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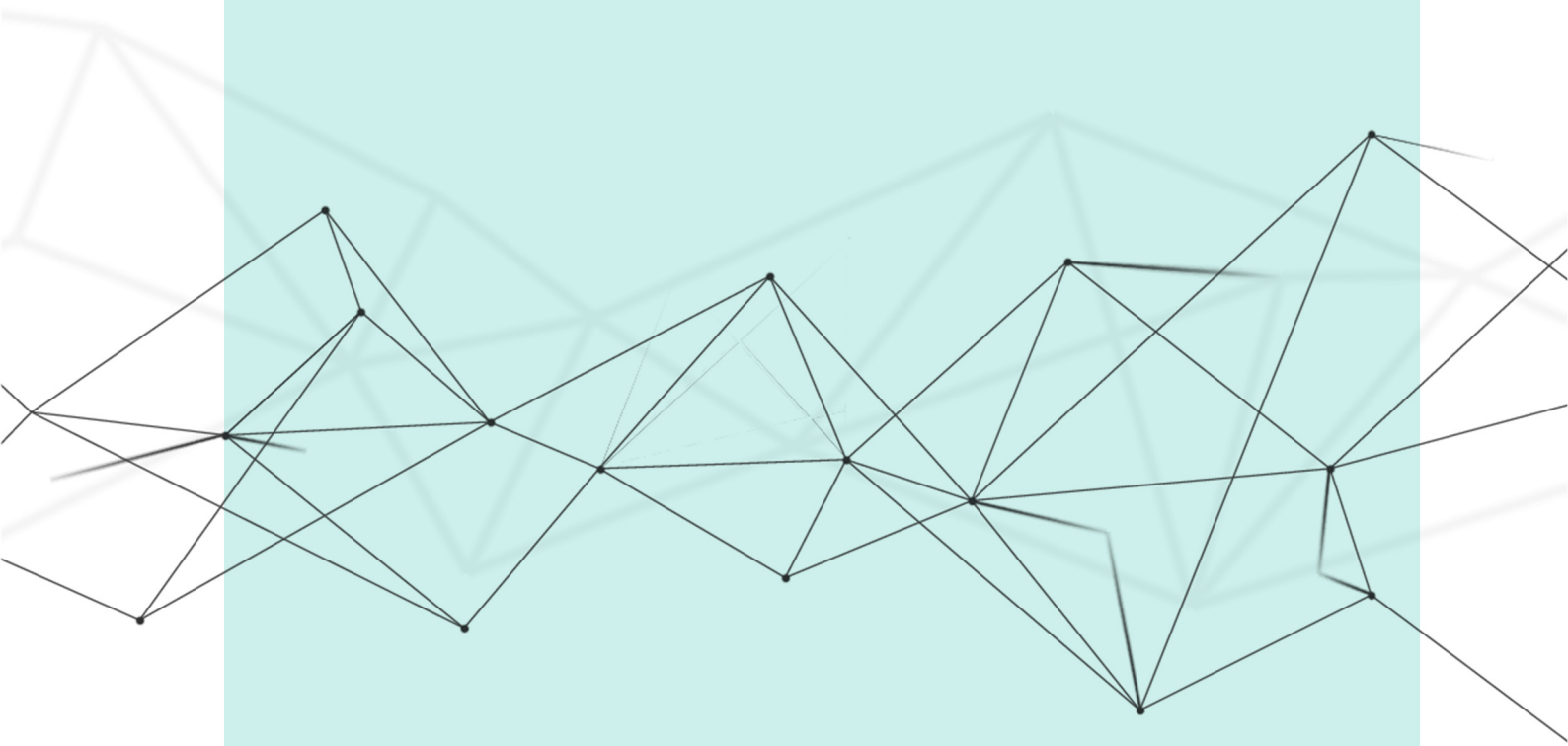
The impact of an interest rate cut on corporate activities in a low interest rate environment



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The impact of an interest rate cut on corporate activities in a low interest rate environment

Summary

In this study, we provide novel evidence regarding the effects of an interest rate cut in a low interest rate environment on real economic outcomes with a focus on firm behaviour in Switzerland. Our main empirical strategy exploits the SNB's policy changes in early 2015, which consists of the removal of an exchange rate floor as well as an unexpected and (arguably exogenous) large cut in interest rates in Switzerland.

Our study shows that despite dipping into negative territory, the traditional effects of an interest rate reduction on firm activity are still in place. We find a robust association between the negative interest rates shock and firm investment and employment: Swiss firms' cumulative net investment rate four years after the interest rate shock is 8pp higher and the cumulative growth rate in firms' head count is 7.5pp larger than those of comparable firms in Germany.

We also analyse to what extent specific firm characteristics moderate the effect of the negative interest rate shock on firm activity. First, we find that smaller firms, which are more likely to be financially constrained, experienced a stronger and faster decrease in their funding rates, translating into a stronger and more pronounced reaction in terms of their debt growth, investment activity, and employment. Second, we show that financially weak firms increased their investments post-shock more than financially healthy firms. Moreover, we provide evidence that is consistent with the notion that improved funding conditions allowed financially weaker firms to stay afloat, increasing their share among the firm population in Switzerland. Third, we investigate how the interest rates cut reshaped the structure of the Swiss economy by comparing the effects for high and low capital-intensive firms. Our results show that capital intensive sectors like the manufacturing industry reacted more strongly to improved funding conditions than asset-light industries like the services sector.

By focusing on the interest rate shock element of the SNB policy change, we complement the literature evaluating the SNB's policy adjustments from early 2015, which so far have mainly been analysed and interpreted with respect to the consequences of their exchange rate effects and their impact on bank lending. By documenting a positive effect of the SNB's interest cut on firm investment activity and employment, our results provide an explanation for the arguably surprisingly good performance of Switzerland in the aftermath of the SNB's policy adjustments: While the removal of the exchange rate floor and the resulting appreciation of the Swiss Franc had a negative impact on export-dependent firms, we show that these adverse effects for exporters were mitigated by the SNB's contemporaneous interest rate reduction. Overall, our results suggest that, while the SNB's policy adjustments had heterogeneous effects on firms depending on their trade exposure, the negative interest rate shock that the policy change entailed stimulated the Swiss economy.

The accelerated effects we find for firms that are small, risky, and financially weak highlight a potential vulnerability of the Swiss economy once interest rates start rising again: While these firms particularly benefited from the interest rate reduction, they might in turn be the first to suffer from discontinued funding once interest rates return to positive territory.

Auswirkungen einer Zinssenkung auf Unternehmensaktivitäten im Niedrigzinsumfeld

Zusammenfassung

In dieser Studie liefern wir neue Belege für die Auswirkungen einer Zinssenkung auf die Realwirtschaft im Niedrigzinsumfeld. Der Schwerpunkt unserer Betrachtungen liegt dabei auf Unternehmensaktivität in der Schweiz. Unsere empirische Strategie basiert auf den Anfang 2015 durchgeführten Interventionen der Schweizerischen Nationalbank (SNB) in Form einer Aufhebung der Wechselkursuntergrenze sowie einer unerwarteten und (daher als exogen einzustufenden) starken Zinssenkung.

Unsere Studie zeigt, dass trotz des Eintritts in den negativen Bereich die in der traditionellen Literatur festgestellten Effekte einer Zinssenkung auf Firmenaktivität noch immer nachweisbar sind. Wir finden einen robusten Zusammenhang zwischen dem Negativzinsschock und Unternehmensaktivität wie z.B. Investitionstätigkeit oder Beschäftigungswachstum. Die kumulierte Nettoinvestitionsrate der betrachteten Schweizer Firmen ist vier Jahre nach dem Zinsschock um 8 Prozentpunkte, die kumulierte Wachstumsrate der Beschäftigung um 7,5 Prozentpunkte höher als bei vergleichbaren Firmen in Deutschland.

Darüber hinaus analysieren wir, inwieweit spezifische Firmeneigenschaften den Effekt des Negativzinsschocks auf die Unternehmensaktivität abmildern. Erstens stellen wir fest, dass kleinere Unternehmen, die eher finanziell eingeschränkt sind, einen stärkeren und schnelleren Rückgang ihrer Fremdkapitalkosten verbuchen. Dies schlägt sich positiv auf Schuldenwachstum, Investitionstätigkeit und Beschäftigungswachstum nieder. Zweitens zeigen wir, dass finanziell schwächere Unternehmen ihre Investitionen nach dem Schock stärker erhöhen als finanziell besser aufgestellte Unternehmen. Darüber hinaus liefern wir Belege für die Hypothese, dass die verbesserten Finanzierungsbedingungen es finanziell schwächeren Firmen vermehrt ermöglichen, sich über Wasser zu halten, wodurch sich ihr Anteil an der Firmenpopulation in der Schweiz erhöht. Drittens untersuchen wir, wie die Zinssenkung die Struktur der Schweizer Wirtschaft verändert, indem wir die Auswirkungen auf kapitalintensive und weniger kapitalintensive Firmen vergleichen. Demnach reagieren kapitalintensive Branchen, wie z.B. die verarbeitende Industrie, stärker auf die verbesserten Finanzierungsbedingungen als z.B. der Dienstleistungssektor.

Indem wir uns insbesondere auf das Zinsschock-Element der SNB-Intervention konzentrieren, ergänzen wir die Literatur über SNB-Interventionen von Anfang 2015, die bisher hauptsächlich im Hinblick auf Wechselkurseffekte und die Auswirkungen auf die Kreditvergabe von Banken analysiert und interpretiert wurden. Wir weisen einen positiven Effekt der Zinssenkung der SNB auf unternehmerische Investitionstätigkeit und Beschäftigungswachstum nach und liefern dadurch eine Erklärung für die wohl überraschend gute Entwicklung der Schweizer Volkswirtschaft nach den geldpolitischen Anpassungen der SNB. Während die Aufhebung der Wechselkursuntergrenze und die daraus resultierende Aufwertung des Schweizer Frankens negative Auswirkungen auf exportabhängige Unternehmen hatte, zeigen wir, dass diese für Exporteure negativen Effekte durch die gleichzeitige Zinssenkung der SNB abgemildert wurden. Insgesamt deuten unsere Ergebnisse darauf hin, dass die geldpolitischen Anpassungen der SNB trotz heterogener Auswirkungen auf die Unternehmenslandschaft die Schweizer Wirtschaft durchaus stimulierte.

Die vergleichsweise starken Effekte, die wir für kleinere, risikoreichere und finanzschwächere Unternehmen finden, deuten auf eine potenzielle Anfälligkeit der Schweizer Wirtschaft hin: während die genannten Firmen besonders von der betrachteten Zinssenkung profitieren, könnten sie wiederum besonders von einem allgemeinen Rückgang der Finanzierungsaktivität betroffen sein, sobald die Zinsen wieder in den positiven Bereich steigen.

Effets d'une baisse des taux d'intérêt sur les activités des entreprises dans un environnement de taux d'intérêt bas

Résumé

Dans cette étude, nous fournissons des résultats inédits concernant les effets de l'environnement actuel de taux d'intérêt ultra-bas sur l'activité économique réelle en mettant l'accent sur le comportement des entreprises en Suisse. Notre principale stratégie empirique repose sur les changements de politique monétaire de la BNS au début de l'année 2015, qui, outre la suppression du taux de change plancher, ont impliqué une baisse importante et inattendue (pouvant de ce fait être considérée comme exogène) des taux d'intérêt en Suisse.

Notre étude montre que, malgré un passage en territoire négatif, les effets traditionnels d'une réduction des taux d'intérêt directeurs sur l'activité des entreprises sont toujours observables. Nous trouvons une relation robuste entre l'introduction des taux d'intérêt négatifs de la BNS et les activités des entreprises telles l'investissement ou la création d'emplois: le taux d'investissement net cumulé des entreprises suisses, quatre ans après le choc de taux d'intérêt, est supérieur de 8 points de pourcentage et le taux de croissance cumulé des effectifs des entreprises est supérieur de 7,5 points de pourcentage à celui des entreprises comparables en Allemagne.

Nous analysons également dans quelle mesure les caractéristiques spécifiques des entreprises peuvent influencer l'effet du choc de taux d'intérêt sur l'activité de ces dernières. Premièrement, nous montrons que ce sont les plus petites entreprises, qui sont plus susceptibles d'être financièrement contraintes, qui ont connu une baisse plus forte et plus rapide de leurs taux de financement. Cela s'est traduit par un impact positif sur la croissance de leur dette, leur activité d'investissement et leur création d'emplois. Deuxièmement, nous démontrons que les entreprises financièrement plus faibles ont davantage augmenté leurs investissements après le choc que les entreprises financièrement fortes. En outre, nous trouvons des preuves qui soutiennent l'idée que l'amélioration des conditions de financement a permis aux entreprises financièrement plus faibles de rester à flot, augmentant ainsi leur part dans la population des entreprises en Suisse. Troisièmement, nous étudions comment la baisse des taux d'intérêt a influencé la structure de l'économie suisse. Aussi, nous trouvons que les secteurs à forte intensité capitalistique, comme l'industrie manufacturière, ont réagi plus fortement à l'amélioration des conditions de financement que les secteurs à faible intensité capitalistique, comme le secteur des services.

En nous concentrant sur les changements de politique monétaire de la BNS au début de l'année 2015, nous complétons les résultats existant dans la littérature. Jusqu'à présent, ces changements ont été principalement analysés et interprétés au regard des conséquences de leurs effets sur le taux de change et de leur impact sur le crédit bancaire. Nous démontrons un effet positif de la baisse des taux d'intérêt directeurs sur l'investissement des entreprises et sur la création d'emplois, fournissant ainsi une explication à la performance étonnamment bonne de l'économie suisse après les ajustements de la politique monétaire de la BNS en 2015. Si la suppression du taux de change plancher et l'appréciation du franc suisse qui en a résulté ont eu un impact négatif sur les entreprises exportatrices, nous montrons que l'introduction des taux d'intérêt négatifs a permis de réduire l'impact négatif sur ces entreprises. Dans l'ensemble, nos résultats suggèrent que, même si les ajustements de la politique monétaire de la BNS ont eu des effets hétérogènes sur les entreprises en fonction de leur exposition au commerce extérieur, l'introduction des taux d'intérêt négatifs a en moyenne stimulé l'économie suisse.

Les effets accentués que nous avons trouvés dans notre analyse pour les entreprises de plus petite taille, à risque et financièrement faibles indiquent une vulnérabilité potentielle de l'économie suisse lorsque les taux d'intérêt recommenceront à augmenter: si ces entreprises ont particulièrement bénéficié de la baisse des taux d'intérêt, elles pourraient à leur tour être les premières à souffrir d'un problème de financement si les taux d'intérêt redeviennent effectivement positifs.

Effetti di un taglio dei tassi d'interesse sulle attività aziendali in un ambiente di bassi tassi d'interesse

Riassunto

In questo lavoro, forniamo nuove evidenze riguardo i risvolti economici di una riduzione dei tassi di interesse, in un contesto di tassi di interesse contenuti, con particolare attenzione al comportamento delle singole imprese in Svizzera. Alla base del nostro studio vi sono i cambiamenti di politica effettuati dalla SNB agli inizi del 2015, i quali hanno comportato una rimozione della soglia di cambio minimo e una ampia e inaspettata diminuzione dei tassi di interesse svizzeri.

La nostra analisi mostra che, nonostante ci si muova in territorio negativo, i tradizionali effetti di una riduzione dei tassi sull'attività delle imprese sono ancora in atto.

Troviamo, infatti, una forte correlazione tra lo shock negativo dei tassi d'interesse, gli investimenti delle imprese e il tasso di occupazione. Il tasso di investimento netto cumulativo delle aziende svizzere quattro anni dopo il suddetto shock appare più alto di 8 punti percentuali, mentre, il tasso di crescita cumulativo del personale delle imprese è superiore di 7,5 punti percentuali rispetto a quello delle analoghe aziende tedesche.

Viene, inoltre, analizzato in che misura le caratteristiche specifiche di ogni impresa mitighino le ripercussioni dell'impatto del tasso d'interesse negativo sulle proprie attività. In primo luogo, si riscontra che le ditte più piccole, maggiormente soggette a vincoli finanziari, hanno registrato una diminuzione più decisa dei loro finanziamenti, che si è tradotta in una drastica reazione in termini di aumento del loro debito, nelle attività di investimento e nell'occupazione. In secondo luogo, si dimostra come le imprese finanziariamente più deboli abbiano aumentato i loro investimenti post-shock più delle imprese finanziariamente sane. Inoltre, forniamo evidenza che il miglioramento delle condizioni di finanziamento ha permesso alle imprese economicamente più fragili di sopravvivere, aumentando di numero sul totale delle aziende svizzere. Confrontando gli effetti registrati sulle imprese ad alta e bassa intensità di capitale, si è analizzato, infine, come il taglio dei tassi d'interesse abbia rimodellato la struttura economica nazionale. I nostri risultati mostrano che i settori ad alto impiego di capitale, come l'industria manifatturiera, hanno reagito in maniera più decisa al miglioramento delle condizioni di finanziamento rispetto alle industrie con una minore intensità di capitale quale, ad esempio, il settore terziario.

Concentrandoci sullo shock dei tassi di interesse, completiamo con le nostre valutazioni la letteratura scientifica sulle suddette politiche economiche del 2015, che finora sono state analizzate e interpretate principalmente in relazione alle conseguenze sul tasso di cambio e al loro impatto sui prestiti bancari. Questo studio, oltre ad aver documentato un effetto favorevole del taglio dei tassi di interesse della SNB, sia sulle attività di investimento delle imprese, sia sull'occupazione, fornisce anche chiarimenti riguardanti le performance straordinariamente positive della Svizzera, all'indomani delle citate modifiche. La rimozione del tasso di cambio minimo e il conseguente apprezzamento del franco svizzero hanno avuto un impatto negativo sulle imprese maggiormente dipendenti dalle esportazioni, tuttavia, viene dimostrato che questi effetti sono stati mitigati dalla contemporanea riduzione del tasso di interesse della SNB. Nel complesso, i nostri risultati suggeriscono che, mentre i cambiamenti delle politiche della SNB hanno avuto effetti eterogenei sulle imprese a seconda della loro esposizione commerciale, l'indotto shock di tasso di interesse negativo ha stimolato l'economia svizzera.

Gli effetti accelerati, che hanno coinvolto le imprese piccole e finanziariamente deboli, evidenziano una potenziale vulnerabilità dell'economia svizzera qualora i tassi di interesse ricomincino a salire. Queste imprese hanno particolarmente beneficiato della riduzione dei tassi d'interesse, ciononostante, potrebbero a loro volta essere le prime a soffrire di un finanziamento discontinuo una volta che questi torneranno in territorio positivo.

CONTENTS

1. INTRODUCTION

The relation between interest rates and real economic activity is a central topic in macroeconomics. But it also matters a great deal for the evaluation of economic policy: As fiscal and monetary actions potentially affect interest rates, they thereby might also affect real economic outcomes. In recent years, this issue has gained particular attention due to the currently persisting low interest rate environment. For several years already, the global economy features noteworthily low levels of interest rates, with values close to or even slightly below zero. Until the 19th century interest rates had already been characterized by a decreasing tendency, both in nominal and real terms. While in the 20th century the interest level in developed economies rose again, the decline taking place since the mid-1990s is unprecedented and represents a historically unique situation (Kugler 2017).

Due to this lack of historical experience, the persistently low level of interest rates represents an unusual economic environment, and we enter largely unknown territory for monetary and fiscal policy. This raises the question whether our established understanding of the relation between interest rates and the real economy also extends to the current setting or whether their relation is fundamentally different "below zero". In this research report, we therefore aim to provide novel evidence regarding the effects of the current ultra-low interest rate environment on real economic outcomes with a focus on firm behaviour in Switzerland. A particular emphasis lies on the identification of causal effects of a further reduction in interest rates when interest rates are already subdued.

Our report starts out with a literature overview providing a conceptual perspective on the relation between interest rates and firm behaviour. There are only few, if any, robust established theoretical and empirical regularities on the effect of low or negative interest rates on firms' investment and innovation behaviour and the associated implications for structural change and a potential misallocation of resources. We hence proceed by designing an original empirical analysis for Switzerland. In doing so, our research design needs to address a fundamental identification challenge: As we will see, many determinants of low interest rates are itself also potential consequences of low interest rates. This creates a potential endogeneity problem for identifying the causal effect of low interest rates on economic activity (Jordà et al. 2020). We therefore turn to central bank policies and institutional factors as a potential source of identifying variation in interest rates as a basis for our empirical analysis.

Of course, central bank policy rates are typically endogenous to economic activity as well. For instance, Gerlach and Moretti (2014) find that movements in central bank policy rates have primarily been a response to the underlying economic forces driving down real rates, rather than reducing them independently (see also Justiniano and Primiceri 2010). However, we will see that Switzerland offers a rather unique institutional setting that provides the opportunity to isolate "quasi experimental" variation in interest rates: Exploiting the Swiss National Bank' s (SNB) unexpected interest rate cut in early 2015 allows us to identify its causal effect on economic activity - namely investments and credit allocation - in our period of interest. This significant interest rate cut accompanied the removal of the Euro/Swiss Franc exchange rate floor by the SNB, intended to ensure that the discontinuation of the floor did not lead to a tightening of monetary conditions. While the removal of the floor has been analysed with respect to its effect on exchange rates (e.g., Auer et al. 2018 and Bonadio et al. 2020) and the interest rate cut with respect to its impact on bank lending (Basten and Mariathasan 2020, Schelling and Towbin 2020 and Baeriswyl et al. 2021), the latter has not yet been exploited to study the effect of a reduction in interest rates on firm behaviour.

Our analysis is based on data from Orbis and CompNet. Orbis allows us to conduct a granular analysis at company level of the approximately 700 largest Swiss companies, which account for around 32% of economic activity in Switzerland. The CompNet dataset provides representative aggregated microdata for the Swiss corporate universe at size class and industry level. We then compare the behaviour of Swiss companies in response to the interest rate cut by the SNB with comparable companies from Germany and, alternatively, a larger set of Northern European countries.

Our first set of results confirms the traditional understanding of the workings of interest rates on firm behaviour. We find that funding rates for firms indeed decreased in response to the SNB's interest rate cut and firms made use of this by accumulating higher debt levels thereafter. When it comes to the use of this additional funding, we see significant increases in firm investments as well as employment. These effects are also quantitative meaningful: Swiss firms' cumulative net investment rate four years after the interest rate shock is 8pp higher and the cumulative growth rate in the firms' head count is 7.5pp larger than those of comparable firms in Germany.

Second, we confirm the existing evidence that the appreciation of the Swiss Franc that followed the removal of the Euro/Swiss Franc exchange rate floor (commonly called the "Swiss Franc shock") did hurt exporting firms (Kaiser et al. 2018). At the same time, we complement this view and interpretation of the SNB's policy adjustments in early 2015 by also considering their interest rate effect: When isolating the pure effect of the SNB's interest rates cut and controlling for the contemporaneous exchange rate effect, it turns out that the rate reduction led to the previously described increases in firm investment and employment. By documenting this positive interest rate effect, our results provide an explanation for the surprisingly robust performance of Swiss firms after the Swiss Franc Shock (see, e.g., Erhardt et al. 2017).

Finally, we also analyse to what extent specific firm characteristics moderate the effect of the negative interest rate shock on firm activity. First, we find that smaller firms, which are more likely to be financially constrained, experienced a stronger and faster decrease in their funding rates, translating into a stronger and more pronounced reaction in terms of their debt growth, investment activity, and employment. Second, we show that financially weak firms increased their investments post-shock more than financially healthy firms. Moreover, we provide evidence that is consistent with the notion that improved funding conditions allowed financially weaker firms to stay afloat, increasing their share among the firm population in Switzerland. Third, we investigate how the interest rates cut reshaped the structure of the Swiss economy by comparing the effects for high and low capital-intensive firms. Our results show that capital intensive sectors like the manufacturing industry reacted more strongly to improved funding conditions than asset-light industries like the services sector.

In summary, our study shows that at least in our period of observation, the traditional relation between interest rate reductions and firm activity is still in place, even though the level of interest rates is already partially in negative territory. We also complement the current assessment of the SNB' policy changes in early 2015 as we find that the interest rate cut component of the policy package had a stimulating effect that mitigated the adverse consequences of the Swiss Franc shock for Swiss exporters.

Finally, it seems that smaller firms are more prone to changes in interest rates due to their stronger exposure to financial constraints. Hence, while the interest rate reduction studied here was particularly beneficial for them, they might in turn be more likely to suffer in case of a reappearance of positive interest rates in the future.

2. WHAT THE LITERATURE TELLS US

2.1 How it works and why this time may be different

We study the effect of low interest rates on economic outcomes in Switzerland, with a focus on non-financial firms. In this section, we provide a systematic overview over the economic mechanisms underlying these effects.

To this end, we survey the relevant literature that deals with identifying the transmission of monetary policy rates to the corporate sector. The main mechanism at play is the credit channel according to Bernanke and Gertler (1995). The extent to which changes in monetary policy rates are passed through to firms is in large part governed by the external finance premium. Based on that, a well-established literature analyzes empirically how firms and their performance respond to rate hikes or reductions as a consequence of the credit market frictions they face (see, e.g., Bernanke and Blinder 1988, Bernanke et al. 1999, Kashyap and Stein 2000).

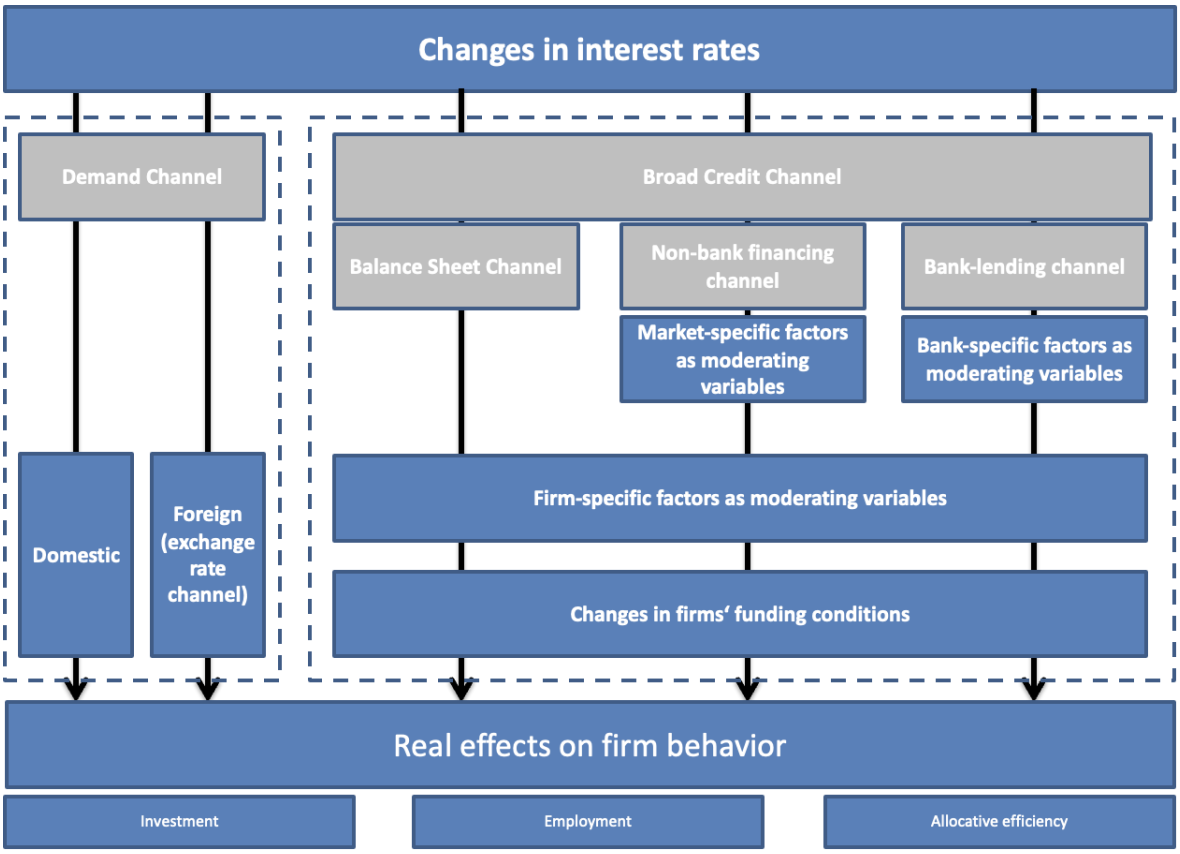
We reconsider the findings from this literature against the background of the current ultra-low-interest rate environment: Dating back at least to Hicks (1937), there exists the notion of an *effective lower bound* (ELB), below which policy rate reductions were supposed to be no longer possible. Although economic reality has shown that the ELB - if it indeed exists - need not be at zero, Eggertsson et al. (2017) as well as Brunnermeier and Koby (2019), among others, show that the effects of monetary policy rate changes may be quite different from what we have seen historically in the current ultra-low or negative interest rate environment.

