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Bachelor thesis in Economics and Business Economics

Does competition increase bonus shares? A panel regression analysis on high-earning bankers in Europe

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Abstract

In response to the 2008 financial crisis, regulators have increasingly tried to restrict excessive bonus pay in the financial sector. This thesis studies the effect of competition on the variable-to-fixed pay ratio among bankers in Europe. In that context, it also demonstrates how competition and bonus rates evolved after the introduction of a European bonus cap. The research analyzes panel data on the remuneration practices of high-earning bankers from 27 European countries in the period from 2010 to 2021. A country-fixed effects panel regression shows mixed results. Though the evidence is predominantly inconclusive, the most elaborate analysis points towards a negative relation between competition and variable-to-fixed pay ratios within a country. This outcome is at odds with the hypothesis that stronger competition for the most talented employees forces firms to pay higher bonus shares. Omitted variables are a likely cause for the discrepancy. Results are different for investment banking and independent control functions, which show a positive relation. Furthermore, the data show a significant drop in average bonus rates after the bonus cap was introduced in Europe. Especially countries with competitive banking industries experienced a large and sudden decrease in bonus shares, whereas countries with less competitive financial markets did not display such a pattern.

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1. Introduction

"When formulating the remuneration policy [of the management board members], an appropriate ratio between the variable and fixed remuneration should in any event be taken into consideration." (Article 3.1.2, Dutch Corporate Governance Code 2022)

Escalating bonus pay for high-level bankers is a highly controversial topic. The news about excessive salaries for key employees causes increasing social unrest and fuels the discussion on (wage) inequality. Consider for example the discussion on Ralph Hamers, former CEO of ING, who was recently reprimanded by the Dutch disciplinary judge due to a 50% raise in salary.[1]

Bonuses can be an effective means to improve bankers' performance, but they may also induce excessive risk-taking in order to maximize short-term profits. Such opportunistic behavior may put the stability of the financial system at risk, as we have seen in the 2008 financial crisis. Therefore, many countries attempt to limit the use of bonus pay through regulations and supervisory institutions. On the other hand, banks often proclaim that high bonuses are necessary in order to attract and retain their most qualified personnel. After all, competition for the select group of best-performing employees is fierce. From this perspective excessive salaries and bonuses among bankers may be justifiable, and perhaps even necessary to ensure proper market functioning.

It is crucial to understand the functioning of incentive pay within the banking sector in order to maintain the stability and social support for our financial system. To this extent the compensation structure of top executives is particularly interesting, as we observe higher shares of variable-to-fixed pay among high earners in finance (Denk, 2015; Célérier & Vallée, 2019; Stieglitz & Wagner, 2020). These bonuses sometimes take such proportions, that it is hard to imagine they truly reflect the optimal incentive to stimulate effort. There are several theories that try to make sense of the underlying mechanism. One of the leading theories suggests that competition for the most talented bankers causes these high shares of bonus pay. Although this theory has recently gained popularity, there is still little empirical evidence linking competition to higher variable-to-fixed pay. This thesis aspires to fill this gap, by empirically examining high earners in domestic banking industries within Europe.

The aim of this thesis is to examine the effect of competition on the share of bonus pay among top earners in European domestic banking industries, and to show how this evolved after the introduction of a European bonus cap. To accomplish this, I will empirically analyze remuneration data from high earning bankers in Europe, covering 27 European countries in the period from 2010 to 2021.

By means of a simple OLS panel regression and a country-fixed effects panel regression, I find some evidence that competition is positively related to the share of bonus pay for investment banking and

[1] For background information, refer to the recent newspaper articles by Betlem and Pols (2023) and Kelder (2023).

independent control functions, and negatively related for the other business areas. In doing so I empirically examine the theoretical predictions by Bénabou and Tirole (2016), Glode and Lowery (2016), and Bijlsma et al. (2018), and contribute to the scarce empirical literature regarding this topic. In the prevailing literature, there is, to the best of my knowledge, only one paper that empirically addresses the effect of product market competition on the share of bonus pay among bankers. This study by Cuñat and Guadalupe (2009) exploits two financial deregulation periods in the United States to find a positive effect of competition on variable-to-fixed pay. Contrary to this study, my thesis exploits data on the European labor market. Moreover, a different methodology shall be applied, namely a country-fixed effects panel regression, which allows for more generalizable results on a diverging set of countries.

Lastly, this thesis adds to the literature on bonus caps. In response to the 2008 financial crisis, the European Union introduced a bonus cap for all its national banking industries. This bonus cap restricts the variable remuneration component to 100% of the fixed component, or 200% subject to shareholders' approval. The restriction only applies to so-called identified staff, meaning staff that has a material impact on the banks' risk profile (EBA, 2016). By creating a legal restriction to bonus pay for material risk takers, regulators aim to prevent excessive risk taking at credit institutions in order to maintain a stable financial sector (explanatory note 65, Directive 2013/36/EU).

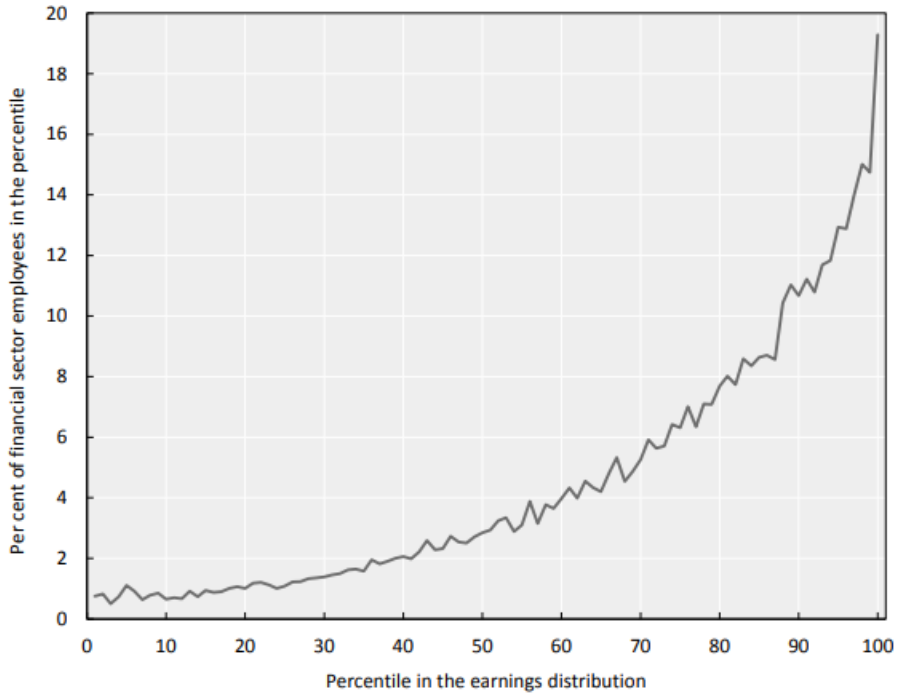
I will investigate how variable and fixed pay evolved after the introduction of the bonus cap. Through a country-fixed effects panel analysis, I show that bonus rates among high earners at European credit institutions have reduced after the introduction of the bonus cap, whilst total remuneration remained roughly unchanged. These findings support the theory brought forward by Bénabou and Tirole (2016), and are consistent with recent empirical research by Meekes and Ronchi (2021) and Colonello et al. (2023). Novel to the aforementioned literature, this thesis also addresses the role of competition with respect to the bonus cap. Interestingly, I find a significant drop in bonus pay in 2014 for countries with a competitive financial industry, whereas this pattern is non-existent for countries with a mildly competitive banking industry.

This thesis is structured in eight chapters. First, chapter 2 introduces the underlying theories and empirical evidence on which my research is based. Subsequently, chapter 3 discusses the institutional background on the European bonus cap and chapter 4 describes the dataset. After that, I will further elaborate on the applied methodology in chapter 5. Chapter 6 shows the main results of the analysis and chapter 7 gives room for discussion, while emphasizing the limitations of this research. Finally, chapter 8 will conclude the thesis with some final remarks and a summary.

2. Theory and existing evidence

Bonus culture within the banking sector

The banking sector is famous for its bonus culture and (extremely) high salaries. According to OECD data, financial sector workers account for 19% of the top 1% earners in Europe in 2010, even though only 4% of the total population works in the financial sector (Denk, 2015). This implies that the financial sector boasts a relatively large amount of (extremely) high earners compared to other sectors. Unsurprisingly, the financial sector therefore has a noticeable effect on income inequality. Additionally, a relatively large share of compensation in the financial sector consists of bonus pay (Denk, 2015). And since performance pay creates higher returns to skill for talented employees as compared to the less talented, this enhances income inequality even further (Lemieux et al., 2009). Altogether, Philippon and Reshef (2012) estimate that about 15% to 25% of total wage inequality in the U.S. since 1980 can be attributed to the financial sector.



Note: The figure depicts the simple average of OECD countries which belong to the European Economic Area and for which data are available. Data for Germany relate to 2006. The sample includes only full-time, full-year equivalent employees to exclude working time effects on earnings. Observations are weighted within countries to make the sample representative of the actual population. The coverage of sectors is not exactly the same for all countries, and the sample size varies considerably across countries.

Source: OECD Secretariat calculations using Eurostat Structure of Earnings Survey.

Figure 1. Share of financial sector employees across the earnings distribution in Europe, using 2010 OECD data (Source: Denk [2015], p. 9)

How can these extremely high salaries and bonuses in finance be explained? Do top-level bankers and investors have such valuable skills that are worth more than in other industries? Do they need such strong incentives to perform efficiently? The literature regarding management compensation distinguishes two main theories. Firstly, the neoclassical view, which argues that escalating compensation is a 'natural' result of supply and demand. Rosen (1981) calls it "*the economics of superstars*", where a very small share of the population is able to earn an extremely high income. This phenomenon can be mainly attributed to imperfect substitution, he argues. Within the banking sector a star CEO is a poor substitute for a superstar CEO, and these small differences can have a significant impact on the bank's performance. Therefore, free market forces will reasonably result in escalating (performance) pay for the very best employees within the sector.

The second theory, conversely, supposes the existence of a market failure. For example, when considering CEO pay, Bertrand and Mullainathan (2001) show that CEOs are strikingly often rewarded for luck; by empirically examining lucky events that fall outside the managerial scope of control, they find that both fixed salaries and bonus pay significantly correlate with luck. More specifically, CEO pay is just as dependent on actual performance as on luck. Managers therefore don't get paid for their true added value, the authors argue. Instead managers owe their (extraordinarily high) salary due to the control they have on their own pay-setting process, particularly when governed poorly. This idea is often endorsed in the literature, as Bebchuk and Fried (2003) illustrate. The authors reason that executive compensation is partly driven by market forces, but also by managerial power and rent-seeking behavior. Additionally, the board of directors often has self-interested incentives to establish or maintain a good relationship with the CEO. This makes them more willing to grant favors and go along with (too) generous compensation schemes, as long as these arrangements are still perceived as acceptable by the outside world. Accordingly, executive compensation not only mitigates the agency problem between shareholders and executives, but it is actually part of the problem itself.

Especially the extraordinary wages within the financial sector may reflect a market failure. Research by Denk (2015) shows that European finance workers earn significantly higher salaries and bonuses compared to similar workers in different sectors. But not only for Europe this is the case: Philippon and Reshef (2012) analyzed data from the U.S. finance industry over the last century to study how compensation, regulations and human capital changed over time. By means of a cross-sectional and individual-fixed effects regression, they find that workers in the top decile of the finance industry earned a wage premium of 250% in 2016, compared to workers in other sectors with the same level of education. Finally, Célérier and Vallée (2019) perform a similar regression to investigate the finance wage premium in France. They find a somewhat smaller premium for top employees in finance of approximately 70%. The contrast in outcome is most likely attributable to the different sets of control variables and country differences. Excessive private returns for top-bankers and investors might be socially inefficient, as many authors theorize. Murphy et al. (1991), for example, argue that the talented

workers within the financial sector mainly act as rent seekers, redistributing wealth throughout the society, whereas their abilities could be better put to use in other sectors to stimulate innovation and growth. Hence a market failure, as private returns in finance might exceed social returns.[2]

Competition as a determinant of bonus pay

As has become clear, empirics point towards relatively high salaries and bonuses among bankers (Denk, 2015; Lemieux et al., 2009). Interestingly, if we focus on top earners within the sector, we also observe a different compensation structure: the ratio variable-to-fixed wage is relatively high among top incomes. Though the share of bonus pay also tends to be higher among top earners in other sectors, this difference particularly stands out in finance (Célérier & Vallée, 2019).

What drives this mechanism? Literature offers two main explanations. The first theory suggests that firm size may explain the higher share of variable pay in finance. This idea gained popularity after research by Gabaix and Landier (2008), who found a close relation to the growing market capitalization within the U.S. and the increasing CEO pay. They argue that the marginal impact of a CEO's talent is assumed to grow as firm size increases. Accordingly, key employees who work at bigger firms have higher marginal returns to effort, which would explain their higher bonuses. After all, when effort becomes more valuable to the firm, this rationalizes stronger incentives to motivate the CEO or key employee to exert more effort. Alternatively, bigger firms can have higher profits and larger budgets. Although this argument is not mentioned in the paper, it could intuitively also be a reason why bigger firms tend to be more generous in their bonuses.

Stieglitz and Wagner (2020) test the firm-size theory on the banking industry specifically. In line with Gabaix and Landier (2008), the authors find higher ratios of variable-to-fixed pay at bigger banks. In particular for investment banking, the employees that work in bigger business units receive a higher share of performance pay, whereas for retail banking this relation is significantly smaller. This implies that the marginal returns to effort do not only differ across firm size, but also across different types of banking activities.

An alternative theory suggests that competition causes higher shares of bonus pay within the financial industry. This idea is endorsed by Bénabou and Tirole (2016), who argue that a competitive bidding process for the most talented employees changes compensation structures by increasing the share of bonus pay. To support their theory, the authors construct a Hotelling-like model in which firms use incentive pay as a screening tool. They find that in highly competitive labor markets, firms are forced

[2] Although this idea seems intuitive, it is difficult to find empirical evidence due to measurement problems. Additionally, the concept of social value is ambiguous and contains a normative aspect. For additional theoretical literature on private versus social returns in finance, also refer to e.g. Baumol (1996) and Philippon (2010).

to offer inefficiently high bonuses in order to attract and retain the most talented employees. As a result, a bonus culture emerges in which decisions center towards measurable and short-term-oriented tasks. Non-rewarded tasks can get neglected and the high ratio of variable-to-fixed compensation may give undesirable incentives, which eventually reduces welfare.

As Bénabou and Tirole (2016) point out, their theory can be well applied to managers and key employees within the banking sector. This is confirmed by Bijlsma et al. (2018), who construct a comparable model, tailored to the financial industry. Their conclusions are similar to Bénabou and Tirole: "*As competition for top traders increases, the importance of sorting the top traders (and avoiding paying similarly high compensations to traders of average ability) grows, and so the benefit of increasing bonus pay over base wage increases, […]*" (p. 3). A final theoretical model on the financial sector is introduced by Glode and Lowery (2016). Their central premise is that financial firms compete for the most talented workers, who can either work as bankers or traders. In their labor market model, bankers are assumed to generate investment opportunities whereas traders only strengthen their employer's position at the expense of their trading partners. Under these assumptions, hiring a financial trader imposes a negative externality on other financial firms. It results in a "defensive bidding process" and excessive compensation for financial traders, in order to prevent them from working at rival firms. This model could explain the increasing compensation for workers within the financial sector, despite the growing supply of labor (Philippon & Reshef, 2012; Celérier & Vallée, 2015). Moreover, it is in line with the findings by Stieglitz and Wagner (2020) that compensation is especially high powered among top traders in finance banking, and to a lesser extent in retail banking.

Despite the empirical trends and the abundance of anecdotal evidence, there is little empirical research on the relation between competition and the share of bonus pay within the banking industry. The most influential research is conducted by Cuñat and Guadalupe (2009). They exploit two financial deregulation periods in the United States as natural experiments. Since the financial deregulations were designed to foster (product) competition in the financial industry, they can be used as an exogenous shock in competition. By means of a difference-in-difference analysis, the authors find a positive effect of product market competition on the share of bonus pay. If we assume that increased product market competition has a spillover effect on the labor market competition, these findings support the theory that increased labor market competition forces firms to rely more heavily on performance pay.

Based on the theories by Bénabou and Tirole (2016), Glode and Lowery (2016), and Bijlsma et al. (2018), and supported by the empirical findings from Cuñat and Guadalupe (2009), the first hypothesis is as follows:

Hypothesis 1: Stronger competition between credit institutions within a member state results in a higher ratio of variable-to-fixed compensation for top earners at credit institutions within that member state.

Regulating bonus pay within the financial sector

As Bénabou and Tirole (2016) point out, excessive bonuses may be socially inefficient. High-powered compensation schemes may strengthen the multitasking problem, shifting effort to easily measurable and short-term oriented tasks at the expense of long-term strategic behavior. Especially for the financial sector, it is well established that inappropriate remuneration schemes may lead to excessive risk taking.[3] This does not only apply to cash bonuses; Bolton et al. (2006) and Bebchuk and Spamann (2009), for example, argue that increased stock-remuneration can also lead to short-termism and speculative investor behavior. Unsurprisingly, the banking bonus culture has been generally identified as one of the driving factors behind the 2008 financial crisis (Bell & Van Reenen, 2014; Meekes & Ronchi, 2021).

For the stability of the financial sector and the economy as a whole, many countries impose legislation on banks and investment firms. This trend is not recent; legislation has long been a determining factor for the financial sector, as Philippon and Reshef (2012) show. The authors demonstrate that the U.S. financial sector has experienced major periods of regulation and deregulation from 1909 until 2006, which are strongly associated with wages and human capital in the sector. More specifically they show a direct relationship between deregulation and increasing numbers of highly skilled workers. The authors reason this is because deregulation provides the opportunity to create a comparative advantage, resulting in more innovation and competition for talent, whereas regulations have a restrictive effect on the ways in which firms can operate.

In response to the 2008 financial crisis a great amount of new regulations was introduced. In Europe, one of the most profound new regulations is a European bonus cap. This bonus cap limits the amount of variable pay to 100% of the fixed pay for the banks' *identified staff*. This so-called identified staff is defined as the group of bankers that has a material impact on the bank's risk profile. By limiting the allowed share of bonus pay for identified staff, regulators seek to combat excessive risk taking at credit-institutions (explanatory note 65, Directive 2013/36/EU).

Introducing a bonus cap can be an economically efficient solution to reduce the negative externalities of excessive variable pay. According to Bénabou and Tirole (2016), a bonus cap limits firms' ability to compete for the most talented employees through escalating incentive pay. Instead, a bonus cap forces firms to compete for employees through offering them a higher fixed pay component. This will be economically efficient, as long as firms do not switch to less efficient screening devices as an alternative form of reward. Alternatively, introducing a bonus cap is unneeded when a market is only mildly competitive, and does not experience inefficiently high variable-to-fixed pay. Applying Bénabou and Tirole's theory to the European bonus cap, we find that it has one major limitation: it assumes that all firms are affected by the bonus cap. Considering that the European bonus cap only applies to credit

[3] See for example Uhde (2016), who conducted an empirical analysis on the European banking sector.

institutions in the financial sector, it may have significant consequences for employee sorting across sectors.[4] Therefore its effect on efficiency and employee sorting is ambiguous ex-ante, and will depend amongst other things on the transferability of workers' skills and their alternative options outside the banking industry (Meekes & Ronchi, 2021).

