfers credit risk to suppliers, creditors, and public administrations. Furthermore, explicit protection from banks and governments distorts competition, creating unfair market conditions that may depress prices of inflate wages beyond sustainable levels. Paradoxically, healthy firms may fail during crises while zombie firms persist (San-Jose et al., 2021).

1.1.2. Global trends and statistics

Defining a zombie firm involves several consideration. Persistent lack of profitability, particularly when accompanied by an inability to service debt obligations, is a primary indicator. Firm age also matters, as younger companies often require time for investment to yield returns. Additionally, expectations of future profitability are critical; temporary loses may reflect restructuring on new investment that could improve performance over time (Banerjee and Hofmann, 2018).

Zombie firms typically experience one of several outcomes: bankruptcy (in the U.S. context), delisting, mergers and acquisitions, recovery, or an indeterminate status. More than half ultimately face bankruptcy or delisting, while only a minority recover. On average, firms remain in zombie status for about five years before exiting through bankruptcy or delisting. Evidence from Altman et al. (2021) show that bankruptcy law reforms² shorten zombie duration by approximately 25% and significantly increase the likelihood of liquidation or restructuring, suggesting that legal frameworks play a pivotal role in accelerating the resolution of zombie firms.

Existing research on zombie firms (Acharya et al., 2017; Altman et al., 2024; Banerjee and Hofmann, 2018; Banerjee & Hofmann, 2020) generally follow two main approaches. The first

² A cross-country sample of 8 staggered bankruptcy reforms from different years used to examine the effects of the modernization of bankrupt laws on zombieism. Particularly whether zombie ratios change differently after a country adopts a more creditor-friendly law versus a more debtor-friendly law. See appendix I for more details.

focuses on developing methodologies to identify zombie firms and exploring the underlying causes of zombification. The second examines the broader economic implications, particularly the effects of resource allocation and growth.

The prevalence of zombie firms, companies that persist despite prolonged financial distress, has grown significantly over the recent decades. Seo et al. (2024) report that the global average proportion of zombie firms increased from 4.6% in 2005 to 8.6% in 2016, with a sharper rise in developed economies compared to developing ones. Similarly, the share of marginal firms in 14 OECD countries expanded from approximately 4% in the mid-1980s to 15% by 2017 (OECD, 2020).

These trends suggest that the incidence of zombie firms escalates during financial crises, highlighting the urgency of research on this phenomenon. In the European Union alone, zombie firms may account for more than 10% of all the companies, representing an estimated value close to one billion euros (Seo et al., 2024). Banerjee and Hofmann (2018) further estimated that between 6% and 12% of firms in advanced economies qualify as zombies, depending on definitional criteria. These trends are based on the definition of zombie firms that suggest they are companies that cannot cover interest payments from operating profits, but continue to survive due to external financial support.

1.2. Institutional determinants of firm survival

Government subsidies are granted for multiple purposes, including resource and income redistribution, optimizing expenditure productivity, correcting market failures, fostering economies of scale, and achieving social policy objectives. From the perspective of the demand for money theory³, firms seek subsidies for transactional, precautionary, and speculative motives, primarily as liquidity support for daily operations. Subsidies can ease financing constraints, enabling firms to allocate internal resources more efficiently and improve operational performances. Target subsidies, such as those for research and development (R&D), directly enhance innovation capacity by increasing R&D expenditures. According to signal theory⁴, subsidies also function as a positive signal to financial institutions, encouraging banks and investors to provide additional funding to subsidized firms (Qiao & Fei, 2021).

³ In monetary economics, the demand for money is the desired holding of financial assets in the form of money: that is, cash or bank deposits rather than investments.

⁴ A concept developed in economics that explains how one party conveys information to another in situations where there is an imbalance in knowledge or information asymmetry.

However, the impact of subsidies differs markedly between zombie and non-zombie firms due to moral hazard. Governments often maintain zombie firms to stabilize employment, preserve tax revenues, ensure social stability, and protect political reputations. Similarly, banks have incentives to conceal non-performing loans; terminating credit to zombie firms would force recognition of defaults, reducing capital adequacy ratios and potentially threatening bank operations. These motivations perpetuate the “stiff but deathless” nature of zombie firms, delaying market exit and creating a crowding-out effect that limits financing for healthy firms, particularly non-state-owned enterprises reliant on external funding (Wang & Zhu, 2020).

While subsidies may temporarily alleviate operational difficulties for zombie firms, they rarely address structural weaknesses such as high debt burdens, low turnover, poor product quality, and technological stagnation. Governments tend to favour large enterprises for subsidies because of their greater contributions to employment, tax revenue, and GDP growth. Yet, due to moral hazard, subsidies improve efficiency and profitability far more in non-zombie firms than in zombies, where they often fail to generate sustainable profitability (Qiao & Fei, 2021).

Information asymmetry compounds these issues, as governments cannot accurately identify which firms genuinely require support or the optimal subsidy level. Increased subsidies may foster dependency among zombie firms, reinforcing behaviours of “waiting, relying, and wanting.” In the short term, subsidies mask financial distress by boosting cash flow, but in the long term, they entrench inefficiency and inhibit profitability, perpetuating zombification (Qiao & Fei, 2021).

Sectorial regulation also influences zombie prevalence. Highly regulated industries such as finance, insurance, and public administration exhibit lower zombie risk due to minimal negative equity exposure, whereas highly leveraged sectors like construction or lightly regulated industries are more susceptible (Wang & Zhu, 2020). Empirical evidence further links zombie persistence to banks’ reluctance to recognize bad debts; continued lending prevents defaults from materializing, safeguarding bank capital but distorting market dynamics (Chang et al., 2020).

Government intervention extends beyond financial subsidies to resource allocation, including land, energy, and mineral rights. Weak environmental enforcement may also favour firms engaging in harmful practices, illustrating the dual role of the state as both “supporting hand” and “grabbing hand” in the market (Chang et al., 2020). Monetary policy amplifies these distortions: by injecting excess reserves and lowering policy interest rates, central banks

incentivize credit expansion beyond natural savings levels, creating misalignments between market rates and equilibrium rates and fuelling credit-driven zombification (Gabriel & Roche, 2023).

Cross-country experiences underscore the role of institutional transparency. For instance, after the U.S. financial crisis, zombie prevalence remained lower than in Japan because American banks promptly disclosed non-performing-loans, limiting incentives to conceal bad debts (Chang et al., 2020).

1.3. Strategic decisions and corporate governance

National bankruptcy codes provide a formal legal framework for distressed firms to recognize or liquidate assets under juridical supervision. Empirical evidence suggests that major reforms to bankruptcy legislation⁵; For example, Brazil who enacted in 2005 a new bankruptcy law similar to chapter 11 of the one in the United States, giving secured creditor's claims priority over tax claims (Altman et al., 2021), significantly reduce zombie prevalence, lowering zombie ratios by approximately 1.4 percent points regardless of definitional criteria (Altman et al., 2024). These reforms accelerate firm exit or restructuring, thereby mitigating prolonged zombification.

Macroeconomic dynamics also shape strategic decision-making. Credit expansion often outpaces real production capacity, creating a lag between sectors demanding finished goods and those producing them. This imbalance intensifies competition for production factors, driving up costs despite technological adoption, outsourcing, and capacity reactivation. Easy access to credit amplifies these distortions, as firms finance expansion based on artificially low capital costs rather than sustainable cash flows. Consequently, profitability projections become skewed, encouraging investment in projects that appear viable under distorted financial conditions but lack long-term feasibility (Gabriel & Roche, 2023).

Zombification further influences managerial behaviour. Firms with negative equity and limited prospects may engage in riskier ventures and opportunistic strategies, exacerbating systemic vulnerabilities. Studies such as Hallak et al. (2018) and McGowan et al. (2018) indicate that zombie concentration differs across regions: while Japan's zombies are predominantly smaller and older firms, European economies exhibit higher prevalence among large, established firms,

⁵ See more bankruptcy laws in appendix I.

often due to preferential government support. Southern European countries such as Greece, Portugal, Italy, and Spain show particularly high zombie incidence (Gabriel & Roche, 2023).