2.2 Mechanisms at work – economic theory and empirical evidence

According to macroeconomic theory, changes in interest rates affect the real economy by influencing aggregate demand through changes in savings, investments, and consumption. At the microeconomic level, a reduction of the real interest rate affects firms in two main ways. First, it increases a firm's incentives to invest, making potential projects, and/or the holding of more inventory more attractive (the *demand channel*). It also affects cash flows and collateral values, and thus lowers funding costs and increases access to funding (the *credit channel*). Both ways complement each other by increasing the number of profitable projects and/or inventory and reducing marginal costs of investing. Economic theory therefore suggests a straightforward relation: an increase in firm investment as a response to decreasing interest rates. The extent, to which a particular firm in a given industry or country reacts to rate changes therefore depends, on the one hand, on the prevalence of either the demand or the credit channel. On the other hand, the literature has shown that the inner workings of the credit channel and its various components do matter, too (see Figure 1).

We classify the literature according to the object of interest. Under the broader credit channel, we look at three of its component channels, each of which focusses on a particular mechanism: the balance sheet channel, the bank lending channel, the non-bank financing channel. The latter two explicitly include financial intermediaries and their characteristics into their analyses. Consequently, we organize the different effects of low interest rates on firm behavior by distinguishing between firm-specific, non-bank specific, and bank-specific factors. With respect to outcomes, we consider the investment and employment behavior of firms at the individual level and assess the allocative efficiency of capital and the associated structural changes from an aggregated perspective.

Figure 1: Interest rate transmission channels



Source: Blacksquare Economics

Motivated by the enduring period of very low interest rates, an active stream of literature emerged which investigates how interest rates might have quantitatively and even qualitatively different effects when their level is extremely low or even negative. Brunnermeier and Koby (2019) introduce the notion of "reversal rates" to mark the level of interest rates at which reductions in monetary policy rates even become contractionary. This raises the question about the determinants of these reversal rates and how they interact with different components of the credit channel to understand the quantitative and qualitative effects of low interest rates. In what follows, we will dive deeper into the two strands of literature about the credit channel and the reversal rate, respectively.

2.2.1 The credit channel

According to conventional economic theory, changes in interest rates affect the real economy by affecting the cost-of-capital and hence lead to changes in expenditures for durable goods like investments, durable consumer goods, and housing, which are all elements of aggregated overall demand. This implies a simple and straightforward relation between a reduction in interest rates and subsequent firm behaviour – the lower interest rates are, the more firms invest, produce, and employ. Incorporating an international perspective, interest rates may also affect the real exchange rate and thereby influence aggregate demand by changing the relative price of domestic and foreign goods. Bernanke and Gertler (1995) explain that this simple understanding of interest rate effects falls short in several dimensions when held against the empirical evidence. They resolve this inconsistency by highlighting that if and how

(strong) a given change in interest rates passes through to firms' financing conditions can differ substantially by different manifestations of the "credit channel". The main idea is that changes in interest rates are not just simply passed-on to firms but also affect their *external finance premium* – the difference in cost firms need to pay for funding from outside vs. inside the firm. The credit channel then summarizes a variety of information frictions and the related credit market imperfections that represent mechanisms by which changes in interest rates affect the external finance premium and hence amplify or dampen their effect on firms. In summary, this implies that one needs to consider the specific economic environment through the lens of the credit channel when assessing the consequences of low interest rates for firm behavior.

The balance sheet channel

The balance sheet channel, as described in Bernanke and Gertler (1995) is the theoretical prediction, that a firm's access to capital should depend on its net worth, i.e., the sum of liquid assets and marketable collateral. Both balance sheet elements reduce the potential conflict of interest with a lender, thus reducing the external finance premium. The literature has evolved around this idea and worked out a range of firm-specific factors that accordingly drive the response to policy rate shocks. Size is essential among these, e.g., with Gertler and Gilchrist (1994) presenting empirical evidence that small firms disproportionately drive the effect of monetary policy on aggregate investment. But age plays a role, too. Bougheas et al. (2006) conclude that "small, young and risky firms" respond more strongly to tight monetary conditions compared to larger and more established ones. Cloyne et al. (2018) show that, as a response to monetary tightening, especially young and non-dividend paying firms reduce borrowing. Moreover, borrowing among these firms is highly correlated with collateral values as opposed to earnings. Looking at employment, Bahaj et al. (2019) confirm the sensitivity of young and more levered firms to monetary policy shocks.

The message on leverage is somewhat mixed. While employment reacts more strongly for more levered firms (Bahaj et al. 2019), investment seems to be different. Ottonello and Winberry (2020) show that firms with low leverage and high distance to default are less responsive to monetary shocks. Jeenas (2019), however, finds that, rather than leverage, it is liquid asset holdings that determine firms' investment behavior in response to aggregate shocks. Even though both balance sheet items do predict lower fixed capital, inventory and sales growth in the cross section, only liquid assets still drive these results when controlling for both.

A common theme across the literature is that policy rates drive firm behaviour to a varying degree. Firms with characteristics that are associated with high risk or large informational asymmetries are particularly sensitive to policy rate changes. Therefore, if investment, employment, and funding volume exhibit this high sensitivity for a particular group of firms, it is likely that credit market frictions exist that restrict their access to funding.

The non-bank financing channel

In general, monetary policy has been shown to have a broad effect on the cost of funds from different sources and across different maturities. Arteta et al. (2016), for example, use a cross-country event study to show that yields have dropped significantly after policy announcements at both the long- and the short-end of the curve. Papers investigating this channel focus on the source of a firm's financing as determinant of its exposure to a monetary policy shock. We

will briefly summarize the findings on bond financing vs. relationship banking and trade credit as a substitute for other forms of financing.

Darmouni et al. (2020) for example, find that firms with more bond debt respond more strongly to unexpected rate changes compared to firms that rely predominantly on bank debt. Their interpretation is that bond-financed firms reduce investment to preserve cash, since renegotiation in bad times is harder than with relationship banking. This is consistent with the amplifying effect of the external finance premium as described in Bernanke and Gertler (1995), among others. Given the higher level of informational asymmetry between firms and bond-investors compared to relationship banks (see, e.g., Bolton et al. 2016), one would expect pass-through differentials to be more pronounced. Anderson and Cesa-Bianchi (2020) confirm this view by showing that highly levered firms exhibit a sharper increase in bond spreads as well as contraction in debt and investment.

Several papers investigate the role of trade credit in the transmission of monetary policy. Reliance on trade credit can dampen the pass through of rate increases by the credit channel, as especially small firms may substitute credit for more generous conditions on their trade payables (Mateut et al. 2006, Guariglia and Mateut 2006, Rochetau et al. 2018).

The bank lending channel

Papers in this area focus on bank-specific factors that moderate the effect of policy rates on firm behaviour. The underlying general notion is that the structure of the banking sector in an economy determines the extent to which policy rate changes affect firm outcomes. More specifically, changes in interest rates affect the balance sheet of banks which subsequently affect their lending abilities (Eisenschmidt and Smets 2019). It is natural to assume that an ultra-low or even negative interest rate environment puts pressure on banks' profitability (Borio et al. 2017; Claessens et al. 2018). More precisely, the following bank balance sheet characteristics determine the strength of the interest rate environment in affecting firm behavior: the proportion of customer/household deposits (Heider et al. 2019), balance sheet liquidity, exposure to the low interest rate environment (Bottero et al. 2020) and the nature of contractual relationship between firm and bank (Ippolito et al. 2018). Consequently, for non-financial firms it matters to which banks they hold relationships. As an example, consider the relationship between a capital constraint bank and a capital constraint firm. Gambacorta and Shin (2018), for example, find that banks follow the same external finance premium rationale as non-financial institutions. As with firms, banks with lower levels of capital expand more when the policy rate falls. So, the tighter the external financing constraint these banks face, the higher the multiplier effect they impose on capital constraint firms.

The literature has also investigated the role of bank stability or soundness and the role of capitalization. The eventual effect on banks' corporate customers then also depends on the firms' balance sheet characteristics. Two mechanisms stand out. One, with respect to the asset-side of the firm balance sheet, Altavilla et al. (2019) show that sound banks can pass-through negative rates to corporate depositors. Thus, the larger a firm's deposits, the more exposed it is to this channel. These corporate depositors then react by increasing their fixed investment. The results offer an explanation consistent with Jeenas (2019), who also finds liquid asset/cash holdings to be an important driver of firm behavior as a response to a reduction in monetary policy rates. Focusing on the interaction between bank and balance sheet characteristics makes this driver explicit. The second mechanism is that, with respect to the passive side of the firm balance sheet, weakly capitalized banks have been shown to give rise to economy-wide misallocation of capital. Peek and Rosengren (2005) document that, to

avoid realizing losses on outstanding loans, these banks have an incentive to extend credit to these same borrowers. A low interest rate environment may thus (among other factors) contribute to credit being inefficiently allocated to otherwise insolvent firms. This misallocation can lead to an increased share of so-called zombie firms and trigger the following economy-wide consequences: Lower profits and investment even at healthy firms, depressed job creation, destruction, and thus lower productivity (Caballero et al. 2008 and Acharya et al. 2019), deflationary effects (Acharya et al. 2020) and constrain growth through overly high barriers to entry (Banerjee and Hofmann 2018).

Given their prominent role in the pass-through mechanism, banks are also supposed to be the drivers behind the potential reversal of monetary policy effects in an ultra-low interest rate environment. According to Brunnermeier and Koby (2019), optimizing banks may respond to rate cuts with higher (rather than lower) loan rates, causing credit volumes to fall. Altavilla et al. (2018) and Lopez et al. (2020), however, find that low and negative rates do not adversely affect bank profitability, suggesting that banks may pass through interest rate cuts also when policy rates move into negative territory. We will explore the reasoning behind this controversy in the following chapter.

2.2.2 Effective lower bound and the reversal rate

In recent years, central banks have tested the limits of lowering monetary policy rates to expand economic activities. In most New Keynesian models, the economy enters a liquidity trap because of an exogenously assumed zero lower bound: at an interest rate of zero there is no possibility to increase the attractiveness of bonds and deposits in comparison to cash lending ("liquidity trap"). This natural (or modeling-induced) threshold is put to test as many central banks went below zero for a longer time period. This motivated Brunnermeier and Koby (2019) to investigate what might be the effective lower bound for monetary policy. They define the reversal interest rate as "the rate at which accommodative monetary policy reverses its effect and becomes contractionary for lending". Under their modeling framework the reversal rate becomes endogenous and they identify four key factors impacting the level of the reversal interest rate: (1) banks' holdings of long-term fixed-income assets, (2) banks' equity capitalization, (3) the tightness of capital constraints, and (4) the deposit supply elasticity faced by banks. Darracq Pariès et al. (2020) further conclude that the reversal rate depends on the composition of financial intermediaries' balance sheets and income, including their capitalization.

A second strand of the literature investigates the effective lower bound of household deposit rates and its determinants. Eisenschmit and Smets (2019) find that the effective lower bound for interest rates on household deposits at banks might be zero, but the pass-through on loan rates is unchanged. Eggertson et al. (2019) show that retail household deposit rates are subject to a lower bound and once this lower bound is met, the pass-through to lending rates and credit volumes is substantially lower and bank equity values decline in response to further policy rate cuts. Drechsler et al. (2017) argue that competition and the degree of market power in the deposit markets are such that increases in policy rates are not passed through to depositors, leading to an outflow of deposits and hence a stronger reduction in lending. They also show this empirically. Drechsler et al. (2018) also find that deposit rates are generally quite insensitive to changes in market interest rates.

2.3 On the search for identifying variation: Why are interest rates so low?

The analysis of the literature above has shown that it already provides some evidence guiding the evaluation of the effects of ultra-low interest rates on firm behavior. However, these existing theories and empirical results are not as clear-cut as to provide an unambiguous assessment. Moreover, a key question is to what extent the existing evidence can reasonably be extrapolated to the Swiss situation, given the country's specific economic characteristics.

We therefore aim to provide novel evidence on how interest rate reductions affect firm behaviour in Switzerland, considering the specific current environment featuring particularly low rates. In doing so, we require exogenous variation of interest rates to identify their causal effect on our real variables of interest. To identify a suitable empirical strategy, we now discuss different factors that theoretically determine the level of interest rates.

The (real) interest rate is the market price for credit and therefore mainly determined by the supply of savings and the demand for investment (Bean 2016, Fischer 2016). To understand the historically low levels of interest rates around the world (King and Low 2014, Rachel and Smith 2015, Del Negro et al. 2019) as well as in Switzerland (Kugler 2017) one therefore needs to consider different factors driving demand and supply, separately.

The following *demand side determinants* of interest rates are typically considered in the literature. Gordon (2012, 2014, 2017) ascribes the current situation of "secular stagnation", i.e., a fundamental lack of aggregate demand, to a persistent decline of general productivity, which accordingly leads to a reduction in the propensity to invest (see also Fernald 2015, Fernald and Wang 2015 as well as Clark 2016). Jorgenson and Vu (2010) state the declining growth of the labour force as an explanation for reduced demand, while Bloom (2009) analyses the role of perceived uncertainty among firms. Further, some authors argue that the economy is undergoing a structural change which leads to lower investment demand as the capital intensity of many industries has gone down and at the same time also the price of many capital goods has been substantially reduced due to technological developments (see Summers 2015, Lian et al. 2020, Barkai 2020, Crouzet and Eberly 2020). Also, the combination of rising economic inequality and wealth-dependent propensities to consume is brought forward as a reason for declining global demand (Cingano 2014, Ostry et al. 2014, Berg et al. 2018). Finally, Jones and Philippon (2016) and Gutiérrez and Philippon (2017) argue that increased market concentration and the accompanied reduction in competition triggers reduced incentives to innovate and accordingly investment demand.

With respect to *supply side determinants,* a common explanation for the severe reduction of interest rates is that demographic developments cause increased saving rates (see, e.g., Rachel and Smith 2015 and Carvalho et al. 2016). Mirroring the argument from above, if increased economic inequality leads to a reduced propensity to consume this reduction also comes along with an increase in the propensity to save (Mian et al. 2020). Also, the reactions to the Great Recession likely affected the global supply of savings, either by changes in financial regulation (Rogoff 2016) or "flight to safety" effects and deteriorating net supply of safe assets (Caballero et al. 2017, Caballero and Farhi 2018). Combining several of these arguments, the accelerated financial integration of China is also a plausible factor (Bernanke 2005).

3. EMPIRICAL STRATEGY AND INSTITUTIONAL SETTING

The analysis of determinants of changes in interest rates in the previous section reveals a fundamental problem for identifying the causal effect of low interest rates on real outcomes: We see that the factors determining changes in interest rates are either very long-term in nature - and hence hardly varying in the short-run - or they are at the same time itself affected by interest rates, giving rise to a fundamental endogeneity problem: When observing empirical associations between real variables and changes in interest rates, it is not clear which one affects the other and hence how exactly interest rates affect real outcomes (Jordà et al. 2020). Overall, a mere correlational analysis is likely to produce spurious results and potentially misleading conclusions.

We therefore turn towards changes in nominal interest rates driven by monetary policy. Theory (e.g., Romer and Romer 1989, 2004) as well as evidence for Switzerland (Fink et al 2020; Grisse and Schumacher 2018) and other countries show that unexpected changes in monetary policy rates indeed affect interest rates and as well as the yield curve and that this also holds in low interest rate environments. However, while central bank rates are not a direct outcome of economic conditions and the resulting equilibrium between the supply and demand for funds, they are set by policy makers as a response to the economic outlook; and thus, still indirectly linked to economic conditions (e.g., Rubin 2005). We therefore notice that an empirical analysis aiming to identify the causal effect of interest rate changes on real outcomes should exploit unexpected changes ("shocks") in monetary policy rates that are unrelated to domestic economic conditions to overcome the fundamental endogeneity problem. This observation guides the development of our empirical strategy laid out in the following section.

The literature has proposed several approaches to this identification problem, which mostly rely on isolating variations in the policy rates unrelated to economic conditions (see Ramey 2016 and Jordà, et al. 2020 for comprehensive summaries). The first approach simply employs regression control featuring observable proxies for economic conditions that could drive monetary policy (e.g., Christiano, Eichenbaum and Evans 1999). The second approach relies on textual analysis of central bank minutes ("narrative" identification approach) to isolate the component of central bank policy changes that are exogenous to economic conditions (e.g., Romer and Romer 1989). The third approach is to control for the contemporaneous central bank forecasts (e.g., Romer and Romer 2004), relying on the assumption that the policy makers cannot observe additional information beyond the staff predictions. Finally, the "high frequency" approach tries to measure exogenous variation in interest rates through asset price movements around policy announcements (e.g., Kuttner 2001), which indicate that there were unexpected factors in the announcement.

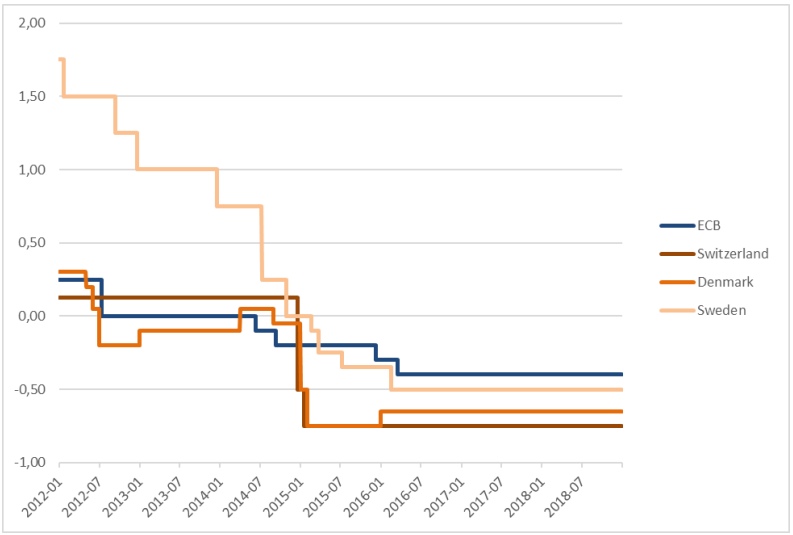
The approach we take in this report follows none of the strategies described above. Rather, we exploit a natural experiment, namely the interest rate change by the SNB in January 2015 to identify the causal effect of interest rates on the real economy. We argue that this change was unexpected by market participants and unrelated to underlying local economic conditions: In the aftermath of the European sovereign debt crisis, several European central banks adopted an ultra-low interest rate policy (see Figure 2). While for the ECB this policy decision was based on economic considerations in the corresponding economies, the SNB introduced it mainly due to reasons exogenous to their domestic economic conditions.

Our empirical strategy is therefore to analyse differences in firm behaviour between Swiss firms (*treatment group*) and German firms (*control group;* as the German economy

experienced a comparable trend pre-2015) in response to the interest rate cut by the SNB in January 2015.[1] This comparison provides a comparatively clean natural experiment, as potential differences between the performance of the respective firms can be causally linked to the change in interest rates which itself was not driven by past or anticipated firm behaviour and its determinants.

As explained above, the previous literature has already exploited the SNB's policy adjustments in early 2015 for empirical analyses, however focusing on their exchange rate effects. Accordingly, in our analysis we explicitly address the exchange rate effect as a confounding factor to isolate the pure causal effect of interest rates on firm behaviour.

Figure 2: European central bank deposit rates



Source: ECB, SNB, Danmarks Nationalbank, and Riksbank

3.1 The research design

In this subsection, we explain the institutional details for Switzerland (our treatment group) and Germany (our main control group) during our sample period and discuss why this setting is well-suited to study the effects of a low interest environment on the real economy.

3.2 Treatment group - Switzerland

Due to its position as a small, open, and export-oriented economy, Switzerland is subject to the problem that the interest rate serves a dual role in shaping economic policy. First, interest rate reductions can traditionally be intended to serve as an economic stimulus. Second, however, such intended stimuli at the same time affects the interest-rate differentials towards other countries, which in turn determine the corresponding exchange rates. For most small-open economies this joint role of interest rates does not cause particularly severe problems, as interest rate differentials to other countries are typically positive due to higher perceived currency risks, leaving enough scope for interest rate reductions without triggering excessive capital inflows (Danthine 2018).

[1] In a robustness check, we include a larger set of countries as control group. Kaufmann and Renkin (2017) employ a similar empirical strategy to study the effect of the Swiss Franc shock on employment by comparing employment outcomes of Swiss firms with similar peers from Austria.

In contrast, Switzerland is traditionally considered a safe haven among international financial markets, which means that investors consider Swiss assets to hold a particularly low level of risk (Auer 2015, Ranaldo and Söderlind 2010, Grisse and Nitschka 2015, Kugler and Weder, 2002, 2004, 2005). Together with low inflation and inflation risk (Kaufmann 2019) and against the background of a strong flight to safety in recent years (Del Negro et al. 2017), this implies that the interest rate differential between Switzerland and other countries is typically negative. It follows that the scope for interest rate reductions before hitting negative territory is particularly small. Accordingly, Switzerland was a frontrunner in the adoption of negative interest rates in a move to prevent increasing capital inflows and the corresponding exchange rate effects (Jordan 2020).

During the European Sovereign debt crisis, the Swiss Franc (CHF) significantly appreciated relative to the Euro, which led the SNB to introduce an EUR/CHF floor of 1.2 CHF vis-à-vis the Euro on September 6, 2011.[2] According to the SNB, "The minimum exchange rate was introduced during a period of exceptional overvaluation of the Swiss Franc and an extremely high level of uncertainty on the financial markets. This exceptional and temporary measure protected the Swiss economy from serious harm."[3] Subsequently, the SNB continuously acquired assets in foreign currency to defend this exchange rate floor and to reduce pressure on the Swiss Franc.

Largely unexpected by markets, the SNB removed the EUR/CHF floor on January 15, 2015. In its press release, the SNB explained that "The euro has depreciated considerably against the US dollar and this, in turn, has caused the Swiss Franc to weaken against the US dollar. In these circumstances, the SNB concluded that enforcing and maintaining the minimum exchange rate for the Swiss Franc against the euro is no longer justified."

The SNB accompanied the end of the exchange rate floor with a reduction of the interest rate on central bank deposits to -0.75% (see Figure 2).[4] The SNB stated that the reason for this policy change was to ensure that the discontinuation of the floor did not lead to an inappropriate tightening of monetary conditions.[5]

After the policy changes in January 2015, the 3-month CHF Libor followed the SNB deposit rate and diverged to -0.75%, while the 3-month Euro Libor rate remained close to zero (see Figure 3). Consequently, from 2015 onwards, a significant interest rate differential persisted between the CHF Libor and the Euro Libor rate, which guided financial markets (i.e., it is fully reflected in market rates throughout the yield curve). Figure 4 shows that the yields on Swiss government bonds dropped across all maturities following the interest rate cut in January 2015 and remained at this lower level afterwards.

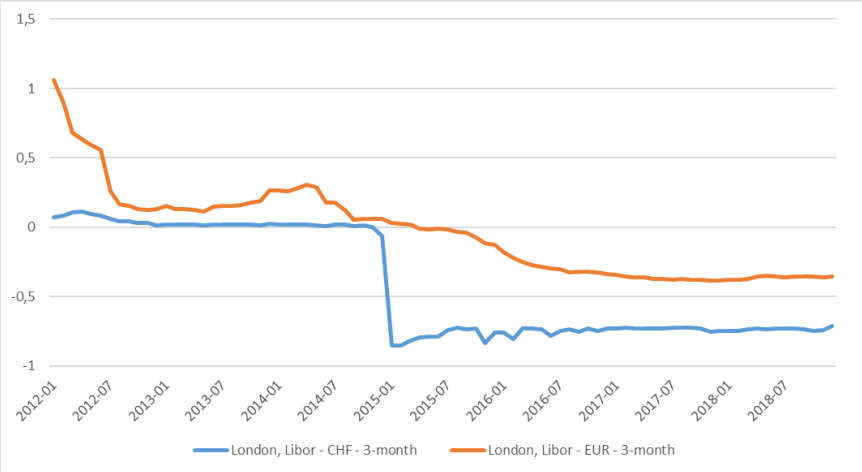
[2] As a traditional safe haven of international capital flows (Auer 2015), Switzerland has been particularly affected by capital inflows following the outbreak of the European sovereign debt crisis.

[3] Swiss National Bank press release from January 15, 2015.

[4] In particular, the SNB lowered the deposit rate to -0.75% and charged -0.75% on any excess reserves above an exemption threshold of 20 times the required reserves (see Swiss National Bank, 2014 for details). These exemptions mitigated the pressure for banks to enter negative territory for retail deposits. Bech and Malkhozov (2016), Basten and Mariathasan (2020), as well as Baeriswyl et al. (2021) empirically show that the pass-through to deposit rates was indeed interrupted, pointing to the actual relevance of a zero lower bound, at least for retail deposit. Though, Revill and Hirt (2019) report that some Swiss banks at last started to charge interest on very large deposits and hence for comparatively rich customers.

[5] In addition, the SNB announced that the policy changes in early 2015 would be complemented with discretionary FX interventions.

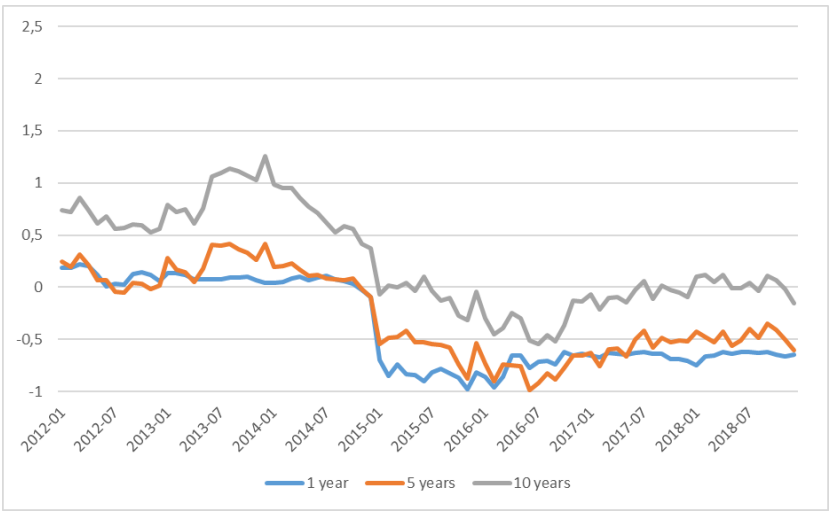
Figure 3: CHF-Euro money market interest rate differential



Source: Swiss National Bank - money market statistics

During that time, the SNB used the 3-month CHF Libor as a reference rate, keeping the interbank lending rate between certain bounds by injecting or extracting liquidity from the market (through open market operations). In December 2014, the lower bound for the CHF Libor rate was at -0.75% and the upper bound at 0.25%. On January 15, 2015, the SNB then moved these target bounds to -1.25% and -0.25%, respectively.