Since the European bonus cap was introduced in 2014, several authors have investigated its effect. A recent paper by Meekes and Ronchi (2021) uses a dynamic difference-in-difference design to study how the Dutch bonus cap affected variable and fixed pay at credit institutions in the Netherlands.[5] To this extent they compared banks that were affected by the bonus cap with financial firms that remained unaffected. The authors find that the bonus cap caused a short spike in variable pay in 2013, but then reduced variable pay significantly from 2014 onwards. Simultaneously banks responded to the bonus cap by increasing fixed pay, such that the ratio of variable-to-fixed pay decreased in order to comply with the 20% bonus cap. Total pay slightly decreased with about 3% to 5% since the introduction of the bonus cap. These results coincide with the recent findings of Colonello et al. (2023). These authors conduct a difference-in-difference analysis on European executives, comparing executives that already complied with the bonus cap in 2013 to executives that did not. They too find that the bonus cap increased fixed pay and reduced variable pay, such that total remuneration remained roughly unaffected.

Meekes and Ronchi (2021) also study how the Dutch bonus cap affected employee sorting. Due to their database with individual-level data, the authors are able to investigate how the bonus cap affected banks' ability to attract and retain workers. They find that banks affected by the bonus cap suffered reduced hiring rates and higher separation rates due to the bonus cap, compared to financial firms that were unaffected by the policy intervention. Most of the employees transferred to other sectors than the financial sector. Altogether these results imply that the bonus cap negatively influenced banks' capacity to attract and retain workers. This again is in line with the findings by Colonello et al. (2023).

Based on the papers by Meekes and Ronchi (2021) and Colonello et al. (2023), the second hypothesis is as follows:

Hypothesis 2: The European bonus cap has been effective in reducing the share of variable-to-fixed pay among top earners at European credit institutions, especially for countries with competitive financial markets and high initial bonus rates.

[4] Employee sorting is a widely covered topic within academic literature. One of the first and most influential papers is written by Lazear (2000a), who argues that variable pay serves as a sorting mechanism, through which workers effectively self-select into jobs and projects. This theory is empirically confirmed by, for example, Dohmen and Falk (2011) conducted a lab experiment and found that productivity sorting has a large positive effect on output. A variable pay scheme attracted more productive participants compared to a fixed wage scheme, and a larger share of males too. For additional papers on productivity sorting through different pay schemes, see, e.g., Lazear (2000b) and Eriksson and Villeval (2008).

[5] The Dutch bonus cap is more restrictive than the European bonus cap. The European bonus cap limits bonuses to 100% of fixed pay, whereas the Dutch bonus cap restricts bonuses to only 20% of fixed pay. This is further explained in chapter 3 on the institutional background of the EU bonus cap.

3. Institutional background on the EU bonus cap

The financial sector is highly regulated in Europe. After the 2008 financial crisis, European Union (EU) legislators introduced strong regulation to prevent excessive risk taking and ensure a stable and sustainable financial market. Also bankers' bonuses are subject to European and national regulation. The first European directive with regard to bankers' remuneration was introduced in 2010 called the *Capital Requirements Directive* (CRD III).[6] This directive lays down rules with regard to the supervision of credit institutions in Europe. Most importantly, it provides supervisory power for member state authorities to collect information on the number of individuals per credit institution that earn at least 1 million euro (so-called high earners).

The definition of a credit institution is specified in a different European regulation, namely the *Capital Requirements Regulation* (CRR).[7] Article 4 paragraph 1 of the CRR provides that a credit institution is "*an undertaking the business of which is to take deposits or other repayable funds from the public and to grant credits for its own account*" (Regulation 575/2013). In other words, credit institutions are what we commonly refer to as banks. Since this definition entails that credit institutions grant credit to the public, most investment firms will not be regarded as banks and are therefore exempted from the reporting requirements of the CRD III.

Three years after the introduction of CRD III, its successor was established: the CRD IV.[8] In addition to the supervisory powers for competent authorities, CRD IV introduced a major restriction on European bonuses for credit institutions. From 2014 onwards, a so-called bonus cap went into force. According to article 94 paragraph 1(g) of the CRD IV, this bonus cap restricts variable pay to 100% of the fixed salary per annum. Depending on the member state, this ratio can be raised to maximally 200% with shareholders' approval (Directive 2013/36/EU). Important to note is that the bonus cap only applies to so-called *identified staff*. This is staff which has been identified as having a material impact on the bank's risk profile (EBA, 2016). Conversely, non-identified staff may still receive a bonus share that surpasses the 100% limit, or 200% with shareholders' approval.

The European bonus cap establishes a maximum bonus share, yet individual member states may decide to set a lower maximum. Belgium, for example, decided to restrict bonuses to 50% of fixed remuneration or 50,000 euro, whichever is lower, and the Netherlands has set an even lower bonus cap of 20% (PWC, 2017). Moreover, member states might choose to enforce EU regulation differently. For instance the UK has notified the EBA to only enforce the bonus cap for key employees at large firms, whereas the Dutch bonus cap covers all employees for all credit institutions (PWC, 2017). This may cause noise in the analysis, as I will discuss in chapter 7 regarding the limitations.

[6] Directive 2010/76/EC (CRD III).
[7] Regulation 575/2013 (CRR).
[8] Directive 2013/36/EU (CRD IV).

4. Data

To investigate the effect of competition on variable-to-fixed pay among European top bankers, I will use panel data on domestic banking sectors in Europe for the period of 2010 until 2021. The data specifically cover this period, as data collection on remuneration practices for high-earning bankers commenced in 2010 (as a result of the CRD III) and the latest available data report was published in 2021. My dataset contains information on 29 different EEA-countries, derived from various sources.

First of all, I collected data from the European Banking Authority (EBA). The EBA collects data from all EEA-countries on high earners in the banking sector who earn at least 1 million euro per financial year. This data is locally gathered by the competent member state authorities from its domestic credit institutions. The EBA publishes its aggregate data in yearly reports called '*benchmarking of remuneration practices at the European Union level and data on high earners*'. For my analysis, I merged the data from all separate annual reports into one database. The EBA data contains country-aggregated information on remuneration practices among high earners, such as the number of high earners, the average individual compensation, the ratio of variable-to-fixed compensation, and the share of variable compensation that is paid through instruments (such as share options). The pre-aggregated data is split out per banking activity, which enables a heterogeneity analysis on the different banking areas. More specifically, the data is divided into 8 categories: (i) asset management, (ii) corporate functions, (iii) independent control functions, (iv) investment banking, (v) management board managers, (vi) management board supervisory functions, (vii) retail banking, and (viii) other business areas. Refer to Appendix A for more detailed information on all banking activities.

In addition to the EBA remuneration data, I collected competition data from the European Central Bank (ECB). The ECB's Statistical Data Warehouse contains yearly Herfindahl indices for 27 European countries, as part of their data on '*banking structural financial indicators*'. These Herfindahl indices capture the relative market shares of credit institutions for total domestic credit. In the next chapter, I will argue why the Herfindahl index is also appropriate to measure competition for top employees.

Lastly, the dataset contains panel data from the OECD about output gaps. This data is taken from the OECD economic outlook (OECD, 2022). The output gaps depict the deviation of actual GDP from potential GDP as a percentage of potential GDP. In other words, the output gap measures to what extent a country's economy uses its full potential. Therefore, it serves as a good indicator for the business cycle and a valuable control variable in the bonus share analysis.

Descriptive statistics

The tables below provide the descriptive statistics for the main variables of interest, split out per banking activity.

Table 1. Descriptive statistics per banking activity, country averages for 2010-2021

Variable	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Number of high earners per country	14.00 (61.37)	10.50 (37.28)	4.14 (16.90)	83.88 (366.68)	27.15 (74.84)	0.60 (1.52)	6.06 (16.50)	12.61 (46.06)	147.22 (574.60)
Average individual compensation (in euros)	1,568,928 (319,156)	1,570,399 (482,151)	1,363,501 (326,398)	1,438,069 (267,807)	1,809,310 (559,623)	1,957,045 (693,788)	1,367,088 (262,564)	1,626,582 (244,643)	1,634,451 (325,937)
Ratio variable-to-fixed pay	3.62 (2.52)	1.50 (1.08)	1.21 (0.69)	2.10 (1.17)	0.88 (0.65)	0.47 (0.51)	1.19 (0.55)	2.81 (4.34)	1.48 (1.46)
Ratio variable-to-instrument pay	0.48 (0.20)	0.44 (0.21)	0.52 (0.29)	0.43 (0.16)	0.48 (010)	0.51 (0.26)	0.47 (0.18)	0.37 (0.26)	0.45 (0.12)
Ratio identified staff	0.70	0.89	0.91	0.80	0.94	0.81	0.88	0.87	0.88
Herfindahl index (scale from 0-100)									12.68 (7.29)
Output gap									-1.93 (1.33)
Number of countries									29

This table shows the descriptive statistics on the panel dataset with regard to high earning bankers in Europe. In total, the dataset contains observations on 29 different countries, which are measured once every year in the period 2010-2021. The number of observations differs between variables and banking activities. Means are represented for all variables. Standard deviations are denoted in parentheses. The ratio variable-to-instrument pay indicates what part of variable compensation was disbursed by means other than a direct cash payment. The output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP.

Table 2. Descriptive statistics per banking activity, total aggregate averages for 2010-2021

Variable	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Number of high earners	351	260	100	2102	708	16	161	324	3752
Average individual compensation (in euros)	1,929,619	1,764,440	1,597,979	1,873,643	2,214,534	1,869,198	1,631,939	1,774,718	1,904,150
Ratio variable-to-fixed pay	3.87	1.23	1.13	2.29	1.12	0.68	1.36	1.93	2.02
Ratio instrument-to-variable pay	0.28	0.51	0.53	0.42	0.51	0.47	0.37	0.26	0.37
Ratio identified staff	0.60	0.91	0.94	0.74	0.89	0.88	0.86	0.62	0.74
Number of countries									29

This table shows the descriptive statistics on the panel dataset with regard to high earning bankers in Europe. In total, the dataset contains observations on 29 different countries, which are measured once every year in the period 2010-2021. The number of observations differs between variables and banking activities. Some banking activities only contain data for 2013-2021, which explains why the average number of high earners per banking activity does not add up to the total average. Means are denoted for all variables. Standard deviations are denoted in parentheses. Since the data are pre-aggregated on a country level per banking activity, standard deviations cannot be calculated for average individual compensation, the ratios variable-to-fixed pay, the ratio instrument-to-variable pay, and the ratio of identified staff. Means for the number of high earners, the Herfindahl index and Output gap are calculated on a country level. Ratio identified staff denotes the ratio of material risk takers compared to the total number of high earners per category. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP.

Table 1 shows the descriptive statistics for the total sample on European high earners at credit institutions. Since this table shows country averages, it does not necessarily reflect the average variable-to-fixed pay ratio for the total sample of high earners. After all, observations of countries with few high earners are given an equal weight as countries that accommodate many high earners. To account for this problem, I aggregated total variable and fixed compensation on a European level before calculating the compensation ratios. These total aggregate statistics are provided in Table 2

As Table 1 shows, most countries have a relatively small amount of high earners. From 2010 until 2021, countries have on average 147 bankers that earn more than 1 million euro per year. This result is strongly driven by an outlier, as depicted in graph 1 from Figure 3. The UK boasts an extraordinary amount of high earners, namely 3105 on average, compared to only 224 high earners in France, which is the second highest amount in Europe. Due to Brexit, data about the UK is only available from 2010 – 2019. This explains the sharp drop in the number (and standard deviation) of high earners from 2020 onwards, as depicted in Figure 2 below.

Figure 2 additionally indicates that a relatively large share of the total population of high earners consists of identified staff that has a material impact on the banks' risk profile. This is understandable, since employees with a salary that exceeds 1 million per year often fulfill high-level tasks. The developments on the total number of high earners strongly depend on the sample. Figure 2 shows that the number of non-identified staff members is significantly higher in the sample including the UK, compared to when the UK is excluded from the sample. Moreover, the share of identified staff sharply increases in 2014 (when the bonus cap is included) for the UK sample, whereas this difference is less apparent in the non-UK sample. Conversely, the non-UK sample shows a strongly increasing trend over time, whereas this trend is more volatile in the UK sample.

Lastly, the number of high earners significantly differs between banking activities. Table 1 indicates that few high earners work in independent control functions or Management Board (MB) supervisory functions, whereas many high earners work as MB manager or investment banker. Investment banking especially boasts many high earners: on average, about 84 high earners work in investment banking, which is more than 50% of all high earning bankers in Europe.

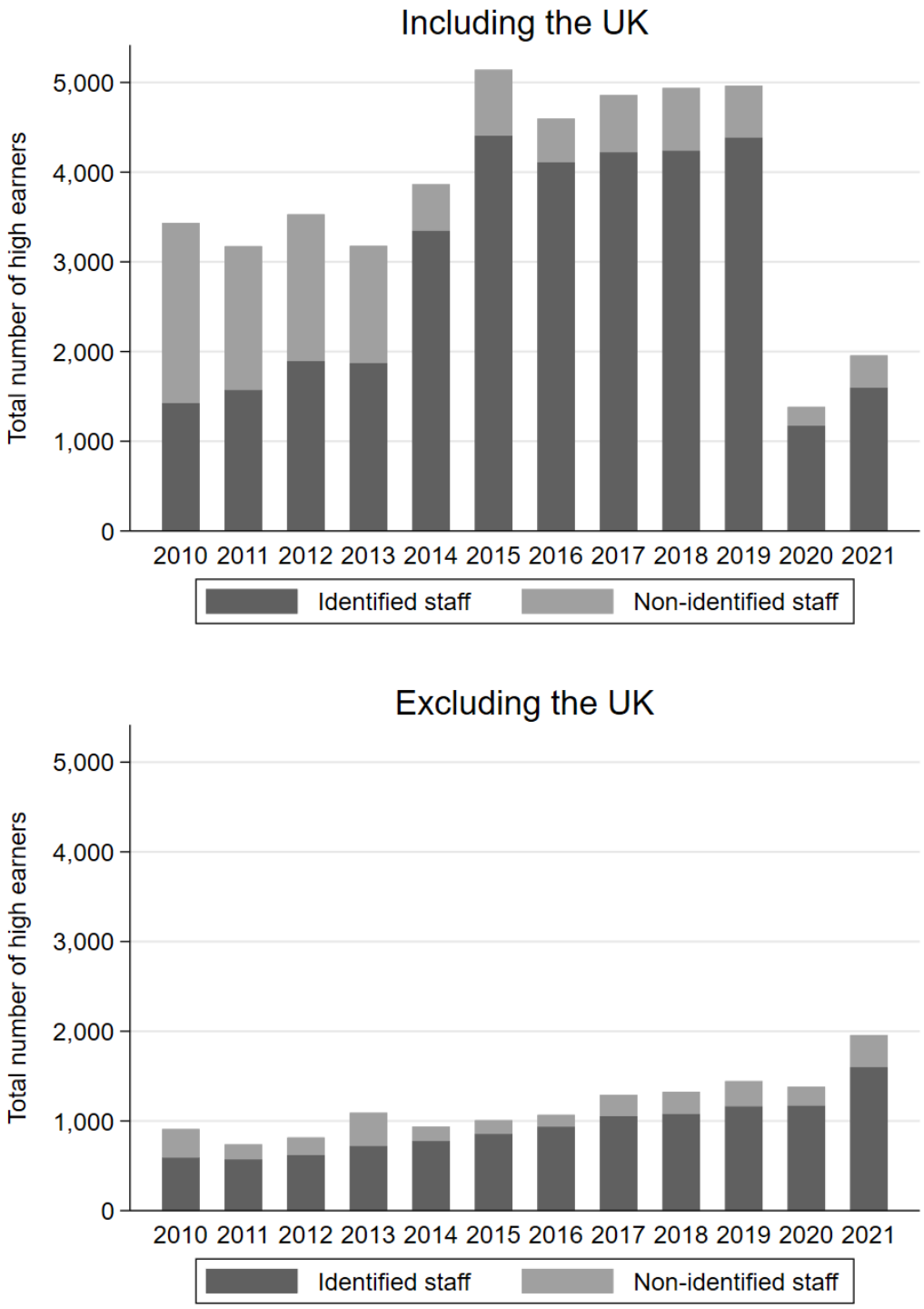


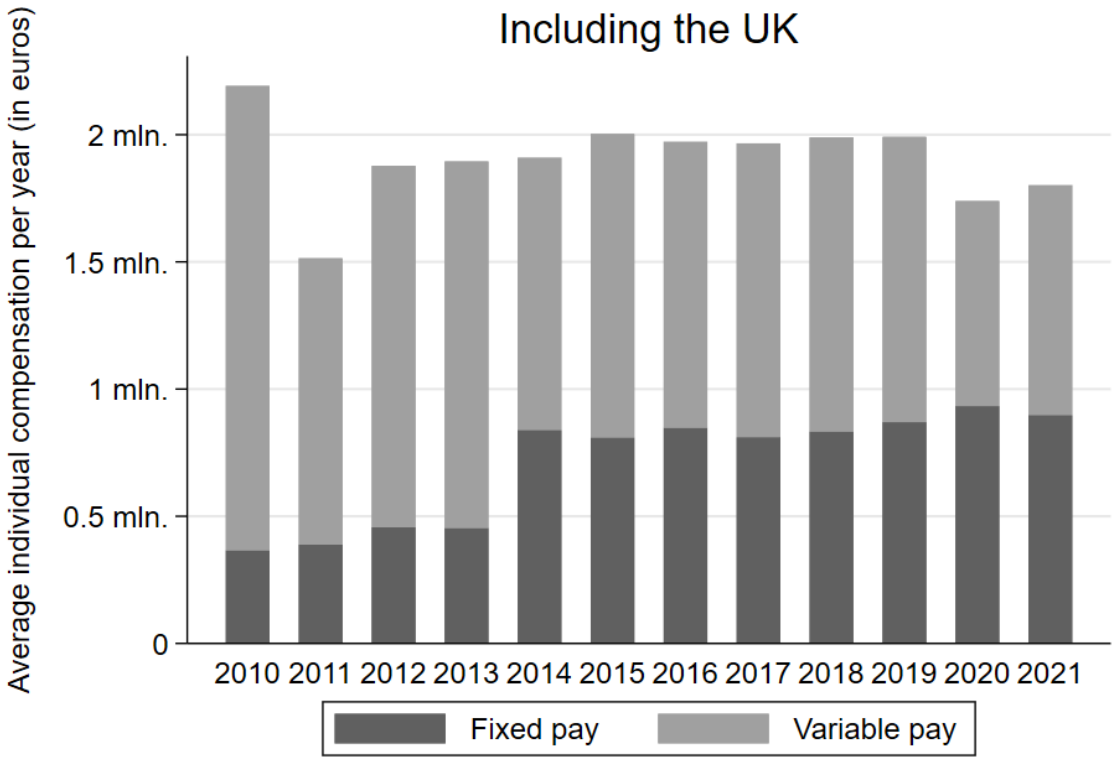
Figure 2. Total number of high earners in Europe, split out between identified staff and non-identified staff, 2010-2021.