Corporate governance plays a critical role in determining zombie firm' survival or exit. Governance structures link boards, shareholder, executives, auditors, and other stakeholders (San-Jose et al., 2021). Four key factors emerge: board size (BS), management ownership, director turnover (DT), and ownership concentration. Empirical findings reveal that large managerial equity stakes prolong zombie status. Smaller boards, though more agile, may assume excessive risk due to strong control incentives, whereas large boards face decision-making inefficiencies from coalition dynamics. Busy directors, those serving on multiple boards, may devote less attention to individual firms, yet some studies argue they enhance prudence and reduce uncertainty through broader experience (Ferris et al., 2020).

Managerial incentive also shape strategic persistence. Executives often resist exit due to personal wealth tied to the firm, reputational concerns, and emotional attachment. Those who have guaranteed loans are particularly motivated to delay closure. Director turnover reflects succession dynamics, which can either revitalize governance or accelerate decline. Ownership concentration introduces moral hazard: dominant shareholders may impose high-risk strategies to recover capital, benefiting disproportionately from success while externalizing losses. This asymmetry fosters adverse selection, as distressed firms attract excessive financing, perpetuating zombification (San-Jose et al., 2021).

Research from Faccio et al. (2016) and San-Jose et al. (2021) expand governance analysis to include demographic and behavioural attributes. For instance, gender diversity at the CEO level appears to reduce zombie risk, as woman exhibit lower risk tolerance on average, a finding supported by experimental economics and psychology. However, exceptions arise when female CEOs are also owners, as ownership amplifies risk-taking incentives. At senior executive levels, gender-based behavioural differences diminish, reflecting the unique skill sets required for high managerial positions.

Despite the insights, limitations persist. Many studies focus on single-country contexts (e.g., France), limiting generalization. Governance characteristics such as board member education, age, and cultural factors remain underexplored. Furthermore, most analyses assume zombie firms ultimately exit, overlooking recover pathways (Veganzones & Severin, 2024).

1.4. Sectorial dynamics and entrepreneurial ecosystem

Zombie firms divert financial resources from healthy enterprises, reduce market efficiency, and create systemic economic distortions. Their persistence hampers the reallocation of capital toward productive uses, delaying industrial transformation, constraining total factor productivity, and weakening innovation capacity, ultimately impeding economic growth. Effective resolution of zombie firms is therefore critical for fostering structural change and sustaining long-term competitiveness.

The crowding-out effects of zombie firms are particularly pronounced in sectors characterized by excess capacity, such as manufacturing, and among labour-intensive firms or those operating in highly marketized regions. These firms already face overcapacity, often operate with large fixed investments with high sunken costs, and work with thin margins which rely on steady cash-flow; all while zombie firms present in the same market maintain or even expand on artificially low prices and occupy the market share that should be reallocated to more efficient firms. Evidence from China illustrates these dynamics, offering valuable lessons for other emerging economies. Empirical studies confirm that a higher proportion of zombie firms within an industry significantly reduces the financing opportunities available to non-zombie firms, as reflected in negative coefficients for industry-level zombie prevalence (Wang & Zhu, 2020).

Beyond financial constraints, zombie firms influence innovation ecosystems. Their presence can depress the innovative performance of non-zombie incumbents by altering competitive dynamics and diverting resources. A 10% increase in the employment share of zombie firms within a sector correlates with a decline in patenting activities among healthy firms ranging from 0.8% to 2.8%, depending on the estimation method (Ascani & Nair, 2025). While this relationship is generally negative, contingencies related to industry structure and firm characteristics may occasionally generate positive spill overs. For instance, heightened competition for resources may incentivize the most resilient non-zombie firms to optimize financial efficiency and intensify innovation efforts, whereas weaker firms experience severe constraints.

Credit misallocation, where a substantial share of bank lending supports zombie firms, has been linked to sluggish post-crisis recovery in the European Union. Liquidity injections that sustain zombies in the short-term often fail to prevent eventual collapse due to persistently low productivity. Meanwhile, their survival depress aggregate industry productivity, crowds out investment, and constraints employment growth among healthy competitors (Acharya et al., 2017; Banerjee & Hofmann, 2018). Nonetheless, some studies such as Banerjee & Hofmann

(2020) and Caballero et al. (2008) argue that delaying zombie exit may mitigate supply chain disruptions and generate temporary demand-side externalities, underscoring the complexity of policy trade-offs.

Financial constraints remain a major barrier to innovation, particularly in credit-dependent economies such as Italy, where limited access to external financing is the primary obstacle to R&D investment (Hottenrott & Peters, 2011). At the micro level, non- zombie firms exhibit significant heterogeneity in their ability to respond to zombie-induced distortions. Stronger firms may leverage internal resources and distinctive capabilities to transform adversity into opportunity, while weaker firms suffer disproportionately. Similarly, market structure matters: healthy firms with substantial market share may withstand intensified competition, whereas smaller firms face heightened risk aversion, limiting their capacity for innovative investment. These dynamics suggest that zombie-induced spill overs are contingent on firm-specific and industry-specific characteristics.

Finally, the literature highlights an unexplored dimension: the existence of zombie firms holding patents. Such firms may have invested heavily in projects that failed to deliver economic or technological returns, possibly due to weak integration between technological development, product strategies, and market positioning. This phenomenon warrants further investigation, as it challenges assumption about the relationship between innovation and firm vitality (Ascani& Nair, 2025).

1.5. Formation and detection

Several macroeconomic and institutional factors contribute to the formation of zombie firms and have a strong explanatory power for global zombification:

- Economic growth patterns; as reduced firm revenues and profitability due to weak or uneven economic growth may result into marginal firms becoming zombies (Caballero et al., 2008).
- Industry composition; as explained above by Wang & Zhu (2020), structural over-capacity and labour-intensive sectors are the most affected by zombification.
- Accommodative monetary policies, which are policies that by central banks tailored to make borrowing cheap and plentiful to stimulate economic activities; by cause of institutional factors for example, seen with Banerjee & Hofmann (2018), which may contribute to zombification by maintaining low interest rates, enabling unproductive firms to survive debt cheaply.

- Expansion of global corporate bond markets; has facilitated the survival of financially distressed firms, providing continued, lifeline funding. (Wang & Zhu, 2020).
- Democratic accountability; as seen with the unnatural selection explained by Peek & Rosengren (2005), where for example elected officials, foster a zombie environment to keep employment statistics or politically sensitive firms.
- Staggered bankruptcy reforms; indicates that creditor-friendly legal frameworks, such as creditor rights, significantly reduce zombie prevalence, lowering zombie ratios by approximately 1.4 percentage points and accelerating firm exit from zombie status.

Conversely, non-adapted legal frameworks foster zombification (Altmann et al., 2024).

To optimize detection, Altmann et al. (2024) propose a two-step filtering process combining an accounting-based measure with a default predictor, excluding extremely small and very large firms due to asset range constraints. The most widely use accounting metric is the Interest Coverage Ratio (ICR), defined as EBIT/Interest or EBITDA/Interest due to its simplicity and data availability. Firms with an ICR below one are typically classified as zombies.

Recent advances in predictive modelling have improved detection accuracy. Seo et al. (2024) identify net profit margin as the most influential predictor followed by selling, general, and administrative cost ratios, gross profit margin, return on equity (ROE), revenue size, operating income growth, net income growth, business age, capital turnover, and debt-to-equity ratio. Seo et al. demonstrate superior predictive performance compared to traditional models like logistic regression, while providing interpretability through variable importance visualizations. These methods address the limitations of conventional “black-box” models (e.g. XGBoost⁶) in financial research. (Brahmana, 2025).

Historically, ex-ante prediction relied on financial ratios and default probability models. Beaver (1966) emphasized liquidity, profitability, and leverage as key indicators. Altmann’s Z-score (1968) remains the most widely applied measure of default risk, while Ohlson’s O-score (1980) and Merton’s Distance-to-Default (1974) introduce probabilistic approaches grounded in logistic regression and structural modelling.