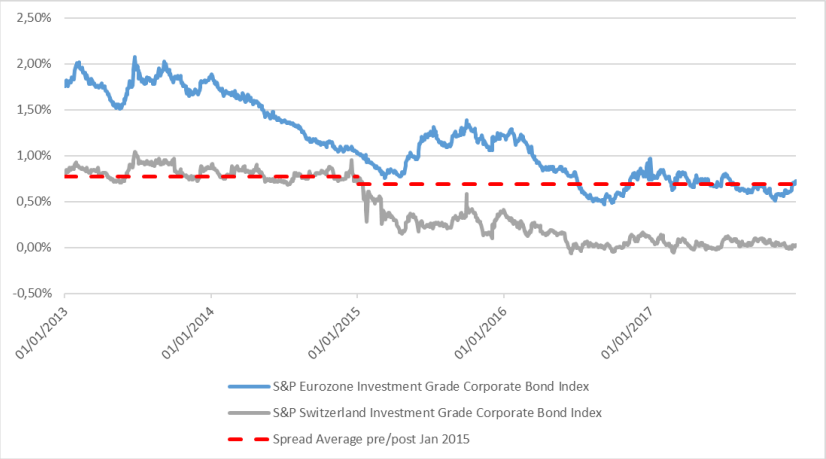
Figure 4: Swiss government bond yields for different maturities



Source: Swiss National Bank - Confederation bond statistics

The decrease in Swiss market rates is also reflected in corporate bond yields. As shown in Figure 5, the interest rate cut by the SNB drove a wedge between the corporate bond yields in Switzerland and the Eurozone. While the Swiss investment grade corporate bond index decreased substantially starting in early 2015, the Eurozone index rebounded again quickly in the first half of 2015, reaching levels even above the rates observed in the second half of 2014.

Figure 5: Comparison between Swiss and European corporate bond yields

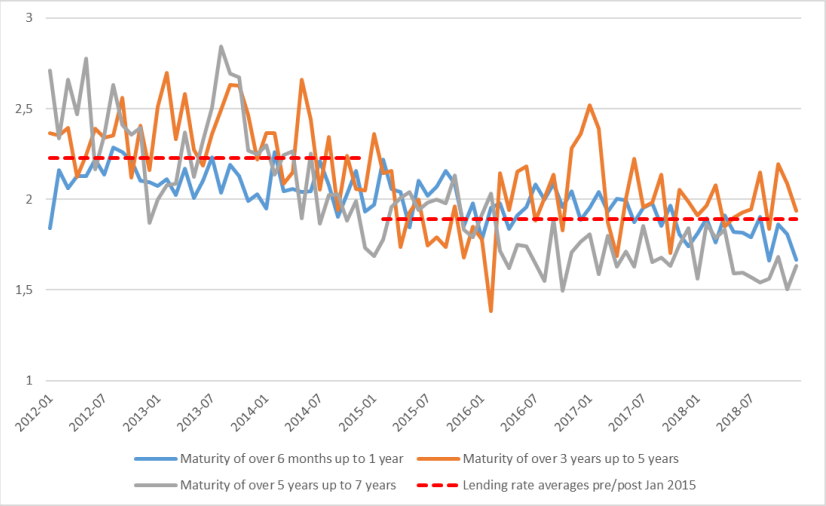


Source: Swiss National Bank - Confederation bond statistics

However, when focusing on the spreads between Eurozone and Swiss corporate bonds instead of levels and taking a more long-term perspective, one can see that the SNB's interest rate cut in 2015 was basically re-establishing earlier differences in yields by countervailing the narrowing of spreads happening in 2014.

When considering bank lending rates for newly issued loans, Figure 6 shows that lending became cheaper after the interest rate reduction by the SNB as pre- and post-event averages differ sharply. The pass-through to loan rates hence appears quite persistent.

Figure 6: Swiss bank lending rates for different maturities (new loan agreements)

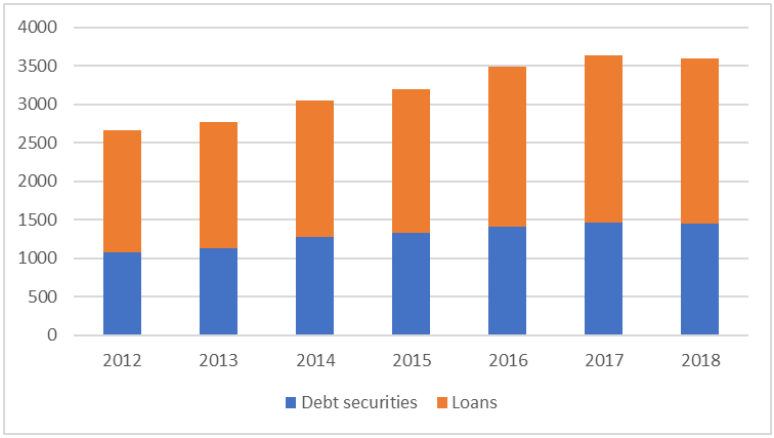


Source: Swiss National Bank - lending rate statistics

Figure 7 shows that banks also increased the supply of debt funding in the aftermath of the interest rate shock in early 2015. Taken together, it seems that banks increased lending in reaction to the reduction in interest rates. Basten and Mariathasan (2020) confirm that loan rates among Swiss banks were indeed reduced after the event. Moreover, analysing the mechanism driving this increase in lending, Schelling and Towbin (2020) show that the effect was particularly strong for banks that rely more heavily on deposit funding and that lending

was preferably allocated to riskier borrowers, indicating the risk-taking channel (Heider et al. 2019, Bubeck et al. 2020) to play a significant role.

Figure 7: Financial Assets of Swiss Financial Corporations



Source: Swiss National Bank - Swiss Financial Accounts

Following the SNB's announcement in January 2015, the EUR/CHF exchange rate decreased from 1.20 EUR/CHF to 1.04 EUR/CHF in April 2015. It then gradually increased until it returned to 1.17 EUR/CHF by December 2017. The sudden appreciation of the Swiss Franc constituted a temporary adverse shock to exports.

Importantly for our empirical approach, the unscheduled policy decisions by the SNB in January 2015 were not anticipated by the market.[6] In fact, the surprise factor is an important element when a central bank considers discontinuing an exchange rate floor since any hint at its discontinuation would fuel speculation, which poses a challenge for defending the floor. The significant reaction of market interest rates in response to the policy change announcement by the SNB is evidence for the fact that the policy changes were not anticipated (see Figure 3 and Figure 4). This circumstance matters because our estimates would likely underestimate the effect of the interest rate cut if it had been anticipated.

Moreover, the rate cut in Switzerland was large compared to rate cuts in the Eurozone (where individual rate cuts amounted to 10 basis points). A large rate cut makes it less likely that the results are driven by the existence of other shocks to interest rates during our sample period. The monetary policy decision by the SNB on January 15, 2015 was clearly the largest shock to interest rates during our sample period.

Finally, and most importantly, the SNB's implementation of ultra-low interest rates in Switzerland was a reaction to foreign developments and aimed at preventing a significant appreciation of the Swiss Franc (by making investments in Switzerland relatively less attractive) rather than to stimulate domestic demand. Hence, the policy change was exogenous to the domestic economic conditions in Switzerland.[7] It thereby constitutes a substantial exogenous variation in interest rates, alleviating endogeneity concerns usually associated with the interdependency between monetary policy and developments in the

[6] The SNB's decision to introduce negative interest on central bank deposits had no precedent in Swiss monetary policy and was implemented with relatively short notice between December 2014 and January 2015.

[7] While the SNB lowered the deposit rate to -0.75% in early 2015, the ECB lowered their rates to only -0.3% by 2015 and employed a more moderate interest rate policy afterwards.

domestic economy. This allows disentangling the effects of an interest rate change from those of local economic conditions.[8]

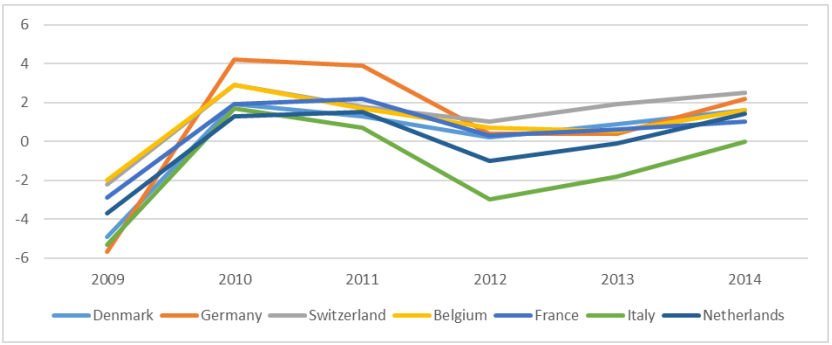
The simultaneous removal of the EUR/CHF exchange rate floor poses a challenge to our empirical strategy, as more export-oriented firms may have suffered from reductions in competitiveness. However, for most variables of interest, this effect should be directed in the opposite direction of the effects of the low interest environment. Any effect size we find should then be considered as a lower bound rather than being driven by changes in exchange rates. In addition, to further alleviate these concerns, we also run further empirical tests explicitly addressing the exchange rate mechanism as a potential confound by investigating the heterogeneity of our results with respect to the level of export/import-reliance of individual firms. This approach even allows us to quantitatively disentangle the exchange-rate effect of the Franc Shock and the interest-rate effect of the SNB's rate cut.

In summary, Switzerland is a well-suited setting to study the effects of an interest rate cut in a low interest environment on the real economy since the rate adjustment in January 2015 (i) was exogenous to domestic economic conditions, (ii) not anticipated by market participants and (iii) large.

3.3 Control group

We use the German economy as a counterfactual in our analysis: While its characteristics and pre-shock trends are comparable to the Swiss economy, German firms are not directly affected by the reduction in interest rates carried out by the SNB, but rather subject to the policy by the ECB, which featured more moderate interest rate adjustments in our period of interest (see Figure 2). Germany therefore constitutes a natural comparison to Swiss firms in studying the effects of interest rate changes[9]: (i) Both countries' public finances are regarded as safe and stable, which makes them both "safe haven" countries; (ii) both economies are similar in the sense that they are both export-dependent (Switzerland being ranked 5th and Germany 16th in 2015 by exports of goods and services per capita); and (iii) both countries are among the European economies least affected by the European sovereign debt crisis.[10]

Figure 8: Real GDP growth (annual percentage change)



Source: IMF World Economic Outlook

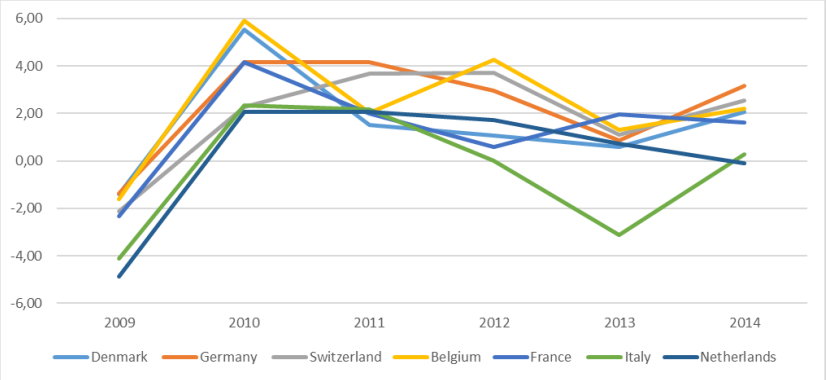
[8] Jiménez et al. (2012, 2014) use a similar identification strategy in the Spanish setting.

[9] In a robustness check, we redo our analysis using a larger control group, that is, Germany, Austria, France, Belgium, and Netherlands.

[10] According to OECD data, government debt of Germany has been at 85% of GDP in 2010 and decreased to 68% in 2019, while Switzerland has had a government debt level of around 43% of GDP between 2010 and 2018.

Figure 8 plots real GDP growth rates for selected European countries. The figure shows that the economies in Switzerland and Germany rebounded most strongly following the crisis in 2008, indicated by real growth rates above 2.5% in 2010. German growth rates then decreased to roughly 0.4% in 2012 and 2013, while Switzerland was able to keep growth rates equal or above 1% during the same period. In 2014, both countries converged to growth rates of 2.5%.

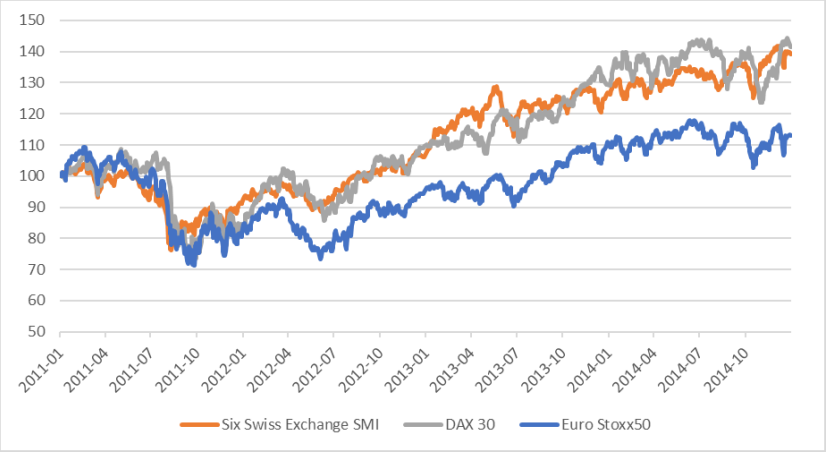
Figure 9: GDP per capita growth (annual percentage change)



Source: IMF World Economic Outlook

In general Switzerland and Germany did experience less severe negative consequences of the crisis compared to other European economies, especially the Southern European countries. Increasing uncertainties due to amplified concerns about the financial solvency of certain European economies increased risk aversion and triggered a flight into "safer" German and Swiss assets. Especially the German Bund and the Swiss Franc were considered as safe havens (De Santis, 2012). Depicting GDP per Capita growth, Figure 9 shows similar trends between Switzerland and Germany, illustrating that their growth rates remained positive during the European sovereign crisis.

Figure 10: Stock market indices (January 2011=100)

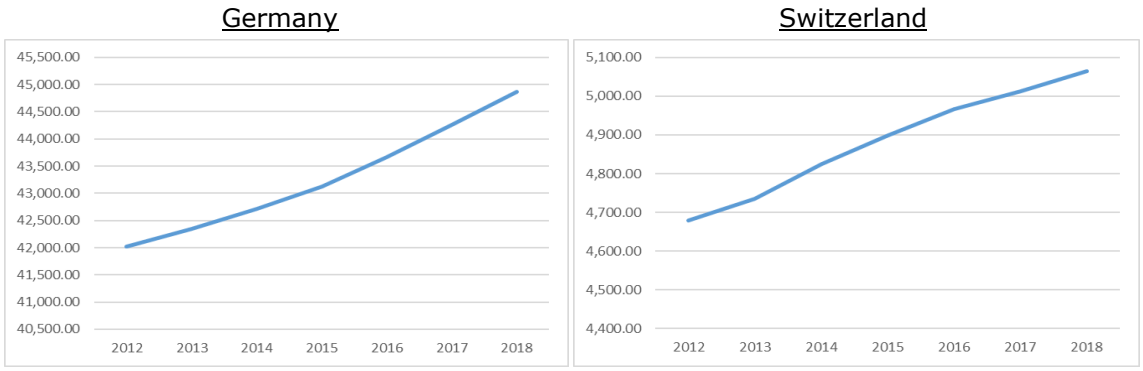


Source: Yahoo Finance

Stock markets in Germany and Switzerland also exhibited similar movements between 2011 and 2014 (see Figure 10). A trend reversal can be observed in August 2011, when stock markets in Europe saw strong corrections due to growing concerns about public finance

sustainability and sovereign debt risks.[11] From this point onwards, the link between the benchmark European stock market (Euro Stoxx 50) and the stock markets of Switzerland and Germany loosened. While Swiss and German stocks grew strongly, it took the European benchmark index until 2014 to recover from the losses incurred in late summer 2011. The trends in both, Swiss and German, stock markets further show the similarities between both countries regarding market participants' perception of their economic performances.

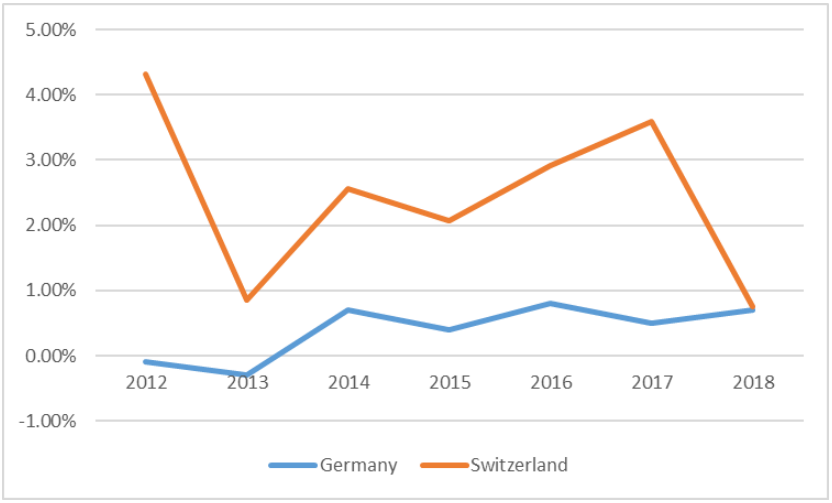
Figure 11: Employment (in Thousand)



Source: Eurostat

Finally, Figure 11 and Figure 12 compare the evolution in employment and the growth in gross investments, our main variables of interest, for Switzerland and Germany, respectively, over our sample period.

Figure 12: Growth in Gross Investments (in %)



Source: BFS and Destatis

Figure 11 shows that the growth in aggregate employment was strictly positive for both Switzerland and Germany during our sample period. Regarding the aggregate investment activity in both countries, Figure 12 shows that the gross investments in Switzerland increased

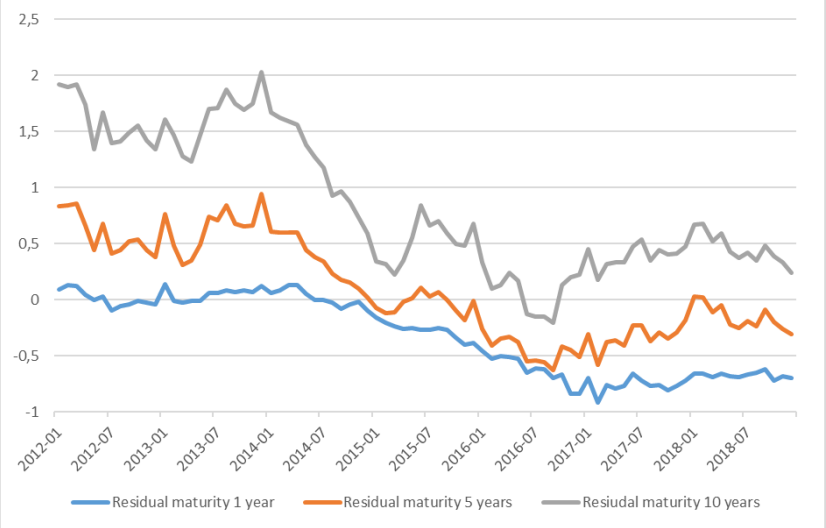
[11] ECB Monthly Bulletin September 2011.

more strongly between 2013 to 2017 compared to the investment activity in Germany. The investment growth in Switzerland then reversed in 2018 to a similar level as in Germany.

When comparing the gross value added of Switzerland and Germany broken down by the different sectors (see Table 6 in the Appendix), we see that the manufacturing sector makes up a slightly larger share of the economy in Germany compared to Switzerland (23% versus 18%, respectively), while the retail and wholesale trade (16% in Switzerland versus 10% in Germany) as well as the financial sector (10% versus 5%, respectively) are larger in Switzerland than in Germany. A similar picture emerges when comparing the two economies based on the distribution of employment in the different industries.

While the economic trends in Germany and Switzerland are comparable in the pre-2015 period, Germany's monetary policy is determined by the ECB, which decreased the interest rates to a much smaller extent in 2015 compared to the SNB. In particular, as inflation in the Eurozone remained subdued at around 1% during 2014, the ECB decided to decrease the deposit interest rate to -0.1% in June 2014 and to -0.2% in September 2014.[12] Moreover, in September 2014, the ECB announced the purchase of asset-backed securities with underlying assets consisting of claims against non-financial firms of the Eurozone and Euro-denominated covered bond portfolios.[13] In January 2015, the ECB announced the expansion of the asset purchase program to sovereign bonds.[14]

Figure 13: German government bond yields for different maturities



Source: Deutsche Bundesbank

While the SNB implemented the sharp interest rate cut in January 2015, the ECB introduced just moderate adjustments in December 2015 and March 2016, when it lowered the deposit facility rate to -0.30% and -0.40%, respectively. These monetary policy changes by the ECB had significantly lower pass-through effects on German government bonds compared to the pass-through effect of the interest rate cut in January 2015 by the SNB on Swiss government bonds. As shown by Figure 13, the yields for 5-year and 10-year German government bonds increased during 2015 and only started decreasing again in early-2016. The 1-year German

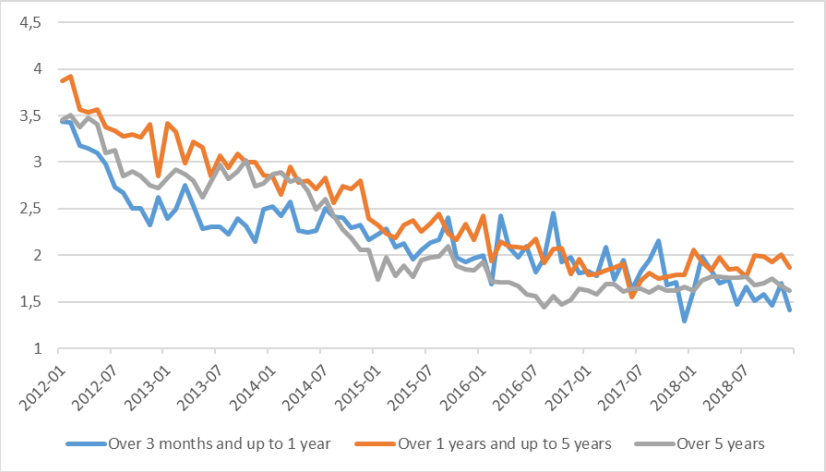
[12] Press conference by Mario Draghi on June 5, 2014.

[13] Press conference by Mario Draghi on September 4, 2014.

[14] ECB press release from January 25, 2015.

government bond yields did barely change during 2015 and then started to decrease only at the end of 2015.

Figure 14: German bank lending rates for different maturities (new loan agreements)



Source: European Central Bank - MFI Interest Rate Statistics

Finally, Figure 14 shows the bank lending rates for new loan agreements in Germany. While the lending rates did not materially change during 2015, the rates started to decrease in 2016, especially the long-term rates (i.e., over 5 years).

4. DATA DESCRIPTION

We employ two databases for our analysis: the Orbis database and CompNet. In this section, we explain their characteristics in more detail.

4.1 Orbis

Orbis is a database provided by Bureau van Dijk (BvD). It is the largest cross-country firm-level database, covering over 200 countries and 200 million firms.[15]

The database contains detailed general firm information, as well as detailed information on balance sheet and income statement components. Moreover, the database includes all industries, as well as both listed and unlisted companies. BvD obtains the data from over 40 different information providers using various data sources, typically national and/or local public institutions collecting data to fulfil legal and/or administrative requirements. National private databases are usually used when administrative databases at the national level are not available or reliable.

Kalemli-Ozcan et al. (2015) show that the European coverage of Orbis for most countries ranges from roughly 70% to over 90% when compared to official statistics depending on the country. In Switzerland, however, there are no legal requirements for companies to file their accounts, which leads to a lower coverage for Swiss companies in Orbis. Publicly quoted Swiss

[15] All results from analysing Orbis data outlined in this study are a summary of the analysis from Eufinger et al. (2021). For convenience, we refrain in the following from referencing Eufinger et al. (2021) when discussing the evidence derived from Orbis.

companies make their financial statements available, which are then collected, analysed, and provided to the Orbis database.[16] In total, Orbis contains detailed information for the about 700 largest Swiss companies for our sample period, which account for roughly 32% of economic activity in Switzerland.[17] The Orbis sample that we employ is thus biased towards large firms and not representative of the Swiss economy. In Germany, there is a legal requirement for companies to announce their balance sheet information, as well as the statement of income. The German companies covered in Orbis account for slightly above 80% of the economic activity in Germany.[18]

We employ the following filtering steps. We exclude financial firms from our analysis and drop observations with missing currency or time information. Moreover, we drop observations that have either negative or missing fixed and/or total assets. For each firm, we solely keep the highest level of consolidation.[19] We winsorize our dependent and control variables at the 3% level.

For our empirical baseline analysis based on the Orbis data, we employ a matching approach to account for the fact that the average firm size is significantly larger in the Swiss firm sample than in the control group. Specifically, for each firm-year observation in Switzerland in the year 2014, $X_{i,j.n,2014}$, we first compute the "distance" between this firm-year observation and all firm-year observations $Y_{i,j.n,2014}$ in the respective control group (either solely Germany or alternatively Germany, Austria, Belgium, France, and Netherlands) in the same industry n, and the same listing group (i.e., listed vs. non-listed firms), using the "distance" defined as

$$\boldsymbol{d}\left(\boldsymbol{X_{i,j=ch.n,2014}}, \boldsymbol{X_{i,j=c.n,2014}}\right) = \sqrt{\boldsymbol{X_{i,j=ch.n,2014} - X_{i,j=c.n,2014}})' W X_{i,j=ch.n,2014} - X_{i,j=c.n,2014})} \qquad \textbf{(1)}$$

where $j = ch$ indicates firms in Switzerland and $j = c$ indicates firms in the respective control group. $X_{i,j.n,t}$ is a column vector of firm characteristics, including firm size, profitability, tangibility, cash holding rate, and leverage. Moreover, $W = Var^{-1}(X)$ is the weighting matrix defined as the inverse of the variance-covariance matrix of X. We then select at most 5 firm-year observations $X_{i,j=c.n,t}$ closest to $X_{i,j=ch.n,t}$ and drop the duplicates. We select 5 matched observations to maintain a relatively balanced treatment and control group since for different firm-year observations in Switzerland, we might end up with overlapping matched observations.

4.2 CompNet

The CompNet dataset contains micro-aggregated firm-level data for the areas finance, labor, competition, productivity, and trade. Most importantly for our purpose, this dataset provides information on various balance sheet and income statement items of firms for a wide range of industries and company sizes. The data are compounded by national data providers and are

[16] BvD obtains information on Swiss companies from Worldbox AG.

[17] Since these are mainly the largest Swiss companies, this sample is not a representative cross-section of the Swiss corporate universe. To estimate the share of the Swiss economy activity represented by the Swiss companies with detailed information in Orbis, we follow Kalemli-Özcan et al. (2019) and compare the cumulative turnover of these companies from Orbis (variable opre) with the cumulative turnover of all industries in Switzerland based on the Eurostat SBS database (variable V12110).

[18] BvD obtains information on German companies from Creditreform and Creditreform Rating AG.

[19] Orbis includes unconsolidated and consolidated data for some firms.

available for 18 EU countries and Switzerland. The CompNet dataset secures confidentiality of individual firms by pooling the firm-level data into aggregated measures.

The dataset's time span ranges from 1999 to 2017, however, for most countries data are only available from 2003 onwards and for some countries the last available year is 2016. The data are aggregated both on a macro-sectorial level (1-digit NACE rev. 2) and on a more detailed sectorial level (2-digit NACE rev. 2). Further, a segmentation based on company size is also available (Macro-Sector-Size-Class).

Variables in the dataset are presented on a descriptive basis, as joint distributions, as regressions and as transition matrices. The descriptive level contains unconditional distributions of all variables, as well as decompositions and productivity dispersions. The joint distribution variables are available at the country, macro-sector, and sector level.