This figure shows the total number of high earners at European credit institutions, broken down into identified staff and non-identified staff. Numbers are calculated on a European aggregate level, both including and excluding the UK. Identified staff qualify as employees that have a material impact on the credit institutions' risk profile.

According to Table 1, the variable-to-fixed pay ratio averages around 1.5 between countries. With regard to the aggregate European sample of high earners in Table 2, the bonus share amounts to 200% of fixed pay, which is even higher than the between-countries average. This implies that countries which accommodate a large number of high earners (such as the UK, France and Germany) on average have higher variable-to-fixed pay ratios than countries that have fewer high earners. The 200% bonus share exceeds the European bonus cap of 100%, yet it complies with the raised bonus cap of 200% limit with shareholders' approval. This high average bonus rate can be mostly attributed to the pre-bonus cap compensation. Moreover, it could be the case that non-identified staff earn significantly higher bonuses, raising the average variable-to-fixed pay ratio. Unfortunately, due to the fact that the data is pre-aggregated, the latter hypothesis cannot be tested.

Interestingly, we observe a sharp drop in variable pay since the bonus cap was introduced in 2014. Figure 3 shows how average individual variable pay has decreased significantly, especially in 2014, from about 1.8 million euros in 2010 to about 0.9 million euro in 2021. Meanwhile, average fixed pay strongly increased from about 0.4 million euros in 2010 to 0.9 million euros in 2021. Interestingly, it again makes a big difference whether the UK is included in the sample or not. The average bonus share in the non-UK sample is substantially lower and less volatile. Moreover, the change in compensation structure after 2014 is less evident in the non-UK sample, implying that the variable-to-fixed pay ratio for the UK in particular decreased strongly.

Just as the number of high earners, the variable-to-fixed pay ratio also differs significantly between banking activities, according to Table 2. For management board supervisory functions we observe an aggregate European bonus share of 68%, whereas for investment banking this amounts to 229% and for asset managers even to 387%. Refer to the appendix for the distribution of the variable-to-fixed pay ratios (between countries), split out per banking activity.



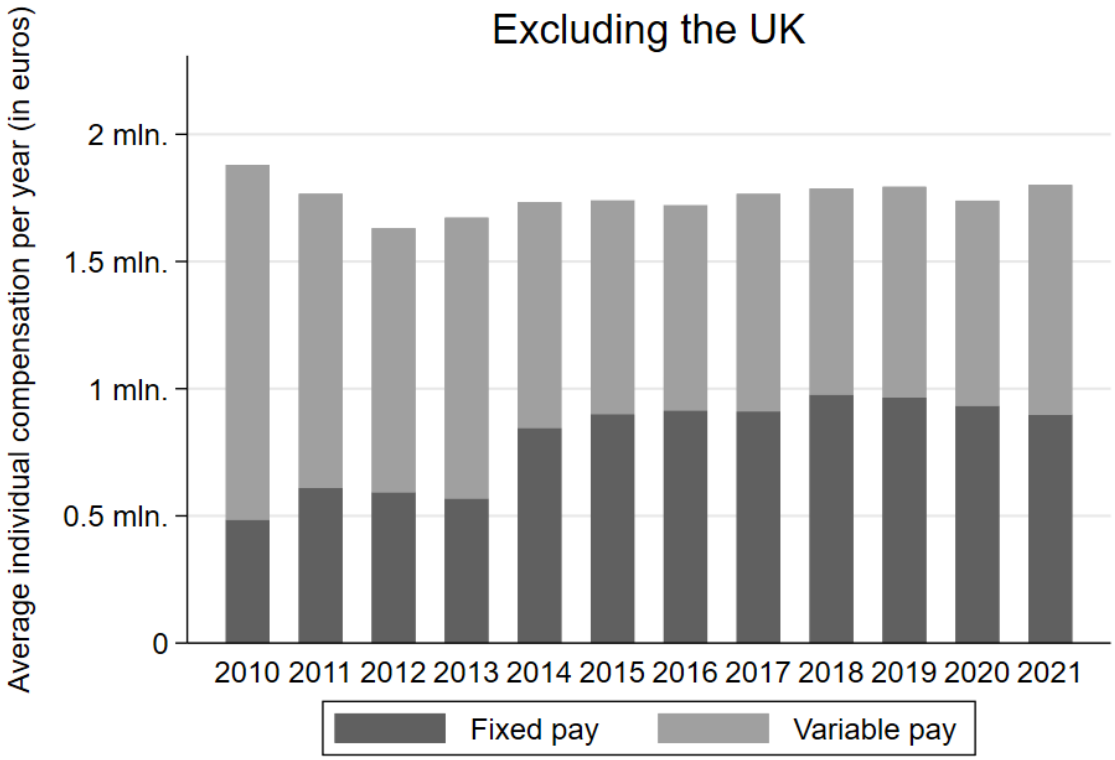


Figure 3. Average individual pay on aggregate European level, split out in fixed and variable components, 2010-2021

This figure shows average individual pay for high earners at European credit institutions, broken down into a fixed and variable (bonus) component. Average compensation is measured in euros on a European aggregate level for the period of 2010-2021.

Finally, with regard to the competition, we observe an average Herfindahl index of 12.7 per country for the period between 2010-2021 (Table 1). The average Herfindahl index is relatively stable over time, as depicted in graph 4 of Figure 3. The average Herfindahl index slightly increased over time, which implies that markets have become more concentrated. However, the upper outliers' Herfindahl indices have decreased over time, resulting in reduced variation between countries.

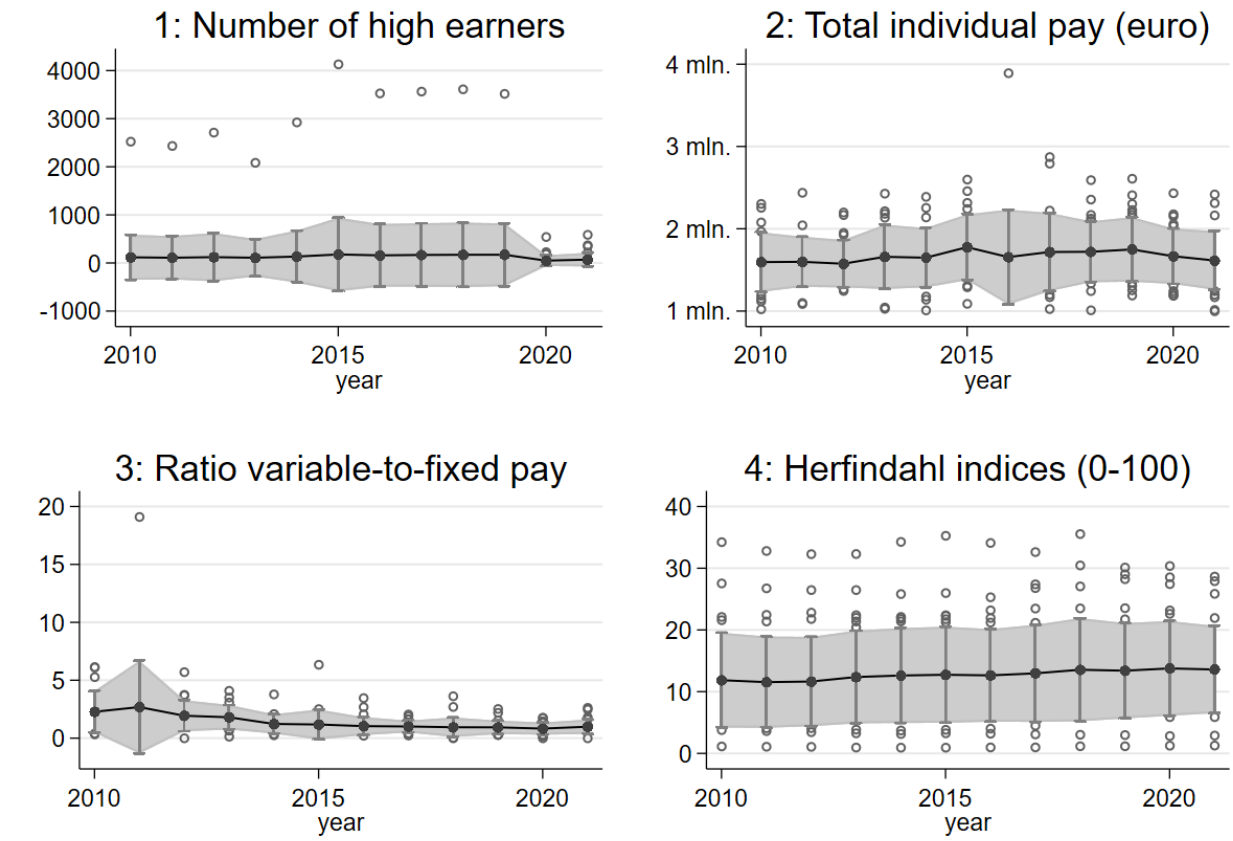


Figure 4. Distribution of key variables over time, 2010-2021

This figure shows the distribution of the key variables for the European panel dataset. It includes graphs on (i) the number of high earners, (ii) total individual pay, (iii) the ratio of variable-to-fixed pay, and (iv) Herfindahl indices. Graphs exhibit the mean and standard deviation for country averages in the period between 2010 and 2021. The white dots represent outliers.

5. Methodology

Measuring competition for talent

Competition for talent is one of the key variables in the analysis. Due to the availability of data, this talent competition on the labor market will be measured using the Herfindahl-Hirschman Index (henceforth the Herfindahl index).

Even though the Herfindahl index is generally used as a measure for product market competition, it is also an appropriate measure for talent competition on the labor market. As product market competition gets more fierce, banks will experience higher pressure to stay efficient and perform well; otherwise they may experience losses in profit and market share, and competitors might get ahead of them. To cope with strong competition, banks will feel a stronger need to hire the very best managers and employees, hence creating higher labor demand. This way, stronger product market competition may also lead to stronger competition for top-performing employees.

The Herfindahl index is a commonly used measure for competition among antitrust authorities and empirical researchers (Rhoades, 1993). It reflects the degree of concentration within a certain market, by including the number of firms and their relative market shares. The Herfindahl index is computed as a sum of the squared market shares, so that higher values reflect weaker competition. Even though the index is commonly applied, it has some limitations. It for example fails to capture potential entrants or product substitutability within a specific market (Griffith et al., 2005). Therefore alternative measures might be more robust in capturing the level of competition within the banking sector, such as the price-cost margin, relative profits (Griffith et al., 2005), or the often-applied Rosse-Panzar method (Molyneux et al., 1994; Bikker & Haaf, 2002).

Despite its limitations, the Herfindahl index is arguably still well-suited to measure competition for high-level employees. The index that will be applied in this study is based on credit institutions' domestic market shares for total credit. The Herfindahl index for country i is computed as follows:

$$Herfindahl\ index_i = \sum_{f=1}^{n} \left(MS_{f,i}\right)^2$$

Where n depicts the number credit institutions in country i, and $MS_{f,i}$ stands for the market share of firm f in country i, based on total domestic credit. The index ranges from 0 – 10,000, where lower values reflect stronger competition. The Herfindahl index in this thesis is normalized to a scale from 0 to 100 in order to facilitate more convenient interpretation and better readability. From an absolute theoretical point of view, a score of 100 represents a monopoly market and a score of approximately 0 represents perfect competition.

Competition analyses

The main aim of this study is to establish the effect of competition on bonus rates within domestic banking industries in Europe. To realize this, two different panel regression analyses will be executed: an Ordinary Least Squares (OLS) panel regression and country-fixed effects panel regression.

OLS panel regression

First, an introductory OLS panel regression is applied to see how competition and bonus shares are related throughout Europe, and to examine how this relation differs between banking activities. The OLS model utilizes robust standard errors in order to meet the assumptions of homoskedasticity and absence of autocorrelation in the error term. However, the conditional independence assumption is not likely to hold; the existence of unobserved variables that are correlated with competition (Herfindahl index) and the share of bonus pay are likely to cause omitted variable bias. For example, differences in culture or demographics between countries will not be accounted for in this model. Therefore, the results of this first analysis cannot be interpreted causally and only serve an introductory purpose.

In order to mitigate omitted variable bias, the analysis will control for the business cycle. This is necessary because firms may have larger budgets and higher profits when the economy is doing well. Consequently, an economic boom could affect the number of mergers and takeovers, thus the Herfindahl index, and simultaneously allow for higher bonuses. Hence, the economic cycle may introduce omitted variable bias. The analysis includes an output gap variable to control for this. Output gap measures the difference between actual GDP and potential GDP in a country, as a percentage of potential GDP. Therefore, the output gap aims to control for the business cycle, bank profits and bank budgets.

Additionally, the model will include year-fixed effects. In doing so, I hope to overcome the effect of yearly shocks and trends throughout Europe, such as GDP or the increasing years of schooling. Additionally the year-fixed effects can be useful for the bonus cap analysis, as they provide information on the year-by-year developments in bonus shares. Finally, the OLS model also incorporates an interaction term between *output gap* and *year*. This controls for a dynamic relation between bonus shares and the business cycles over time.

The first model will not include country-fixed effects yet, as these will be included in the main (second) analysis. Additionally, the OLS model also doesn't include an interaction term between *Herfindahl index* and *year*, which would have allowed for different competition-effects over time. In other words, the analysis will not investigate the possibility of a heterogenous competition effect over time, but instead focuses on the average effect of competition on pay structure. This is because the aim of this thesis is to investigate a general relationship between competition and variable-to-fixed pay; the exact year-by-year developments of this relation fall outside the scope of this thesis.

Altogether, this yields the following OLS regression equation (1):

$$(\mathbf{1})\ Bonus\ Share_{i,t} = \alpha + \beta_1\, Herfindahl_{i,t} + \beta_2\, Output\ gap_{i,t} + \beta_3\, Year_t + \beta_4\, Year_t * Output\ gap_{i,t} + \varepsilon_{i,t}$$

Where *bonus share* denotes the average variable-to-fixed pay ratio for country i and year t. *Herfindahl* stands for the Herfindahl index in that same country and *output gap* reflects that country's difference between actual GDP and potential GDP, as a percentage of potential GDP.

According to the literature, competition can have a different effect on bonus rates, depending on the specific type of banking activity. Glode and Lowery (2016), for example, make a distinction between bankers and traders, arguing that competition mainly causes high bonus shares amongst traders. To test their theory, equation (1) will also be estimated for all eight different subsamples of banking activities. This heterogeneity analysis is executed by means of a split-sample analysis, instead of applying an interaction term between *Herfindahl index* and *banking activity*, because this gives a more flexible approach on sample sizes per model. Moreover, it benefits the interpretability of results.

Country-fixed effects panel regression

As a main analysis, I will use a country-fixed effects panel regression in an attempt to establish the causal effect of competition on the variable-to-fixed pay ratio. The analysis will use heteroskedasticity-robust standard errors, clustered at a country level. By applying country-fixed effects, the analysis accounts for predetermined differences in countries, such as certain demographics and cultural aspects. Therefore, this research is more likely to approximate a causal effect than the simple OLS panel regression. Yet, it does not guarantee that competition is an exogenous factor in the model; the country-fixed effects control for time-invariant differences between countries, but they cannot control for time-varying differences. Countries can, for example, have different trends in GDP, education or regulation, which will not be captured in the model. Therefore it is still possible that unobserved variables cause variation in both competition and bonus pay, making it difficult to draw reliable causal conclusions due to omitted variable bias.

Similar to the simple OLS regression model, I try to overcome omitted variable bias by including year-fixed effects in the country-fixed effects model. Additionally, the model includes an output gap variable to control for the business cycle, and an interaction term to allow for different business cycles over time. Lastly, it incorporates an interaction term between *country* and *year*. This allows to control for different yearly trends between countries. The country-fixed effects regression equation (2) for country i in year t looks as follows:

$$(\mathbf{2})\ Bonus\ Share_{i,t} = \alpha_i + \beta_1\, Herfindahl_{i,t} + \beta_2\, Output\ gap_{i,t} + \beta_3\, Year_t + \beta_4\, Year_t * Output\ gap_{i,t} + \beta_5\, Year_t * Country_i + \varepsilon_{i,t}$$

The interpretation of this equation is similar to equation (1) of the OLS panel regression analysis, except the second analysis includes country-fixed effects and an interaction term between *country* and *year*. In order to examine heterogenous competition effects between banking activities, the country-fixed effects panel regression analysis will be conducted for all subsamples of banking activities.

Bonus cap analysis

Finally, the analysis will address the European bonus cap. As Figure 3 in the previous chapter illustrates, it seems plausible that the introduction of the bonus cap in Europe significantly reduced the variable-to-fixed ratio. To study how bonus shares among high-earning European bankers evolved over time, the separate year-fixed effect coefficients from the country-fixed effects model (equation 2) will be further analyzed. In particular the focus will be on 2014, the year in which the bonus cap was introduced. Still, we must be careful with drawing causal conclusions, as there may be other factors that changed in 2014 which also impacted compensation structure.

Moreover, I will investigate whether the underlying competitive mechanism has changed due to the introduction of the bonus cap. So far, I have presumed a constant effect of competition over time, but this does not necessarily have to be the case. I include an interaction term between the Herfindahl index and a bonus cap dummy to estimate the competitive effect before and after the introduction of the European bonus cap. The bonus cap dummy takes value 1 for years from 2014 onwards, and value 0 for the years before the bonus cap was introduced. This way the interaction term quantifies the post-bonus cap relation between competition and bonus shares, whereas the single Herfindahl coefficient indicates the pre-bonus cap situation. This yields equation (3):

$$(\mathbf{3})\ Bonus\ Share_{i,t} = \alpha_i + \beta_1\, Herfindahl_{i,t} + \beta_2\, Herfindahl_{i,t} * Bonus\ cap_t + \beta_3\, Output\ gap_{i,t} + \beta_4\, Year_t + \beta_5\, Year_t * Output\ gap_{i,t} + \beta_6\, Year_t * Country_i + \varepsilon_{i,t}$$

The bonus cap is proposed to be a solution to excessive bonuses due to fierce competition for top employees (Bénabou & Tirole, 2016). To test if the bonus cap is indeed more effective in highly competitive markets, I divide all countries into three equal subsamples of eight countries, based on the competitiveness of their financial markets. The first group is characterized by strongly competitive financial markets with Herfindahl indices below 9. The second group only has medium-competitive markets, between 9 and 13.77, and the third group contains all countries with Herfindahl indices above 13.77. This way I will explore heterogeneous yearly trends, conditional on the level of competition on the domestic financial markets. Refer to Figure D1 in the appendix for further background the formation of the country subsamples.