However, traditional methods face notable limitations:

- Historical bias: prediction based on past financial statement fail to capture rapidly changing market conditions or non-financial factors.

⁶ XGBoost (eXtreme Gradient Boosting) is a distributed, open-source machine learning library that uses gradient boosted decision trees, a supervised learning boosting algorithm that makes use of gradient descent. It is known for its speed, efficiency and ability to scale well with large datasets.

- Data manipulation risk: financial metrics can be volatile and subject to accounting discretion.
- Lack of contextualisation: universal models overlook industry-specific and firm-level characteristics.
- Short-term focus: conventional analysis emphasizes immediate performance rather than long-term sustainability.

These shortcomings underscore the need for more sophisticated, transparent, and comprehensive models. AI-based predictors, such as those proposed by Seo et al. (2024), bridge the gap between accuracy and interpretability. Nonetheless, limitations remain: qualitative factors such as leadership quality, innovation capacity, and organizational culture are often excluded, and models trained on specific contexts such as South Korean firms post-COVID-19, may lack generalizability across regions and economic environments (Zoller-Rydzek & Keller, 2020).

1.6. Solutions suggested in the literature

The persistence of zombie firms poses significant challenges for economic efficiency and resource allocation. Empirical evidence indicates that only about 25% of zombie firms successfully recover, while the average duration of zombie status is approximately five years before restructuring, delisting, or acquisition occurs (Altmann et al., 2024).

1.6.1. Firm-level recovery strategies

Dai et al. (2018) identify several measures that enhance the likelihood of recovery, including reductions in labour costs, state-owned enterprise (SOE) reforms, deleveraging, and asset sales. Conversely, asset injections tend to have negligible or negative effects on recovery prospects.

These findings suggest that restructuring strategies focused on cost reduction and financial discipline are more effective than capital infusions.

1.6.2. Government interventions

In the short-term, resolving zombie firms is inherently costly and may lead to large-scale unemployment. To mitigate social consequences, governments can implement comprehensive labour adjustment programs, including unemployment compensation, employee resettlement, job creation in public welfare sectors, entrepreneurship support, and reemployment training (Dai et al., 2018). On the long run however, it might be interesting to underline that due to various reasons developed above (productivity and profitability reduced due to scarce resource

allocation caused by zombie activity, weakened financial system, etc.) which have cumulative effects over-time, leaving zombie firms in the market is expected to be even more costly.

Government procurement emerges as a demand-side policy tool with potential to revitalize zombie firms. Yu et al. (2024) argue that procurement can stimulate R&D investment, enhance product competitiveness, and expand market share. Unlike private transactions, government contracts offer payment reliability and long-term agreements, reducing financial uncertainty. Furthermore, procurement serves as a positive market signal, improving transparency and attracting scrutiny from analysts and media, which pressures management to improve efficiency. Empirical studies confirm that procurement positively influences technological innovation, sales performance, and information quality (Aschhoff & Sofka, 2009). However, potential biases exist: firms in better operational condition are more likely to secure procurement contracts, and regional disparities in IT infrastructure may affect disclosure and selection processes.

Wu and Pan (2023) advocate for differential policy approaches, recommending classification of zombie firms by industry and region to tailor interventions. Strengthening regional financial development is critical to alleviate financing constraints and redirect firms toward real investment rather than financial speculation.

1.6.3. Macroeconomic regulatory measures

Gabriel and Roche (2023) emphasize preventive strategies, including limiting interest rate manipulation and credit expansion in pre-crisis periods and implementing flexible, expedited insolvency regimes post-crisis. Firms should monitor their dependence on low-interest environments for profitability, as excessive reliance increases zombification risk (Wu & Pan, 2021). Competition policies that promote productive firms and discourage excessive leverage can further reduce zombie emergence.

1.6.4. Human capital and corporate governance

Human resources management plays a role in mitigating productivity stagnation through continuous skill assessments, training programs, and employee engagement initiatives. These measures ensure workforce adaptability and sustain operational efficiency. From a governance perspective, San-Jose et al. (2021) propose integrating governmental, ethical, and corporate approaches to limit zombification risks. Recommendations include codes of conduct for CEOs, decision-making limits for boards, and internal mechanisms mandating timely exit decisions.

Clear guidelines on firm closure and enhance awareness of financial and social consequences are essential.

1.6.5. Conditional support and innovation-oriented policies

Ascani and Nair (2025) advocate for conditional support schemes aimed at restoring solvency rather than perpetuating zombie status. Policies should incentivize private sector investment in distressed firms, particularly those with valuable knowledge resources that can be commercialized. Such measures avoid adding debt while leveraging innovation potential, offering a balanced approach between liquidation and recovery.

CHAPTER 2: HYPOTHESES

Following the overview of the literature on the factors that shape the lifecycle of zombie firms across different national and industry contexts, our research question has evolved into:

What explains regional disparities between zombie firm prevalence and recovery between Flanders and Wallonia in Belgium, and how are these differences reflected at industry level innovation?

Along these lines, the following hypotheses are formulated to provide elements of response to the research question. The timeframe of 2012 – 2024 is used to capture post-crisis and COVID-19 effects.

2.1. First hypothesis

Altman et al. (2024) and Banerjee & Hofmann (2018) like most studies on zombie firms, rely on interest coverage ratio ($ICR < 1$) as the primary criterion for identifying zombie firms. This approach has multiple limitations as seen above (overestimate zombification, ignore qualitative factors, etc.). Having gone through corporate governance factors (board size, ownership concentration, CEO attributes) and firm characteristics (age, size, R&D intensity) it would be interesting to examine the following hypothesis:

H1: A blended model integrating financial ratios, governance attributes and innovation factors improves the accuracy of zombie firm identification compared to traditional ICR- based classification.

The aim here would be to confirm what it seen in the literature, qualitative factors are essential to detect zombie firms and distinguish them from firms who are poorly performing but do not fall in the definition of zombification set above.

2.2. Second hypothesis

Gabriel & Roche (2023) show that zombie concentration varies across countries and sectors, with southern Europe (Greece, Portugal, Italy, and Spain) exhibiting higher prevalence in certain industries (especially among large, established firms). Moreover, Ascani & Nair (2025) highlight sectorial spill overs on innovation. As a result from those observations, the following hypothesis has been constructed:

H2: Zombie prevalence differs significantly between Flanders and Wallonia due to structural differences in industry composition and innovation ecosystem.

This hypothesis could allow us to not only test that sectorial heterogeneity (e.g. industry mix, innovation capacity) has a considerable impact on fostering zombie firms, but also add to the literature by having an intra-country regional study focusing on the subject.

2.3. Third hypothesis

According to Ascani & Nair (2025), zombie presence reduces overall capacity to foster innovation, which is translated in their study in a reduction of patenting activity among healthy firms. To test this affirmation, it would be interesting to assess whether it remains relevant in a regional based comparison. Given this observation, the following hypothesis is constructed:

H3: The presence of zombie firms in a given industry negatively affects the innovation performance of non-zombie firms, but this effect is weaker in firms with strong internal R&D capabilities.

Understanding this could benefit policymakers design conditional support schemes to protect firms with high potential innovative capabilities.

2.4. Fourth hypothesis

Qiao & Fei (2021) and Wang & Zhu (2020) emphasize that subsidies can alleviate financing constraints and improve efficiency, but moral hazard often reduces their effectiveness for zombie firms. Additionally, Wu & Pan (2023) argue that regional financial development influences the access of firms to credit and investment opportunities. However, their studies like others do not examine up close how financial development interacts with subsidies to affect Zombie survival, especially in small countries from the European Union. This reveals the opportunity to focus on subsidies not as a standalone factor but add regional heterogeneity and the interaction effect.

As a result the following hypothesis is constructed:

H4: Regional financial development moderates the relationship between government subsidies and zombie firm survival.

Understanding this interaction may play a crucial role for designing targeted policy interventions that avoid perpetuating zombification and fostering zombie firms all while supporting regional economic resilience.