5. EMPIRICAL IMPLEMENTATION

Our empirical analysis applies three different strategies. The first strategy (the *continuous approach*) aims at maximizing the generality of the potential conclusions and therefore takes a broad and inclusive empirical perspective by investigating how changes in the average firm funding conditions at the country-industry level (henceforth called "markets") affect market outcomes. The second strategy (the *shock approach*) estimates the average treatment effect of a sudden interest rates decrease in a low interest rate environment on firm-level outcomes (i.e., the level responses). The objective of the third strategy (the *within-industry approach*) is to investigate and test for the transmission mechanisms through which the interest rate reduction affects firm behaviour.

5.1 The continuous approach: Effects of changes in the markets' funding conditions on market outcomes

For this analysis, we employ the CompNet data and its full sample of European countries and test in the cross-section of countries and industries, whether markets that experience a stronger change in their funding conditions subsequently have different average market outcomes, like for example differences in the investment rate (an approach similar to the one used in Acharya et al. 2020). For this wider long-run analysis, we exploit the fact that while interest rates and funding costs generally declined in Europe in the last decade, this decrease occurred at a different pace across countries and industries. Specifically, we employ the following regression specification to investigate the effect on a particular market outcome, $c_{j,n,t}$:

$$\boldsymbol{c_{j,n,t} = d_{n,t} + g_{j,t} + s_{j,n} + \Psi * Funding\ Costs_{j,n,t-1} + u_{j,n,t}} \qquad \textbf{(2)}$$

where the unit of observation is country j, industry n, and year t. Our key explanatory variable for this analysis is the lagged funding costs level, $Funding\ Costs_{j,n,t-1}$, in a particular market. We control for industry-country, country-year, and industry-year fixed effects. Country-year fixed effects absorb all shocks at the national level (e.g., changes in tax rates and national regulations) that could affect firms' policies and performance. Industry-year fixed effects absorb all shocks at the industry level (e.g., Europe-wide demand shocks). Country-industry fixed effects control for time-invariant industry-country characteristics.

5.2 The shock approach: Analysing the Franc Shock using Orbis data

To gauge the average treatment effect of the negative interest rate shock in Switzerland in January 2015 on firm-level outcomes, we compare the behavior of Swiss firms – the treatment group - with the behaviour of German firms (our main specification) or firms in Germany, Austria, Belgium, France, and the Netherlands (our robustness check) – the control group - that are active in the same industries.

Using Orbis data, we estimate the level response of the firm outcome of firm i in country j and industry n at horizon $h \geq 0$ post-2015, denoted $fb_{i,j,n,h}$. Accordingly, our treatment variable is characterized by a dummy variable ($Treat_j$) that is equal to one for firms incorporated in Switzerland and zero otherwise, as well as a dummy $Shock_{2015}$ that is equal to one in year 2015 and zero otherwise.

For the analysis, we employ panel regressions in the spirit of Jordà's (2005) local projections (LP), regressing the cumulative difference $\Delta_h fb_{i,j,n,2015+h}$ (where $\Delta_h fb_{i,j,n,2015+h} = fb_{i,j,n,2015+h} - fb_{i,j,n,2014}$) on the treatment variables, alongside a set of firm control variables. The LP method does not impose any underlying dynamics on the variables in the system, which confers the advantages that it is more robust to misspecification and does not suffer from the curse of dimensionality inherent to Vector autoregressions.

The general form of our baseline panel regression specification is as follows:

$$\Delta_h \boldsymbol{fb_{i,j,n,2015+h}} = \boldsymbol{f_{i,j,n,h}} + \boldsymbol{d_{n,h,2015+h}} + \boldsymbol{\Psi_h Treat_j \times Shock_{2015}} + \boldsymbol{\Theta_h W_{i,j,n,2014}} + \boldsymbol{u_{i,j,n,2015+h}}, \qquad \textbf{(3)}$$

where $h = 0,1,2,3$ denotes the horizon (in years) at which the relative impact effect is being estimated.[20] Fortunately, the interest rate shock is close to the end of the fiscal year 2014. Hence, the firms' year-end 2014 financial statements capture well the firms' pre-shock state. Accordingly, the year-end 2015 (i.e., $h = 0$) financial statements represent the firms' state one year post-treatment, while $h = 1,2,3$ represent their states, two, three, and four years post-treatment, respectively. The coefficients of interest in the regression are the Ψ_h, which measure responses of our firm outcomes of interest to the interest rate shock at horizon h.

We include fixed effects for the cumulative outcome growth over horizon $h+1$ of firm i in country j and industry n, denoted $f_{i,j,n,h}$, as well as industry-year fixed effects for $h+1$ -year growth measured in period $2015 + h$, which we denote as $d_{n,h,2015+h}$. These fixed effects account for unobserved time-varying shocks to an industry and unobserved time-invariant firm (and country) heterogeneity that may affect firm outcomes like, for example, a firm's industry affiliation.

Moreover, $W_{i,j,n,2014}$ is a vector of lagged firm-level controls, where we include firm size (*ln(total assets)*), profitability (Ebit/total assets), tangibility (fixed assets/total assets), cash holdings (cash/total assets), and leverage (interest bearing debt/total assets) as controls. The firm controls are measured in year 2014 to ensure exogeneity with respect to the interest rate change. Θ_h are the associated regression coefficients.

Table 4 in the Appendix summarizes the variables used in the empirical analysis based on the Orbis database and provides details about their calculation based on the raw Orbis variables.

[20] We conduct estimations of the firms' responses up to the horizon of $H = 3$ years since the year 2018 is the last available year in the Orbis dataset.

5.2.1 The shock approach: Controlling for exchange rate effects

As described in Section 3, the removal of the EUR/CHF floor that occurred simultaneously with the interest rate reduction poses a challenge to our identification strategy since the resulting exchange rate shock may have led to adverse effects for export-oriented firms due to the associated reduction in international competitiveness. In general, we argue that the adverse effects of the Swiss Franc appreciation on export-dependent firms run counter to the supposedly stimulating effects of a reduction in interest rates and thus, if they had an impact, downward bias our estimates.

There are three potential channels through which Swiss firms are affected by the appreciation of the Swiss Franc in early 2015. First, the currency appreciation might have led to a loss of price competitiveness abroad. Second, import competition for Swiss producers on the domestic market might have increased. Third, the appreciation might have led to a discount on intermediate consumption and capital goods that are processed or used in Switzerland. Therefore, the effects of the Swiss Franc appreciation in early 2015 is likely heterogenous with respect to firms' export exposure. Firms that sell a larger share of their products or services abroad should respond more negative to the appreciation while firms that are hedged against the currency appreciation through relatively lower costs of imported intermediate inputs should react more positive.

To disentangle the effect of the Swiss Franc appreciation, and its effect on exports and imports, from the effect of the interest rate reduction, we additionally control for the firms' exposure to the currency shock. In particular, following Ekholm et al. (2012) and Kaiser et al. (2018), we measure a firm's net exposure to the Franc shock as $(exports - imports)/(gross\ production\ value)$ of the industry (Nace 1-digit and 2-digit; which corresponds to the Noga classification) of the firm. To construct this variable, we obtain export and import data[21] from the Eidgenössische Zollverwaltung (EZV) and data about the gross production value provided by the Swiss Federal Statistical Office. We denote this variable $Trade\_Net_n$. The unweighted median of $Trade\_Net_n$ across all 2-digit industries in Switzerland is -0.3% and its 10% and 90% percentile are -6% and 16%, respectively.

Accordingly, to disentangle the currency appreciation from the interest rate effect and to test the robustness of our results we extend Specification (3) by adding $Trade\_Net_n$ as additional interaction control:

$$\Delta_h \boldsymbol{fb}_{i,j,n,t+h} = \boldsymbol{f}_{i,j,n,h} + \boldsymbol{d}_{n,h,t+h} + \boldsymbol{\Psi_{h1}} \boldsymbol{Treat}_{i,j,n} \times \boldsymbol{Shock}_{t=2015} + \boldsymbol{\Psi_{h2}} \boldsymbol{Treat}_{i,j,n} \times \boldsymbol{Shock}_{t=2015} \times \boldsymbol{Trade\_Net_n} + \boldsymbol{\Theta_h} \boldsymbol{W}_{i,j,n,t-1} + \boldsymbol{u}_{i,j,n,h,t+h}, \quad \textbf{(4)}$$

Hence, Ψ_{h1} now captures the level effect for firms that are not affected by the currency appreciation (i.e., where exports equal imports and thus the value of $Trade\_Net_n$ is close to zero), while Ψ_{h2} captures the additional effect for firms that have a negative or positive trade exposure loading. If the effects are influenced by a change in export and/or better import conditions of Swiss firms due to the Swiss Franc shock, we should see a statistically significant coefficient Ψ_{h2}.

[21] We use trade data from the year 2016, which is the year with available trade data that is closest to our treatment year 2015. The EZV only provides a detailed industry breakdown of the Swiss trade data from 2016 onwards.

5.3 The shock approach: Analysing the Franc Shock using CompNet

For the analysis based on the CompNet data, we need to slightly adjust our methodology, given that the CompNet data is only available at the industry-country level. In particular, we adjust the panel regression Specification (4) to

$$\Delta \boldsymbol{ib}_{j,ns,2015+h} = \boldsymbol{i}_{j,ns,h} + \boldsymbol{d}_{ns,h,2015+h} + \boldsymbol{\Psi}_{h1}\boldsymbol{Treat}_j \times \boldsymbol{Shock}_{2015} + \boldsymbol{\Psi}_{h2}\boldsymbol{Treat}_j \times \boldsymbol{Shock}_{2015} \times \boldsymbol{Trade\_Net}_n + \boldsymbol{\Theta}_h \boldsymbol{W}_{j,ns,2014} + \boldsymbol{u}_{j,ns,h,2015+h} \quad \textbf{(5)}$$

where $\Delta_h ib_{j,ns,t+h}$ denotes the cumulative difference in the behavioral outcome of firms in size class s and industry n in country j (i.e., $\Delta_h ib_{j,ns,2015+h} = ib_{j,ns,2015+h} - ib_{j,ns,2014}$) at horizons $h = 0{,}1$ (note that for most countries CompNet data end in 2016).[22] Accordingly, our treatment variable is now characterized by a dummy variable ($Treat_j$) that is equal to one if the particular industry is located in Switzerland and zero otherwise, as well as a dummy, $Shock_{2015}$, that is again equal to one in year 2015 and zero otherwise.

$i_{j,ns,h}$ denotes the fixed effect for the cumulative outcome growth over horizon $h+1$ of size-industry group ns in country j and $d_{ns,h,2015+h}$ is shorthand for size class-industry-year dummies for $h+1$ -year growth measured in period $2015 + h$. In our CompNet level response specification, we directly control for firms' exposure to the Swiss Franc shock by including the $Trade\_Net_n$ interaction.

$W_{ns,2014}$ is a vector of lagged controls to account for differences between size-industry groups across countries. Here, we include firm size, profitability, tangibility, and cash holdings as controls.[23] The firm controls are again measured in year 2014 to ensure exogeneity with respect to the interest rate shock. Ψ_{h1}, Ψ_{h2}, and Θ_h are regression coefficients.

5.4 The within-industry approach using Orbis data

We estimate how the firms' behavioral outcomes at horizon $h \geq 0$ behave differently in response to the interest rate change in January 2015 conditional on firm characteristics. This analysis aims at shedding light on the channels through which low interest rates affect firm behaviour.

Since this analysis does not require to simultaneously measure level responses of firm outcomes, we can include industry-country-year fixed effects in the regression specification. These capture unobserved time-varying shocks to an industry in a given country-year pair that may affect firm outcomes. Specifically, these fixed effects absorb any industry-wide effects that are due to the removal of the Swiss Franc floor and thus also control for the export- and import-exposure shared by the firms in a particular industry, which is particularly important for our setting. Moreover, these fixed effects capture all country-level shocks such as tax rates and regulatory changes that might affect firm outcomes.

To analyse the influence of different firm characteristics on the behavioural response to the interest rate cut in the same industries, we employ the following panel regression specification:

$$\Delta_h \boldsymbol{fb}_{i,j,n,2015+h} = \boldsymbol{f}_{i,j,n,h} + \boldsymbol{e}_{j,n,h,2015+h} + \left(\boldsymbol{\Omega}_h^Z + \boldsymbol{\Psi}_h^Z \boldsymbol{Treat}_{j,} \times \boldsymbol{Shock}_{2015}\right)\boldsymbol{Z}_{i,j,n,2014} + \boldsymbol{u}_{i,j,n,h,2015+h} \quad \textbf{(6)}$$

[22] Note that we employ the size-class macro-sector dataset of CompNet since it allows us to control for size within an industry, which is important as firm size is likely a moderator for the transmission of the interest rate cut to firm outcomes.

[23] Leverage information is unfortunately missing for Germany.

where $e_{j,n,h,2015+h}$ is shorthand for country-industry-year dummies for $h+1$ -year growth measured in period $2015 + h$, while Ω_h^Z and Ψ_h^Z are regression coefficients. Moreover, $Z_{i,j,n,t-1}$ is a vector of lagged firm-level controls (i.e., firm size, profitability, tangibility, cash holdings, and leverage) and our respective firm characteristic of interest. Here, the coefficient of interest is the Ψ_h^Z for the respective firm characteristic of interest, which measures the relevance of the respective firm characteristic in predicting heterogeneity in firms' responsiveness at horizon h.

5.5 The within-industry approach using CompNet

Finally, to test for the influence of different firm characteristics using the CompNet data (which is at the industry-country level), we adjust Specification (6) to the following panel regression specification:

$$\Delta \boldsymbol{ib}_{g,j,n,2015+h} = \boldsymbol{i}_{g,j,n,h} + \boldsymbol{e}_{j,n,h,2015+h} + \left(\boldsymbol{\Omega}_h^g + \boldsymbol{\Psi}_h^g \boldsymbol{Treat}_j \times \boldsymbol{Shock}_{2015}\right)\boldsymbol{g} + \boldsymbol{u}_{g,j,n,h,2015+h} \qquad \textbf{(7)}$$

where again $e_{j,n,h,2015+h}$ is shorthand for country-industry-year dummies for $h+1$-year growth measured in period $t + h$. Ω_h^g and Ψ_h^g are regression coefficients. Index g is a cardinal variable that indicates the firms' percentile ranking in the distribution of the respective firm characteristic (e.g., ranked according to firm size). The percentile rankings have values 20, 40, 60, 80, and 100, which we normalize by dividing the values by 10.

The coefficient of interest in this regression is Ψ_h^g, measuring the relevance of the within subgroup ranking in predicting heterogeneity in firms' responsiveness at horizon h.

6. RESULTS

We present our results in three steps: First, we investigate the aggregated effects of lower interest rates on general firm behaviour, exploiting the panel dimension of the CompNet data (*the continuous approach*), as well as the exogenous nature of the SNB's negative interest rate shock (*the shock approach*). Regarding the latter, we provide a detailed walk-through for the likely causal chain of events. Second, we investigate heterogeneous effects relying on a *within-industry approach* to understand which type of firms are particularly affected by low interest rates. Finally, we derive aggregated implications of low interest rates for the structure of the economy.

6.1 The investment and employment reaction of firms to reductions in interest rates

6.1.1 The effect of changes in the markets' funding conditions on investments following the continuous approach

We start with the continuous approach following Specification (2) using CompNet data, where we exploit that the decline of interest rates and funding costs in Europe in the last decade occurred at a difference pace across countries and industries to investigate the link between funding costs and investment rates — measured as ratio of investment (change in nominal capital plus depreciation) to nominal capital in the previous year. To proxy for the funding

conditions in a particular market, we employ CompNet data and the ratio of interest paid to average debt (based on current and previous year).[24]

Table 1: Effect of changes in firms funding conditions on investment

	Investment Rate	Investment Rate	Investment Rate	Investment Rate
Funding Costs	-55.47***	-66.68***	-33.19*	-42.69**
	(0.002)	(0.000)	(0.058)	(0.025)
Observations	6,716	6,628	6,716	6,628
R-squared	0.25	0.35	0.31	0.41
Country-Industry FE	✓	✓	✓	✓
Year FE	✓			
Industry-Year FE		✓		✓
Country-Year FE			✓	✓

*This table presents estimation results from Specification (2) using CompNet data. The dependent variable is the annual investment rate from t-1 to t, measured as the ratio of investment (change in nominal capital plus depreciation) to nominal capital in the previous year. Funding Costs is the ratio of interest paid to average debt (based on current and previous year). Standard errors are clustered at the industry-country level. *** p<0.01, ** p<0.05, * p<0.1*

The results in Table 1 show the estimated coefficient Ψ, which implies that markets experiencing a reduction in average funding costs subsequently have a higher average investment rate. The estimated coefficient is relatively robust to the addition of different layers of fixed effects.

Despite this tight set of fixed effects, which controls for a wide set of potential confounds, we next aim to confirm this result by exploiting the exogenous nature of the SNB's interest rate cut in 2015 for identification.

6.1.2 How did the Swiss Interest Rate Shock affect firms' funding conditions?

In our baseline analysis, we gauge the average treatment effect of the negative interest rate shock in January 2015 on firm-level outcomes by comparing the behavior of Swiss firms with the behaviour of matched German firms.[25]

Table 2: Summary statistics

	Median pre-2015			Mean pre-2015		
	Germany	Switzerland	Diff	Germany	Switzerland	Diff
Firm Size	17.98	18.22	0.24***	18.24	18.59	0.35***
Revenues	17.95	17.69	-0.26***	18.04	18.11	0.07
Profitability	0.03	0.03	-0.01***	0.04	0.03	-0.01***
Tangibility	0.70	0.68	-0.01	0.64	0.63	-0.01
Cash Holdings	0.08	0.09	0.01*	0.15	0.14	-0.00
Leverage	0.19	0.21	0.02	0.24	0.26	0.02***
Net Worth	0.36	0.29	-0.07***	0.35	0.30	-0.05***

Table 2 presents descriptive statistics for firms in the Orbis sample separately for Switzerland (treatment) and Germany (control). Naturally, the sample firms are comparable across all

[24] The countries included in this sample are Belgium, Croatia, Denmark, Finland, France, Germany, Italy, Lithuania, Netherlands, Portugal, Romania, Slovenia, Spain, Sweden, and Switzerland.

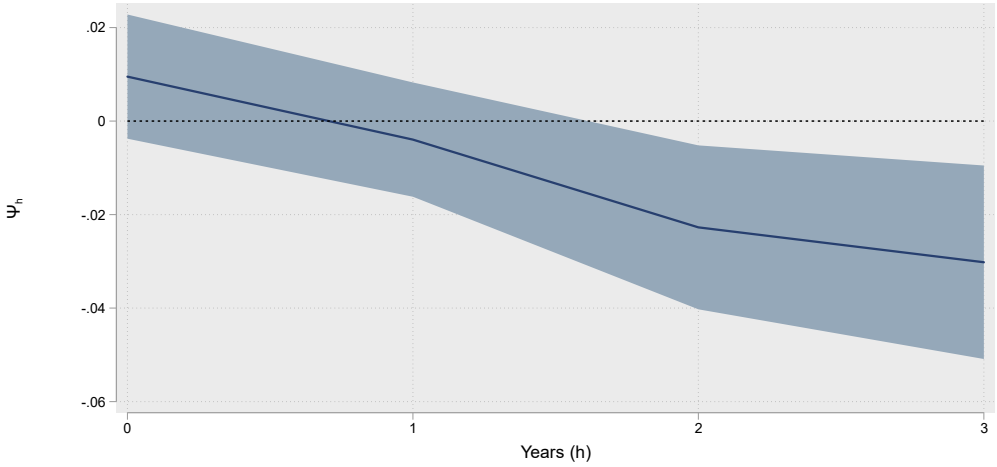
[25] In the Appendix, we test the robustness of our results with respect to (i) employing a larger set of control countries (i.e., Germany, Austria, Belgium, France, and Netherlands), (ii) using the raw non-matched Orbis sample, and (iii) excluding firms from the pharmaceutical industry from the analysis.

matched firm characteristics, that is, firm size, profitability, tangibility, cash holding rate, and leverage. Even though differences are sometime statistically significant, they are very small in magnitude.

Figure 15 presents the estimates for Ψ_h according to Specification (3) – the shock approach – and the corresponding 95% confidence interval. The change in the funding rate post-2015 serves as the dependent variable and we measure firms' funding conditions as the ratio of interest expenses over interest bearing debt.

The figure shows that Swiss firms enjoyed a reduction in their funding costs post-shock relative to comparable German firms. Although funding rates did not change directly after the shock, differences of point estimates turn negative from the third year after the event onwards. Quantitatively, these estimates imply that four years post-shock the implied interest rate for Swiss firms decreased on average by 2.5pp more than comparable firms in the control group.

Figure 15: Change in the Funding Rate



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the change in the funding rate, which we measure as interest expenses over interest-bearing debt, from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

When comparing the evolution of the firms' funding cost in the post-shock period from Figure 15 with the changes in the rates discussed in Section 3, we see that the estimated magnitude of the reduction in the firms' funding costs is larger than the average rate decrease and that the estimated funding cost reduction occurs later than the observed rate decrease. There are two factors that may explain this pattern.

First, since we measure the firms' funding conditions as interest expenses over interest bearing debt, our measure only varies with marginal changes due to new debt (and the associated interest rate) and debt repayments. Hence, this measure picks up changes in the firms' funding costs only with a time lag, which can explain why the difference in the funding cost change is not significant in the intermediate post-shock period and why it is widening until the end of our sample period.

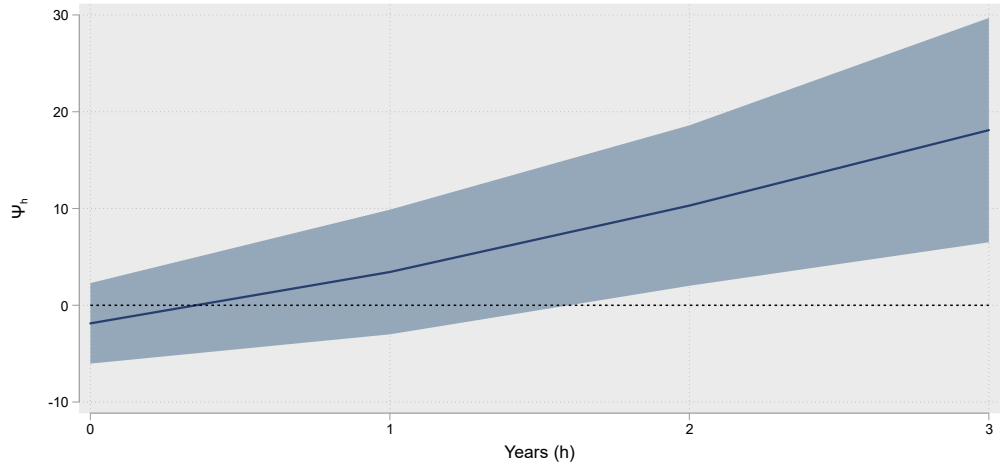
Second, the existing evidence about the effect of the SNB's interest rate reduction on bank lending suggests that banks affected by the rate cut shifted their loan supply towards riskier borrowers (see Heider et al. 2019; Bubeck et al. 2020; Basten and Mariathasan 2020); Schelling and Towbin 2020). The ease in funding conditions post-shock thus likely occurred mainly through a loan volume increase to weaker firms at rates below their pre-shock levels,

and not necessarily through a loan rate cut across all borrowers. As a result, due to the simultaneous shift in volume to weaker firms and the downward rate shift for the respective borrowers (i.e., weak borrowers obtained debt at lower rates than before), funding rates decreased significantly for affected firms, while the average interest rates across all borrowers only slightly changed. Since Figure 15 compares the difference in the change in the funding conditions between Swiss and German firms pre- and post-shock, the large magnitude in the funding cost reduction is likely due to the fact that weak Swiss firms were able to raise additional debt at lower rates post-shock, while the funding conditions improved significantly less for weak German firms.

6.1.3 Did firms make use of improved funding opportunities by increasing their debt?

Given the reduction in funding costs of Swiss firms after the negative interest rate shock shown in Figure 15, we next investigate how firms responded to their improved funding conditions. While it seems straightforward at first glance that reduced observable funding rates should lead to increased lending, our discussion of the bank lending channel in Section 2.2 indicates that frictions can substantially govern the existence or at least the strength of this effect.

Figure 16: Growth in Interest Bearing Debt

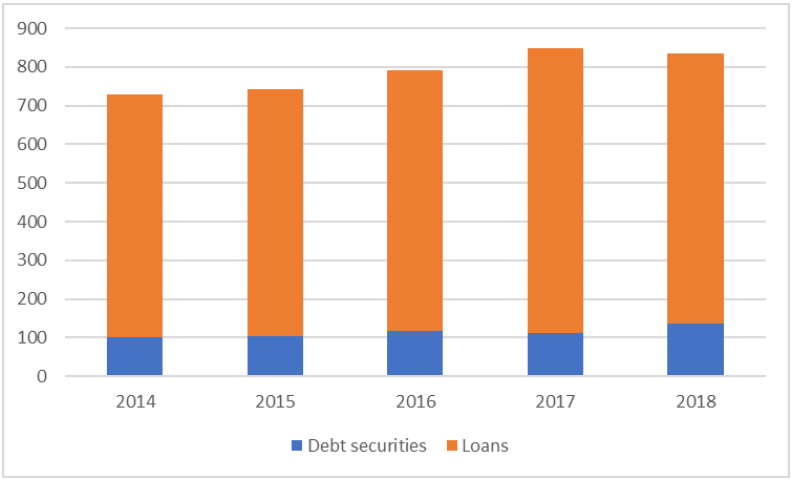


This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in interest bearing debt (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

For this analysis, we employ the growth in interest bearing debt (i.e., the sum of loan and bond financing) post-shock as dependent variable in Specification (3). Figure 16 shows that Swiss firms indeed made use of their lower funding rates by raising additional debt financing. The point estimates for Ψ_h imply that four years post-shock the cumulative growth in interest bearing debt is roughly 19pp larger for Swiss firms compared to the German control firms. This translates into a roughly 4.75pp higher growth in interest bearing debt per year.

This increase in debt is also in line with the increase in liabilities of Swiss non-financial corporations at the aggregate between 2014 and 2018. As shown in Figure 17 aggregate debt increased by 14,5% between 2014 and 2018 Overall, it therefore seems that there was indeed a pass-through from the interest rate to the funding conditions of individual firms.

Figure 17: Liabilities of Swiss Non-Financial Corporations

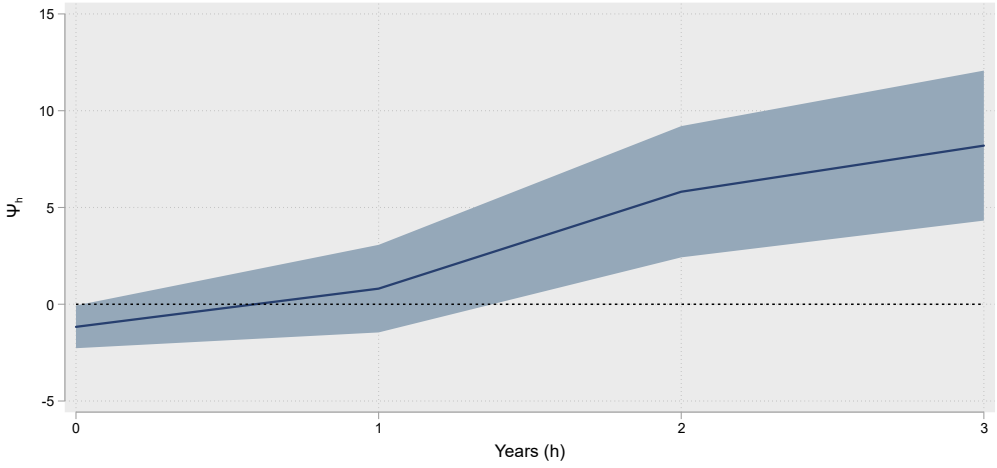


Source: Swiss National Bank – Swiss Financial Accounts

6.1.4 How did firms make use of improved funding opportunities?

Given that Swiss firms raised additional debt funding after the negative interest rate shock, we next investigate how firms deployed this additional liquidity. In general, there are three main ways of how firms can spend their additional funds. First, firms could use the funds to invest into fixed assets (i.e., on capital expenditures). Second, firms may allocate more funds to their net working capital to, for example, increase stocks, repay suppliers quicker or offer better payment terms to their customers (i.e., provide more trade credit). Third, firms may store the proceeds from the additional debt financing as cash on their balance sheet.