6. Results

OLS panel regression results

Table 3. Correlation table for total sample of high earners

Variables	(1)	(2)	(3)	(4)
(1) Herfindahl index	1.000			
(2) Ratio variable-to-fixed pay	-0.022	1.000		
(3) Number of high earners	-0.060	-0.039	1.000	
(4) Ratio identified staff	0.132	-0.203	-0.060	1.000

This table shows the correlational results for the key variables of the analysis. Data is split out per banking activity and pre-aggregated on a country level. The sample includes all 8 categories of banking activities for 27 EU countries in the period 2010-2021. Herfindahl index is measured on a scale from 0 – 100. The ratio identified staff depicts the total number of material risk takers (identified staff) relative to the total number of high earners.

At first glance, stronger competition seems to be associated with higher bonus shares. Table 3 shows a negative correlation of -0.022 between the Herfindahl index and variable-to-fixed pay ratio. This means that an increase in Herfindahl index, and thus a decrease in competition, is associated with a decrease in bonus rates. Hence, a positive relation between competition and bonus share, which corresponds with the existing literature.

Table 3 additionally indicates that countries with less competitive financial sectors accommodate fewer high earners. Intuitively this would be in line with general economic theory, suggesting that stronger competition minimizes employers' power and instead forces firms to pay their employees closer to their marginal product. Moreover, countries with a large amount of high earners exhibit a smaller share of identified staff, which is the staff that has a material impact on the banks' risk profile. A possible explanation is that banks only have a select number of positions that significantly impact its risk profile. Consequently, when banks accommodate a large number of high earners, the ratio of identified staff gets diluted.

Figure 5 graphically displays the cross-sectional relationship between competition and bonus share among European high earners at credit institutions. The scatterplots employ country averages for the period between 2010 and 2021 to show a negative relation between the average ratio of variable-to-fixed pay and the Herfindahl index. This translates to a positive correlation between competition and variable-to-fixed pay, similar to Table 3. The figure shows two scatterplots: the first scatterplot displays the full sample of European countries, whereas the second plot excludes Slovakia. Slovakia is an outlier with an average variable-to-fixed pay ratio of over 800%. Since Slovakia has only had very few high earners

over time, the ratio of 800% is fully determined by only ten observations of which eight date back to 2011 and 2012 (before the bonus cap). Therefore, a second scatterplot is included without Slovakia to give a clearer correlational picture. For completeness, the appendix includes a scatterplot with all datapoints per country per year (Figure B1). Moreover, Figure B2 is included to show the year-by-year developments on the relation between bonus share and competition.

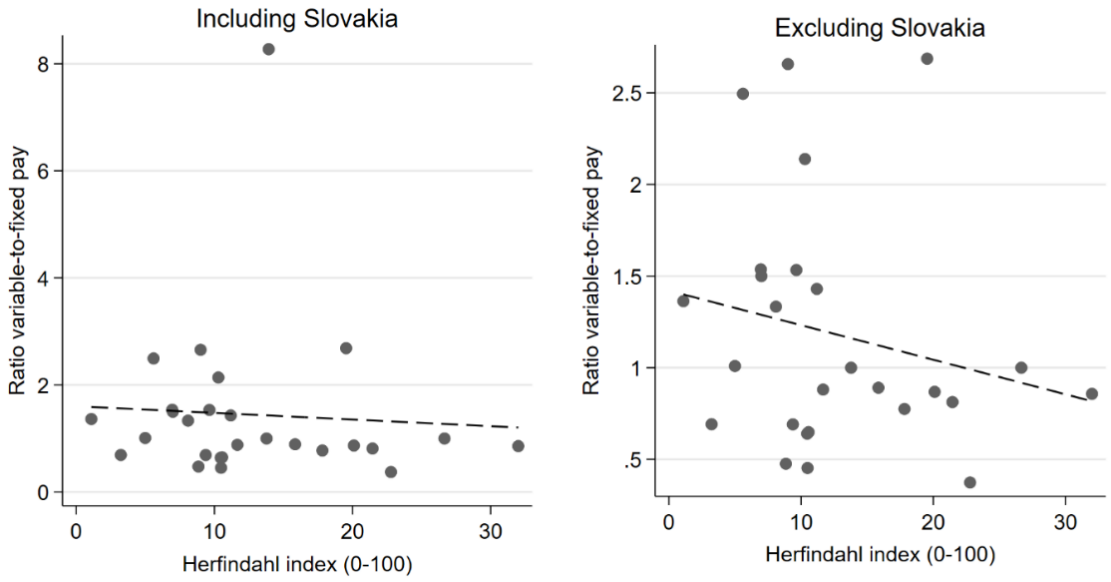


Figure 5. Cross-sectional scatterplots on the ratio variable-to-fixed pay and Herfindahl index, country-averages for the period 2010-2021

This figure shows the relationship between the average variable-to-fixed pay ratio and Herfindahl indices for the period 2010-2021. The left scatterplot displays averages of the entire sample of countries. The right scatterplot excludes Slovakia to show the relation without outliers. Herfindahl index is measured on a scale from 0-100.

Moving on to the first regression analysis, Table 4 presents the results of the OLS panel regression. Model 1 only includes the Herfindahl index to show the simple relation between competition and bonus rates. It shows a negative association, insignificant at a 10% confidence level. For model 2 *output gap* is added as a control variable. The output gap measures the difference between actual GDP and potential GDP in a country, as a percentage of potential GDP. Therefore, higher negative values reflect a period of economic downturn, whereas values close to zero (or even positive values) reflect an economic boom. When controlling for the business cycle, we find that *output gap* is negatively related to the ratio variable-to-fixed remuneration. This means that banks tend to rely more on fixed pay in economic prosperity and more on bonuses in economic downturn. Moreover, the output gap takes away most of the Herfindahl coefficient. This implies the business cycle is negatively correlated with the Herfindahl index; intuitively, when the economy is doing well the Herfindahl index decreases and competition is more fierce, but when the economy is performing badly, bad-performing banks may be subject to a

hostile takeover or cease to exist, such that the Herfindahl index increases. Model 3 adds year-fixed effects to control for yearly trends in compensation structure. This only results in a marginal change in the Herfindahl coefficient, which remains insignificant at the 10% confidence level. Lastly, model 4 includes an interaction term between *year* and *output gap* to allow for different effects of the business cycle over time. Still, the Herfindahl coefficient approximates zero, implying no direct relationship between competition and bonus share when controlling for the business cycle and fixed yearly trends.

Table 4. OLS panel regression results, total sample of high earners

Ratio variable-to-fixed pay	Model 1	Model 2	Model 3	Model 4
Herfindahl index	-0.016 (0.011)	-0.004 (0.015)	0.006 (0.016)	0.007 (0.016)
Output gap		-0.054* (0.027)	-0.023 (0.039)	-0.285 (0.175)
Year FE			YES	YES
Year # Output gap				YES
Constant	1.485***	1.337***	2.271***	1.639***
Observations	242	212	212	212

*This table shows the OLS panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay. The sample includes aggregate numbers of the entire banking sector for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. For model 3 and 4, the year 2010 serves as reference year. Robust standard errors are denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

In addition to the analysis on total average bonus shares among credit institutions, Table 5 provides the regression results of model 3 for all different banking activities. Interestingly, this heterogeneity analysis tells a different story than the aggregate analysis. According to Table 5, most banking activities display insignificant positive relations (for example asset management, independent control functions and other areas). Corporate functions even show a positive relation that is significant at the 90% confidence level. On the other hand, investment banking, MB management functions and retail banking show a significant negative relation between Herfindahl index and bonus rates. These positive and negative coefficients cancel out, such that the aggregate analysis does not point towards a significant result. Yet if all banking activities are analyzed separately, we do find suggestive evidence for a positive relation between competition and bonus shares for some activities, and a negative relation for others. The heterogeneity results for model 4 are largely similar to those of model 3, except for some differences in significance levels. The heterogeneity results for model 4 can be found in the appendix, Table B1.

Table 5. OLS panel regression results, heterogeneity analysis model 3

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	0.024	0.063*	0.005	-0.020*	-0.018**	-0.001	-0.021**	0.033	0.006
	(0.066)	(0.034)	(0.024)	(0.011)	(0.008)	(0.031)	(0.009)	(0.045)	(0.016)
Output gap	-0.150	0.078	-0.017	-0.048	0.048	0.034	-0.106***	-0.105	-0.023
	(0.133)	(0.085)	(0.042)	(0.035)	(0.033)	(0.050)	(0.034)	(0.097)	(0.039)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	12.443	1.443***	1.786***	3.630***	1.661***	0.730	1.530***	0.974	2.271***
Observations	127	105	65	168	144	42	163	119	212

*.This table shows the OLS panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. Results are obtained through a split-sample analysis. For all subsamples of banking activities, a separate OLS regression was performed. Subsamples contain aggregate data for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap shows the deviation of actual GDP from potential GDP, as a percentage of potential GDP. The year 2010 serves as reference year for the year-fixed effects. Robust standard errors are denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Country-fixed effects results

Table 4. Country-fixed effects panel regression analysis, total sample of high earners

Ratio variable-to-fixed pay	Model 1	Model 2	Model 3	Model 4	Model 5
Herfindahl index	-0.033 (0.037)	-0.029 (0.111)	0.085 (0.083)	0.057 (0.081)	0.178** (0.072)
Output gap		-0.040 (0.032)	-0.004 (0.031)	-0.129 (0.174)	-0.006 (0.158)
Country FE	YES	YES	YES	YES	YES
Year FE			YES	YES	YES
Year # Output gap				YES	YES
Country # Year					YES
Constant	1.674***	1.628	1.711*	1.698*	-521.088***
Number of countries	27	22	22	22	22
Observations	242	212	212	212	212

*This table shows the country-fixed effects panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay. The sample includes aggregate numbers of domestic banking sectors for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. For model 3, 4 and 5, the year 2010 serves as reference year for the year-fixed effects. Note that especially the constant for Model 5 should not be interpreted. This constant is strongly negative, since year is included as a continuous variable in the country interaction term to control for a steadily inclining yearly trend. Robust standard errors are clustered at a country level and denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

In an attempt to establish a causal relationship between competition and bonus shares, I exploit within-country variation by means of a country-fixed effects panel analysis (Table 4). Model 1 only includes the Herfindahl index and the ratio variable-to-fixed pay. Similar to the introductory OLS panel results, this model shows a negative relation. Model 2 extends the first model by adding *output gap* to the analysis as a control for the business cycle. In contrast to the simple OLS panel results, this changes the Herfindahl coefficient only marginally. Both the results from model 1 and 2 are statistically insignificant. This is most likely due to an insufficient sample size and too large random variation. As a consequence, the results are especially unreliable and do not provide sufficient evidence for any relation at all. Yet, they do not preclude an effect either.

When adding year-fixed effects in model 3, the Herfindahl coefficient sharply increases to 0.085. And also when model 4 includes an interaction term between *year* and *output gap*, the coefficient remains positive. Both the Herfindahl coefficients from model 3 and 4 are statistically insignificant, presumably due to their random variation. It is therefore not possible to derive reliable estimates from the models.

On the other hand, the year-fixed effects coefficients are statistically significantly and show strong negative values for the years from 2014 onwards. These results are not included in Table 4 and instead will be discussed more extensively in the bonus cap analysis.[9]

Finally, model 5 introduces an interaction term between *country* and *year*. Since *year* is included as a numerical value, this model controls for an inclining linear trend per country. Contrary to the preceding models, the Herfindahl index in model 5 is statistically significant at a 5% confidence level. The coefficient amounts to 0.178, with a 95% confidence interval between 0.028 and 0.327. If these results could be interpreted causally, an increase in the Herfindahl index of 1 would result in an estimated increase in bonus share between 2.8 and 32.7 percentage points, ceteris paribus.

Model 5 points towards a negative relation between competition and bonus shares. This contradicts predominant literature, as well as my first hypothesis. How can this result be explained? First of all, measurement errors may be at play due to the definition of variable and fixed pay, as I will explain in chapter 7. More importantly, however, omitted variables may be the reason why the data display a negative relation between competition on bonus shares. I identified two main omitted variables: firm size and firm profits. These unobserved variables are likely to be negatively related (or affected) by competition and simultaneously have a positive effect on the ratio variable-to-fixed pay. Chapter 7 further elaborates on the possible mechanisms and limitations.

Similar to the OLS panel analysis, the results of the country-fixed effects panel regression drastically change when we distinguish between different banking activities. The split-sample heterogeneity analysis is conducted for model 3 and model 5 of the country-fixed effects panel analysis. Extensive results can be found in Table C1 and C2 of the appendix. Figure 6 graphically displays the Herfindahl coefficients for model 3 and model 5. As follows from Table 4, model 3 controls for the business cycle and year-fixed effects, whereas model 5 also controls for linear inclining yearly trends at the country level.

Figure 6 shows that the Herfindahl index is negatively related to variable-to-fixed pay for most banking activities. Starting with the results from model 3, we find positive coefficients for asset managers and corporate functions. These positive coefficients are statistically insignificant. The six remaining business areas display a negative relation. Most of these are statistically insignificant as well on a 10% confidence level, except for independent control functions, management board supervisory functions and investment bankers. Particularly investment banking stands out with a relatively strong Herfindahl coefficient of -0.132, significant at a 1% confidence level. If this result would depict a causal relationship, a decrease of 1 in the Herfindahl index would, on average, cause an increase in bonus share of 13 percentage points for investment bankers, ceteris paribus. This conclusion would confirm the first hypothesis. The results from model 5 show increased negative Herfindahl coefficients compared to model 3. In particular the Herfindahl coefficients for asset management and independent control

[9] Refer to e.g. Figure 7 or Table C1 in the appendix.

functions strongly decreased, to -1.129 and -0.903 respectively. At the same time, random variation has grown as the confidence intervals have become wider. All results are statistically insignificant at a 10% confidence level, except for independent control functions and management board supervisory functions. The coefficient for independent control functions is strongly negative, similar to model 3. On the other hand, management board supervisory functions switched sign and now shows a significant positive relation.

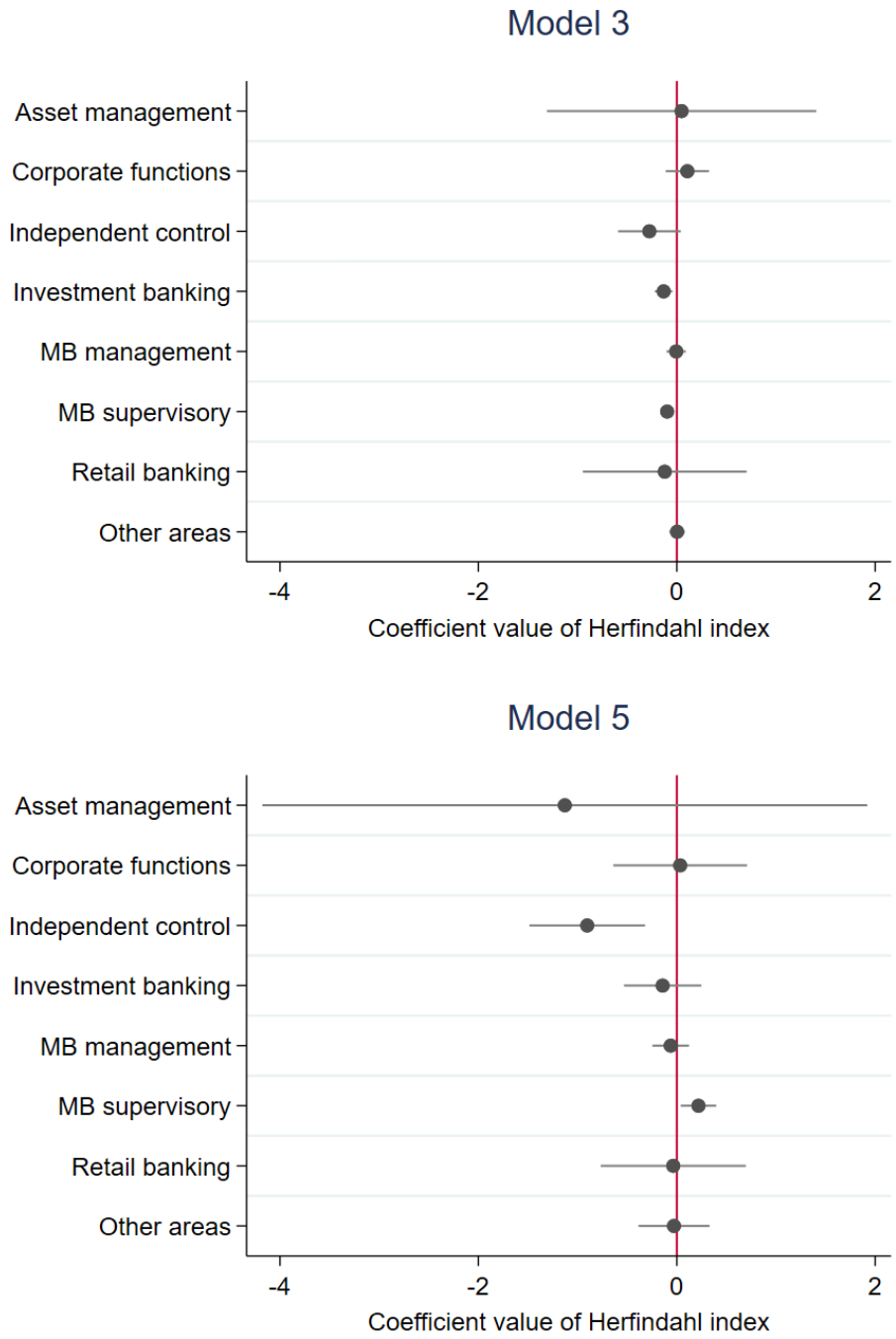


Figure 6. Herfindahl coefficient estimates per banking activity, country-fixed effects model 3 and 5

This figure shows the coefficient values of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. The dots represent coefficient values. Spikes show the 95% confidence interval. The sample

includes aggregate numbers per banking activity for countries between 2010 and 2021. Coefficient values are provided for country-fixed effects model 3 and 5. Model 3 includes control variables for the Herfindahl index and output gap. Model 5 is extended by adding interaction terms between (i) year and output gap, and (ii) country and year. Both models use robust standard errors, clustered at a country level. As the figure shows, 2010 serves as reference year.

Bonus cap results

So far I have presumed that competition has had a stable effect on bonus shares over time. However, this may not necessarily be the case. The variable-to-fixed pay ratio has changed significantly in Europe after the introduction of the bonus cap in 2014.[10] It is possible that the underlying competitive mechanism has changed too due to the bonus cap. Therefore, this final analysis takes a closer look at the European bonus cap with respect to bonus shares and competition.