PART II: METHODOLOGY

CHAPTER 1: DATA AND SAMPLING

1.1. Data

The primary data source for this research is Bel-first, a comprehensive database of Belgian firms covering balance sheet, profit & losses, employment and other firm characteristics that will be needed. This choice is justified by the holistic view provided, facilitating the research of qualitative attributes along with financial ones. Additionally, with this data source we are able to obtain a dynamic view of the company information, matching with the framework selected (2012-2025).

1.2. Sample description

There are different sets of sample sizes used because of the difficulties having all the data available for all the explanatory variables for the period selected. For a more exhaustive analysis the starting point was 12298 companies (6149 in Wallonia and 6149 in Flanders). For this initial sample size, there were consistently all the financial data available. Because going forward there were less non-financial data available, a choice was made to reduce the sample size to 1000 companies (500 in Wallonia and 500 in Flanders) for which 8700 firm observations had all the variables that could be collected for a valid computation on the hypothesis developed.

Some limitations were faced. For example the fact that Bel-first does not include data of firms that have exited the market, observations on those firms could have been made to determine whether they showed zombie characteristics and would have given insight on zombie exit (using the hypothesis that some of them could have been classified as zombies).

CHAPTER 2: OPERATIONALISATION OF VARIABLES

2.1. Dependent variables

The following table retraces the dependent variables calculated:

Hypothesis	Dependent Variable	Measurement
H1	$Zombie_{i,t}$	1 if $ICR_{i,t} < 1$
H2	$Zombie_{i,t}$	1 if $ICR_{i,t} < 1$
H3	$Innovation_{i,t}$	$\log(1 + Intangible\ assets_{i,t})$
H4	$Zombie_{t+1}$	1 if firm is Zombie at t+1

The core variable of interest here is whether a firm can be classified as a zombie firm. Following Altman et al. (2024) and Banerjee & Hofmann (2018), this can be determined by using the ICR:

$$ICR_{i,t} = \frac{EBIT_{i,t}}{Interest\ Expenses_{i,t}} \quad (1a)$$

Let us remember that a firm i is classified as a zombie at year t if:

$$Zombie_{i,t} = 1 \quad \text{if} \quad ICR_{i,t} < 1 \quad (\text{For at least 3 consecutive years})$$

Meaning that the firm does not generate sufficient operating income to cover interest payments.

Building on the two-step filtering process proposed by Altmann et al. (2024), which combines an accounting-based measure with a default predictor, this study adopts a blended model approach. In line with the theoretical arguments developed in the literature review, the model tries to incorporate financial, governance, environment and firm level characteristics as the principle analytical dimensions through which zombie firms are identified and examine:

$$Zombie_{i,t} = F(\alpha + \beta_1 Financial_{i,t} + \beta_2 Governance_{i,t} + \beta_3 Innovation_{i,t} + \beta_4 FirmControls_{i,t} + \mu_j + \lambda_t) \quad (1b)$$

Having previously computed how to determine whether a company is zombie or not in H1, for H2, we are trying to observe the difference of zombie prevalence in Wallonia and in Flanders using the following computation:

$$Zombie_{i,t} = \alpha + \beta Wallonia_i + \delta_t + \theta_1 \ln(Assets_{i,t}) + \theta_2 Leverage_{i,t} + \varepsilon_{i,t} \quad (2)$$

To test this hypothesis we needed to isolate the effect of being in Wallonia on the probability of a given company being a zombie firm all while removing the influence of variables that

could introduce confusion (here we selected firm size, business cycle conditions and some leverages).

A year fixed ratio has been added because zombie prevalence can vary in time due to exceptional macroeconomic shocks (such as recessions, energy shocks, COVID-19, etc.)

For H3, because of the difficulty finding separate data on R&D expenditures and patent information for most companies, Intangible assets was used as an innovation measure because it simultaneously includes R&D, patent, software and organisational capital (Wikipedia contributors. (2025), “Financing Innovation under Ambiguity and Skewness,” (2022)). Thus, the following logarithmic computation is used as an innovation variable proxy because it reduces skewness⁷ and allows elasticity interpretation:

$$\log(1 + \text{Intangible assets}_{i,t}) = \beta_1 \text{ZombieShare}_{j,t} + \beta_2 \text{Cap}_{i,t} + \beta_3 (\text{ZombieShare}_{j,t} \times \text{Cap}_{i,t}) + \mu_j + \lambda_t + \varepsilon_{i,t} \quad (3)$$

For H4, the following regression structure was inspired by Caballero et al. (2008), who modelled the probability that a distressed firm remains unviable due to external financial support. The interaction term with the regional indicator allows us to look at the zombie persistence effect of subsidies across the two regions of interest:

$$\text{Zombie}_{i,t+1} = \beta_1 \text{SubsidyIntensity}_{i,t} + \beta_2 \text{Region}_{i,t} + \beta_3 (\text{SubsidyIntensity}_{i,t} \times \text{Region}_{i,t}) + \gamma X_{i,t} + \lambda_t + \varepsilon_{i,t} \quad (4)$$

2.2. Independent variables

1. $\text{Financial}_{i,t}$, represents the chosen financial indicators: ICR, profitability, liquidity and leverage ratios.
2. $\text{Governance}_{i,t}$, represents the ownership concentration⁸.
3. $\text{Innovation}_{i,t}$, represents the innovation indicator chosen: intangible assets.
4. $\text{FirmControls}_{i,t}$, represents the chosen firm degree of maturity: firm size, firm age, capital intensity and industry NACE classification.
5. $\text{ZombieShare}_{j,t} = \frac{\text{Zombie firms in industry } j}{\text{Total firms in industry } j}$, represents the congestion and misallocation of zombie firms in an industry. The higher the zombie share the higher the congestion.

⁷ Skewness is crucial to make sure that the data is normally distributed. This factor is important to insure an accurate interpretation. For more details see Wackerly et al.(2002).

⁸ See the table of indicator of degree on ownership concentration in Appendix (other: list II)

6. $Cap_{i,t}$ is the variable that captures the firm's internal ability to innovate. it is proxied by the intangible assets amortization.
7. $ZombieShare_{j,t} \times Cap_{i,t}$ is the core of H3, capturing the influence of strong internal innovative capabilities on effects of zombification.
 - If $\beta_3 > 0$, than strong firms can resist Zombie pressure.
 - If $\beta_3 = 0$, than Zombie firms harm all firms equally.
 - If $\beta_3 < 0$, than even strong firms are dragged down by zombie firm effects.
8. $SubsidyIntensity_{i,t} = \frac{Subsidies_{i,t}}{Assets_{i,t}}$, is the measure used to calculate subsidies scaled by assets to avoid size bias and mechanical correlation with firm scale.
9. $Region_{i,t}$, is the variable explaining the effect of being either in Wallonia or in Flanders.
10. $(SubsidyIntensity_{i,t} \times Region_{i,t})$, is the core variable explaining whether financial development moderates the effects of subsidies.

2.3. Control Variables

- $\ln(Assets_{i,t})$ is used to determine the firm size (Dang et al., 2017). This parameter is also used as a control variable because depending on size only a firm can may accumulate more debt, have easier access to credit or can be more likely to be bailed out.
- By definition a zombie firm is financially distressed, the control variable $Leverage_{i,t}$ is used to subtract balance sheet effects and isolate pure institutional differences.
- μ_j is an industry fixed effect to control capital intensity, market structure, technology, etc.
- λ_t is a year fixed effect to control macroeconomic influences by year.
- $X_{i,t}$ is a control variable that effect survival probabilities regardless of subsidies.

The selection of control variables was inspired by Collijs & De Busscher (2020), who examine the impact of zombie firms on the productivity of non-zombie firms and emphasize that other external may simultaneously influence the outcome of interest. Including these variables in the model allows the analysis to account for potential confounding effects.