Figure 18: Net Investment Rate

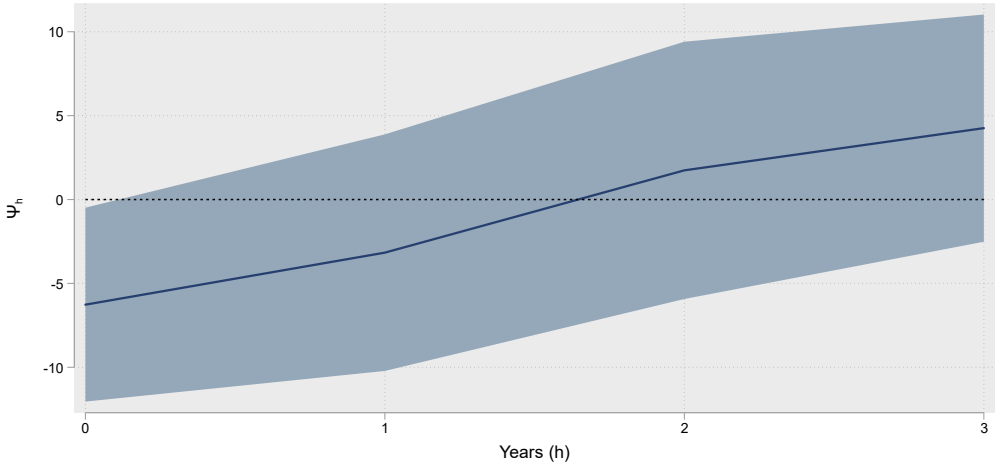


This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Regarding firms' investment activity, Figure 18 indicates that the negative interest rate shock had a positive impact on capital expenditures. That is, Swiss firms significantly increased their net investment rate relative to the control group (the difference becomes significant during the third year), measured as the growth rate in fixed assets post-shock (i.e., $\ln(Fixed\ Assets_t) - \ln(Fixed\ Assets_{t-1})$).

Regarding timing, this increase in investment activity corresponds well to the increase in leverage shown in Figure 16. Quantitatively, the point estimates imply that four years post-shock the cumulated net investment rate is 8pp larger for Swiss firms relative to the control group. This corresponds to a roughly 2pp higher net investment rate per year.

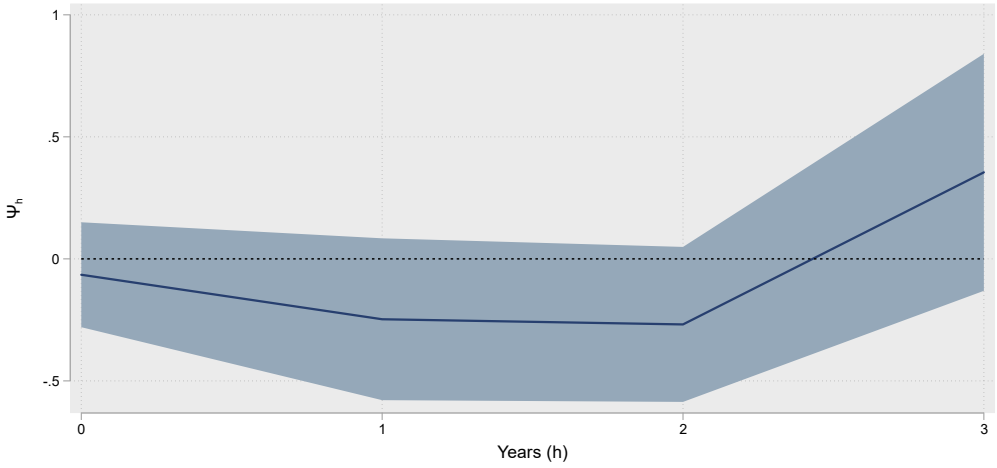
Figure 19: Growth in Net Working Capital



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in the net working capital (in percentage points) between 2014 and 2015+h, which is defined as stocks + receivables and other assets - trade payables due within 1 year. Standard errors are clustered at the industry-country-year level.

To put this magnitude into perspective, note that the mean net investment ratio for large European firms is 13.6%, according to IMF data.[26] Moreover, it is important to note that Switzerland has a large capital stock and thus high depreciations. As a result, the net investment ratio in Switzerland is average in international comparison (see Busch et al., 2017).

Figure 20: Change in Receivables/Total Assets



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the percentage point change in the receivables over total assets (where receivables/total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

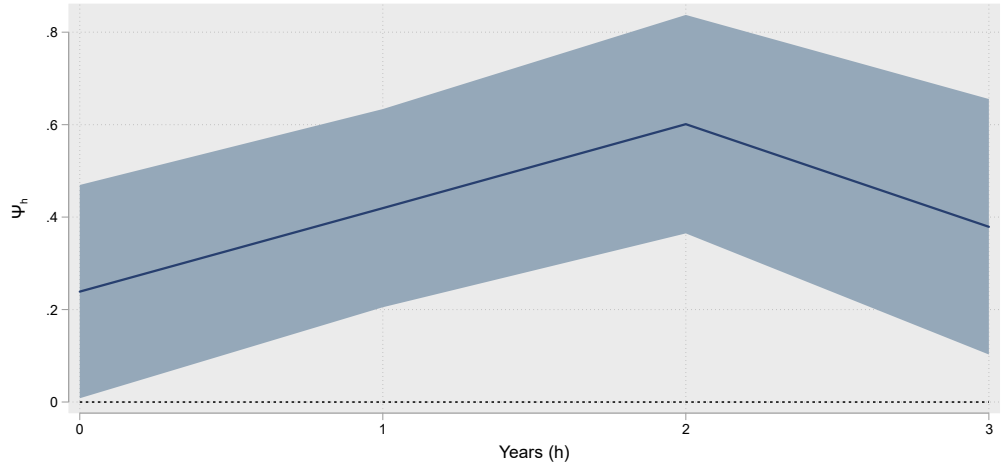
[26] See https://www.imf.org/external/pubs/ft/scr/2016/cr16220.pdf

Regarding the effect on net working capital investments, Figure 19 shows that immediately after the interest rate shock, Swiss firms significantly reduced their net working capital position relative to the control group. The longer-term effect is insignificant. The initial decrease in the firms' net working capital position could in general be driven by a reduction in receivables (i.e., firms collect quicker from their customers) or by an increase in trade payables (i.e., firms pay suppliers on average later).

In Figure 20 and 21, we therefore decompose the effect on the firms' net working capital into changes in receivables and changes in payables, respectively. While there is a slight marginally significant negative effect on the ratio of receivables/total assets of about 0.25pp two years after the shock, the ratio of payables/total assets significantly increased immediately post-shock by roughly 0.25pp. Hence, the decrease in working capital seems to be mainly driven by a decrease of trade payables. Taken together, the slight decrease in receivables and the significant increase in payables allows firms to free up liquidity.

Moreover, this evidence indicates that the Swiss firms in the Orbis sample, which includes mainly large firms, were able to put more pressure on their suppliers (usually smaller firms) regarding the generosity of the payment terms. Since it is unlikely that this response of large firms was due to a deterioration in their financial health (as overall funding conditions improved), this evidence indicates that large firms might have skimmed rents from smaller firms that post-shock benefited from the improvement in the access to funding.

Figure 21: Change in Trade Payables/Total Assets



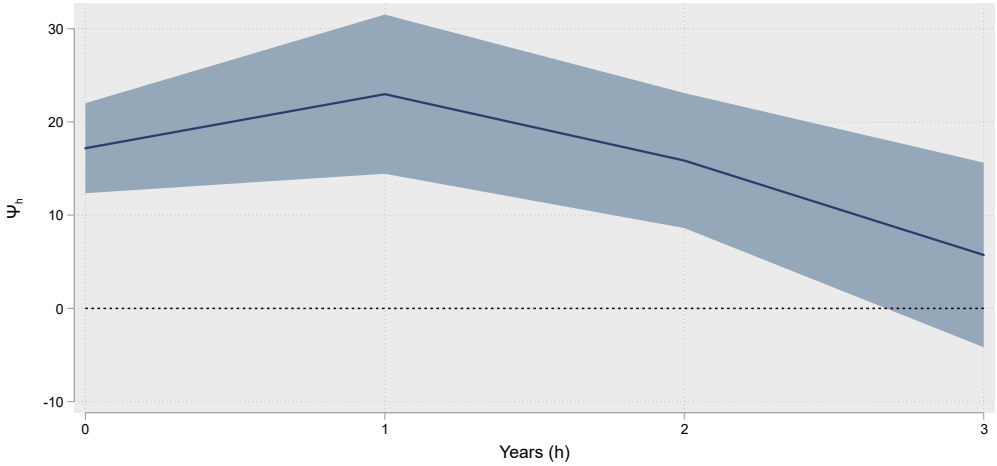
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the percentage point change in the trade payables over total assets (where trade payables /total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

However, Figure 18 reveals that Swiss firms did not immediately use their additional liquidity for expanding their fixed assets. The evidence in Figure 22 suggests that they rather hoarded more cash in the post-shock period (likely for precautionary reasons), that is, cash holdings increased immediately post-shock. This result indicates that Swiss firms stored part of the proceeds from the reduction in working capital as cash holdings on the balance sheet and invested it only later (together with the additional funds from raising more debt) when cash holdings were reduced again.

Regarding the economic magnitude, the point estimates shown in Figure 22 indicate that already one year after the shock Swiss firms have a roughly 18pp higher growth in cash holdings compared to firms in the control group. The growth rate differential increases to

roughly 22pp two years after the shock and stays significantly positively different for almost the entire sample period.

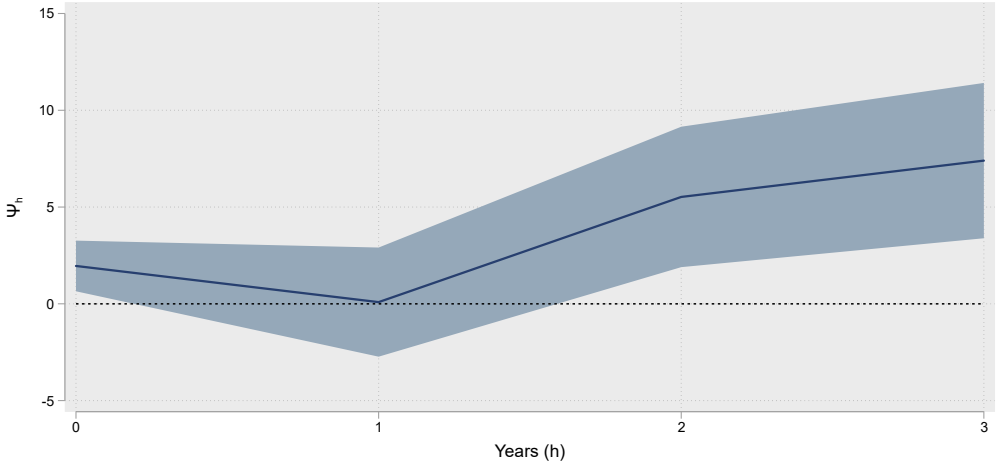
Figure 22: Growth in Cash Holdings



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in cash holdings (percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Improved funding conditions and the resulting higher investment activity and corporate expansion seem also to have spurred employment, as shown in Figure 23. Quantitatively, four years post-shock, the cumulative growth rate in the firms' head count is 7.5pp larger for Swiss firms compared to the control group. This roughly corresponds to a 1.9pp higher employment growth per year.

Figure 23: Employment Growth



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

As discussed in Section 3, we consider Germany to be the most suitable comparison due to its close similarity to Switzerland. Nevertheless, one might argue that specific events in Germany around the time of our event might induce bias into our results. In Appendix 0, we hence show that our results are also robust to including a larger number of countries in our control group (Section 1.1). To that end, we include all northern (continental) Eurozone countries not

substantially affected by the European sovereign debt crisis, which showed GDP growth comparable to Switzerland pre-2015 (i.e., Germany, Austria, Belgium, France, and Netherlands; see Figure 8).

Moreover, to ensure that our results are not driven by the matching approach, we rerun our analysis for the raw full sample (Section 1.2). Note that differences in firm characteristics are still accounted for due to the inclusion of control variables and our stringent fixed effects specification. Our results are also robust to employing the full sample.

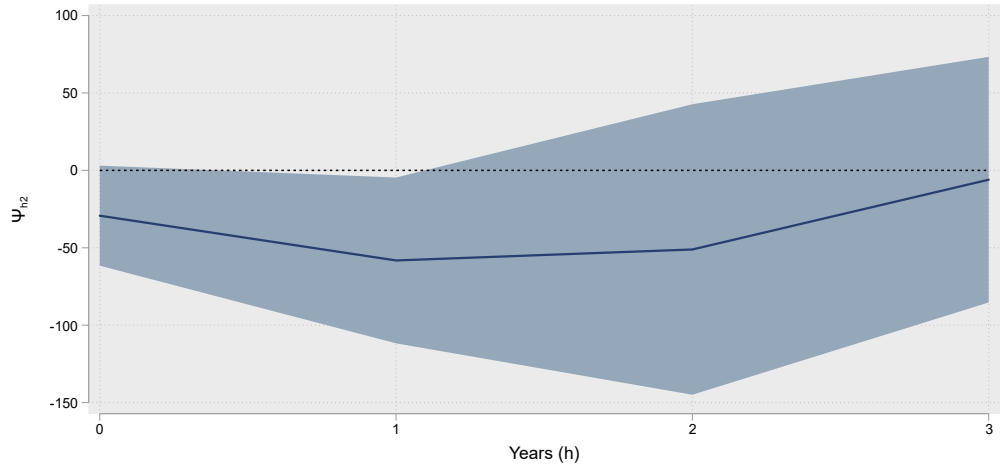
Finally, we show that results hold when excluding the pharmaceutical industry (Section 1.3), which is a dominant industry in Switzerland as it directly and indirectly employs about 135,000 people, contributes to 5.7% to the gross domestic product of Switzerland, and contributes roughly 30% to the country's exports.

6.1.5 Disentangling exchange rate and interest rate effects

Next, we investigate to what extent the appreciation of the Swiss Franc that occurred simultaneously to the negative interest rate shock influenced firm outcomes by empirically disentangling the interest rate effect (i.e., the effect due to an improvement in the funding conditions) from effects driven by changes in the exchange rate.

Employing Specification (4) – the shock approach: controlling for exchange rate effects – we redo our analysis from Specification (3), but now additionally control for the firms' exchange rate exposure (i.e., the importance of their exports relative to their imports). Figure 61 to Figure 63 in the Appendix show the point estimates and 95% confidence interval for Ψ_{h1} for our main dependent variables, that is, the growth in interest-bearing debt, the net investment rate, and the employment growth. These results show that the estimated effects for firms that are not significantly exposed to the currency appreciation (i.e., firms with a $Trade\_Net_n$ close to zero) are similar to the effect size estimated without the currency exposure control in the previous sections.

Figure 24: Growth in Interest Bearing Debt (triple interaction)

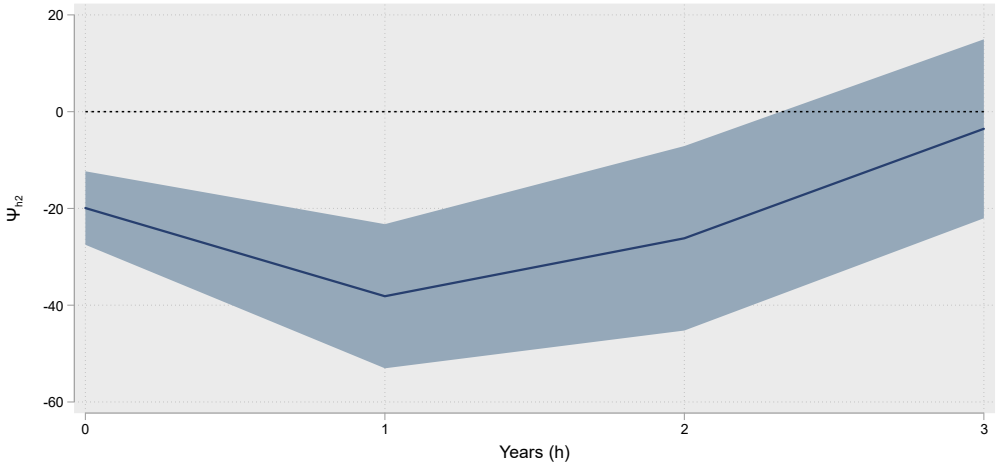


This figure plots the point estimates and 95% confidence intervals for Ψ_{h2} from estimating Specification (4) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in interest bearing debt (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

However, firms' export and import exposure does indeed matter. Figure 24 to Figure 26 show plot point estimates and 95% confidence intervals for Ψ_{h2} from Specification (4). The general

picture that emerges is that firms with a higher $Trade\_Net_n$ (i.e., more export-dependent and/or less import-dependent) tend to raise less additional debt and invest less.

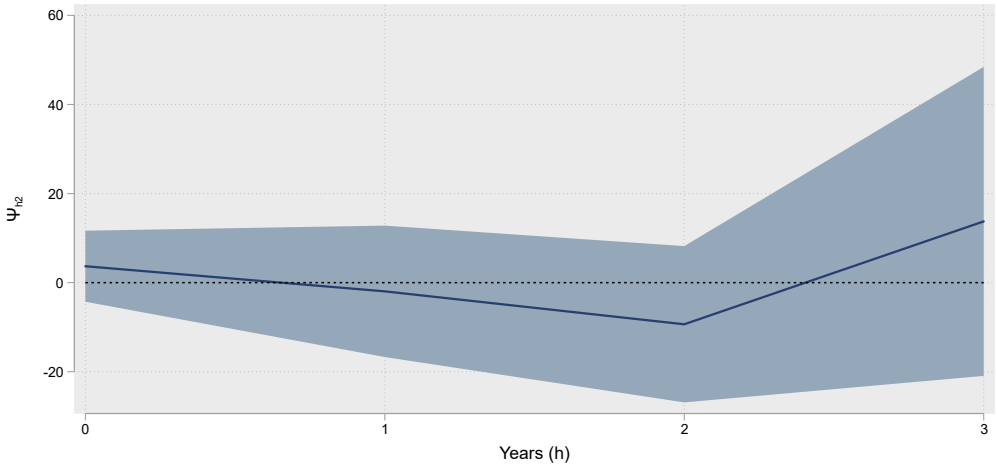
Figure 25: Net Investment Rate (triple interaction)



This figure plots the point estimates and 95% confidence intervals for Ψ_{h2} from estimating Specification (4) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

In particular, point estimates from Figure 24 suggest that firms at the 90% percentile $Trade\_Net_n$ (i.e., with $Trade\_Net_n$ = 16%) have roughly an 8.8pp lower growth in interest-bearing debt (16%*-55pp) than firms with a neutral currency exposure, while firms at the 10% percentile have a 3.3pp higher debt growth (-6%*-55pp). However, this additional effect for currency exposed firms reverts towards zero towards the end of our sample period.

Figure 26: Employment Growth (triple interaction)



This figure plots the point estimates and 95% confidence intervals for Ψ_{h2} from estimating Specification (4) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Similarly, Figure 25 shows that two years post-shock, Swiss firms at the 90% percentile of $Trade\_Net_n$ have a roughly 6pp lower net investment rate than Swiss firms without a significant currency exposure (16%*-38pp). In contrast, Swiss firms at the 10% percentile have a 2.3pp higher investment rate two years after the shock. As it was the case for growth in interest-bearing debt, the effect of being exposed to the currency appreciation also reverts to zero for

investment activity towards the end of our sample period. The likely explanation for this effect reversion is that at the end of our sample period (i.e., starting in mid-2017) the Swiss Franc depreciated again against the Euro.

When looking at the joint effect, the point estimates of Ψ_{h1} (see Section 2 in the Appendix) and the point estimates of Ψ_{h2} shown in Figure 24 and Figure 25 suggest that the overall effect of the events in Switzerland in early 2015 had a negative (positive) effect for firms with a relatively high (negative) export-exposure and/or low import-exposure in the short- and medium-term but a stimulating effect for all firms in the longer run. Figure 26 shows no heterogenous effect for the employment growth of firms depending on their currency exposure.

Using a back-of-the-envelope calculation allows us to inform the debate about the share of the Swiss economy that experienced a net gain/loss from the joint effect of the policy adjustments by the SNB in early 2015 (i.e., the sum of the effect from the appreciation of the Swiss Franc and the effect of the interest rate reduction). For this analysis, we first sort the Swiss industries according to their net exposure to the Swiss Franc shock (i.e., their $Trade\_Net_n$). We then group the industries into three groups: (i) industries with a non-negative $Trade\_Net_n$ that experienced a net gain from the SNB policies three years post-shock, (ii) industries with a positive $Trade\_Net_n$ that experienced a net loss from the SNB policies three years post-shock, and (iii) industries with a negative $Trade\_Net_n$.

To determine the $Trade\_Net_n$ above which firms experienced a negative joint effect, we solve $0 = \Psi_{h1} + \Psi_{h2} \times Trade\_Net_n$ (i.e., $0 = 4.5pp + 23pp \times Trade\_Net_n$) for $Trade\_Net_n$, which implies that three years after the SNB policy changes, all industries with an $Trade\_Net_n$ below 5% experienced a net benefit from the policies. In a final step, we derive the aggregated gross production value for the three industry groups and their gross production value share within the Swiss economy.

This back-of-the-envelope calculation suggests that firms representing roughly 41% of the Swiss economy (measured as their share in the total gross production value) are more import- than export-dependent and thus benefited from the joint effect of the policy changes. Firms representing about 34% of the Swiss economy have either a negligible net export exposure or a positive net export exposure that is still small enough that their net joint effect from the policy adjustment was still non-negative. Finally, firms representing roughly 25% of the Swiss economy experienced an overall negative impact.

Taken together, these results confirm previous evidence documenting the adverse effects of the appreciation caused by the Swiss Franc shock on *some* firms (Kaiser et al. 2018, Efing et al. 2016). These studies, however, focus on estimating heterogenous effects of the Swiss Franc shock on Swiss firms, that is, whether Swiss firms that are export-dependent are affected more strongly by the sudden appreciation in the Swiss Franc than firms that are less exposed to exports.

We complement this view and interpretation of the SNB's policy adjustments in early 2015 by also considering their interest rate effect, which requires an analysis across countries: When isolating the pure effect of the SNB's interest rates cut and controlling for the contemporaneous exchange rate effect, it turns out that the rate reduction led to the previously described increases in firm investment and employment. By documenting this positive interest rate effect, our results provide an explanation for the surprisingly robust performance of Swiss firms after the Swiss Franc Shock (see, e.g., Erhardt et al. 2017). It is important to note that

these results are not necessarily representative for the Swiss economy as the Orbis data for Switzerland are biased towards large firms and the distribution of firms across industries is different compared to the Swiss economy.

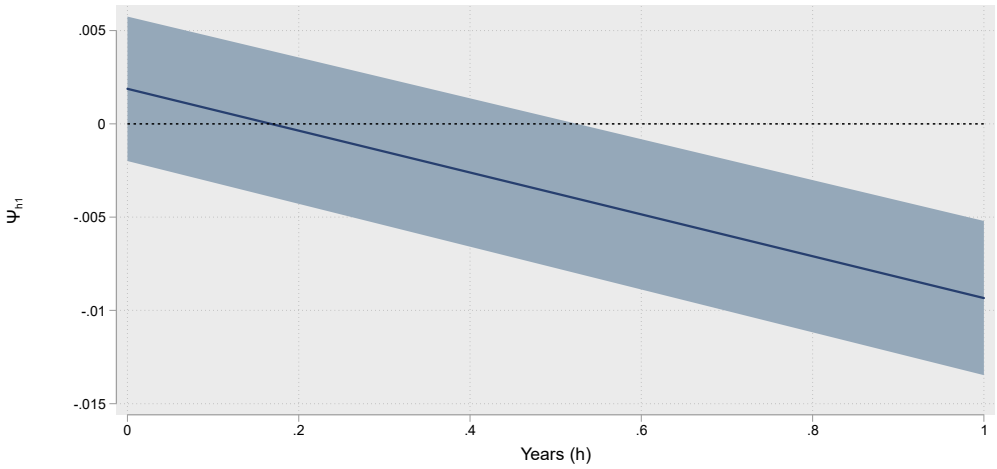
6.2 Do different firms react differently to interest rate reductions?

In the following, we estimate how firms' behavioral outcomes in response to the interest rate change in January 2015 depend on different firm and industry characteristics. This analysis aims at shedding light on the transmission mechanism of the change in interest rates to firm-level outcomes underlying the results shown in previous sections.

6.2.1 Does firm size matter?

Given the existing literature as summarized in Section 2.2, an obvious next question to ask is whether firms of different size react differently to the interest rate shock in Switzerland. Answering this requires the use of the CompNet data which includes small- and medium-sized firms and is hence more representative of the Swiss economy than the Orbis data. In particular, the average size (measured as total assets) of Swiss firms in the CompNet sample is 9.4 million Euro, while it is 1.5 billion Euro in Orbis. Accordingly, a comparison of the results from the Orbis and the CompNet sample allows to draw conclusions about the differential effect for larger and smaller firms.[27]

Figure 27: Change in Funding Rate



This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the change in the funding rate, which measure as the ratio of interest paid to average debt (based on current and previous year), from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

We present the results of this empirical analysis in shock-response figures, where we plot the estimated coefficients of interest and their 90% confidence interval. For this analysis based on the CompNet sample, we employ Specification (5) – the shock approach: Analysing the Franc Shock using CompNet.[28] As a control group with use Germany, France, Belgium, and the Netherlands (note that Austria is not included in CompNet). The reason we do not focus solely

[27] Table 5 in the Appendix presents the variables used in the empirical analysis based on the CompNet database and provides details about their calculation based on the raw CompNet variables.

[28] Note that due to data availability, our analysis on the CompNet 7. Vintage sample is restricted to the years until 2016.

on Germany (as we do in the Orbis analysis) is that for Germany data about the borrowing rate and debt information is missing.[29]

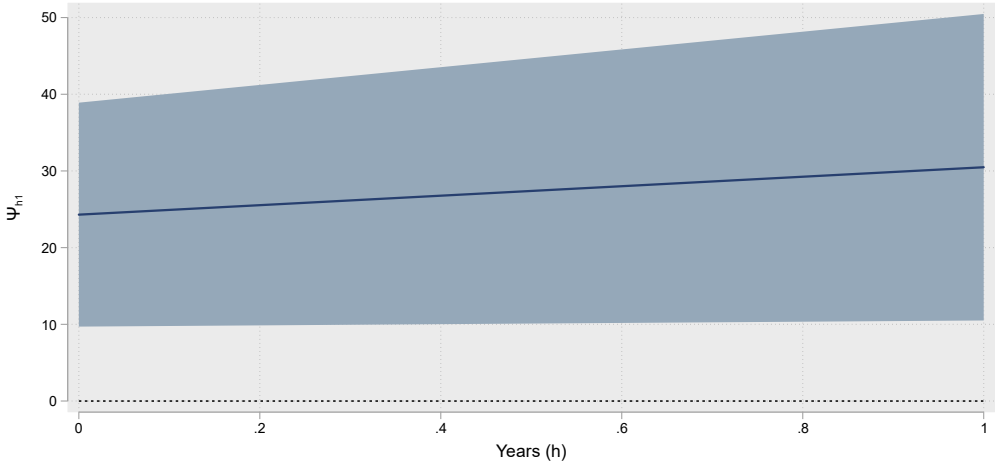
According to the results in Figure 27, Swiss firms have 0.8pp lower funding costs two years post-shock compared to the firms in the control group. This shows that for smaller firms (i.e., firms in CompNet) funding rates decrease faster and stronger as compared to the larger firms in the Orbis sample (see Figure 15).