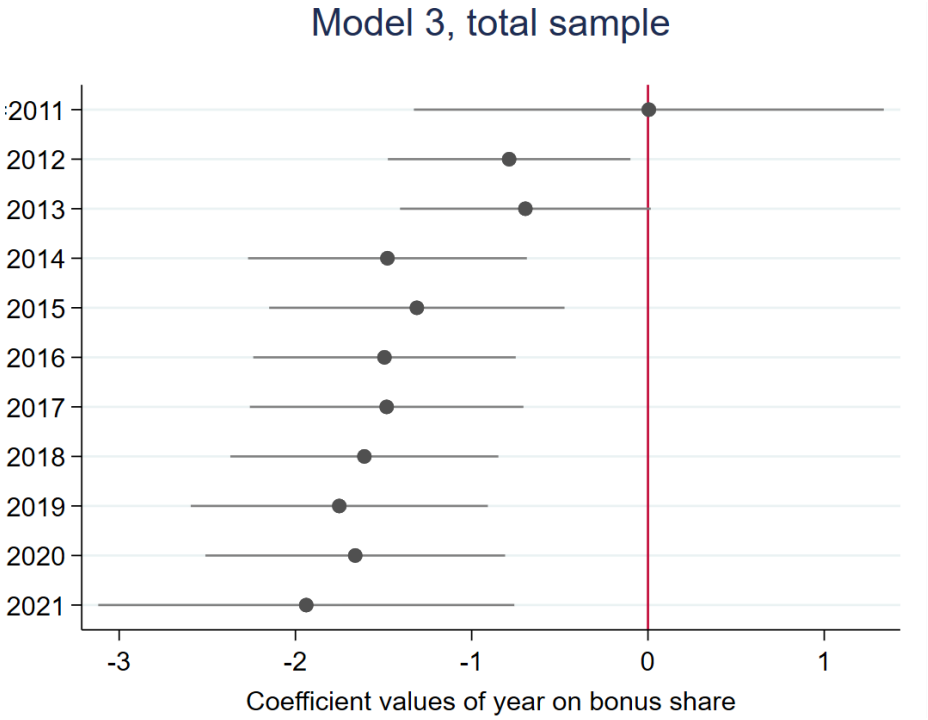


Figure 7. Year-fixed effects coefficient estimates, country-fixed effects model 3

This figure shows the year-fixed effect coefficient values on the ratio variable-to-fixed pay. The dots represent coefficient values. Spikes show the 95% confidence interval. The sample includes aggregate numbers on the European domestic banking sectors for countries between 2010 and 2021. The estimates are obtained through country-fixed effects model 3. This model includes control variables for the Herfindahl index and output gap. The analysis uses robust standard errors, clustered at a country level. As the figure shows, 2010 serves as reference year.

[10] For validation refer to Figure 3, Meekes and Ronchi (2021) or Colonello et al. (2023).

First we take a closer look at the country-fixed effects panel regression to examine how bonus shares developed over time. The analysis' year coefficients are graphically displayed in Figure 7. The coefficient plot shows coefficient values for model 3. Models 4 and 5 are not incorporated as these models have an interaction term between *year* and *output gap* and/or *country*, which makes interpretation difficult. Refer to Table C1 in the appendix for the precise coefficient estimates per banking activity.

Figure 7 shows that the variable-to-fixed pay ratio was at its peak in 2010 (the reference year) and 2011. The following two years, bonus rates already decreased significantly with about 70 percentage points. At time of the introduction of the bonus cap in 2014, variable-to-fixed pay decreased with an additional 70 percentage points. This sharp decrease seems to be permanent, as bonus shares remained relatively stable since 2014. If anything, bonus rates have slowly declined even further. Interestingly, the average European bonus share slightly increased in 2013, in anticipation of the bonus cap the year after. This result corresponds with the findings by Meekes and Ronchi (2021) for the Netherlands.

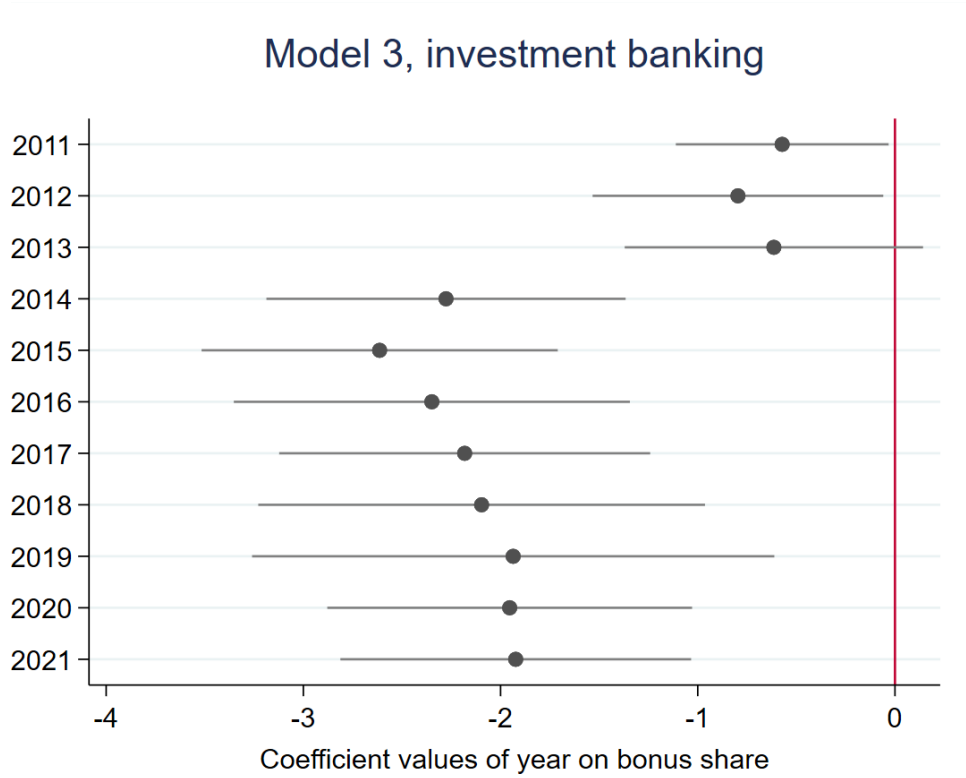


Figure 8. Year-fixed effect coefficient estimates for investment banking, country-fixed effects model 3

This figure shows the year-fixed effect coefficient values on the ratio variable-to-fixed pay. The sample includes the investment banking business area for countries between 2010 and 2021. The estimates are obtained through country-fixed effects model 3. This model includes control variables for the Herfindahl index and output gap. The analysis uses robust standard errors, clustered at a country level. As the figure shows, 2010 serves as reference year.

A heterogeneity analysis reveals that bonus shares developed differently across banking activities (for detailed results, refer to Table C1 in the appendix). Figure 8 presents the year-fixed effect coefficients for investment bankers. This pattern is different from the aggregate analysis. After the introduction of the bonus cap, it shows a 166 percentage points decrease in variable-to-fixed pay compared to 2013 for investment bankers, which is significantly stronger than the average. Moreover, bonus shares for investment bankers slowly increased again since 2014, unlike the average trend, which shows a continuous decrease.

Note that we must be careful with making precise estimates of the impact of the bonus cap based on the abovementioned graphs. The year-fixed effects capture joint yearly changes for the entire European sample. Therefore the 2014 coefficient value encapsulates all possible factors that caused a change in variable-to-fixed pay in 2014. The European bonus cap will likely be a decisive factor for the negative change in bonus shares, yet it may not necessarily be the only one.

Table 5. Country-fixed effects panel regression results with regard to the bonus cap

Ratio variable-to-fixed pay	Total sample			Investment banking		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Herfindahl index *(pre bonus cap)*	0.071 (0.105)	0.067 (0.062)	0.151* (0.074)	-0.168*** (0.051)	-0.125** (0.047)	-0.151 (0.203)
Herfindahl index # Bonus cap	-0.078*** (0.027)	0.036 (0.033)	0.029 (0.030)	-0.118*** (0.022)	0.029 (0.040)	0.007 (0.050)
Output gap	-0.006 (0.030)	-0.003 (0.030)	-0.011 (0.156)	-0.071 ((0.042)	-0.035 (0.049)	-0.160 (0.111)
Country FE	YES	YES	YES	YES	YES	YES
Year FE		YES	YES		YES	YES
Year # Output gap			YES			YES
Country # Year			YES			YES
Constant	1.215	1.874**	-507.701***	4.143***	4.632***	-531.429***
Number of countries	22	22	22	18	18	18
Observations	212	212	212	168	168	168

This table shows the country-fixed effects panel regression estimates of the Herfindahl index before and after 2014 on the ratio variable-to-fixed pay. As Bonus cap is 0 for the years before 2014 and 1 for the years after, the interaction term between Herfindahl index and Bonus cap quantifies the post-bonus cap Herfindahl coefficient.

*The table employs two different samples. The total sample includes numbers on the European domestic banking sectors for countries between 2010 and 2021. The investment banking sample contains country-aggregate numbers of the subsample of investment bankers. Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. For model 2 and 3, the year 2010 serves as reference year for the year-fixed effects. Note that especially the constant for model 3 should not be interpreted. This constant is strongly negative, since year is included as a continuous variable in the country interaction term to control for a steadily inclining yearly trend. Robust standard errors are clustered at a country level and denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Finally, I investigate whether the relation between competition and variable-to-fixed compensation has changed in Europe after the introduction of the bonus cap in 2014. To that extent I apply a country-fixed effects panel regression that distinguishes between the period before and after 2014. A bonus cap dummy indicates whether the bonus cap was in force (value 1) or not (value 0).

Table 5 contains the results for both the total sample and the subsample of investment bankers. Starting with model 1, we find a positive pre-bonus cap Herfindahl coefficient for the total sample. This coefficient is insignificant, which might be due to the limited amount of datapoints. In contrast, the pre-bonus cap coefficient for investment banking is -0.168 and significant at a 1% confidence level. This means that before the introduction of the bonus cap, competition was positively related to investment bankers' bonus shares. Additionally, model 1 displays negative post-bonus cap Herfindahl coefficients for both the total sample and the investment banking subsample. The coefficient is presumably negative due to the impact of the bonus cap, decreasing variable-to-fixed pay ratios from 2014 onwards. Both post-bonus cap coefficients are significant at a 1% confidence level.

Turning to model 2 and 3, we find insignificant post-bonus cap Herfindahl coefficients for both the total sample and the investment banking subsample. This is attributable to the added year-fixed effects, which absorb the year-by-year fixed changes in bonus shares. Consequently, the effect of the bonus cap (among other things) will be captured in the year-fixed effects. As a result, the post-bonus cap Herfindahl coefficient now measures if the relation between competition and bonus shares changed after 2014. As the coefficients for both samples are highly insignificant, there is no conclusive evidence that the interaction between competition and bonus rates significantly changed due to the introduction of the European bonus cap.

At last, I graphically examine heterogeneous developments in bonus shares for different domestic competition levels. Figure 9 shows how bonus shares developed over time for highly competitive, mediumly competitive and mildly competitive financial markets. For this figure, all countries have been divided into three groups, based on the average competitiveness of their financial markets in 2010-2021. The figure shows that countries with highly competitive financial markets experienced a sharp drop in bonus shares in 2014, whereas this pattern is less visible for countries with averagely competitive markets and almost absent for countries with mildly competitive financial markets. This implies that the bonus cap may have had a greater effect on the variable-to-fixed pay ratio for countries with a more

competitive banking sector. Refer to figure D1 in the appendix for background on the competition-group formation.

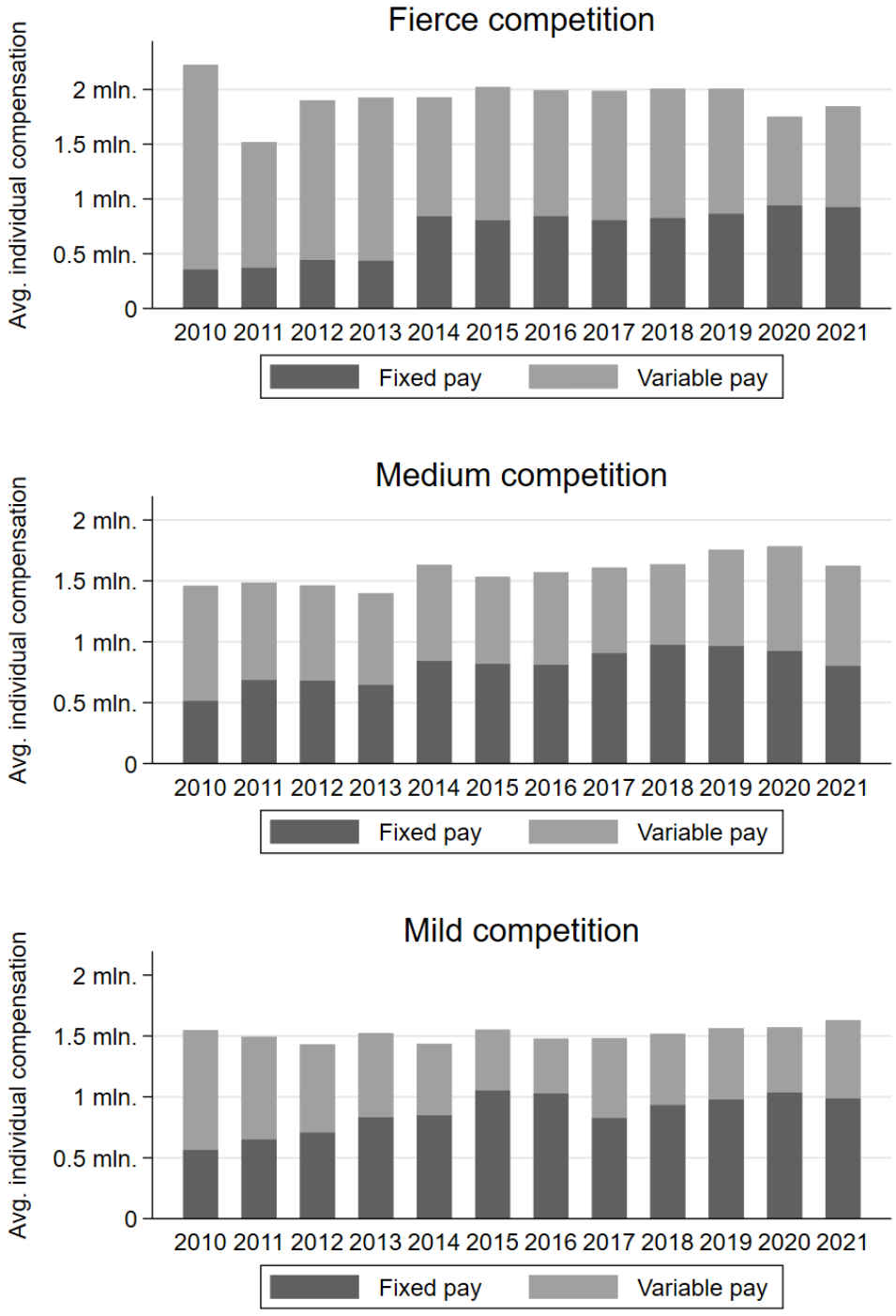


Figure 9. Compensation structure for three categories of countries, based on the competitiveness of their financial markets

This figure shows average individual pay for high earners at European credit institutions, broken down into a fixed and variable component. Countries are divided into three equal groups, based on the average competitiveness of their financial markets for the period of 2010-2021. Average compensation is measured in euros on an aggregate European group level.

7. Discussion

Theoretical reflection

The results I have found partly support the existing literature on competition, bonus shares and bonus caps. Below I will summarize the three main results and discuss how they relate to the existing theories and empirical evidence.

1. Although the results for the total domestic banking sectors are predominantly inconclusive, the most elaborate country-fixed effects panel analysis (model 5) points towards a negative relation between competition and bonus shares within Europe.

The negative aggregate results do not correspond with the predominant theoretical literature. Based on the theoretical studies by Bénabou and Tirole (2016), Glode and Lowery (2016), and Bijlsma et al. (2018), we would expect a positive relation between competition and bonus shares. After all, they argue, stronger labor market competition drives banks to offer higher bonus rates in order to attract and retain the most talented employees. What might be the reason why the aggregate empirical results deviate from the theoretical predictions? First of all, systematic measurement errors in the variable and fixed pay components may cause bias, as I will explain in the limitations section. Moreover, unobserved variables can cause omitted variable bias when they influence both competition and bonus rates. In such case, the remuneration data gives an incorrect representation of the underlying competitive mechanism. I identified two expected omitted variables: firm size and firm profits.

First of all, firm size is likely to be negatively related (or affected) by competition and simultaneously have a positive effect on the ratio variable-to-fixed pay. As the Herfindahl index measures market concentration, higher Herfindahl values may depict a financial market with only a few big credit institutions, whereas lower Herfindahl values may represent a financial market with a large amount of smaller credit institutions. This way, the Herfindahl index may be positively related to firm size. Or, alternatively, firm size may be negatively related to competition. At the same time, firm size seems to be positively related to bonus shares. Literature empirically found that bigger firms pay higher shares of variable pay to their executives and high-level employees (Gabaix & Landier, 2008; Stieglitz & Wagner, 2020). Arguably, this is because key employees at bigger firms have higher marginal returns to effort, which translates to higher bonuses. Altogether, this means that mildly competitive financial markets may accommodate bigger firms that pay higher shares of bonus pay. Hence, a negative relation between competition and bonus rates, offering a plausible explanation for the results I found.

A second possible explanation involves firms' profits. According to traditional economic theory, stronger competition deteriorates firms' profits. Since my analysis only contains high earners, who often have high-ranking positions, it is likely that their compensation heavily depends on the banks' profits. Assuming that fixed pay is less susceptible to annual profit changes than variable pay, this would result in a positive relation between profit and bonus shares. Altogether, when a country experiences a shock that increases competition, this mechanism could lead to lower bonus rates. To account for this problem, the analysis includes *output gap* as a control variable. Yet, the business cycle is not necessarily a good indicator for credit institutions' profits and therefore the abovementioned profit-mechanism cannot be ruled out.

2. Contrary to the aggregate results, heterogeneity results frequently show a positive relation between competition and variable-to-fixed pay among top bankers in independent control functions and investment banking.

When each banking sector is investigated separately, the results strongly diverge from the aggregate analysis. For most banking activities, the results are inconclusive.[11] Yet for independent control functions, and to a lesser extent investment banking, the country-fixed effects panel analysis shows a consistent and statistically significant positive relation between competition and the variable-to-fixed pay ratio. This is indeed in line with the theoretical predictions by Bénabou and Tirole (2016), Glode and Lowery (2016), and Bijlsma et al. (2018). But why do independent control functions and investment banking in particular stand out, whereas others banking activities do not?

First of all, it may be that investment banking and independent control functions rely less on firm-specific knowledge, and instead involve more general and industry specific skills and knowledge. This in turn could cause higher labor mobility for investment bankers and independent control functions, compared to employees in other functions. Therefore labor market competition could be more fierce for investment banking and independent control functions, so that only in these sectors a competitive bidding process results in higher bonus shares. Such an argument is in line with Jovanovic (1979), who argues that more firm-specific human capital will likely result in lower separation rates and a so-called 'job tenure effect'. Moreover, this line of reasoning relates to models about firm specific versus general training by e.g. Acemoglu and Pischke (1998). Although the theory in general seems plausible, there is little evidence that it actually applies to my findings. It is difficult to verify that investment banking and independent control functions are indeed less dependent on firm-specific knowledge than other business areas, such as management functions or retail bankers.