PART III: ANALYSIS AND RESULTS

CHAPTER 1: FIRST HYPOTHESIS

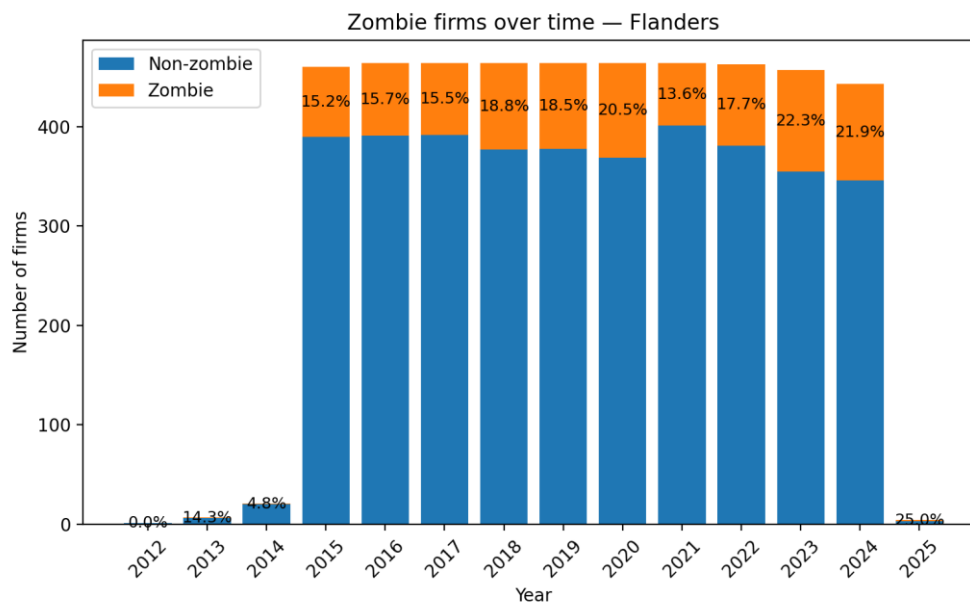
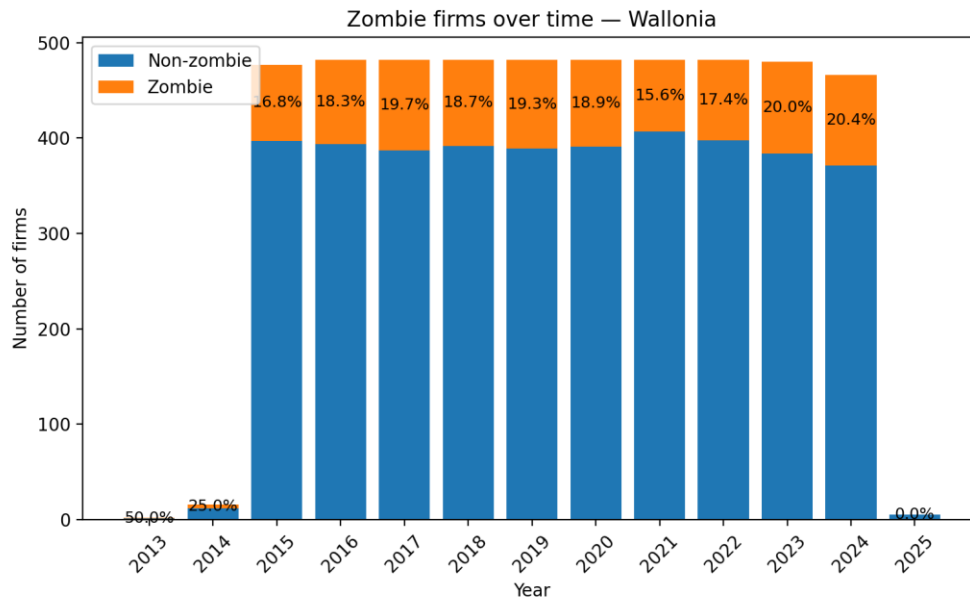
In 2023, a total of 74,050 enterprises were established in the Flemish region and 26,443 in the Walloon region (*Enterprise Incorporations*, n.d.). Because the dataset is an equal split of companies from the two regions, depending heavily on which firms fell into the sample chosen the results could have been unbalanced. A necessary additional step was then taken using a 5-fold stratified cross-validation⁹ test to make sure that the correct model is used. The following results were obtained:

Model	AUC	Accuracy	Precision	Recall
ICR rule (ICR < 1)	0.879	0.758	0.020	1.000
ICR-only logit (CV)	0.920	0.796	0.017	0.750
Blended logit (CV)	0.954	0.983	0.083	0.250

The AUC (Area Under the Curve), which measures the probability that the model assigns a higher zombie probability to a true zombie firm rather than a non-zombie firm (an AUC = 1 means a perfect classification), shows that with a score of 0.954, the best model is the blended model which integrates Financial, Governmental, firm and innovation parameters for a better prediction of zombie status. The accuracy rate, which reflects which fraction of the firms are correctly classified, also gives the blended model the highest score. The precision indicator, which predicts how often the model is right when it attributes zombie status to a company, supports also the blended model. However, the recall indicator gives a percentage of how many actual zombie firms the model detects; 25% is the percentage of zombie firms detected in the blended model whereas 100% of zombie firms were in the simple model for which a company is considered zombie if the ICR is inferior to one for at least 3 consecutive years. This supports H1.

The Following graphs illustrate the percentage of zombie firms per year in each region:

⁹ A technique for model evaluation, used to predict how a model performs on an independent dataset. For more information see Kuhn and Johnson (2013).



The fact that we can conclude zombie status is not well predicted by the first predictor confirms the limitations mentioned above by Caballero et al. (2008), about the use of the ICR as only metric and also implies that zombification is not primarily a financial phenomenon; zombie firms are companies whose capital structure has become incompatible with their operating performance. Economically we can say that zombie firms represent a misrepresentation of risk in the financial system. Furthermore, because we have proven that zombie firms can be identifiable using models that incorporate market, balance-sheet and environmental information, it implies that regulators have the information needed to detect them. This importance of detection is already acknowledged by De Jonghe (2021) who stress the importance of the choice of how zombie firms are identified, as it may lead to substantial

differences in the estimated zombie population, both in terms of the number of zombie firms and the quality of zombie firms.

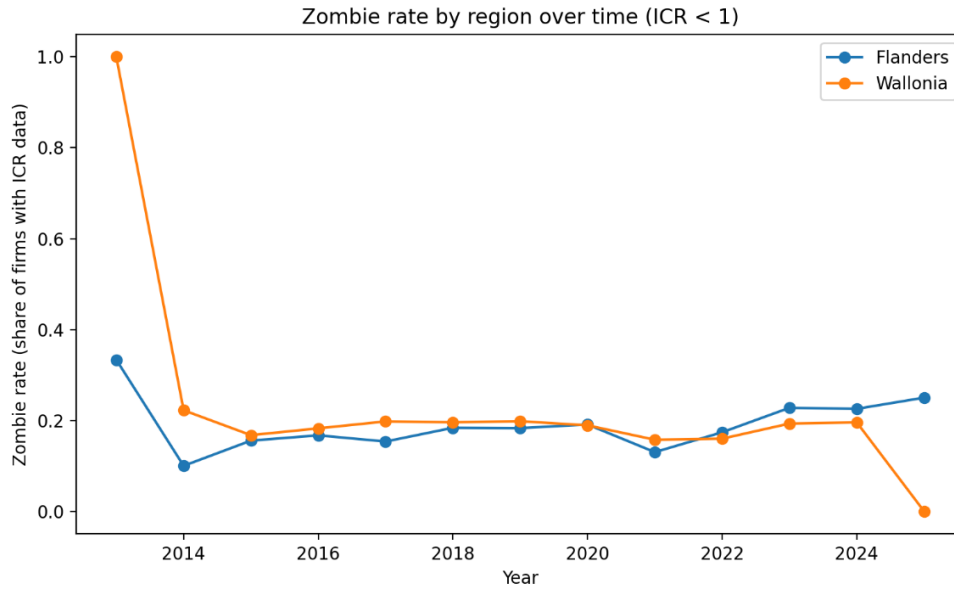
CHAPTER 2: SECOND HYPOTHESIS

Controlling the effects of firm size, leverage and time effects, the overall results of the regressions show that the coefficient of being a firm in Wallonia is positive, suggesting that those firms have 5.7%¹⁰ higher probability of being zombie firms compared to the ones in Flanders.