6.2.2 Smaller firms react faster and stronger

Given the faster and stronger decrease in firm funding rates, we next focus on whether this translates into faster and stronger reactions of small firms for our main outcome variables: Interest bearing debt, firm investment, and employment.

Comparing the evidence in Figure 28 with the results in Figure 16 reveals that for smaller firms the growth in interest bearing debt occurs immediately after the interest rate shock, while for larger firms the effect becomes significant only three years post-shock. For this test, we employ the growth in interest-bearing debt (in percentage points), which in CompNet is defined as the sum of current and noncurrent liabilities excluding accounts payable as the dependent variable. This evidence again supports the notion that smaller firms benefited sooner and stronger from the negative interest rate shock.

Figure 28: Growth in Interest Bearing Debt



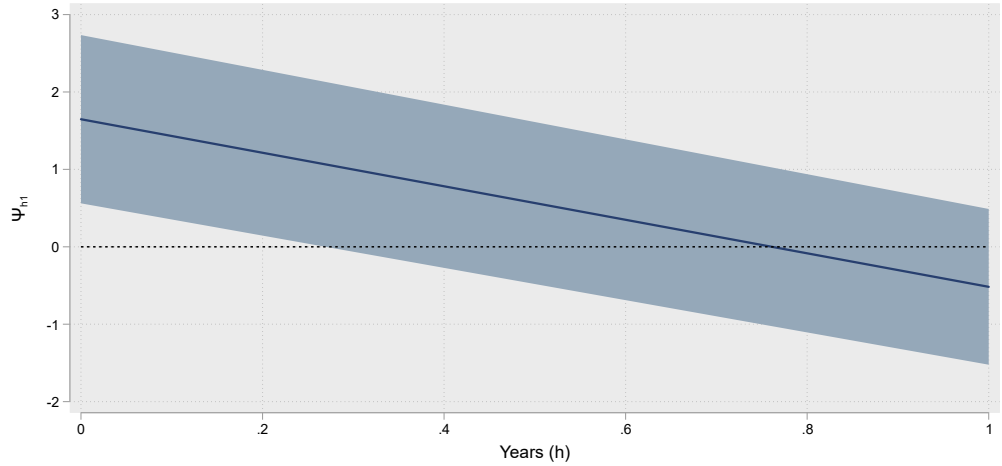
This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the growth in interest-bearing debt (in percentage points), defined as the sum of current and noncurrent liabilities excluding creditors (accounts payable), from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

Figure 29 reveals that smaller firms immediately reacted to better funding conditions by increasing their investments already during the first year after the shock. Here, we employ the percentage point change in the investment rate as dependent variable. The investment rate in CompNet is measured as the ratio of investment (change in nominal capital plus depreciation) to nominal capital in the previous year. Since the figure plots annual changes (not cumulative effects like the other figures), an insignificant change in year h=1 implies that

[29] When only using Germany as control group the effect on investment is insignificant, while the effect on employment is very similar.

Swiss firms on average sustain the higher fixed asset level gain in year h=0 for two years post-shock compared to firms in the control group.

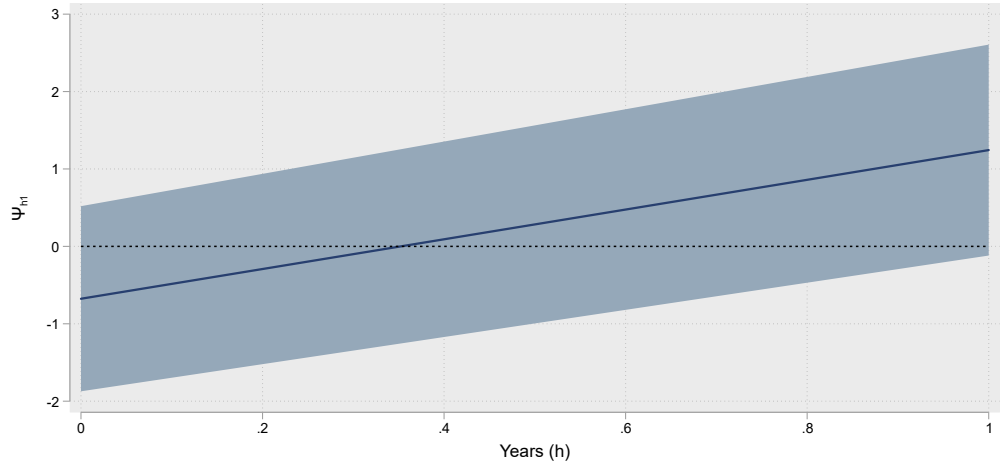
Figure 29: Change in Investment Rate



This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the percentage point change in the investment rate, measured as ratio of investment (change in nominal capital plus depreciation) to nominal capital in the previous year, from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

Figure 30 shows the effect of the interest shock on employment growth, which is measured as the growth in number of employees. The effect two years post-shock is almost significant at the 10% level. For larger firms, the positive and significant effect on employment only occurs three years post-shock (see Figure 23).

Figure 30: Employment Growth



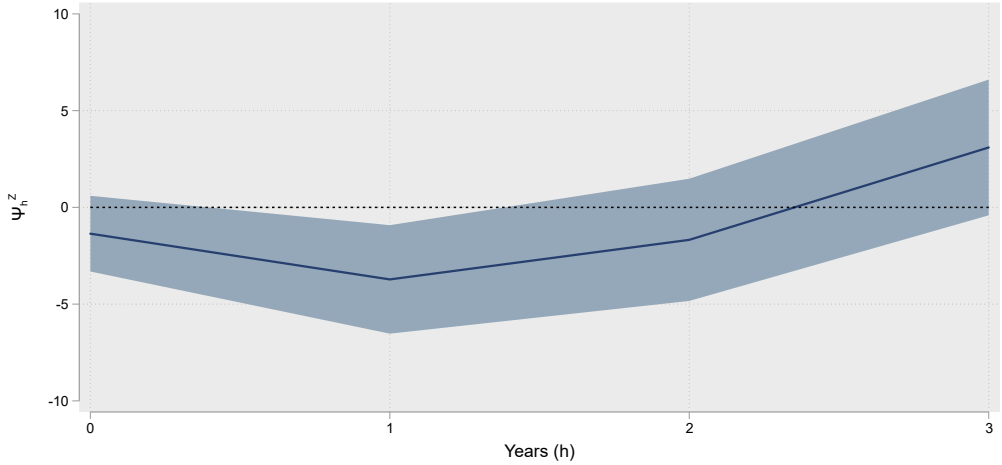
This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the growth in employment (i.e., growth in number of employees; growth in percentage points) from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

In our CompNet analysis we directly control for firms' exposure to exports and imports. Accordingly, the results in this section are the average treatment effects for a firm in an industry whose trade exposure is neutral.

When looking at the point estimated for Ψ_{h2} from Specification (5), we see that - similar to our Orbis analysis - effects on employment tend to be weaker for firms that are very export

exposed (see Figure 65 in the Appendix). We do not find heterogenous effects with regard to the change in investment activity (see Figure 64 in the Appendix).

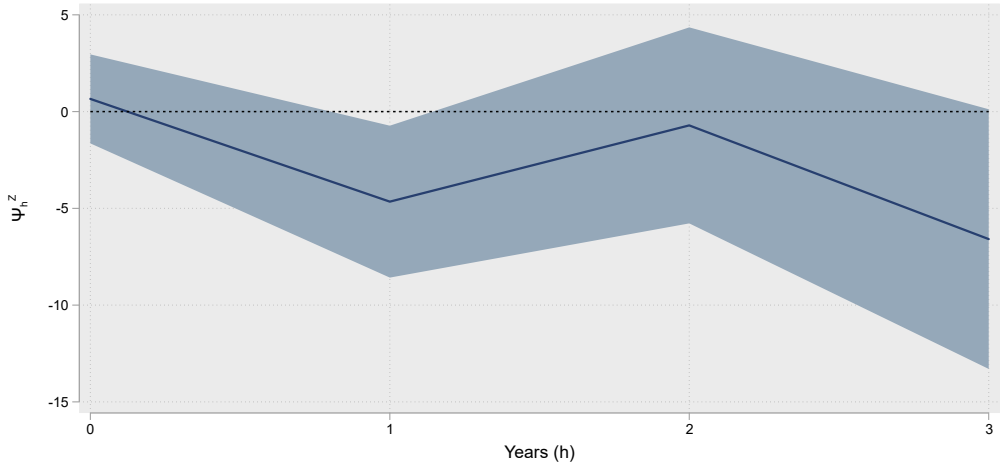
Figure 31: Net Investment Rate conditional on Revenue



This figure plots the point estimates and 90% confidence intervals for Ψ_h^Z (for ln(revenue) of the firm) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Compnet also provides us with the opportunity to analyse joint distributions.[30] As a last step, we thus analyse heterogenous effects of the interest shock on net investments and employment conditional on revenue. Figure 31 depicts the estimates of Ψ_h^Z from Specification (6) – the within industry approach. The results show that after the negative interest rate shock, larger firms tend to invest less relative to smaller firms in the same industry. Quantitatively, a 1% larger firm size translates into a 0.04pp lower net investment rate two years after the shock. This heterogenous effect reverses towards the third post-shock year.

Figure 32: Employment Growth conditional on Revenue



This figure plots the point estimates and 90% confidence intervals for Ψ_h^Z (for ln(revenue) of the firm) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

[30] For this within industry analysis we can employ the 8. Vintage for Swiss firms and thus a longer sampler period (until 2018) than in our other analyses based on CompNet data.

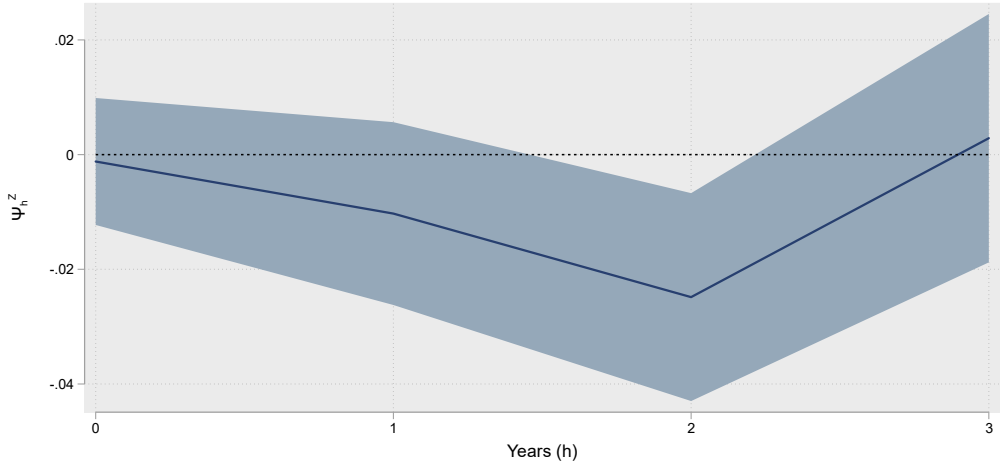
Similarly, larger firms also tend to have a lower employment growth post-shock compared to smaller firms in the same industry, as shown by Figure 32. Regarding the economic magnitude, a 1% larger firm size translates into a 0.045pp lower employment growth two years after the shock.

These results indicate that the balance sheet channel (see Section 2.2.1) was active during our sample period. That is, smaller firms, which are considered to be higher risk and for which informational asymmetries are larger (e.g., Whited, 1992; Rajan and Zingales, 1998; Beck, Demirgüç-Kunt, and Maksimovic, 2005), react more strongly to a reduction in interest rates. This evidence suggests that the negative rate shock was able to further reduce credit market frictions that restricted small firms access to funding.

6.2.3 The role of firms' financial health

Based on the idea that financial frictions are larger for higher indebted and weak firms and therefore these firms should benefit most from better funding conditions, we next analyse if there exist different effects of the interest rate shock on firms' outcomes for companies with strong or weak financial health. To do so we use a common measure to proxy firms' financial health – interest coverage ratio, measured as operating profits over interest expenses.

Figure 33: Net Investment Rate conditional on Interest Coverage Ratio – Orbis



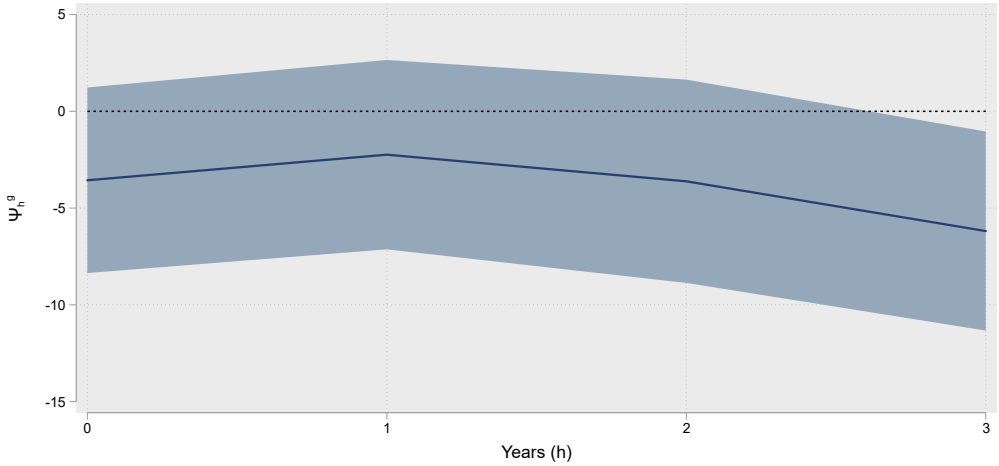
This figure plots the point estimates and 90% confidence intervals for Ψ_h^Z (for the interest coverage ratio, measured as operating profit over interest expenses) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 33 shows that firms with a higher interest coverage ratio tend to invest less post-shock. That is, a firm at the 90th percentile of the distribution of the interest coverage ratio (56.07) has a roughly a 1.3pp lower net investment rate growth three years after the shock compared to a firm at the 10th percentile (-3.73). This heterogenous effect disappears again four years after the shock. This evidence suggests that weak/indebted firms responded slightly more in terms of an increase in their investment activity than healthy firms.

We find similar evidence for the test on the influence of the interest coverage on firm behaviour in response to the negative interest shock when employing the CompNet data, as shown in

Figure 34. Firms with a higher interest coverage ratio tend to increase their investment activity less than weak/indebted firms with a low interest coverage ratio.

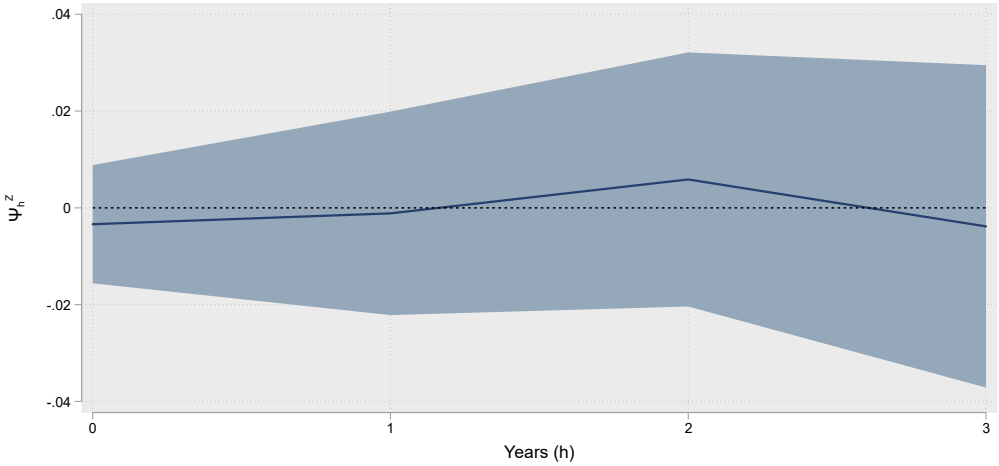
Figure 34: Net Investment Rate conditional on Interest Coverage Ratio – CompNet



This figure plots the point estimates and 90% confidence intervals for Ψ_h^g (for the interest coverage ratio, measured as operating profit over interest expenses) from estimating Specification (7) using CompNet data for Switzerland. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-year level.

Figure 35 plots the results for the moderation effect of the interest coverage ratio on the transmission of the negative interest rate shock on employment growth. The results show no significant influence of firm health on its employment decisions post-shock.

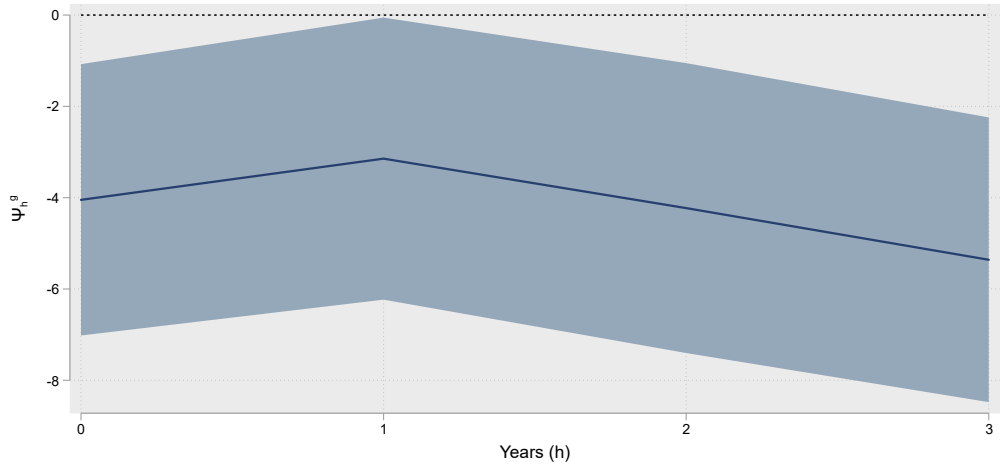
Figure 35: Employment Growth conditional on Interest Coverage Ratio – Orbis



This figure plots the point estimates and 90% confidence intervals for Ψ_h^z (for the interest coverage ratio, measured as operating profit over interest expenses) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

For the CompNet sample, we find a significant difference between healthy and weak firms in terms of their employment growth in the post-shock period (see Figure 36). Quantitively, a one percentile higher interest coverage ratio implies a 2pp lower employment growth already one year after the interest rate shock. Weak firms sustain this difference in the employment growth throughout our sample period.

Figure 36: Employment Growth conditional on Interest Coverage Ratio – CompNet



This figure plots the point estimates and 90% confidence intervals for Ψ_h^g (for the interest coverage ratio, measured as operating profit over interest expenses) from estimating Specification (7) using CompNet data for Switzerland. The dependent variable is the growth in employment (i.e., growth in number of employees; growth in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-year level.

These results on the influence of financial health on the firms' responsiveness to the negative interest rate shock are further evidence for the workings of the balance sheet channel (see Section 2.2.1) since riskier firms seem to respond more than healthy firms. Given this evidence, we investigate in subsection 6.3.2, if the stronger reaction of financially weak firms led to a decrease in their investment efficiency.

6.3 (How) Do reduced interest rates (re-)shape the structure of the economy?

6.3.1 Are capital-intense firms driving overall effects?

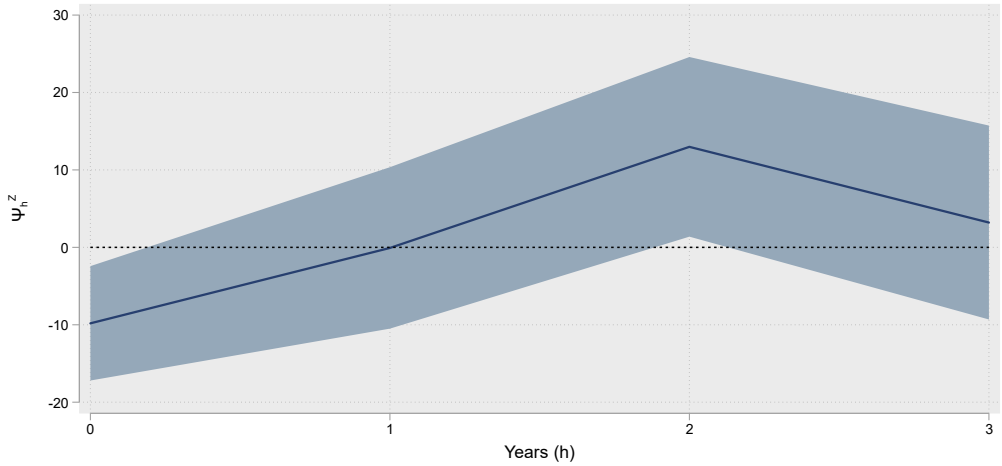
In this subsection, we focus on heterogenous effects of the interest rate shock on investment activity and employment with regard to firms' capital-intensity. We measure the firms' capital intensity as their ln(fixed assets) over number of employees, that is, the ratio of capital to labour input used in the company.

The prior about the influence of this moderating factor is that firms with a high capital intensity should react stronger to an improvement in funding conditions compared to firms with a low capital intensity. The dynamics and amount of capital intensity mainly depend on the kind of sector in which the firm is active. This analysis thus also sheds light on the relative impact of a change in interest rates on two key sectors, that is, the manufacturing sector consisting of high capital intense firms and the service sector, consisting of low capital intense firms.

While initially investing less, Figure 37 shows that capital intensive firms cumulatively invest more in the medium run. That is, a firm at the 90th percentile of the capital intensity distribution (i.e., 0.49) has a 6pp higher net investment rate three years after the interest rate shock than a firm at the median (i.e., 0.05).

When conducting the corresponding test with CompNet data (there capital intensity is measured as fixed assets over number of employees) using the CompNet within-industry approach from Specification (7), we again see a slight positive effect for capital intense firms in the medium run (see Figure 38).

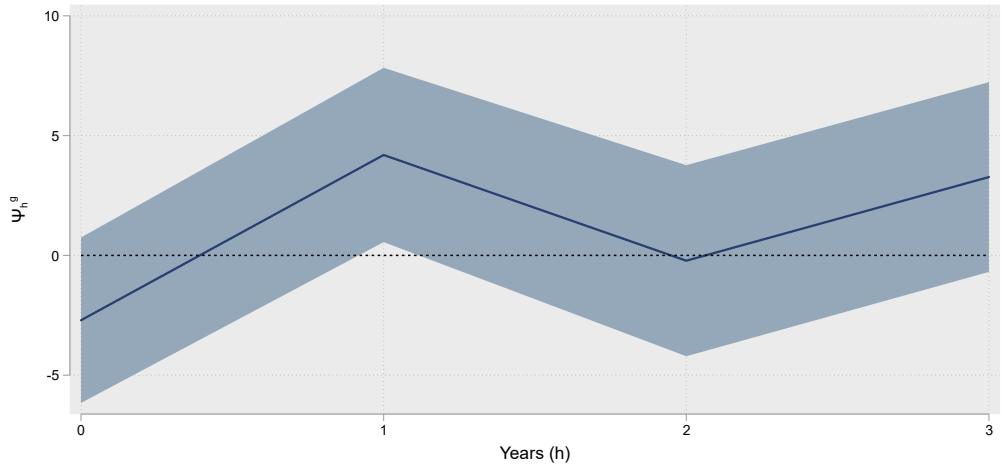
Figure 37: Net Investment Rate conditional on Capital Intensity – Orbis



This figure plots the point estimates and 90% confidence intervals for Ψ_h^z (for capital intensity, measured as ln(fixed assets) over number of employees) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

This effect has a similar economic magnitude as in our Orbis based analysis. That is, moving up one percentile (e.g., from the median to the 60th percentile) implies a 2pp (4*0.5; the coefficient represents a two percentile higher ranking in the distribution) higher net investment rate two years post-shock.

Figure 38: Net Investment Rate conditional on Capital Intensity – CompNet

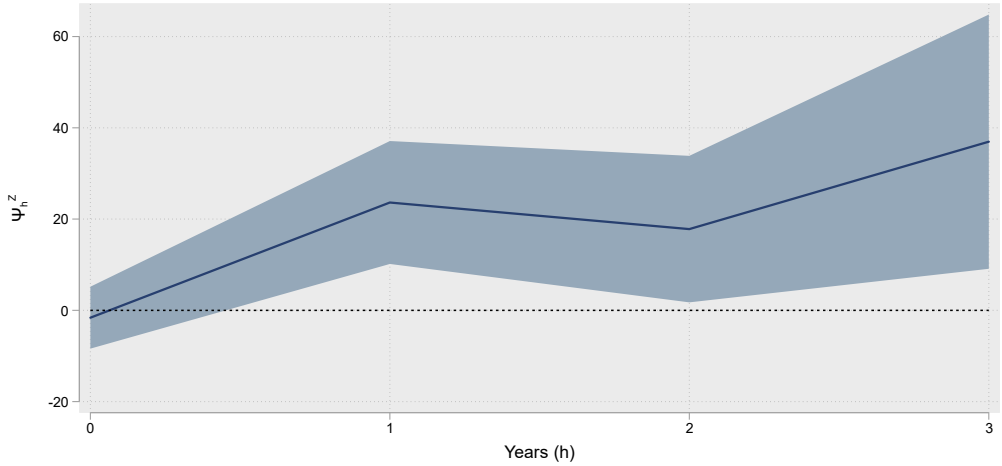


This figure plots the point estimates and 90% confidence intervals for Ψ_h^g (for capital intensity, measured as real capital over number of employees) from estimating Specification (7) using CompNet data for Switzerland. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-year level.

Second, we move to the heterogeneous effect of firms' capital intensity on their employment growth. Figure 39 shows the results using the Orbis within-industry approach, while Figure 40 represents the respective analysis for the CompNet data. Across both tests, we find that firms with a higher capital intensity responded more strongly to the negative interest rate shock and raised their head count stronger than less capital-intensive firms. Quantitatively, based on the Orbis data a firm at the 90th percentile of the capital intensity distribution (i.e., 0.49) has about 8pp higher employment growth 2-3 years after the interest rate shock than a firm at the median (i.e., 0.05). The point estimates based on the CompNet data imply that firms with

a one percentile higher capital intensity had a 1.3pp higher net investment rate two years post-shock.

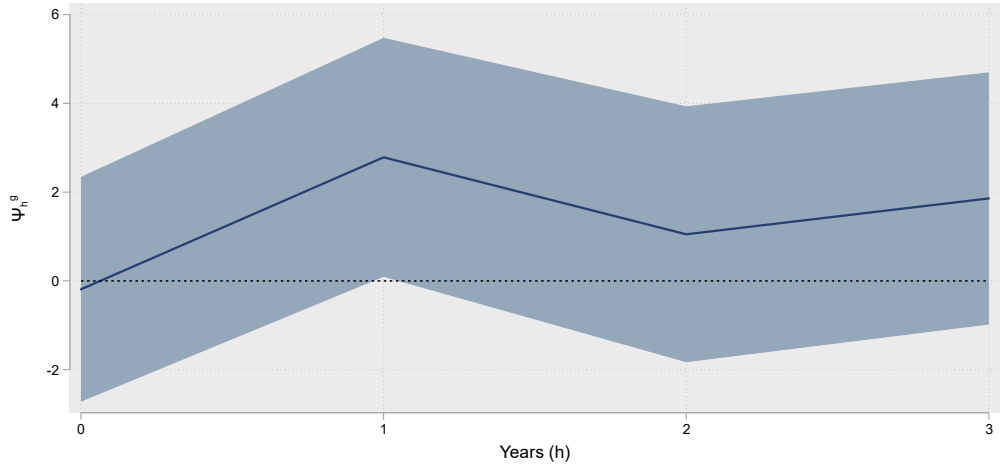
Figure 39: Employment Growth conditional on Capital Intensity – Orbis



This figure plots the point estimates and 90% confidence intervals for Ψ_h^z (for the capital intensity, measured as ln(fixed assets) over number of employees) from estimating Specification (6) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Overall, these results suggest that the negative interest rate shock has a different impact on companies in different industries. That is, capital intensive sectors like the manufacturing industry (in Switzerland the Pharmaceutical industry is one of the most important industries in this sector) reacted more strongly to improved funding conditions than asset-light industries like the services and the trade sectors (e.g., energy trade and telecommunications services).