Secondly, the theory by Glode and Lowery (2016) could offer a (partial) explanation for the heterogenous results. The authors make a distinction between bankers and traders; whereas bankers identify profitable investment opportunities and increase total surplus, traders only help to make the most profitable trades at costs of other firms. This way, hiring a trader imposes a negative externality on other firms. As firms try to attract the most talented traders and prevent them from working at rival firms, a competitive bidding process results in escalating bonus rates. For bankers, this is not the case, resulting in lower wages and bonus shares among bankers. Applying this theory on my results, it could indeed explain why only investment banking shows a significant negative relation between competition and bonus shares. After all, investment banking activities consist for a large part of trading and sales.[12] However, the theory does not provide an explanation for the results for independent control functions. The precise mechanism behind my heterogenous results remains therefore uncertain.

3. On average, the variable-to-fixed pay ratio in Europe decreased after the introduction of the bonus cap. However, countries with a more competitive banking industry experienced a larger

[11] Results are inconclusive for asset management, corporate functions, MB managers, MB supervisory functions, retail banking and other functions.
[12] Refer to Appendix A for an extensive list on all banking activities.

and more sudden drop in bonus rates compared to countries with less competitive financial markets.

Though the evidence in itself is not causal, the bonus cap seems to have had a stronger impact for countries with a more competitive banking industry. This corresponds with the findings by Bénabou and Tirole (2016). The authors propose a bonus cap to cope with the negative externalities of excessive bonus pay. Their argument is that if a maximum ratio between variable and fixed pay is established, firms cannot offer excessive bonuses anymore to compete for the most talented employees. Instead, competition will shift to the fixed pay component. According to this theory, a bonus cap will only be effective for countries that suffer from escalating performance pay due to fierce competition to begin with; for countries that do not experience such competitive process, a bonus cap will not make any difference. This indeed can be observed in the data. As countries with mildly competitive financial markets experienced relatively low bonus rates before 2014, their trend hardly changed after introduction of the bonus cap.

Furthermore, Bénabou and Tirole (2016) argue that a bonus cap will shift the margin of competition from the variable to the fixed pay component. Total pay therefore remains constant and only fixed pay vis-à vis variable pay should change. This is indeed what happened when the European bonus cap was established. Looking at the compensation structure over time for countries with competitive financial sectors, we observe an increase in fixed pay and a decrease in variable pay, leaving total pay unaffected. These findings also correspond with previous bonus cap studies by Meekes and Ronchi (2021) and Colonello et al. (2023).

Robustness

In order to test the robustness of my results, I alter the country-fixed effects models by looking at the ratio of variable-to-total pay, instead of variable-to-fixed. Figure 10 shows that the ratio variable-to-fixed compensation is highly skewed to the right; most observations lie between 0 and 2, yet a few outliers take extreme values of 5, 6, or even 18. As an OLS regression is sensitive to outliers, the main analysis could contain biased estimates. Therefore, as a robustness check, I also conduct the analyses with variable-to-total pay ratio as dependent variable. This ratio follows a distribution closer to the normal distribution, so that it is less susceptible to the distortive effect of outliers (see Figure 10).[13] For completeness, all country-fixed effects models have been conducted with variable-to-total pay ratio. The exhaustive robustness results are provided in the appendix.

[13] Similar to this method, I could have also applied a logarithm on the variable-to-fixed pay ratio. This would also alter the distribution (see Figure E1 in the appendix). Though this method is often applied, in my case it would introduce another problem as ratios of 0 cannot be included in the log analysis. Therefore, making use of the variable-to-total pay ratio is more appropriate in this case.

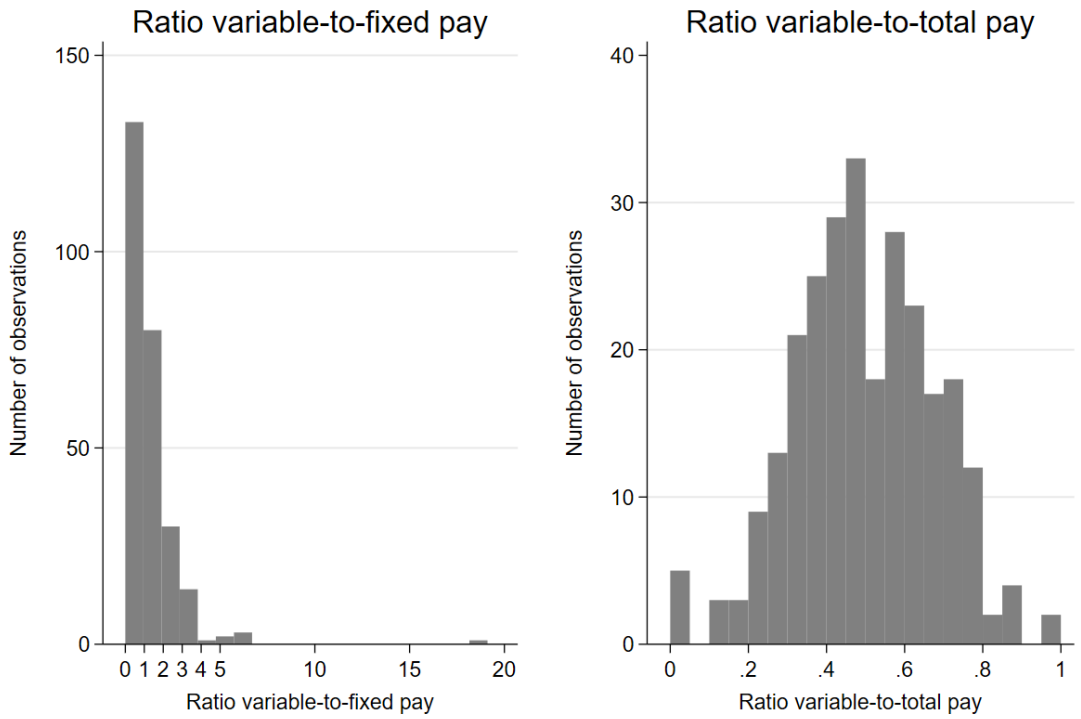


Figure 10. Distribution of observed pay ratios, total observations for 2010-2021

This figure shows the distribution of average variable-to-fixed and variable-to-total pay ratios for high earners at European credit institutions. The sample includes average observations for the total banking sector per year and country between 2010 and 2021.

Upon first inspection, the results on the total banking sector have not changed much compared to the main analysis. The country-fixed effects results display a positive relation between Herfindahl index and variable-to-total pay when controlling for year-fixed effects, similar to the main analysis. The findings from the robustness check even appear to hold greater statistical significance than those of the primary analysis. Furthermore, the year-by-year pattern of the year-fixed effects is almost identical to the main analysis. Finally, it also seems to be the case that the bonus cap has had a greater effect on the variable-to-total pay ratio for countries with a more competitive banking industry. Therefore, the results on the total banking sector seem robust. For the detailed analyses, refer to Table E1 until Table E6 in the appendix.

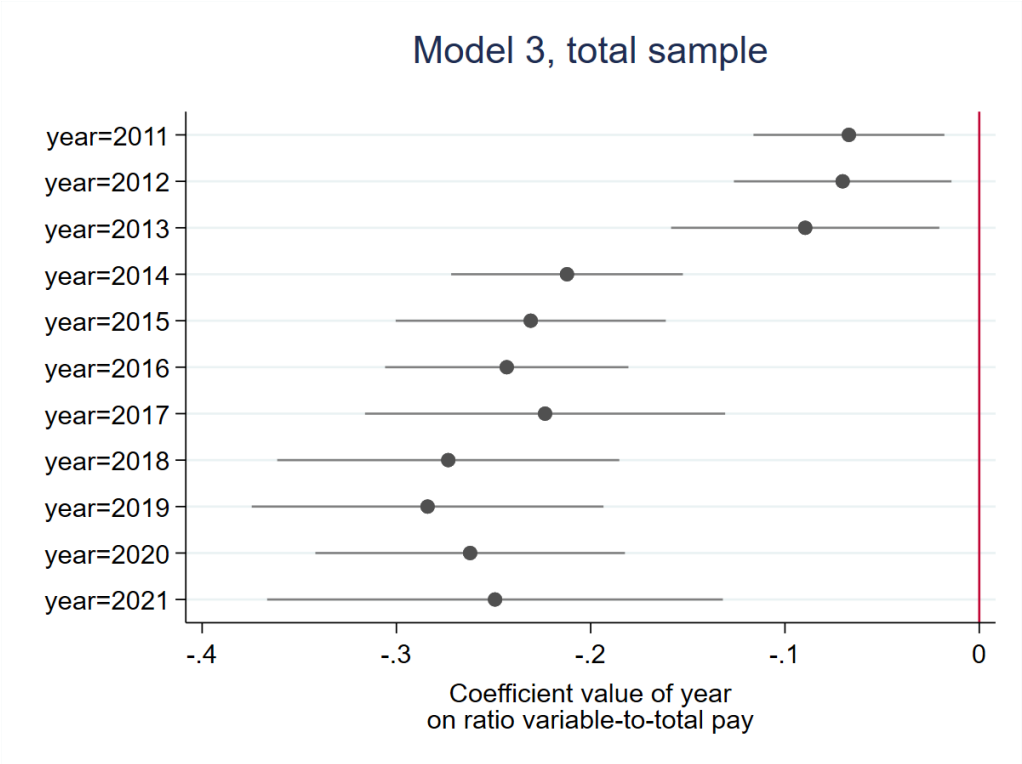


Figure 11. Year-fixed effect coefficient estimates, country-fixed effects model 3 (robustness check)

This figure shows the year-fixed effects coefficient values on the ratio variable-to-total pay. The dots represent coefficient values. Spikes show the 95% confidence interval. The sample includes numbers of domestic banking sectors for countries between 2010 and 2021. The estimates are obtained through country-fixed effects model 3. This model includes control variables for the Herfindahl index and output gap. The analysis uses robust standard errors, clustered at a country level. As the figure shows, 2010 serves as reference year.

The heterogeneity results, on the other hand, seem somewhat less robust to the use of the variable-to-total pay instead of variable-to-fixed pay ratio. As shown in Figure 12, the heterogeneity results from the country-fixed effects panel regression have lower statistical significance compared to the primary analysis. With respect to model 3, none of the results are statistically significant at a 10% confidence level. This differs from the main analysis, which contains significant results for investment banking, independent control functions and management board supervisory functions. Finally, the results for model 5 are to a large extent robust: it shows a significant negative coefficient for independent control functions and a significant positive coefficient for management board supervisory functions, similar to the main analysis.

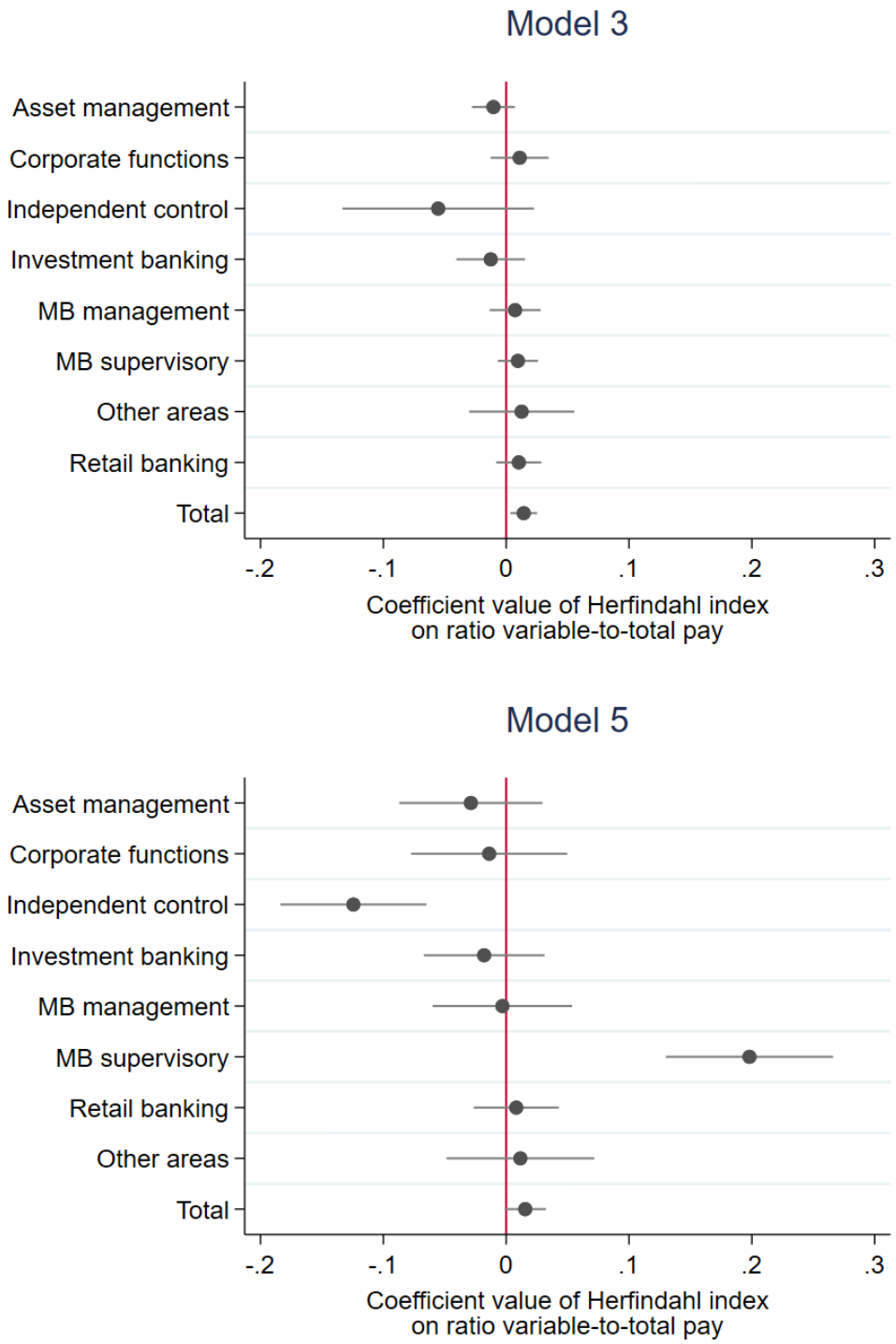


Figure 12. Herfindahl coefficient estimates on variable-to-total pay per banking activity

This figure shows the coefficient values of the Herfindahl index on the ratio variable-to-total pay, split out per banking activity. The dots represent coefficient values. Spikes show the 95% confidence interval. The sample includes aggregate numbers per banking activity for countries between 2010 and 2021. Coefficient values are provided for country-fixed effects model 3 and 5. Model 3 includes control variables for the Herfindahl index and output gap. Model 5 is extended by adding interaction terms between (i) year and output gap, and (ii) country and year. Both models use robust standard errors, clustered at a country level. As the figure shows, 2010 serves as reference year.

Limitations

The applied analyses and methodologies in this thesis have some important limitations. It is crucial to understand these limitations in order to draw the correct conclusions and recognise the added value of this study.

The first and foremost limitation concerns the causality of my results. As mentioned, the country-fixed effects panel analysis aims to establish the causal effect of competition on variable-to-fixed pay among high earners at European credit institutions. However, only when assuming that the conditional independence assumption holds, the results can actually be interpreted causally. In reality, the conditional independence assumption will likely be violated; there may be many unobserved variables that are correlated with both the Herfindahl index and bonus rates. Especially if workers self-select into different sectors based on the degree of competition, this may lead to unobserved characteristics that impact the wage components (Lazear, 2000a; Cuñat & Guadalupe, 2009).

I have tried to overcome omitted variable bias by applying year-fixed and country-fixed effects. Though these account for fixed yearly shocks in bonus shares and time-invariant differences between countries, they cannot control for time-varying differences. Some evident (time-varying) omitted variables have been discussed in the previous section already. Firm size, for example, may constitute an important omitted variable, as it could be positively associated with the Herfindahl index and simultaneously have a positive effect on bonus shares. Another example is banks' profits. A final omitted variable that has not been discussed yet is domestic financial regulation. As Philippon and Reshef (2012) show, financial sector regulations have varied greatly over time and strongly interact with wages and the amount of human capital in the financial sector. Moreover, it seems likely that financial regulations can also affect the competitive landscape for domestic credit.[14] Hence, financial regulations could be another plausible omitted variable. Altogether, the presence of omitted variables results in the inability to interpret my findings causally. Still, the relational evidence put forward in this thesis is suggestive and can be a good starting point for future research.

Another point of concern is the definition of 'variable compensation' that is used for the data collection. The EBA guidelines define variable remuneration as all payments and benefits that depend on performance, hence including variable cash, share and instrument payments (EBA, 2014). However, as Kokkinis (2019) points out, this may not necessarily be an accurate reflection of actual performance pay. The author demonstrates that major UK banks have tried to circumvent the European bonus cap by implementing fixed share pay allowances. These are fixed payments made in shares, which issuance does not depend on performance so that they legally qualify as fixed pay. Nevertheless, the true value

[14] An important sidenote is that financial regulation is increasingly harmonized throughout Europe. This will likely reduce the omitted variable bias due to financial regulation, since between-country differences in regulation become smaller.

of the fixed share allowances still partly depends on performance, as share prices can be influenced through performance. My dataset only contains information on instrumental pay from 2013 onwards, therefore I cannot reliably assess if such a pattern indeed emerged in 2014.

With particular respect to the bonus cap analysis, there are two main limitations. First, the analysis cannot guarantee that the observed results are actually caused by the introduction of the bonus cap. The country-fixed effects panel regression only includes EU countries that became subject to the bonus cap in 2014. Therefore the analysis lacks a suitable control group. Accordingly, the bonus cap analysis is de facto a simple before-after comparison and not suitable for reliable causal estimations. Yet, this does not mean that the results are totally valueless; when analysing bonus shares over the years, we find a remarkable change in the trend for most EU countries, precisely after the introduction of the bonus cap in 2014. Simultaneously there is, to the best of my knowledge, no alternative policy change in 2014 that could have drastically affected the bonus rates among EU credit institutions. Though omitted variable bias could be the sole reason for the observed results, in my view, this seems unlikely. It seems safe to say that the results are at least partly driven by the bonus cap. The concerns merely imply that, based upon the before-after comparison, it is not possible to make a reliable estimation of the exact impact of the European bonus cap due to the lack of an appropriate control group.

Lastly, the bonus cap analysis is subject to some implementation noise. As discussed in chapter 3, the bonus cap stems from the CRD IV. This directive establishes a lower bound and guarantees an ultimate bonus share of 100% for material risk takers at European credit institutions, or 200% with shareholders' approval. However, countries may decide to enforce it differently and set lower boundaries. The Netherlands and Belgium, for example, apply a bonus cap of 20% and 50% respectively (PWC, 2017). Moreover, the definition of material risk taker leaves room for interpretation. All this makes it difficult to speak in terms of 'the bonus cap', since in practice there are many slightly different versions of the bonus cap across Europe. Consequently, doing precise aggregate European estimations on the effect of the bonus cap is complicated. For that purpose, a country-level analysis may be a better fit. The implementational differences between countries can be an interesting topic for future research.