This result is not only economically viable, but also statistically significant (p-value= 0.003), indicating that it is mostly unlikely to arise by chance. The results support H2 and by the same occasion what Wu & Pan (2023) suggest; that a given region can influence the access of firms to credit and investment opportunities, making some of them more prone to zombification.

According to (Economic History, 2024) Wallonia invested in protecting its older industrial base, this effect translating into investing substantial subsidies for struggling companies, making them today rank lowest in Belgian indices for economic and development indicators. In contrast, neighbouring Flanders, invested in potential future trade growth and has thrived by directing funds towards innovative infrastructure projects, highlighting a divergence influenced by economic factors, cultural tensions, and a unique political economy. Regional institutions and economic ecosystems play a fundamental role in shaping firm survival dynamics. Thus, regional heterogeneity is proven and we can observe via the following graph what it means in terms of zombie prevalence.

¹⁰ See table II in appendix.

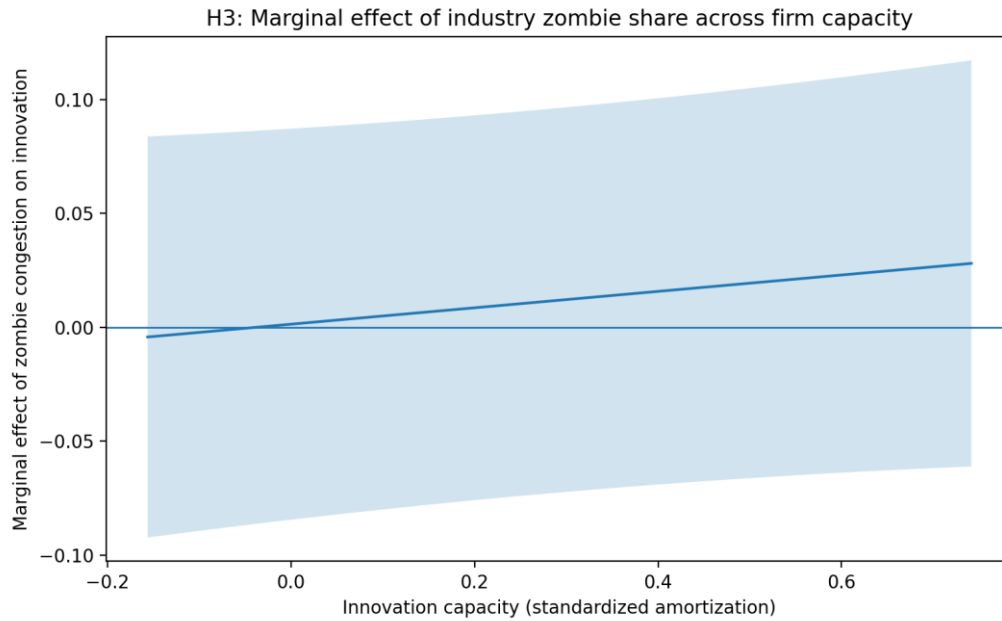


Looking at this graph, a stable structural difference between the two regions can be noticed and this time series plot shows that it varies by year, suggesting that regional effect is present but not as strikingly different as one would expect. Regional effect is only partially critical and can simply not explain the whole zombie effect as it is suggested in the literature reviewed above (Wang & Zhu, 2020).

CHAPTER 3: THIRD HYPOTHESIS

The previous hypothesis already sets a precedent on the fact that zombie firms are more prevalent in Wallonia than in Flanders. This hypothesis is based on Ascani & Nair (2025)'s theory that zombie firms distort competition, absorb resources and weaken incentives to invest. The next step would be to examine the intercept of interest β_3 , which gives insight into the effect of zombie presence on innovative activity for healthier firms.

The results, as shown in the following graph, indicate that industry zombie share has essentially no effect on firm-level innovation; the statistical coefficient on zombie share β_1 cannot be distinguished from 0 (p-value = 0.156), meaning the higher zombie prevalence within the industry is not associated with lower innovation by non-zombie firms in this sample. Furthermore, our interaction variable β_3 is also statistically insignificant (p-value = 0.156), implying that zombie congestion does not differentially affect firms depending on their internal innovation capabilities.



The most robust and economically meaningful result in the model is the strong positive effect of firm-level innovative capacity. Firms with higher intangible investment and greater absorptive capacity systematically invest more in innovation, regardless of the competitive environment they face (Griffith et al., 2003). This indicates that in Belgium, innovation is primarily driven by internal firm capabilities.

This result suggests that innovative firms are able to isolate themselves from zombie effects. Even if low-productivity firms remain in the market, innovative firms continue to invest when they have strong internal knowledge capital and skilled human resources,

This also reinforces the idea hinted above, that the Belgian innovative system appears to be firm-driven rather than competition-driven. Competition is but one of many factors that drive innovation and promoting competition is not the best or only method to promote innovation. Other drivers such as exogenous factors and foreign investor participation help explain why zombie congestion does not reduce innovative capacity in Belgium as strongly as could be expected. In particular foreign ownership and venture capital participation in Belgian technology and innovation ecosystem has grown to 66% of funding since 2020 (OECD, 2023; DE POORTER et al., 2024). This implies that a large share of innovative Belgian firms finance their growth and R&D through international capital markets rather than domestic banks. As a result, even if zombie firms continue to absorb domestic credit and resources, innovative firms are partially isolated from these distortions because they rely on external sources of financing that are not affected by domestic zombification.

This mechanism contrasts with the experience of Japan and southern Europe economies, where zombie firms were found to reduce both productivity and investment, including R&D, because firms in those systems were heavily dependent on domestic bank credit and local capital markets (Caballero et al., 2008; Banerjee & Hofmann, 2018). In those contexts, zombie firms constrained the financing available to healthy firms, directly suppressing innovation. Belgium's case appears to be different. While zombie firms are prevalent (as shown in H2), they do not significantly reduce innovation by healthier firms, because innovative firms have access to alternative sources of capital and operate within a diversified, internationally integrated innovation system.

This phenomenon highlights an important point, which is that the harm zombie firms cause might not be uniform across countries or regions, but dependent of financial markets and innovation contexts. In Belgium, they appear to distort efficiency and fiscal costs (Collijs & De Busscher, 2020), but innovation remains driven by firm-level capabilities and some degree of institutional support.

Furthermore, according to Acquiremedia (2023), there is a considerable decrease in state aid that kept some companies afloat despite their poor management. Zombie companies are now being forced to put down the books, liberating resources for non-zombie firms in the same market.

CHAPTER 4: FOURTH HYPOTHESIS

The results provide strong evidence that subsidies significantly increase zombie persistence, but also reveal a counterintuitive regional pattern. The coefficient on subsidy intensity is large and highly significant ($\beta_1 = 1.876$, with a p-value < 0.001), indicating that zombie firms receiving higher public support are much more likely to remain zombies in the following year. This aligns with previous findings that public support has played a central role in sustaining zombie firms. However, it contradicts the assumption that Wallonia, with its strong public sector and interventionist policies that rely more heavily on public financial instruments and state-owned investment vehicles (e.g., “Société Régionale d’Investissement de Wallonie”/SRIW) to support firms and employment (OECD, 2022), should exhibit stronger subsidy-driven bias; the results suggest instead that subsidies are more distortionary in Flanders.

However, the results of the interaction coefficient of subsidy intensity in Wallonia is negative and statistically significant ($\beta_3 = -1.197$, with a p-value < 0.001), implying that while

subsidies alone increase zombie persistence everywhere, they do so significantly less in Wallonia rather than in Flanders. This remains consistent with DE POORTER et al. (2024), who, looking at the regions, noticed that Flanders-based innovative companies historically received a larger share of total investment volume (52%), whilst Wallonia comes in at 17% of the cumulative capital. One plausible explanation could lie in the institutional design of public support in the two regions. Additionally, when we look at specific subsidies like the ones released after the COVID-19 pandemic, Magerman et al. (2025) did not find signs of helping zombie firms disproportionately; the support programs in Wallonia generally resembled quite closely the similar support programs in Flanders, and reinforced the idea that policies¹¹ had a strong impact on firm performance and survival, allowing them to weather massive crisis, without feeding too much into zombification.