Figure 40: Employment Growth conditional on Capital Intensity – CompNet



This figure plots the point estimates and 90% confidence intervals for Ψ_h^g (for capital intensity, measured as real capital over number of employees) from estimating Specification (7) using CompNet data for Switzerland. The dependent variable is the growth in employment (i.e., growth in number of employees; growth in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-year level.

6.3.2 Did the quality of capital allocation deteriorate?

Given that our results in the previous subsections suggest that the interest rate shock overall spurred firms' investment and employment, a natural next question that arises is whether

firms used the additional funding opportunities efficiently and whether the improved funding conditions affected firms' profitability.

To test to what extent a change in the funding costs is associated with a change in the efficiency of the allocation of capital across firms, we follow Hsieh and Klenow (2009) and Gopinath et al. (2017) and track the dispersion (as measured by the standard deviation) of the marginal revenue product of capital (MRPK) across country-industry pairs (which we call markets in the following) and time. The underlying idea is that, given the MRPK is diminishing (i.e., additional units of capital deliver declining additional profits), firms should optimally invest until the MRPK equals their funding rate. In the absence of any financial frictions, the MRPK should thus be equalized across otherwise similar firms. Hence, the dispersion of the MRPK across firms in a particular market is a measure of the degree of the efficiency of capital allocation since the aggregate output could be increased by reallocating capital from firms with a low MRPK to firms with a higher MRPK.

To investigate the link between funding costs and the efficiency of capital allocation, we employ the continuous approach from Specification (2) and CompNet data, exploiting again the variation in the funding costs decline in Europe across countries and industries.[31] To proxy for the funding conditions in a particular market, we use the ratio of interest paid to average debt (based on the current and previous year). Moreover, we employ a MRPK estimate derived from the OLS estimation of a revenue-based based translog production function with variable inputs (which is directly available in CompNet).

Table 3: Funding Costs and Capital Allocation

	SD(MRPK)	SD(MRPK)	SD(MRPK)	SD(MRPK)
Funding Costs	1.72**	1.78***	2.41**	2.01**
	(0.016)	(0.005)	(0.016)	(0.013)
Observations	7,083	7,019	7,083	7,019
R-squared	0.96	0.67	0.97	0.97
Country-Industry FE	✓	✓	✓	✓
Year FE	✓			
Industry-Year FE		✓		✓
Country-Year FE			✓	✓

*This table presents estimation results from Specifications (2) using CompNet data. The dependent variable is the standard deviation of the markets' marginal revenue product of capital (MRPK) derived from the OLS estimation of a revenue-based based translog production function with variable inputs. Funding Costs are measured the ratio of interest paid to average debt (based on the current and previous year). Standard errors are clustered at the industry-country level. *** p<0.01, ** p<0.05, * p<0.1*

The results in Table 3 show the estimated coefficient Ψ from Specification (2), which implies that markets that experience a stronger reduction in the average funding costs subsequently have a higher capital allocation efficiency (i.e., lower MRPK standard deviation). The estimated coefficient is relatively robust as we add additional layers of fixed effects. This evidence indicates that more favourable funding conditions allow firms with a relatively high MRPK but difficulties to obtain sufficient funding to raise additional debt, thereby reducing the dispersion of the MRPK.

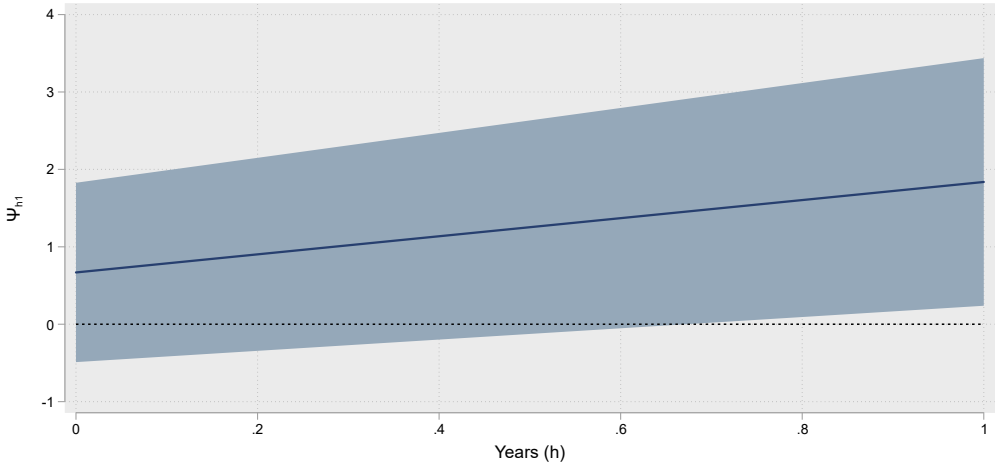
Given that more favourable funding conditions seem to facilitate the allocation of capital to firms in need of further funding to finance investments with a relatively high marginal revenue product of capital, we next investigate whether the negative interest rate shock changed the

[31] The countries included in this sample are Belgium, Croatia, Denmark, Finland, France, Germany, Italy, Lithuania, Netherlands, Portugal, Romania, Slovenia, Spain, Sweden, and Switzerland.

share of financially weak versus healthy firms in the economy. For this test, we employ the shock approach from Specification (5) and CompNet data, which provides for each market information about the share of firms that have a negative profit for at least three years and no high labour growth (which we call weak firms in the following).[32]

Figure 41 shows that two years post-shock the change in the share of weak firms is roughly 1.5pp higher for Swiss firms compared to the control group. This evidence can either be caused by a post-shock deterioration in the firms' profitability (e.g., through additional expenditures in marketing or R&D), or the fact that the improved funding conditions allowed more struggling firms that previously faced financial constraints to stay afloat.

Figure 41: Change in the Share Weak Firms



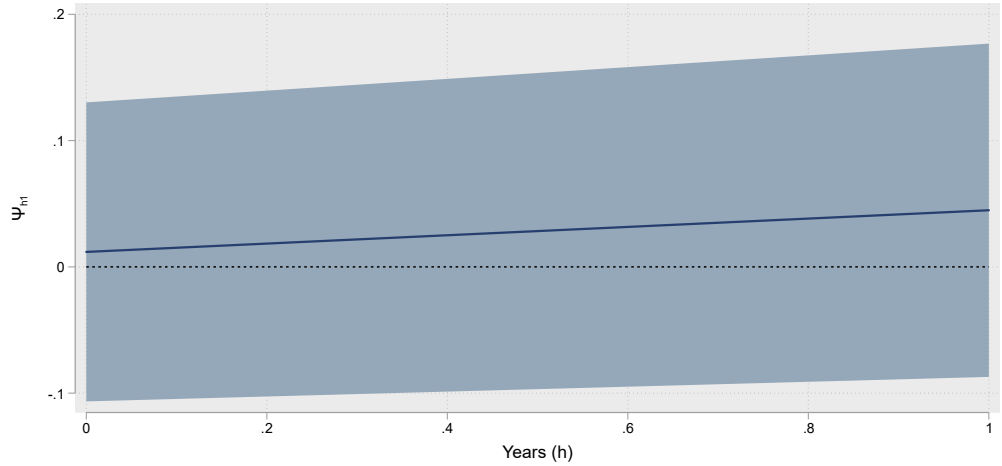
This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the percentage point change in the share of firms with negative profit for three years and no high labour growth from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

To shed more light on the channel through which the composition of weak versus healthy firms changed in the post-shock period, we next analyse whether the negative interest rate shock affected the profitability of Swiss firms. Figure 42 plots the point estimates of Ψ_{h1} for the shock approach from Specification (5) using CompNet data, where we employ the percentage point change in the return on assets, defined as the ratio of operating profit to average total assets (based on current and previous year) as dependent variable. The results show that there is no statistically significant difference between Swiss and control firms regarding changes in their return on assets.

Therefore, the increase in the share of weak firms shown in Figure 41 is likely driven by the impact of the reduction in funding rates on firm default rates, that is, improved funding conditions allowed more weak firms to stay afloat, increasing their share among the firm population. This interpretation is also supported by the evidence presented in Eckert et al. (2020), who show that the frequency of firm bankruptcies in Switzerland was somewhat subdued in 2015 and 2016.

[32] In the CompNet data these firms are called "zombie firms", which is in line with zombie definitions frequently used in the literature. However, a zombie definition that is mainly based on the health of the firm cannot distinguish between firms that are only temporary weak and still have good long-term prospects, and "true" zombie firms, that is, non-viable firms (the NPV of the firm is negative) that stay alive only due to certain credit market frictions (e.g., zombie lending by undercapitalized banks). Therefore, we call this measure "weak" instead of "zombie" firms.

Figure 42: Change in Return on Assets – CompNet



This figure plots the point estimates and 90% confidence intervals for Ψ_{h1} from estimating Specification (5) using CompNet data and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the percentage point change in the return on assets, defined as the ratio of operating profit to average total assets (based on current and previous year), from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

7. CONCLUSION

Our study shows that despite dipping into negative territory, the traditional effects of an interest rate reduction on firm activity are still in place. Our main empirical strategy exploits the SNB's policy changes in early 2015, which besides the removal of an exchange rate floor involved an unexpected and (arguably exogenous) large drop of interest rates in Switzerland.

For the firms in our sample, we find a robust association between the SNB's negative interest rates shock and firm investment and employment using a variety of empirical approaches that facilitate a causal interpretation of these findings. Swiss firms' cumulative net investment rate four years after the interest rate shock is 8pp higher and the cumulative growth rate in the firms' head count is 7.5pp larger than those of comparable firms in Germany.

By focusing on the interest rate shock element of the SNB policy change, we complement the literature evaluating the SNB's policy adjustments from early 2015, which so far have mainly been analysed and interpreted with respect to the consequences of their exchange rate effects and their impact on bank lending. While our results confirm that the removal of the exchange rate floor and the resulting appreciation of the Swiss Franc had a negative impact on firms with a stronger reliance on exports over imports, we find that the average treatment effect of the negative interest shock for firms with a neutral trade exposure was positive. Our results thus suggest that the interest rate cut component of the SNB's policy package had a stimulating effect that mitigated the adverse consequences of the Swiss Franc shock for Swiss exporters.

Our results thereby confirm and extend previous empirical evidence. Kaiser et al. (2018) show that the investment activity of companies that were more exposed to the appreciation of the Swiss Franc in early 2015 decreased relative to less exposed firms afterwards. In particular, they find that the Swiss Franc shock depressed investment in exposed firms relative to the rest of firms by 15% in 2015 and by 12.7% in 2016. These estimates are also comparable to Efing et al. (2016), who also investigate the consequences of the Franc shock on investment. Using a sample of roughly 140 publicly traded large firms, they find that those with high

currency exposure reduced capital expenditures in 2015 by 8% relative to firms with a lower currency exposure. Our estimates for larger firms are closely in line with these findings.

We also analyse to what extent specific firm characteristics (size, financial health, capital intensity) moderate the effect of the negative interest rate shock on firm activity. First, we show that smaller firms, which are more likely to be financially constrained, experienced a stronger and faster decrease in their funding rates, translating into a stronger and more pronounced reaction in terms of their debt growth, investment activity, and employment. We also demonstrate that financially weak firms increased their investments post-shock stronger than financially healthy firms. Further, we investigate how the interest rates cut reshaped the structure of the Swiss economy by comparing the effects for high and low capital-intensive firms. That is, capital intensive sectors like the manufacturing industry reacted more strongly to improved funding conditions than asset-light industries like the services sector. Second, we find evidence that is consistent with the notion that improved funding conditions allowed financially weaker firms to stay afloat, increasing their share among the firm population in Switzerland.

Overall, our results delineate areas of interest for policy makers and provide avenues for further research. Regarding the latter, the current data coverage does unfortunately not allow us to provide a definite assessment of the prevalence of detrimental effects on capital allocation following the SNB's interest rate cut in 2015 – a phenomenon described as "zombie lending" in the literature. We consider this issue to be worthy of future investigation once additional data is available. Regarding the former, our results appear particularly relevant in light of the reviving discussion of rising interest rates in the future. The accelerated effects we found in our analysis for firms that are small, risky, and financially weak highlight a potential vulnerability of the Swiss economy once interest rates start rising again: While these firms particularly benefited from interest rate reductions, they might in turn be the first to suffer from discontinued funding if interest rates indeed return to positive territory.

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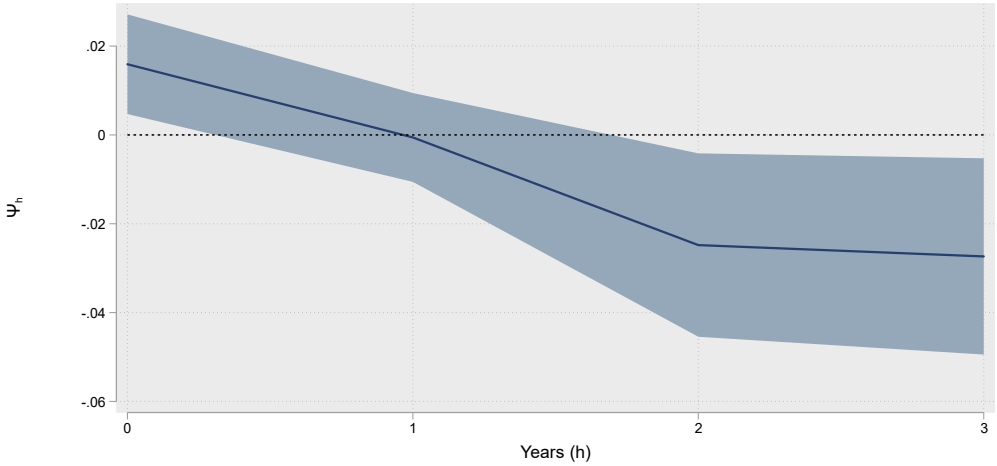
APPENDIX

1. ROBUSTNESS

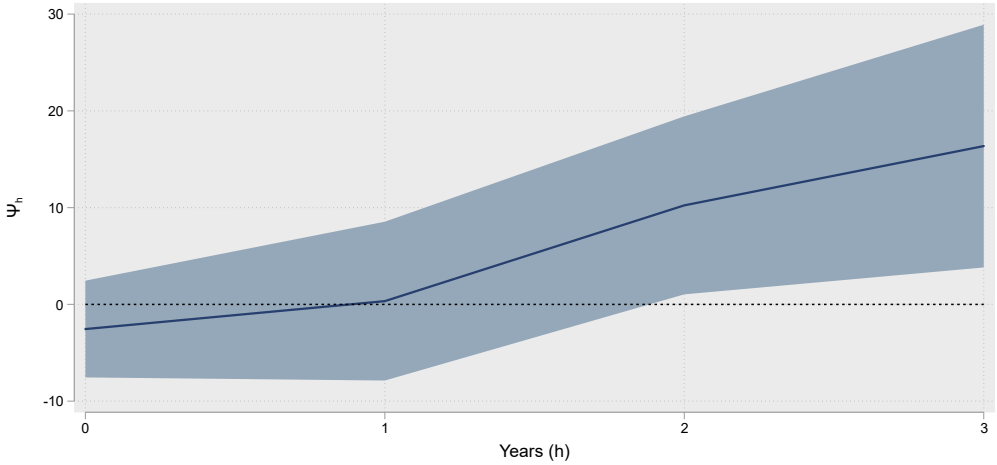
1.1 Orbis Europe Control Group

Figure 43: Change in Funding Rate



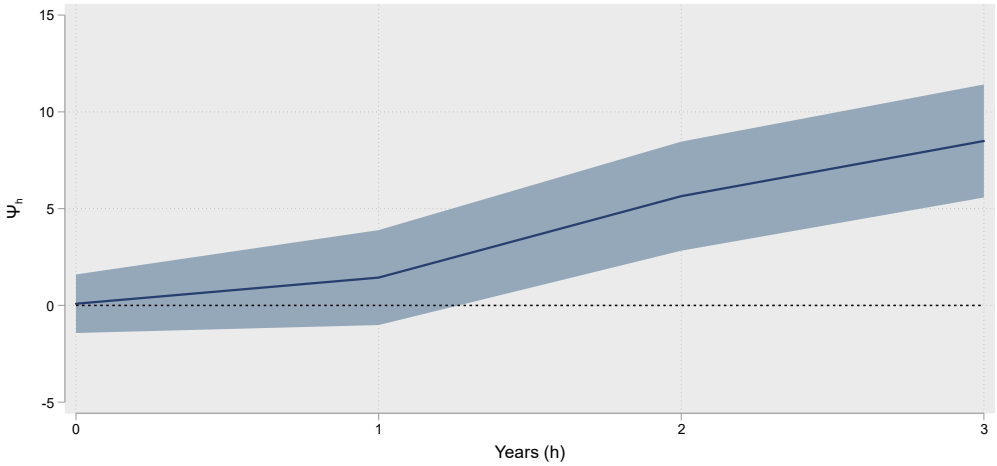
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the change in the funding rate, which we measure as interest expenses over interest-bearing debt, from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 44: Growth in Interest Bearing Debt



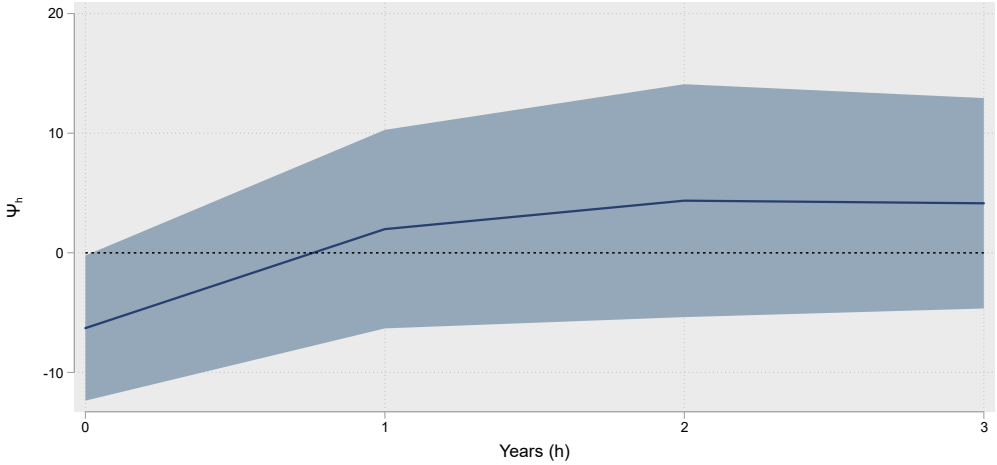
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the growth in interest bearing debt (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 45: Net Investment Rate



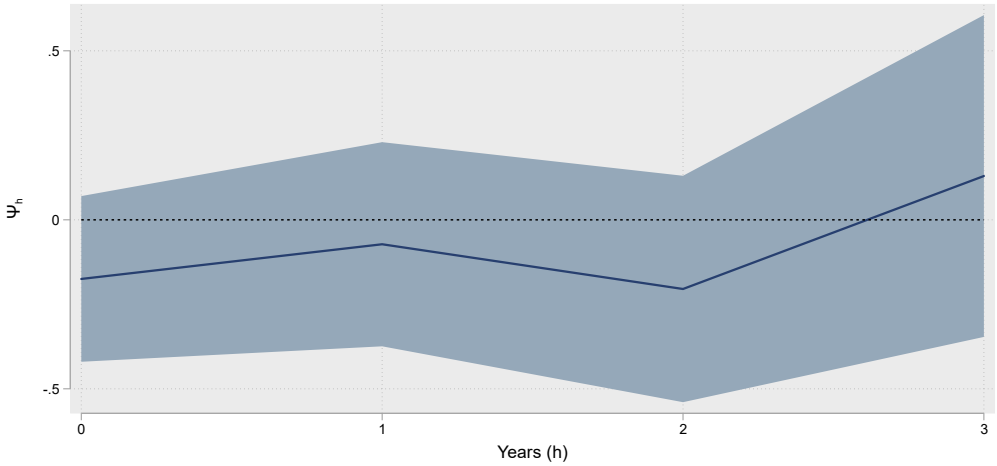
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 46: Growth in Working Capital



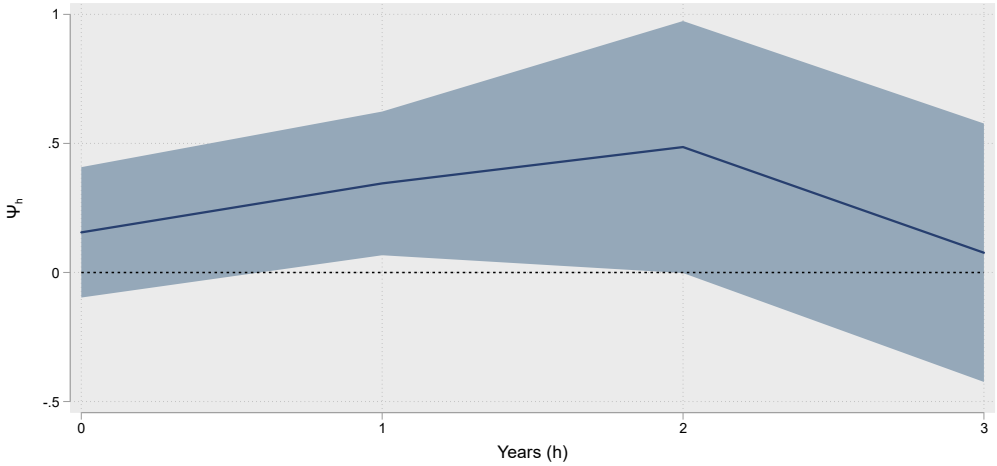
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the growth in the net working capital (in percentage points) between 2014 and 2015+h, which is defined as stocks + receivables and other assets - trade payables due within 1 year. Standard errors are clustered at the industry-country-year level.

Figure 47: Change in Receivables / Total Assets



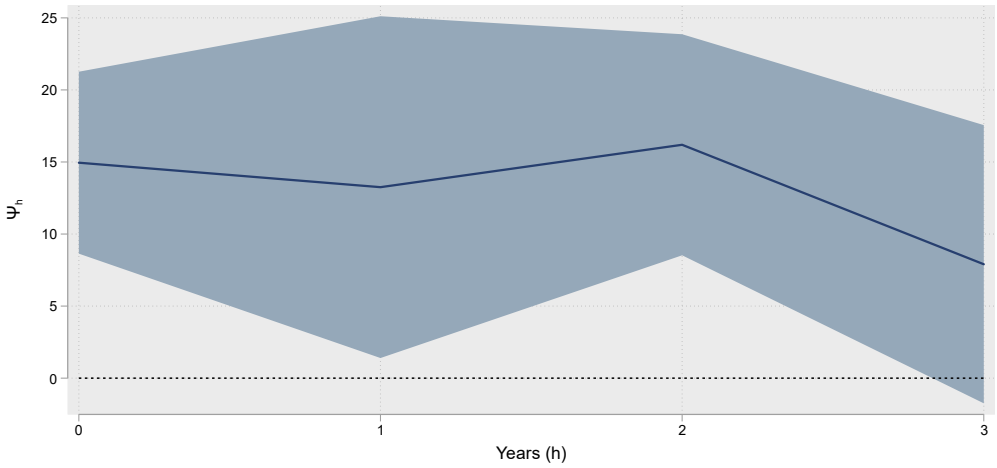
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the percentage point change in the receivables over total assets (where receivables/total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 48: Change in Payables / Total Assets



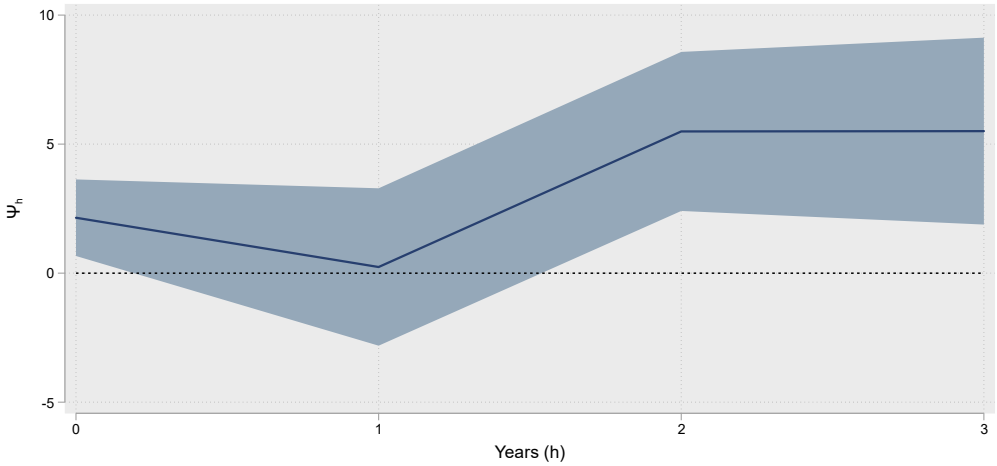
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the percentage point change in the trade payables over total assets (where trade payables /total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 49: Growth in Cash Holdings



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the growth in cash holdings (percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

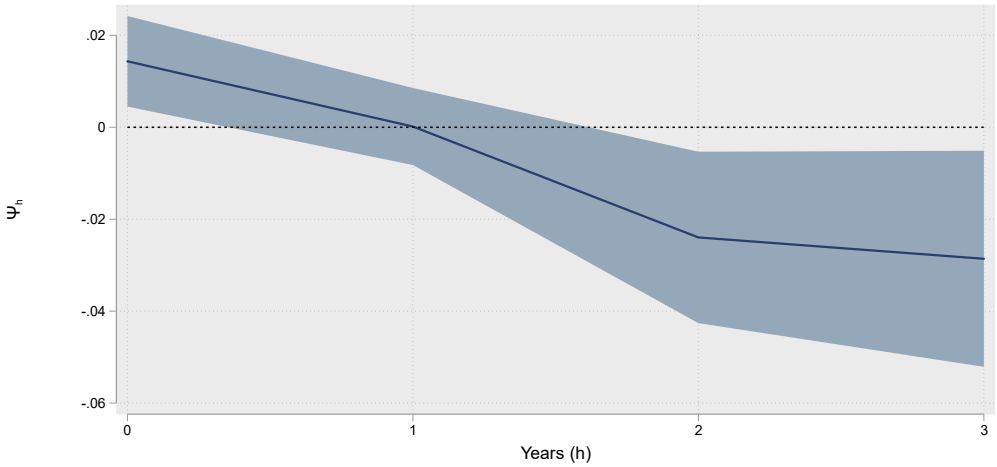
Figure 50: Employment Growth



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and firms from Germany, Austria, Belgium, France, and the Netherlands as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