8. Conclusion

This thesis has aimed to empirically examine the effect of competition on the variable-to-fixed pay ratio among high earners within domestic banking sectors in Europe. Although the results are mixed, evidence from a country-fixed effects panel regression predominantly points towards a negative relation between competition and bonus shares for bankers in general. This is at odds with the leading theories, suggesting that stronger competition drives banks to increase bonus shares in order to retain and attract the most talented employees. Omitted variables are a likely cause for the discrepancy. Especially firms size and firm profit could offer a plausible alternative theory why stronger competition may lead to lower variable-to-fixed pay for high-level employees and executives. Though aggregate results suggest a negative relation, a heterogeneity analysis uncovers a divergent pattern for independent control functions and investment banking. Despite mixed outcomes, the findings provide evidence that stronger competition within a country is related to higher variable-to-fixed pay ratios for these banking activities. It remains unclear why this is the case for investment banking and independent control functions in particular. This question remains for future study.

Besides the competition analysis, this thesis demonstrated how bonus shares have evolved after the introduction of a European bonus cap in 2014. I find an average drop in variable-to-fixed pay of about 70 percentage points from 2013 to 2014, whilst total pay remained roughly unaffected. This decrease seems to be permanent, as bonus shares remained relatively stable after 2014. Though the results in itself cannot be interpreted causally, they offer a strong indication that the bonus cap has had a significant effect on bonus shares. Interestingly, countries with a more competitive banking industry experienced a sharp drop in bonus rates after the introduction of the bonus cap, whereas the trend for countries with less competitive financial markets hardly changed. This corresponds with theories proposing a bonus cap as a solution to escalating performance pay due to a competitive bidding process for the best-performing employees.

The most important limitation of this thesis is the lack of causal evidence. The observed results may well be attributable to mechanisms that have not been captured in my models. An interesting discussion is the role of firm size and firm profit in relation to bonus shares and competition. Furthermore, the question remains whether competition affects the compensation structure for lower-paid employees too. These topics remain to be explored in future research.

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Appendix A

Comprehensive list of banking activities and business areas

The EBA remuneration data (country level) distinguishes eight different banking activities or business areas. The exact interpretation of all activities is provided by the EBA's guidelines on the data collection regarding high earners (EBA, 2014). The list of banking activities below has been extracted from these guidelines:

1. *"Management board supervisory functions: this includes the members of the supervisory management body.*

2. *Management board management: this includes the executive members of the management body. Often the management consists of a chief executive officer (CEO), a chief financial officer (CFO), and sometimes a chief operating officer (COO) and/or a chief informational officer (CIO).*

3. *Investment banking: in general terms, investment banking focuses on attracting and increasing capital. More specifically, investment banking includes corporate finance advice services, private equity, capital markets, trading and sales.*

4. *Retail banking: this activity involves total lending activities to both individuals and enterprises.*

5. *Asset management: this activity includes portfolio management and other forms of asset management.*

6. *Corporate functions: this activity includes all functions that have responsibilities for the whole institution, such as human resource management (HRM) or IT functions.*

7. *Independent control functions: this includes all staff who is active in the independent risk management, compliance and internal audit functions.*

8. *Other functions: this includes all other staff who cannot be categorized into one of the other business areas."*

(Source: EBA guidelines for data collection, p. 11)

Additional figures, descriptive statistics

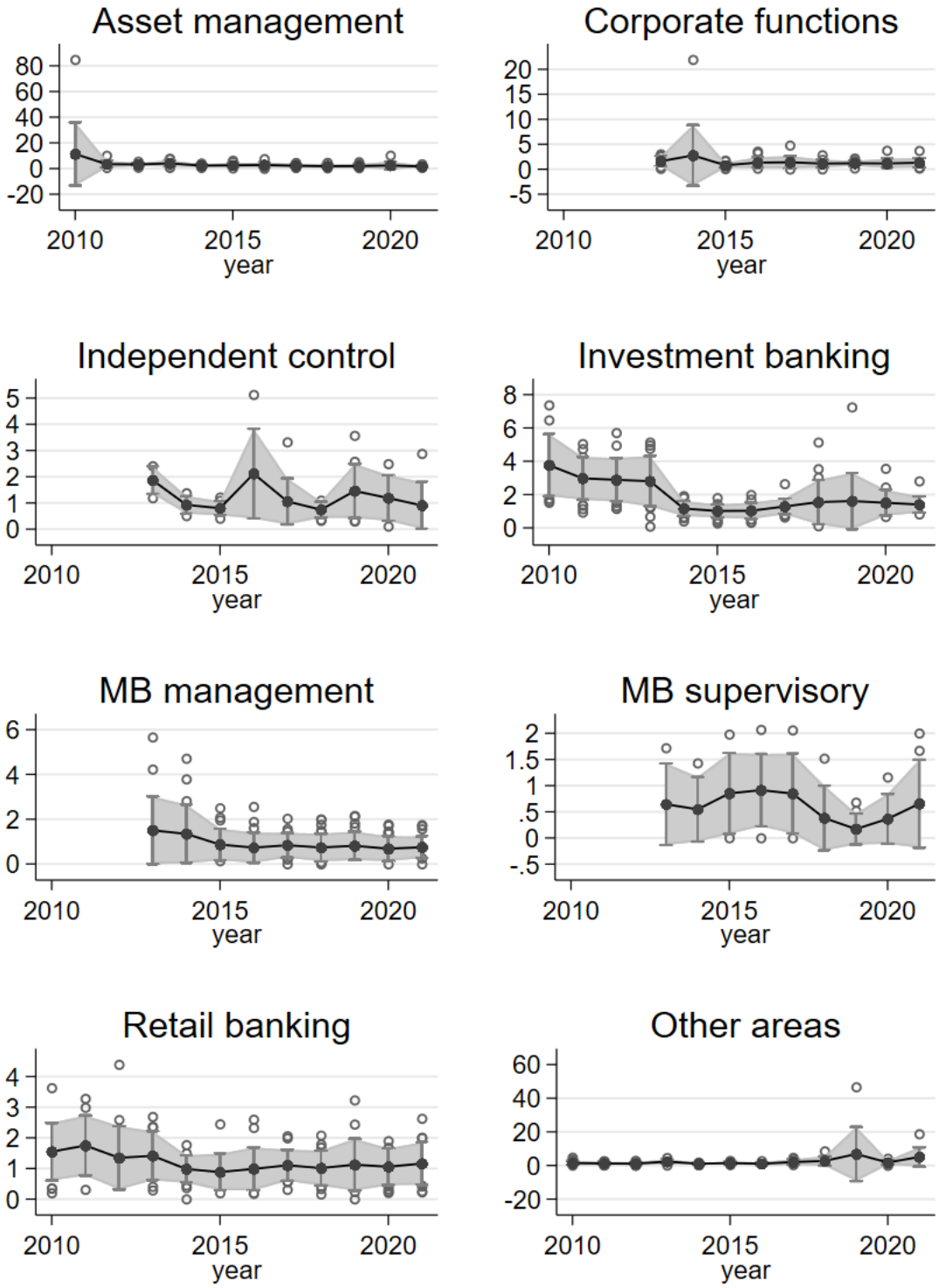

Figure A1. Distribution of variable-to-fixed pay ratios per banking activity

This figure shows the distribution of the variable-to-fixed pay ratio per banking activity. Graphs exhibit the mean and standard deviation for country averages in the period between 2010 and 2021. The white dots represent outliers.

Appendix B

Additional figures and tables, OLS panel regression analysis

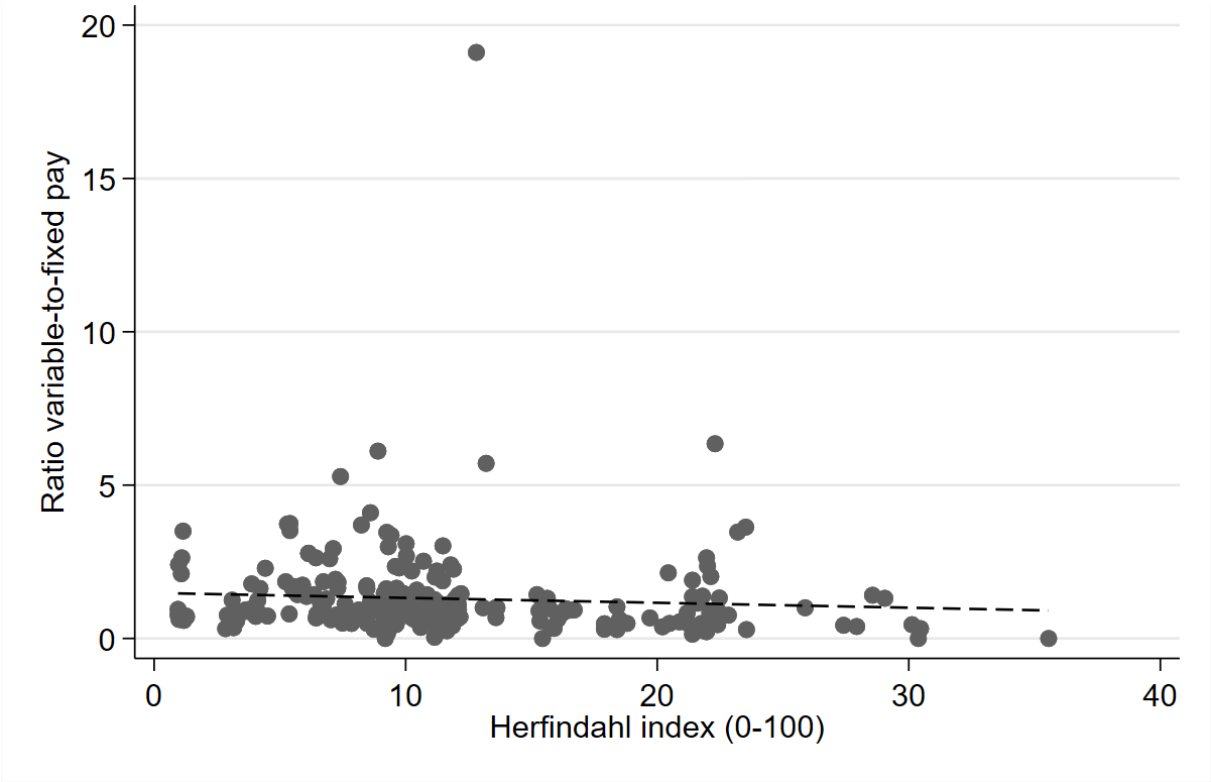

Figure B1. Scatterplot on the variable-to-fixed pay ratio and Herfindahl index, all observations for the period 2010-2021

This figure shows the relationship between the variable-to-fixed pay ratios and Herfindahl indices for the period 2010-2021. Yearly observations for all countries are included on the total banking sector. Herfindahl index is measured on a scale from 0-100.

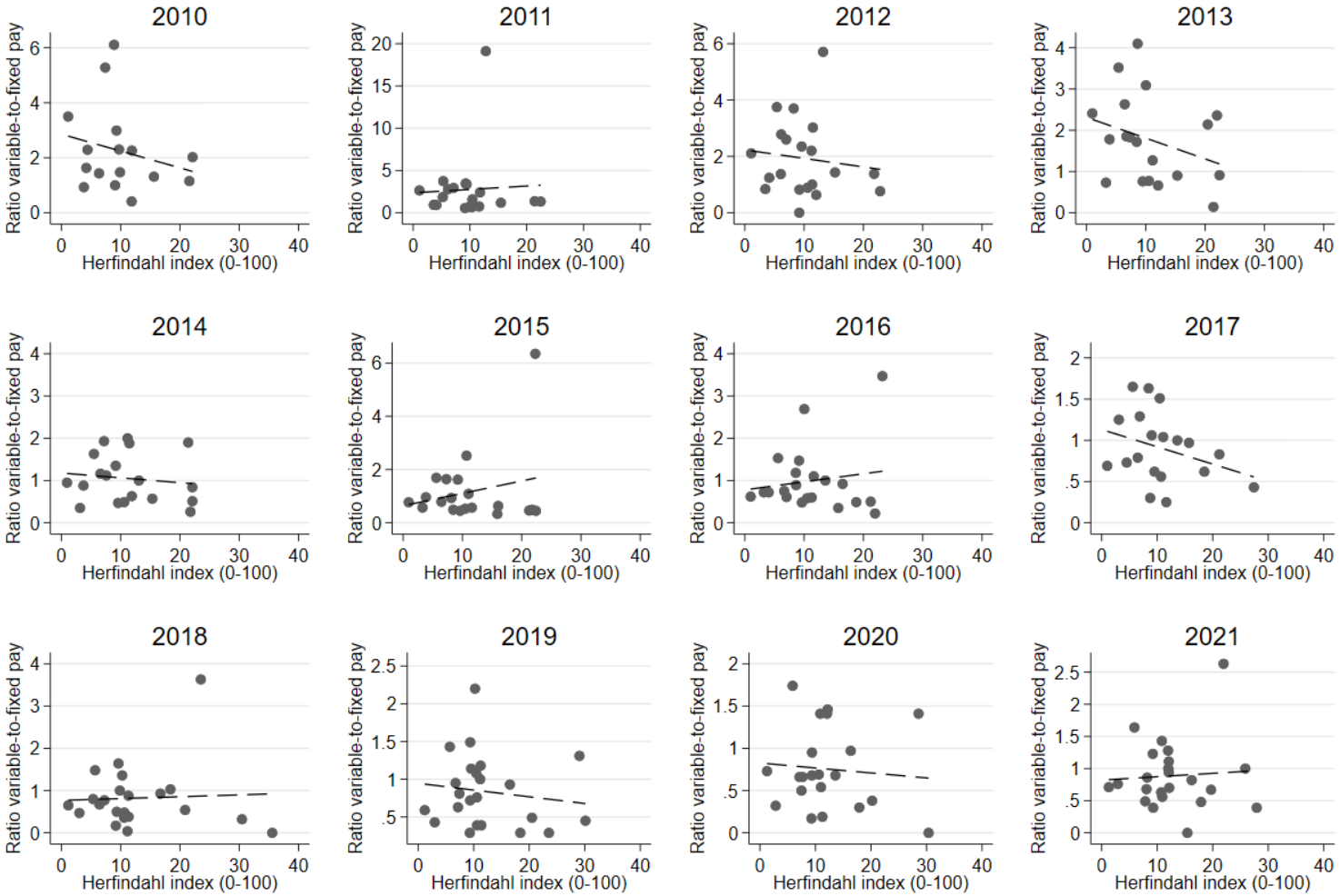

Figure B2. Scatterplots on the variable-to-fixed pay ratio and Herfindahl index, year by year for the period 2010-2021

This figure shows the yearly changes in the relationship between the variable-to-fixed pay ratio and Herfindahl indices. Plots display the observations for all countries on the total banking sector per year. Herfindahl index is measured on a scale from 0-100. At first sight, the relationship seems somewhat volatile since it often changes over the years. However, with a closer inspection we find that the results are strongly driven by outliers. If outliers were to be excluded, we would find a relatively stable negative correlation over the years.

Table B1. Cross sectional OLS regression results, heterogeneity analysis model 4

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	0.035 (0.067)	0.066* (0.036)	0.004 (0.023)	-0.017 (0.012)	-0.019** (0.008)	-0.009 (0.036)	-0.023** (0.009)	0.023 (0.048)	0.007 (0.016)
Output gap	-1.062 (1.368)	0.273** (0.107)	0.122*** (0.036)	-0.359*** (0.116)	0.002 (0.090)	-0.288 (0.188)	-0.048 (0.059)	-0.006 (0.146)	-0.285 (0.175)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year # Output gap	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	9.768	2.027***	2.253***	2.777***	1.520***	0.026	1.690***	1.300*	1.639***
Observations	127	105	65	168	144	42	163	119	212

*This table shows the OLS panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. Results are obtained through a split-sample analysis. For all subsamples of banking activities, a separate OLS regression was performed. Subsamples contain aggregate data for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap shows the deviation of actual GDP from potential GDP, as a percentage of potential GDP. Robust standard errors are denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Appendix C

Additional figures and tables, country-fixed effects panel regression

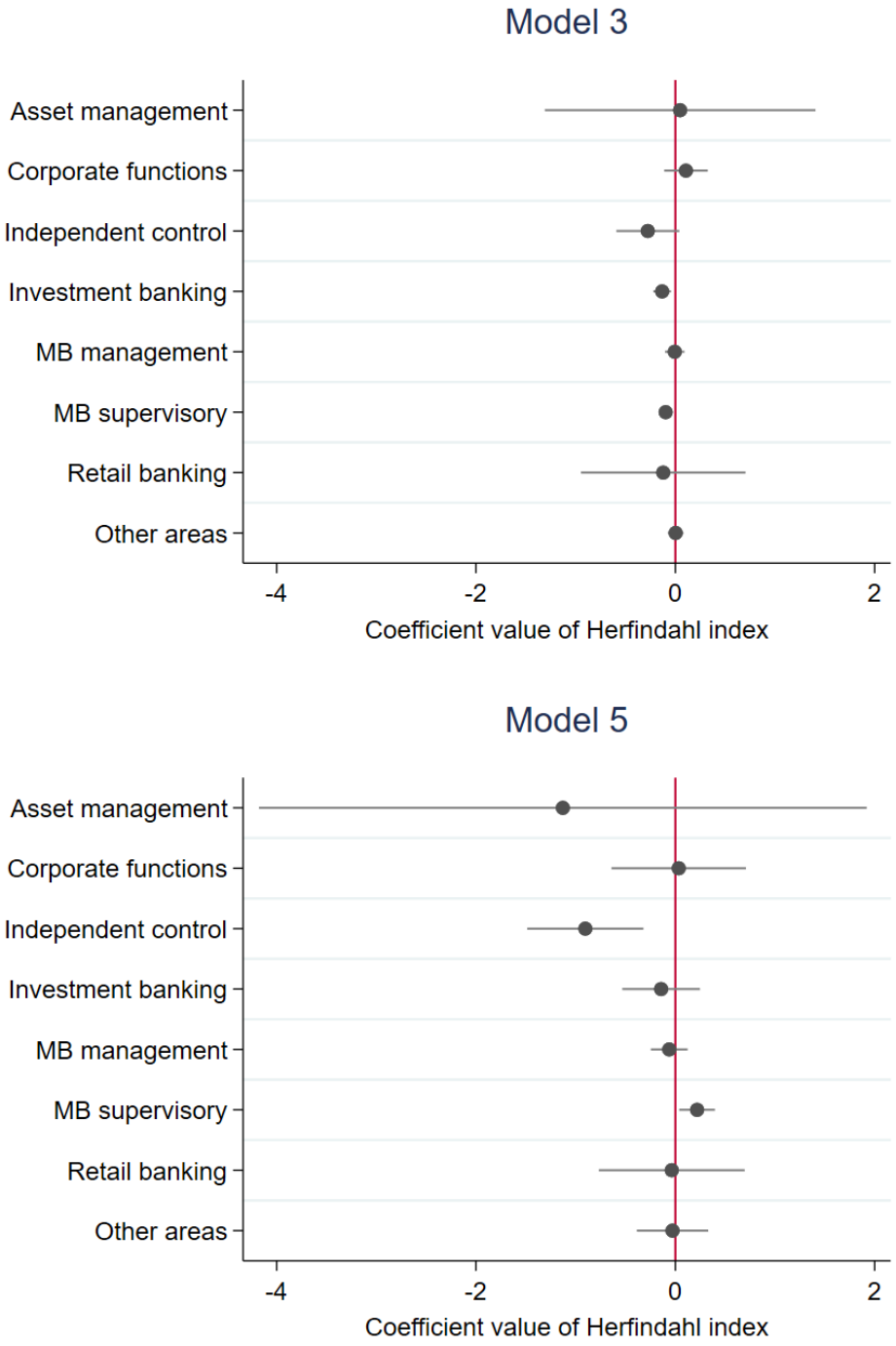

Figure C1 (*recap; also displayed in the main text*). Herfindahl coefficient estimates per banking activity, country-fixed effects model 3 and 5