For an overall view, De Jonghe et al. (2021) provide evidence on how and why bank specialization in Belgium impacts zombie lending, the banks often specialize in lending to specific sectors and gain sector-specific information through having many interactions with borrowers from the same sector; they argue that such sectorial information advantage also makes banks more aware of zombie firms in the sector as well as more knowledgeable about the negative impact that zombie firms have on healthy borrowers. Additionally, they argue that sector specialization is associated with lower and even reduced credit supply to zombie borrowers.

¹¹ See the policies referenced in list III in appendix

PART IV: CONCLUSION

CHAPTER 1: SUMMARY OF RESULTS

The core literature definition (Altmann et al., 2024), which links zombie firms to weak debt-servicing capacity and creditor forbearance (often in low rate environment) is important as a starting point because the theoretical and empirical analysis emphasizes that zombies are not merely low-performance firms; they are firms whose continued survival reflects weakened market discipline and financing frictions (or policy choices) that delay restructuring and zombie firm exit. Underlying this precision matters because the hypothesis developed are not just about whether firms are distressed or not, but also why distress is regionally uneven and why zombie firms might be able to recover differently across regions.

H2 results imply that the Wallonia and Flanders zombie disparity cannot be explained purely by the observable financial structure of firms, not only by common macro shocks (referencing pure year fixed effects). Instead, the results are consistent with the idea that zombie prevalence is also shaped by regional economic structure and institutional environment (Acharya et al., 2017; Banerjee & Hofmann, 2018).

From a broader perspective, the zombie literature stresses that zombification tends to be higher where restructuring and exit mechanisms are weaker, and where financing conditions reduce the pressure to resolve distress quickly. Caballero et al. (2008) show how creditor forbearance and delayed restructuring can raise the share of zombie and depress reallocation; similarly, McGowan et al. (2018) frame zombie firms as a symptom of weak market selection and resource misallocation.

After affirming the regional zombie disparities it was crucial to explain why during the next step at H4, which moves to prevalence to persistence. The positive subsidy persistence affirmation fits with the logic that external support keep distressed firms alive without forcing deep restructuring. This is consistent with the broader evidence that zombies persist when financial pressure is reduced. In summary, how support is channelled matters more than whether support exists; public support is not one homogeneous thing as explained by De Jonghe et al. (2021) and Yu et al. (2024).

In Flanders, business support and innovation aids are heavily organized through regional agencies such as “VLAIO” which explicitly provides subsidy instruments for training, investment, R&D, etc. (VLAIO (*Agentschap Innoveren & Ondernemen*), n.d.). Whereas in Wallonia, the public support landscape includes major public finance actors under “Wallonie

Entreprendre” (including the SRIW referenced above), with large portfolios of financing and guarantees, often framed as development and restructuring tools (OECD, 2022). Nevertheless, this remains an interpretation of the results observations, not a proven causal statement.

In summary, Belgium shows strong regional differences in zombie prevalence and persistence, but these differences do not translate into a statistically robust industry level innovation crowding-out effect, Suggesting that the problem might be more about efficiency and fiscal/financial discipline than about measurable innovation suppression, at least in this dataset.

CHAPTER 2: LIMITES OF THE THESIS

Although personal competences have been reinforced all through this theses and the fact that some of the results were significant, several methodological and data-related limitations were identified. These limitations do not invalidate the findings; rather they clarify what cannot be inferred from this analysis.

2.1. Defining zombie firms

Zombie firms are identified using the interest coverage ratio ($ICR < 1$), which is as explained above, a limitation shared by virtually a large scale of zombie studies. Using this definition classified a large fraction of firms as zombies, illustrating that this ratio-based measure overestimates zombification.

With more resources, other definitions could be used for a better comparison of models.

2.2. Measuring Innovation

Innovation is approximated by intangible assets, which reflects capitalized R&D, software, patents and other intellectual property. This is a limitation as it does not capture all forms of innovation. The stance adopted here is that the full spectrum of innovative activity cannot be captured by formal asset-like documented innovation. Even if some data were available (like patents, organizational change, etc.), another difficulty would be to make those and other qualitative attributes quantifiable. Meaning that the null finding for H3 is somewhat meaningful, but it is a finding about innovation as measured in this research.

2.3. Industry-level aggregation and competition

The NACE industry level is used as zombie congestion is measure; a standard compromise between precision and data availability, but it does not perfectly represent the competitive environment faced by each firm.

The assumption for having this as a limitation is that firms often compete in regional, product-specific markets or other dimensions that cut across NACE classifications. A firm may face intense zombie pressure in a local market even if the industry zombie share is low, or vice versa. This measurement error may weaken the estimated zombie-innovation relationship in H3.

However, this bias works against finding significant results. If even with this noise a strong effect were present it would be detected. The fact that the effect is essentially zero suggests that

any true zombie congestion effect on innovation is likely modest in Belgium relative firm capabilities effect.

2.4. Bel-first data

This database covers incorporated firms and provides rich financial information. But it has two important weaknesses.

First, several qualitative indicators were missing to have a more granular interpretation of the results. Patents information, policies adopted, R&D expenditures, bank credit, etc, could have resulted in a richer interpretation if the data were used. The collection of this different information from various data sources would have constituted a robust workload for the time constraint.

Second, firms that exit quickly may disappear from the dataset, and all the data from firms that are no longer active totally disappear from the database. This is particularly relevant for zombie persistence analysis, which relies on observing firms over time and would have oriented our study towards these firms to study whether the persistence of zombies may be even stronger in reality than observed in the data or whether there is a clear pattern linked to zombification before they exit the market.

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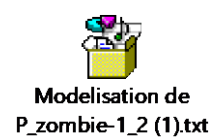
APPENDIX

A. DATA SOURCE



B. REGRESSION RESULTS

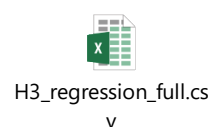
I. Table I: H1 blended model regression results



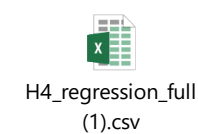
II. Table II: H2 regression results



III. Table III: H3 regression results



IV. Table IV: H4 regression results



C. OTHER

I. List of bankruptcy reforms from (Altman et al., 2021)

Table 9: Country and Event List of Formalized/Reformed Bankruptcy Laws Since 2000