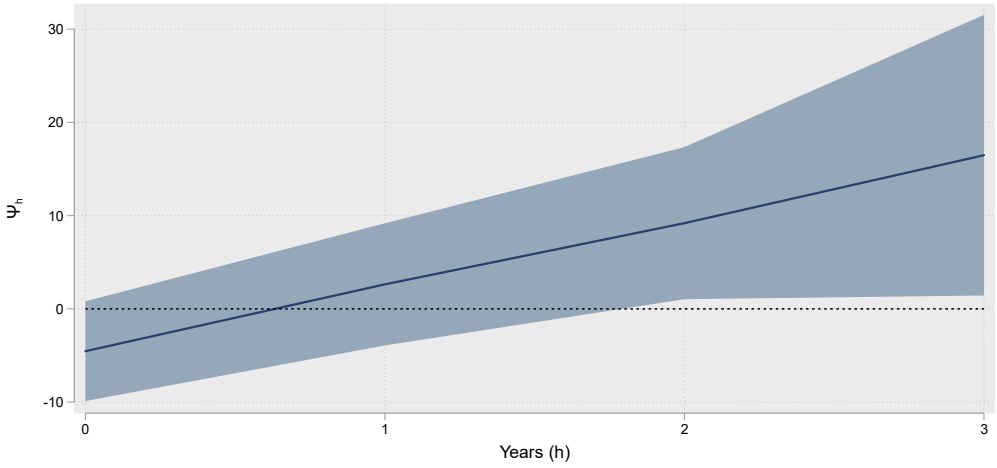
1.2 Orbis Non-Matched Sample

Figure 51: Change in Funding Rate



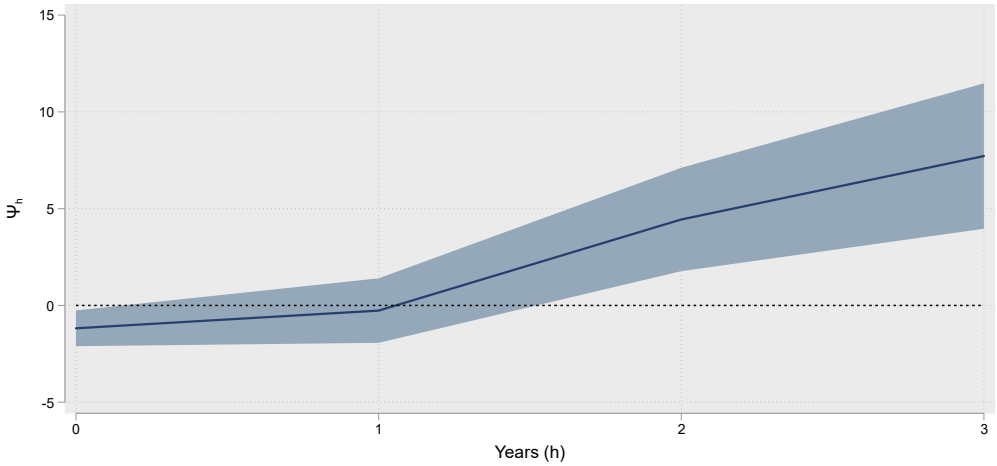
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the change in the funding rate, which we measure as interest expenses over interest-bearing debt, from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 52: Growth in Interest Bearing Debt



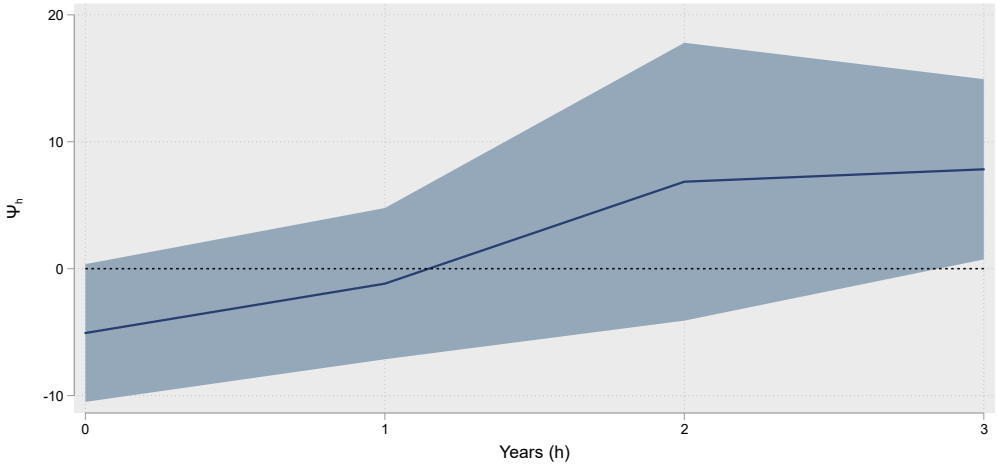
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the growth in interest bearing debt (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 53: Net Investment Rate



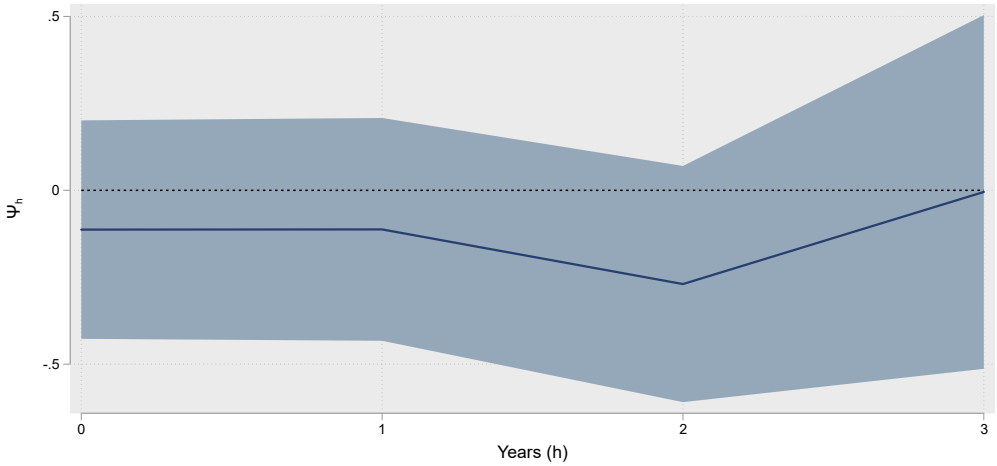
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 54: Growth in Working Capital



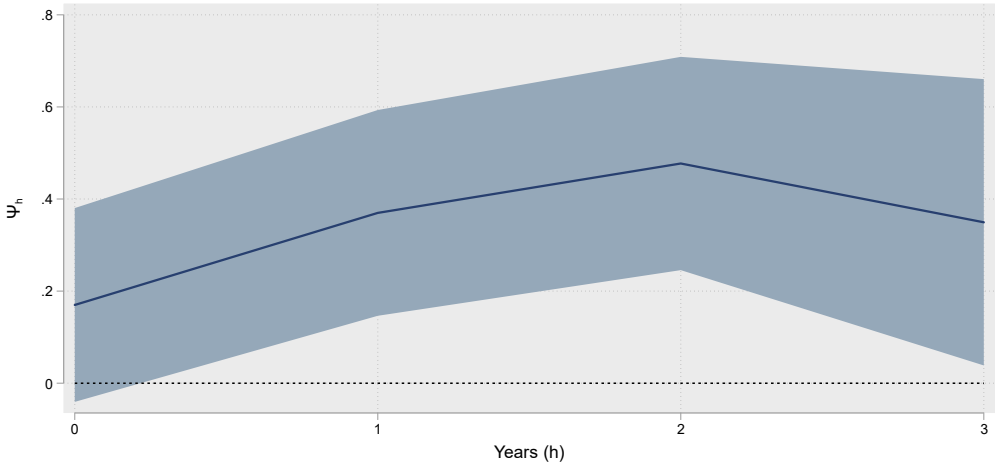
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the growth in the net working capital (in percentage points) between 2014 and 2015+h, which is defined as stocks + receivables and other assets - trade payables due within 1 year. Standard errors are clustered at the industry-country-year level.

Figure 55: Change in Receivables / Total Assets



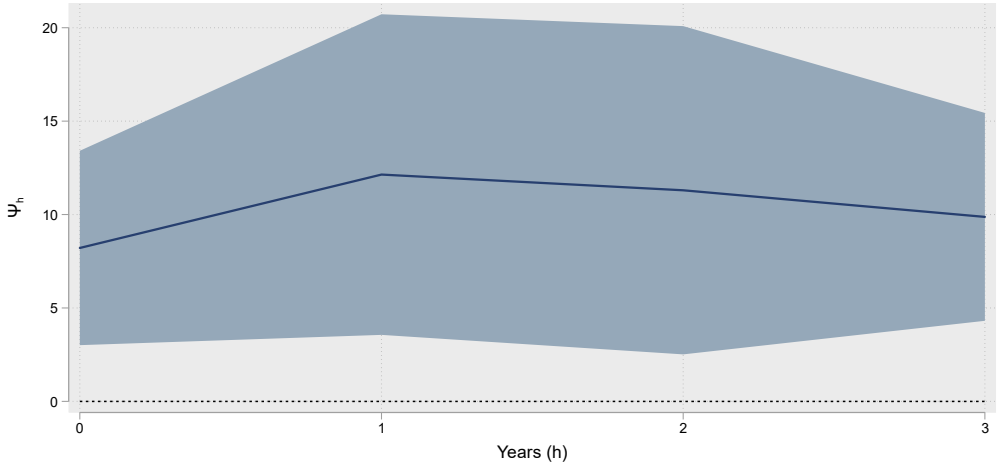
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the percentage point change in the receivables over total assets (where receivables/total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 56: Change in Payables / Total Assets



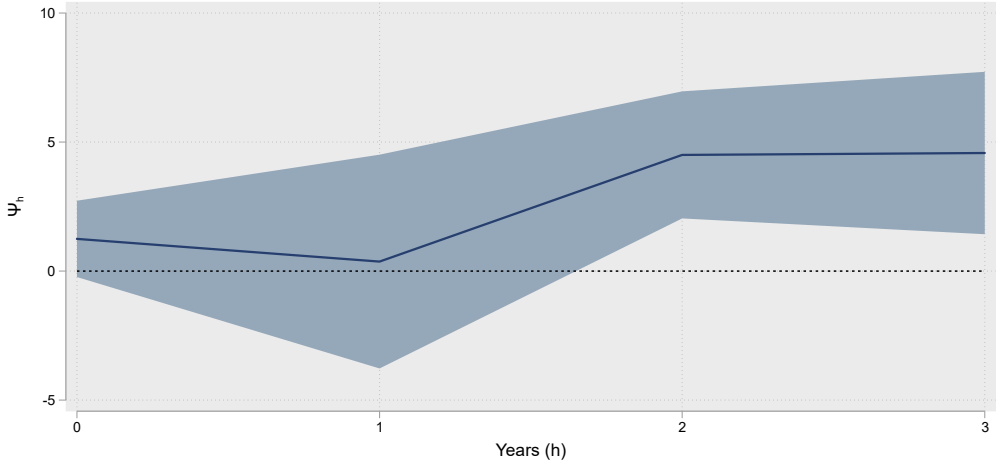
This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the percentage point change in the trade payables over total assets (where trade payables /total assets is measured in %) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 57: Growth in Cash Holdings



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the growth in cash holdings (percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

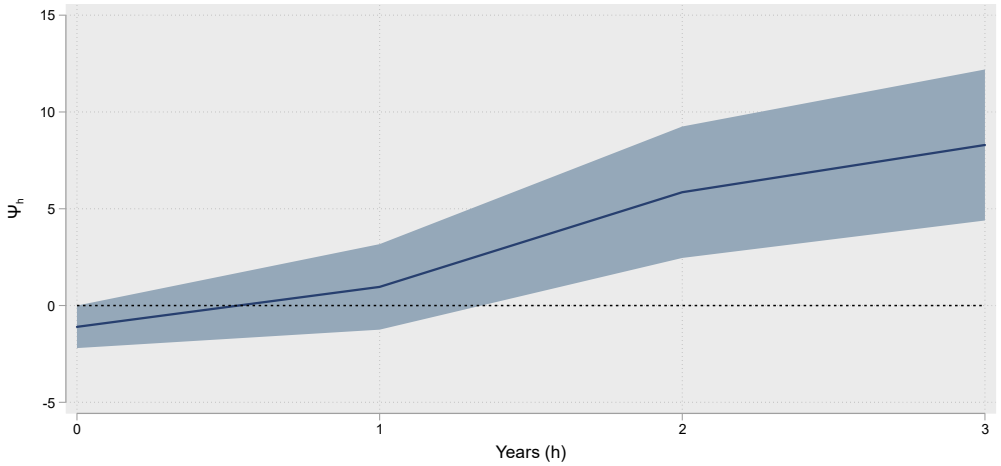
Figure 58: Employment Growth



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the non-matched Orbis sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

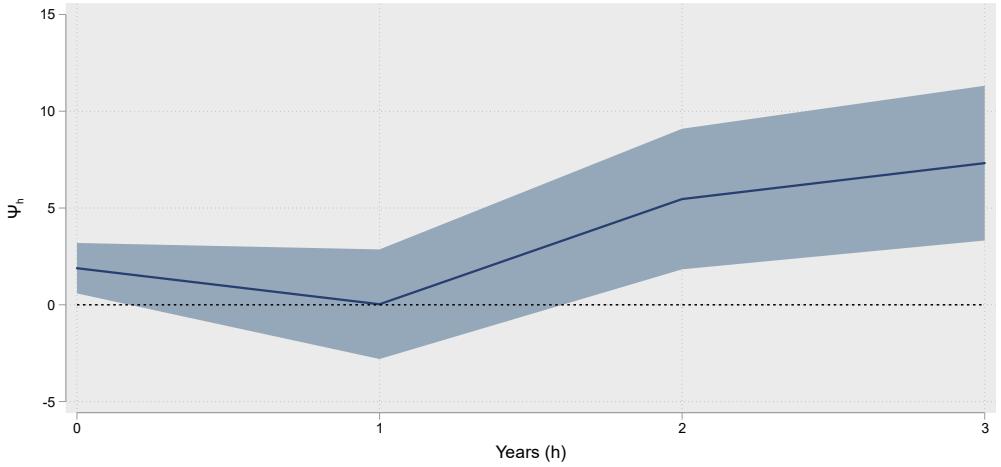
1.3 Excluding Pharmaceutical Industry

Figure 59: Net Investment Rate / Excluding Pharmaceutical Industry



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group, excluding the pharmaceutical industry (Nace 21). The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

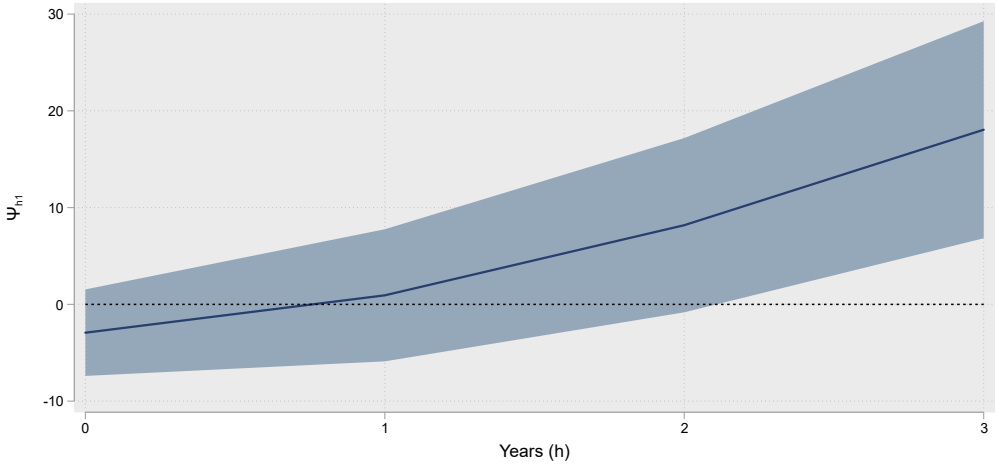
Figure 60: Employment Growth / Excluding Pharmaceutical Industry



This figure plots the point estimates and 95% confidence intervals for Ψ_h from estimating Specification (3) using the matched Orbis sample and German firms as control group, excluding the pharmaceutical industry (Nace 21). The dependent variable is the growth in employment (i.e., number of employees; growth measured in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

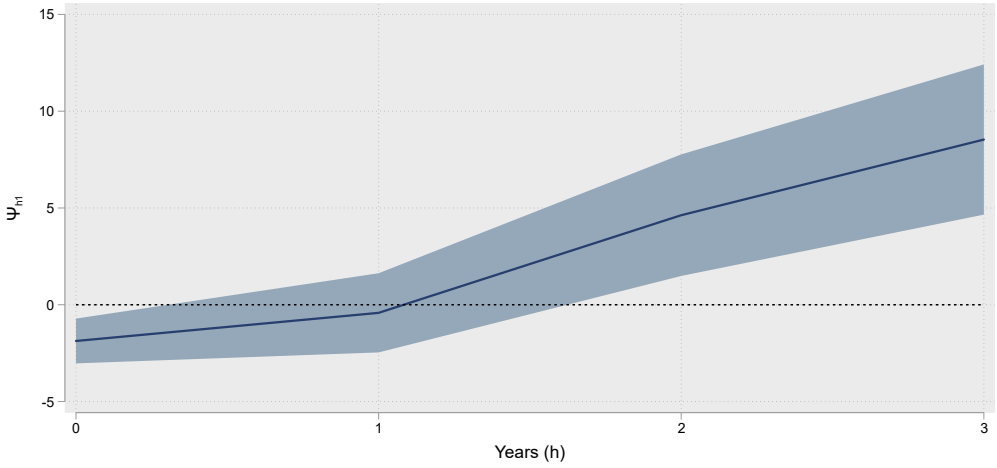
2. TRADE CONTROL – ORBIS

Figure 61: Growth in Interest Bearing Debt (double interaction)



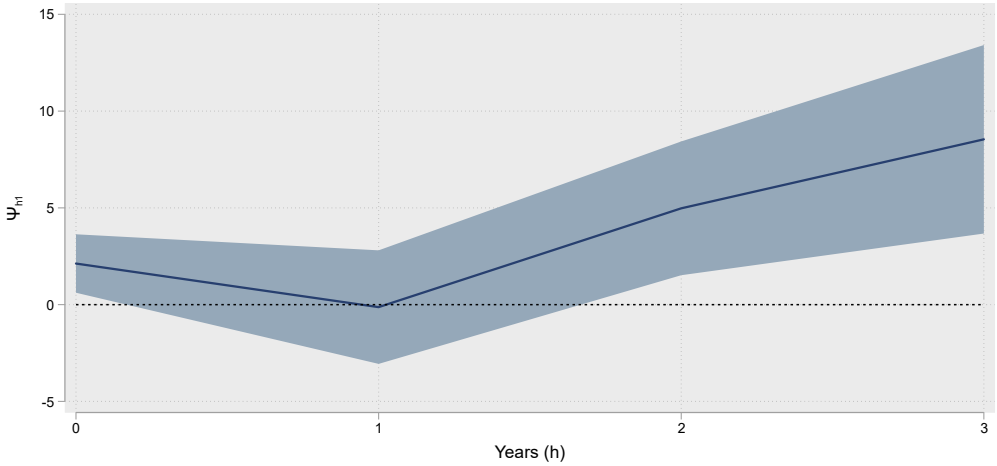
This figure plots the point estimates and 95% confidence intervals for Ψ_{h1} from estimating Specification (4) using the matched Orbis sample and German firms as control group. The dependent variable is the growth in interest bearing debt (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

Figure 62: Net Investment Rate (double interaction)



This figure plots the point estimates and 95% confidence intervals for Ψ_{h1} from estimating Specification (4) using the matched Orbis sample and German firms as control group. The dependent variable is the net investment rate between 2014 and 2015+h, which we measure as growth in fixed assets (in percentage points) from 2014 to 2015+h. Standard errors are clustered at the industry-country-year level.

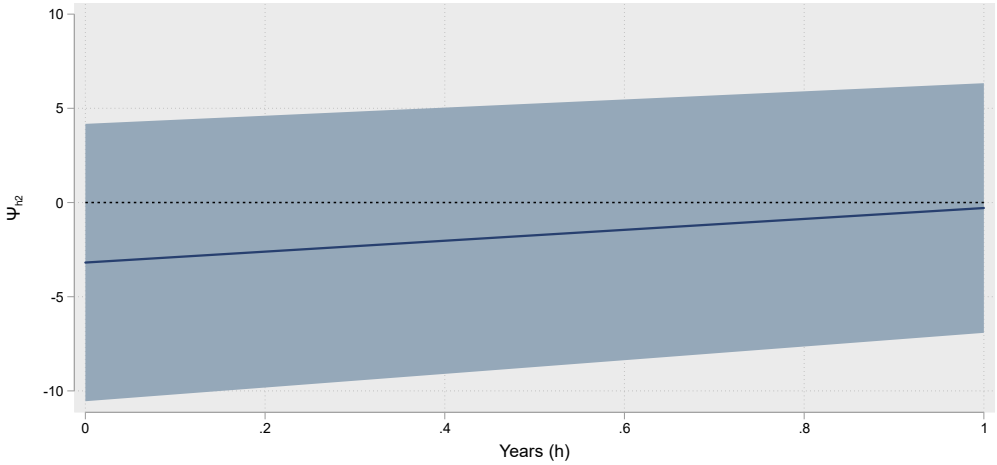
Figure 63: Employment Growth (double interaction)



This figure plots the point estimates and 95% confidence intervals for Ψ_{h1} from estimating Specification (4) sample and German firms as control group. The dependent variable is the growth in employment (i.e., number of employees; growth in percentage points) between 2014 and 2015+h. Standard errors are clustered at the industry-country-year level.

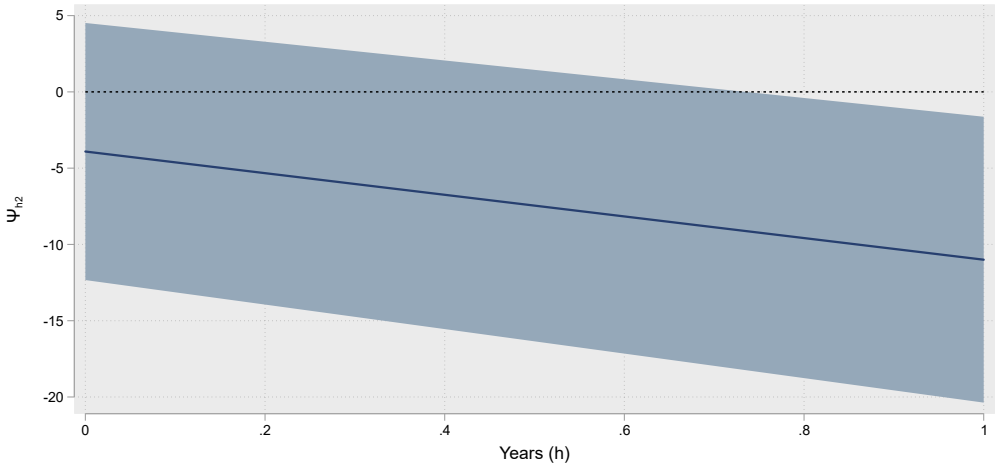
3. TRADE CONTROL – COMPNET

Figure 64: Change in Investment Rate (triple interaction)



This figure plots the point estimates and 90% confidence intervals for Ψ_{h2} from estimating Specification (5) and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the change in the investment rate, measured as ratio of investment (change in nominal capital plus depreciation) to nominal capital in the previous year, from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

Figure 65: Employment Growth (triple interaction)



This figure plots the point estimates and 90% confidence intervals for Ψ_{h2} from estimating Specification (5) and Germany, France, Belgium, and the Netherlands as control group. The dependent variable is the growth in employment (i.e., growth in number of employees; growth in percentage points) from 2014 to 2015+h. Standard errors are clustered at the size class-industry-year level.

4. ADDITIONAL TABLES

Table 4: Variable definitions - Orbis

Description	Formula and Orbis Code
Dependent variables	
ΔFunding Rate	$Fh.inte/(Fh.loan + Fh.ltdb) - L.inte/(L.loan + L.ltdb)$
Interest-Bearing Debt Growth (in pp)	$100 * [\ln(\text{Fh.loan} + \text{Fh.ltdb}) - \ln(\text{L.loan} + \text{L.ltdb})]$
Net Investment Rate (in pp)	$100 * [ln(Fh.fias) - ln(L.fias)]$
Working Capital Growth (in pp)	$100 * [ln(Fh.wkca) - ln(L.wkca)]$
ΔReceivables/Total Assets (in pp)	$100 * [(Fh.debt/Fh.toas) - (L.debt/L.toas)]$
ΔPayables/Total Assets (in pp)	$100 * [(Fh.cred/Fh.toas) - (L.cred/L.toas)]$
Cash Holdings Growth (in pp)	$100 * [ln(Fh.cash) - ln(L.cash)]$
Employment Growth (in pp)	$100 * [ln(Fh.empl) - ln(L.empl)]$
ΔCROCI	$\Delta 100 * [ebta/(L.tshf + L.loan + L.ltdb)]$
Control variables	
Firm Size	$ln(toas)$
Profitability	$ebit/toas$
Tangibility	$fias/toas$
Cash Holdings	$cash/toas$
Leverage	$(loan + ltdb)/toas$
Net Worth	$(tshf - ncli - culi - cash)/toas$

Table 5: Variable definitions - CompNet

Description	Formula and Orbis Code
Dependent variables	
ΔFunding Rate	$Fh.FR12\_inte\_debt\_mn - L.FR12\_inte\_debt\_mn$
Interest-Bearing Debt Growth (in pp)	$100 * [ln(Fh.FV02\_debt\_fin\_mn * Fh.FV02\_debt\_fin\_sw)) - ln(L.FV02\_debt\_fin\_mn * L.FV02\_debt\_fin\_sw)]$
Change in Investment Rate (in pp)	$Fh.FR14\_invest\_k\_mn - L.FR14\_invest\_k\_mn$
Employment Growth (in pp)	$100 * [ln(Fh.LV21\_l\_mn * LV21\_l\_sw) - ln(L.LV21\_l\_mn * LV21\_l\_sw)]$
ΔReturn on Assets	$Fh.FR31\_roa\_mn - L.FR31\_roa\_mn$
Control variables	
Firm Size	$ln(L.FV20\_ta\_mn * L.FV20\_ta\_sw)$
Profitability	$L.FR31\_roa\_mn * L.FR31\_roa\_sw$
Tangibility	$L.FR03\_collateral\_ta\_mn * L.FR03\_collateral\_ta\_sw$
Cash Holdings	$L.FR01\_cash\_ta\_mn * L.FR01\_cash\_ta\_sw$

Table 6: Employment and gross value added comparison

	Germany				Switzerland			
Industry	Employment (in Thousands)	%	Gross Value Added (in Million)	%	Employment (in Thousands)	%	Gross Value Added (in Million)	%
Agriculture, forestry and fishing	633.00	1.47%	20,720.0	0.76%	165.90	3.39%	3918.6	0.64%
Mining and quarrying	59.00	0.14%	4,606.0	0.17%	4.57	0.09%	774	0.13%
Manufacturing	7,508.00	17.41%	615,764.0	22.62%	663.27	13.54%	110,573	18.03%
Electricity, gas, steam and air conditioning supply	250.00	0.58%	46,119.0	1.69%	28.45	0.58%	9,845	1.61%
Water supply	265.00	0.61%	28,995.0	1.07%	17.70	0.36%	2,137	0.35%
Construction	2,426.00	5.63%	124,907.0	4.59%	337.60	6.89%	31,546	5.15%
Wholesale and retail trade	5,874.00	13.62%	265,240.0	9.74%	623.01	12.72%	97,015	15.82%
Transporting and storage	2,167.00	5.03%	123,508.0	4.54%	233.26	4.76%	24,045	3.92%
Accommodation and food service activities	1,805.00	4.19%	41,591.0	1.53%	240.54	4.91%	11,591	1.89%
Information and communication	1,224.00	2.84%	126,057.0	4.63%	155.73	3.18%	27,215	4.44%
Financial and insurance activities	1,181.00	2.74%	119,828.0	4.40%	232.05	4.74%	61909.5	10.10%
Real estate activities	468.00	1.09%	299,286.0	10.99%	54.98	1.12%	41,445	6.76%
Professional, scientific and technical activities	2,738.00	6.35%	170,370.0	6.26%	384.61	7.85%	45,124	7.36%
Administrative and support service activities	3,082.00	7.15%	136,484.0	5.01%	311.47	6.36%	19,085	3.11%
Public administration and defence; social security	2,559.00	5.93%	165,079.0	6.06%	193.11	3.94%	63625.8	10.38%
Education	2,434.00	5.64%	122,747.0	4.51%	322.04	6.57%	3849.6	0.63%
Human health and social work activities	5,493.00	12.74%	202,523.0	7.44%	637.90	13.02%	45775.9	7.47%
Arts, entertainment and recreation	670.00	1.55%	37,102.0	1.36%	87.90	1.79%	3582.5	0.58%
Other services activities	1,453.00	3.37%	64,267.0	2.36%	145.33	2.97%	8039.8	1.31%
Activities of households as employers	833.00	1.93%	6,827.0	0.25%	59.73	1.22%	2027.5	0.33%
Total	43,122.00	100.00%	2,722,020.00	100.00%	4,899.15	100.00%	613,124.30	100.00%

Source: Eurostat