Country	Year	Bankruptcy law reforms	Friendly	References
Brazil	2005	The country formalized a new bankruptcy law similar to US Chapter 11 and Chapter 7 (Amends Federal Law 11.101). The new law changed the order in which claims are paid when a firm is liquidated, giving higher priority to secured creditors (giving secured creditors' claims priority over tax claims).	Creditor	Pontcelli and Alencar (2016); John et al. (2020)
China	2007	The modern bankruptcy law, Enterprise Bankruptcy Law, was enacted in 2007, replacing the 1986 Bankruptcy Law and all other insolvency provisions. The new law introduced a detailed reorganization procedure that resembles Chapter 11 of the US Bankruptcy Code, and adopted several international recognized practices such as automatic stay on assets.	Debtor	Li and Pontcelli (2021); Hotchkiss et al. (2022)
France	2006	La Loi de Sauvegarde des Entreprises (The Business Safeguard Act) was enacted in 2006—formalizing the bankruptcy law (facilitating debt renegotiations). To receive safeguard protection, a firm needs to prove that although it has not yet suspended debt service payments, its financial condition is such that it will be unable to make future payments. The safeguard procedure includes an automatic stay that prevents secured lenders from seizing the collateral. The debtor continues to manage the company throughout the process, similar to US Chapter 11.	Debtor	Gilson et al. (2010); Altman et al. (2019)
India	2002	The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interests Act (SARFAESI) was enacted in 2002. It is a major reform to increasing creditor rights that allows them to bypass the lengthy and judicial process to seize and liquidate the assets of the defaulting firm.	Creditor	Vig (2013); Gopalan et al. (2017); Gormley et al. (2018); Altman et al. (2019)
Italy	2005	The 2005 reform introduced reorganization procedures, facilitating loan renegotiation; the 2006 reform led to substantial strengthening of creditor rights.	Creditor	Rodano et al. (2016)
Japan	2009	Japan's insolvency code historically provided creditor-oriented procedures, often dominated by large <i>keiretsu</i> banks. A quasi debtor-in-possession system was introduced in 2009 under which the debtor's director or counsel is appointed as trustee. The revision aims at strengthening the provisions for firms restructured as going concerns.	Debtor	Altman et al. (2019)
Spain	2004	The modern Insolvency Law (Ley Concursal) came into effect on September 1, 2004; the reform led to the strengthening of creditor rights (the DMS creditor rights index increases by 1).	Creditor	Djankov et al. (2007)
UK	2002	The Enterprise Act of 2002 was adopted based on the Insolvency Act and Insolvency Rules of 1986 and the Companies Act of 1985. It abolished administrative receivership for loans made after September 15, 2003, and substituted it with Administration, the closest to US Chapter 11. It emphasizes the survival of the debtor as a going concern.	Debtor	Davydenko and Franks (2008); Gilson et al. (2010); Altman et al. (2019)

II. Bureau Van Dijk (BVD) ownership concentration indicator from Researchgate (n.d)

Indicator and Degree of Ownership Concentration	Main Significance	Supplementary Clarifications
A Low ownership concentration	Independent companies—those with known recorded shareholders, each of them having less than 25% of direct or total ownership of the company	A⁺—Companies with six or more shareholders and/or companies in whose case the sum of direct ownership is above 75% A—Companies with 4 or 5 shareholders and/or companies that are the ultimate owners of another company (given that the information is included in a source), even when its shareholders are not mentioned. A[−]—Companies with 1 to 3 shareholders
B Medium-low ownership concentration	Companies with known recorded shareholders with ownerships below 50%, but with one or more shareholders with ownership percentages above 25%	B ⁺ , B and B [−] —allocated similarly to A clarifications above
C Medium-high ownership concentration	Companies with known recorded shareholders that have a total or calculated ownership above 50%	C⁺—Companies with a sum of direct percentage of ownership is 50.01% or higher C—Also assigned to companies in whose case an ultimate owner is mentioned in a source, although its ownership percentage is unknown

III. List of supports in Wallonia from (Magerman et al., 2025)

Table 4: Inventory of the different support premia (2020-2021).

	Premium
1	Support: €5000 lump sum. First application: March 27, 2020. Requirements: (i) completely closed due to sanitary measures, and (ii) operating in a (part of a) sector listed by decree of the Walloon government.
2	Support: €2500 lump sum. First application: June 1, 2020. Requirements: (i) self-employed conducting their activity in the Walloon Region who can prove they substantially interrupted their activity; OR (ii) businesses that can prove they substantially interrupted their activity in the Walloon Region, OR (iii) businesses whose manager is not a self-employed worker, to those that can prove that the majority of their employees were on temporary unemployment due to force majeure. This allowance cannot be combined with the allowance in premium 1, or with grants awarded by another region in the context of the crisis.
3	Support: €3500 lump sum. First application: September 9, 2020. Requirements: businesses that have received premium 1, provided they are still affected by the sanitary measures in July 2020 and operate in one of the sectors listed by decree of the Walloon government.
4	Support: 30% of sales last year, with min €3000, max €5000 (0 FTE), €10000 (1-10 FTE), €20000 (11-50 FTE) and €40000 (50+ FTE). First application: November 11, 2020. Requirements: Sales should be less than 40% of year before for third or fourth trimester of 2020.
5	Support: €3000 (0 FTE), €5000 (1-5 FTE), €7000 (6-10 FTE), €9000 (10+ FTE). First application: November 16, 2020. Requirements: Hotel and catering industry.
6	Support: €2250 (0 FTE), €3750 (1-5 FTE), €5250 (6-10 FTE), €6750 (10+ FTE). First application: December 16, 2020.
7	Support: 30% of sales last year, with min €3000, max €5000 (0 FTE), €10000 (1-10 FTE), €20000 (11-50 FTE) and €40000 (50+ FTE). First application: February 24, 2021. Requirements: Sales should be less than 40% of year before for third or fourth trimester of 2020.
8	Support: €3000 (0 FTE), €5000 (1-5 FTE), €7000 (6-10 FTE), €9000 (10+ FTE). First application: February 24, 2021. Requirements: Non-profit associations.
9	Support: €2250 (0 FTE), €3750 (1-5 FTE), €5250 (6-10 FTE), €6750 (10+ FTE). First application: February 24, 2021. Requirements: Non-profit associations.
10a	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE) and €12000 (10+ FTE). First application: March 10, 2021.
10b	Support: €3250 (0 FTE), €5500 (1-5 FTE), €7500 (6-10 FTE) and €9750 (10+ FTE). First application: March 10, 2021.
11	Support: between €6000 - €321000. First application: April 22, 2021.
12	Support: between €6000 - €130000. First application: June 16, 2021.
13	Support: between €4500 - €75000. First application: May 27, 2021.
14	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE), €12000 (10+ FTE). First application: May 27, 2021.
15	Support: between €825 - €493911. First application: June 8, 2021.
16a	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE), €12000 (10+ FTE). First application: May 12, 2021.
16b	Support: €3250 (0 FTE), €5500 (1-5 FTE), €7500 (6-10 FTE), €9750 (10+ FTE). First application: May 12, 2021.
17a	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE), €12000 (10+ FTE). First application: October 1, 2021.
17b	Support: €3250 (0 FTE), €5500 (1-5 FTE), €7500 (6-10 FTE), €9750 (10+ FTE). First application: October 1, 2021.
18	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE), €12000 (10+ FTE). First application: October 2, 2021.
19a	Support: €4000 (0 FTE), €6500 (1-5 FTE), €9500 (6-10 FTE), €12000 (10+ FTE). First application: September 30, 2021.
19b	Support: amounts of €3500, €7500, €9750. First application: October 4, 2021.
20	Support: between €34 - €150000. First application: August 25, 2021.
21	Support: between €3000 - €65000. First application: August 23, 2021.
22	Support: between €4000 - €18000. First application: July 28, 2021.
23	Support: amounts of €8000, €12000, €18000. First application: November 24, 2021.
Cheques	Support: between €1500 - €10000. First application: September 30, 2021.

Abstract :

The persistence of zombie firms, companies that remain active despite being unable to generate sufficient profits to service their debt, has become a major concern in advanced economies. While a growing literature documents the macroeconomic consequences of zombie firms, little is known about how zombification differs within countries and how institutional environments shape firm survival and innovation. This thesis addresses this gap by analysing regional disparities in zombie firm prevalence and persistence between Flanders and Wallonia in Belgium and by examining their implications for innovation.

Using firm-level data from Bel-First, the empirical strategy combines logistic and linear panel regressions to test zombie firm detection, regional prevalence, innovation effects, and subsidy-driven persistence. The analysis shows that firms located in Wallonia are more likely to be classified as zombie than comparable firms in Flanders, pointing to structural regional differences in firm vulnerability. Moreover, the results indicate that public subsidies are strongly associated with persistence of zombie firms, however, their effects are found to be stronger in Flanders than in Wallonia, suggesting that the design and implementation of support of support instruments matter more than their volume.

Finally, industry-level zombie prevalence does not significantly reduce firm-level innovation once firm capabilities are taken into account, this implies that in Belgium innovation remains largely driven by firm-specific capabilities and access to international capital rather domestic competitive distortions.

Overall, the findings show that regional institutions and financial support mechanisms play a central role in shaping zombie firm dynamics in Belgium, while the innovation consequences are more limited than commonly assumed.

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