Table C1. Country-fixed effects panel regression results, heterogeneity analysis model 3

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	0.048 (0.637)	0.106 (0.102)	-0.276* (0.146)	-0.132*** (0.042)	-0.006 (0.047)	-0.097*** (0.029)	-0.122 (0.391)	-0.122 (0.391)	0.085 (0.083)
Output gap	-0.087 (0.256)	0.105 (0.098)	-0.026 (0.075)	-0.035 (0.050)	0.019’ (0.018)	0.044 (0.107)	0.358 (0.378)	0.358 (0.378)	-0.004 (0.031)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE									
2010	*Reference year*			*Reference year*			*Reference year*	*Reference year*	*Reference year*
2011	-10.470 (9.514)			-0.572** (0.256)			0.240 (0.340)	-0.934 (0.568)	0.005 (0.641)
2012	-10.029 (9.878)			-0.796** (0.349)			-0.245 (0.345)	-1.041 (0.602)	-0.788** (0.331)
2013	-9.572 (10.082)	*Reference year*	*Reference year*	-0.614 (0.359)	*Reference year*	*Reference year*	-0.234 (0.245)	1.025 (0.889)	-0.695* (0.342)
2014	-11.043 (9.842)	0.978 (1.628)	-0.877*** (0.247)	-2.277*** (0.432)	-0.302 (0.231)	-0.208 (0.269)	-0.616* (0.295)	-1.964** (0.920)	-1.478*** (0.380)
2015	-10.941 (9.943)	-1.165** (0.510)	-0.937*** (0.271)	-2.613*** (0.428)	-0.410** (0.178)	-0.132 (0.359)	-0.638** (0.281)	-1.621 (1.166)	-1.311*** (0.403)

2016	-10.578	-0.723	0.354	-2.348***	-0.583***	-0.316	-0.472	-1.201**	-1.495***
	(9.730)	(0.812)	(1.088)	(0.476)	(0.185)	(0.596)	(0.298)	(0.530)	(0.358)
2017	-10.796	-1.083	-0.596	-2.182***	-0.546**	-0.422	-0.308	-0.593	-1.482***
	(9.858)	(0.797)	(0.494)	(0.446)	(0.223)	(0.686)	(0.331)	(0.770)	(0.373)
2018	-10.965	-1.394	-0.678	-2.096***	-0.659***	-0.529	-0.327	0.078	-1.609***
	(9.604)	(0.811)	(0.493)	(0.537)	(0.211)	(0.873)	(0.330)	(0.777)	(0.366)
2019	-11.111	-1.339	-0.094	-1.936***	-0.713***	-0.494	-0.160	2.971	-1.751***
	(9.899)	(0.843)	(0.657)	(0.628)	(0.221)	(0.953)	(0.376)	(4.452)	(0.405)
2020	-11.107	-0.541	-0.534	-1.954***	-0.598**	0.382	-0.756**	1.900	-1.661***
	(10.587)	(0.338)	(0.488)	(0.438)	(0.224)	(0.529)	(0.340)	(2.010)	(0.409)
2021	-11.512	-0.707*	-0.530	-1.923***	-0.519**	0.537	-0.544*	0.767	-1.939***
	(10.017)	(0.335)	(0.446)	(0.422)	(0.218)	(0.520)	(0.289)	(1.287)	(0.568)
Constant	12.831	1.363	3.963***	4.694***	1.422**	1.543***	1.373***	4.393	1.711*
Observations	127	105	65	168	144	42	163	119	212
Number of countries	16	16	14	18	21	11	18	18	22

*This table shows the country-fixed effects panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. Results are obtained through a split-sample analysis. For all subsamples of banking activities, a separate OLS regression was performed. Subsamples contain aggregate data for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. Robust standard errors are clustered at a country level and denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Table C2. Country-fixed effects panel regression results, heterogeneity analysis model 5

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-1.129 (1.430)	0.034 (0.316)	-0.903*** (0.270)	-0.143 (0.185)	-0.061 (0.088)	0.218** (0.080)	-0.029 (0.170)	-0.036 (0.347)	0.178** (0.072)
Output gap	-1.046 (1.726)	0.339 (0.348)	0.258 (0.220)	-0.160 (0.111)	-0.021 (0.063)	-0.108* (0.052)	0.227*** (0.067)	-0.005 (0.324)	-0.006 (0.158)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year # Output gap	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country # Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	1,302.623*	-226.495	-705.487*	-531.605***	-298.849***	-133.340*	-455.480***	-1,098.910	-521.088***
Observations	127	105	65	168	144	42	163	119	212
Number of countries	16	16	14	18	21	11	18	18	22

This table shows the country-fixed effects panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. Results are obtained through a split-sample analysis. For all subsamples of banking activities, a separate OLS regression was performed. Subsamples contain aggregate data for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. Note that the constants should not be interpreted; since year *is included as a continuous variable (in the country interaction term) to control for a steadily inclining yearly trend, the constants are strongly negative. Robust standard errors are clustered at a country level and denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Appendix D

Additional figures and tables, bonus cap analysis

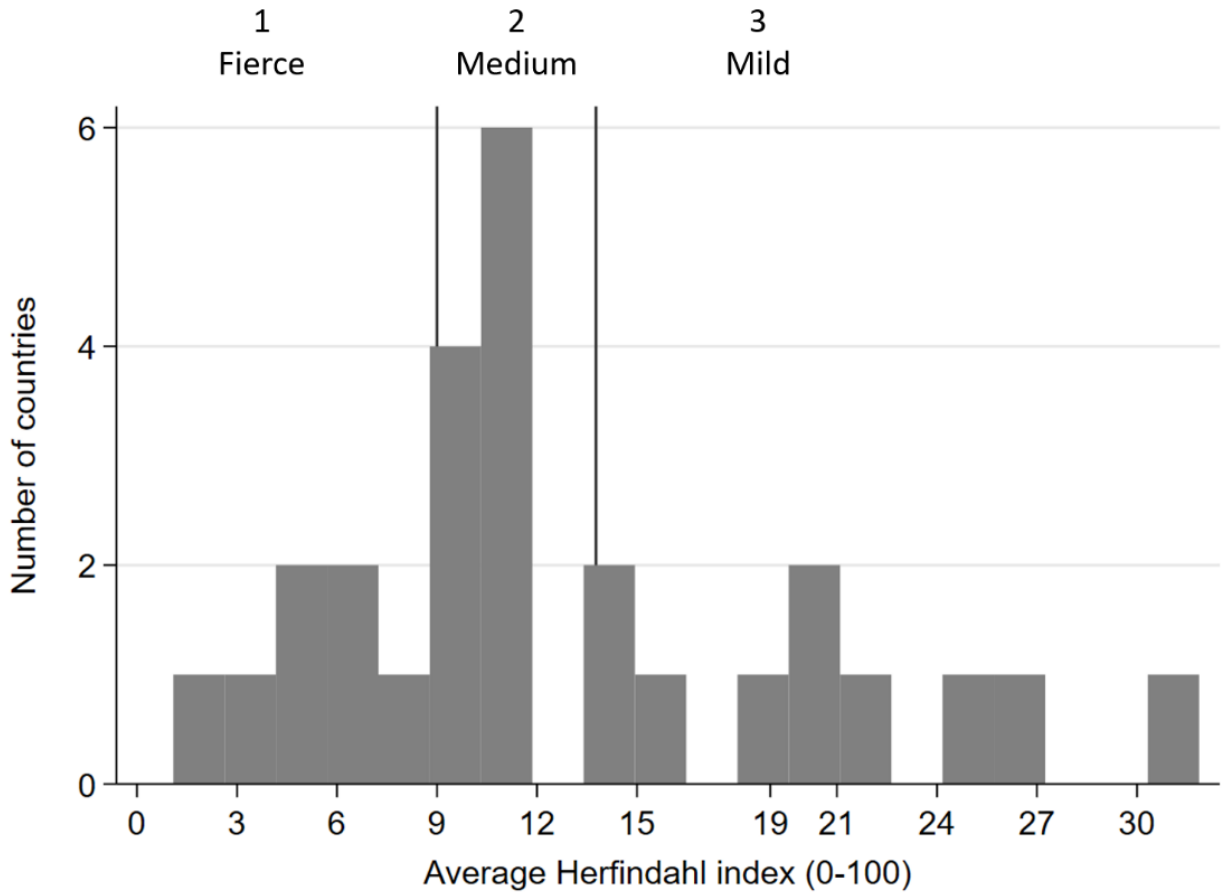

Figure D1. Distribution of countries based on their Herfindahl index, divided into three equal subgroups

This figure shows the distribution of countries based on their average Herfindahl index for the period of 2010-2021. The total group of countries is divided into three equally large subgroups. The first group is characterized by the lowest Herfindahl indices between 0 and 9.03, hence labelled fierce competition. The second group has Herfindahl indices between 9.04 and 13.77. The third group has mildly competitive financial markets as it displays the largest Herfindahl indices (13.78 and higher). Herfindahl indices are measured on a scale from 1-100.

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Table D1. Country-fixed effects panel regression results with respect to the bonus cap, model 1

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.568	0.009	-0.168	-0.168***	0.001	0.063	-0.018	-0.006	0.071
	(0.592)	(0.080)	(0.158)	(0.051)	(0.040)	(0.054)	(0.044)	(0.290)	(0.105)
Herfindahl index # Bonus cap	-0.287	-0.038**	-0.080*	-0.118***	-0.035*	-0.047	-0.034*	0.022	-0.078***
	(0.208)	(0.018)	(0.041)	(0.022)	(0.018)	(0.050)	(0.018)	(0.037)	(0.027)
Output gap	-0.108	-0.021	0.002	-0.071	-0.005	-0.036	-0.033	0.323	-0.006
	(0.111)	(0.064)	(0.019)	(0.042)	(0.011)	(0.026)	(0.033)	(0.390)	(0.030)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	10.060	1.657**	3.271**	4.143***	1.149***	0.312	1.517***	2.841	1.215
Number of countries	16	16	14	18	21	11	18	18	22
Observations	127	105	65	168	144	42	163	119	212

*This table shows the country-fixed effects panel regression estimates of the Herfindahl index on the ratio variable-to-fixed pay, split out per banking activity. Results are obtained through a split-sample analysis. For all subsamples of banking activities, a separate regression was performed. Subsamples contain aggregate data for countries between 2010 and 2021. The Herfindahl index is measured on a scale from 0-100. Output gap measures the deviation of actual GDP from potential GDP, as a percentage of potential GDP. Robust standard errors are clustered at a country level and denoted in parentheses. Stars represent: *** p<0.01, ** p<0.05, * p<0.1.*

Table D2. Country-fixed effects panel regression results with respect to the bonus cap, model 2

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	0.025 (0.666)	0.106 (0.100)	-0.315* (0.171)	-0.125** (0.047)	-0.021 (0.054)	0.039 (0.098)	0.004 (0.041)	-0.146 (0.384)	0.067 (0.062)
Herfindahl index # Bonus cap	-0.081 (0.204)	0.001 (0.043)	0.034 (0.135)	0.029 (0.040)	0.022 (0.019)	-0.133 (0.107)	0.013 (0.020)	0.045 (0.069)	0.036 (0.033)
Output gap	-0.071 (0.263)	0.105 (0.098)	-0.028 (0.077)	-0.035 (0.049)	0.017 (0.019)	0.032 (0.102)	-0.080 (0.050)	0.344 (0.370)	-0.003 (0.030)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	13.014	1.364	4.174***	4.632***	1.543**	0.721	1.361***	4.568	1.874**
Number of countries	16	16	14	18	21	11	18	18	22
Observations	127	105	65	168	144	42	163	119	212

Interpretation of this table is similar to Table D1.

Table D3. Country-fixed effects panel regression results with respect to the bonus cap, model 3

Ratio variable-to-fixed pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-1.395	0.086	-1.199**	-0.151	-0.090	0.136	-0.059	-0.023	0.151*
	(1.574)	(0.383)	(0.443)	(0.203)	(0.095)	(0.130)	(0.177)	(0.327)	(0.074)
Herfindahl index # Bonus cap	0.206*	-0.026	0.155	0.007	0.022	0.053	0.020	-0.011	0.029
	(0.111)	(0.044)	(0.104)	(0.050)	(0.018)	(0.035)	(0.019)	(0.127)	(0.030)
Output gap	-1.096	0.361	0.169	-0.160	-0.032	-0.118*	0.227***	0.000	-0.011
	(1.751)	(0.362)	(0.174)	(0.111)	(0.059)	(0.056)	(0.068)	(0.339)	(0.156)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year # Output gap	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country # Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	1,241.513*	-221.851	-833.288**	-531.429***	-295.843***	-238.908**	-454.525***	-1,099.440	-507.701***
Number of countries	16	16	14	18	21	11	18	18	22
Observations	127	105	65	168	144	42	163	119	212

Interpretation of this table is similar to Table D1.

Appendix E

Additional figures and tables[15], robustness checks

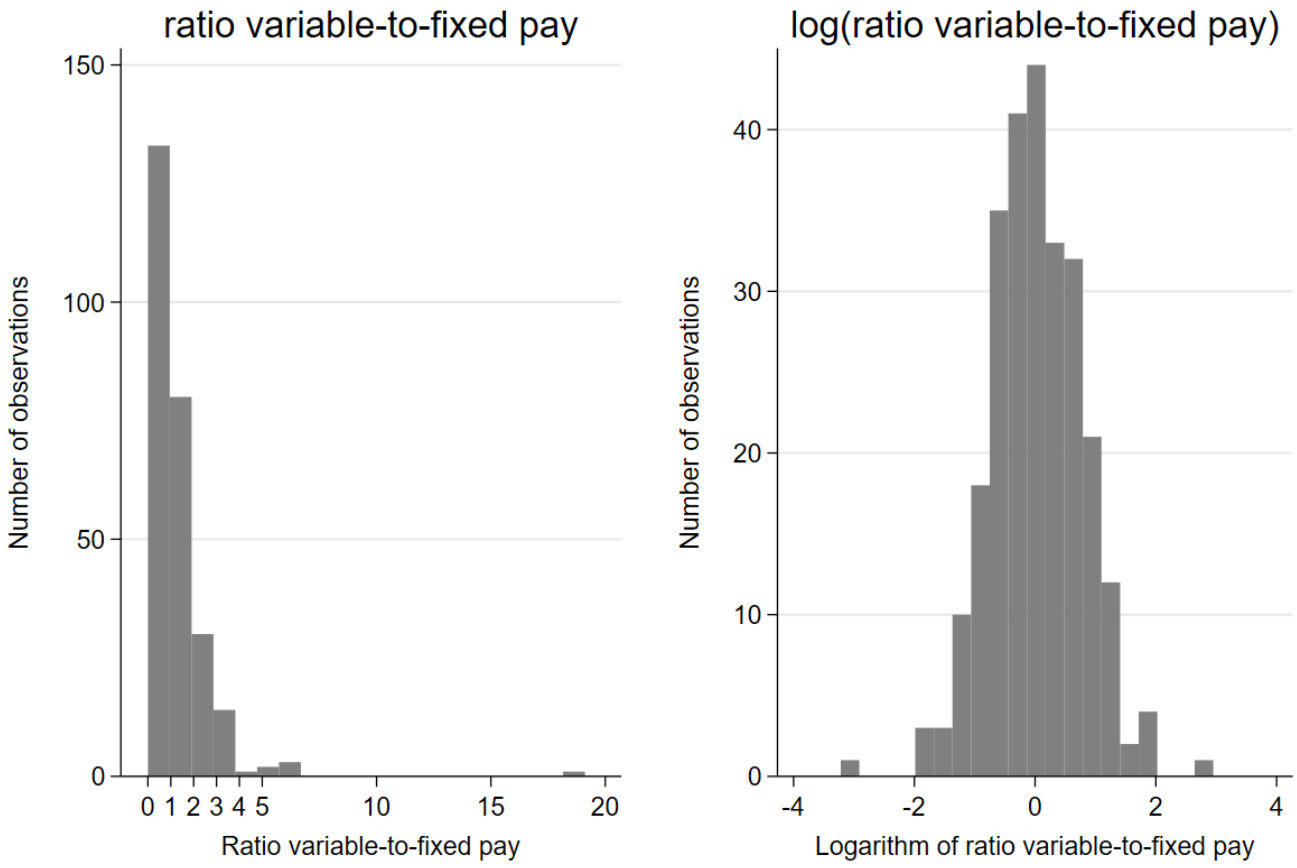

Figure E1. Distribution of variable-to-fixed pay ratio, total observations for 2010-2021

This figure shows the distributions of the average variable-to-fixed pay ratio for high earners at European credit institutions, both with and without applying a logarithm. The sample includes average observations for the total banking sector per year and country between 2010 and 2021. The logarithm-sample excludes all variable-to-fixed pay ratios with a value of 0.

[15] Table notes are not provided for the robustness tables; their interpretation is similar to the main analysis, except for their dependent variable being variable-to-total pay instead of variable-to-fixed pay.

Table E1. Country-fixed effects panel regression results on variable-to-total pay, total sample of high earners

Ratio variable-to-total pay	Model 1	Model 2	Model 3	Model 4	Model 5
Herfindahl index	-0.010* (0.005)	-0.001 (0.010)	0.014** (0.005)	0.011* (0.006)	0.016* (0.008)
Output gap		-0.006 (0.004)	0.003 (0.005)	0.006 (0.011)	0.017 (0.011)
Country FE	YES	YES	YES	YES	YES
Year FE			YES	YES	YES
Year # Output gap *(Reference year: 2010)*				YES	YES
Country # Year *(Reference year: 2010)*					YES
Constant	0.605***	0.507***	0.550***	0.590***	-11.413
Number of countries	27	22	22	22	22
Observations	243	213	213	213	213

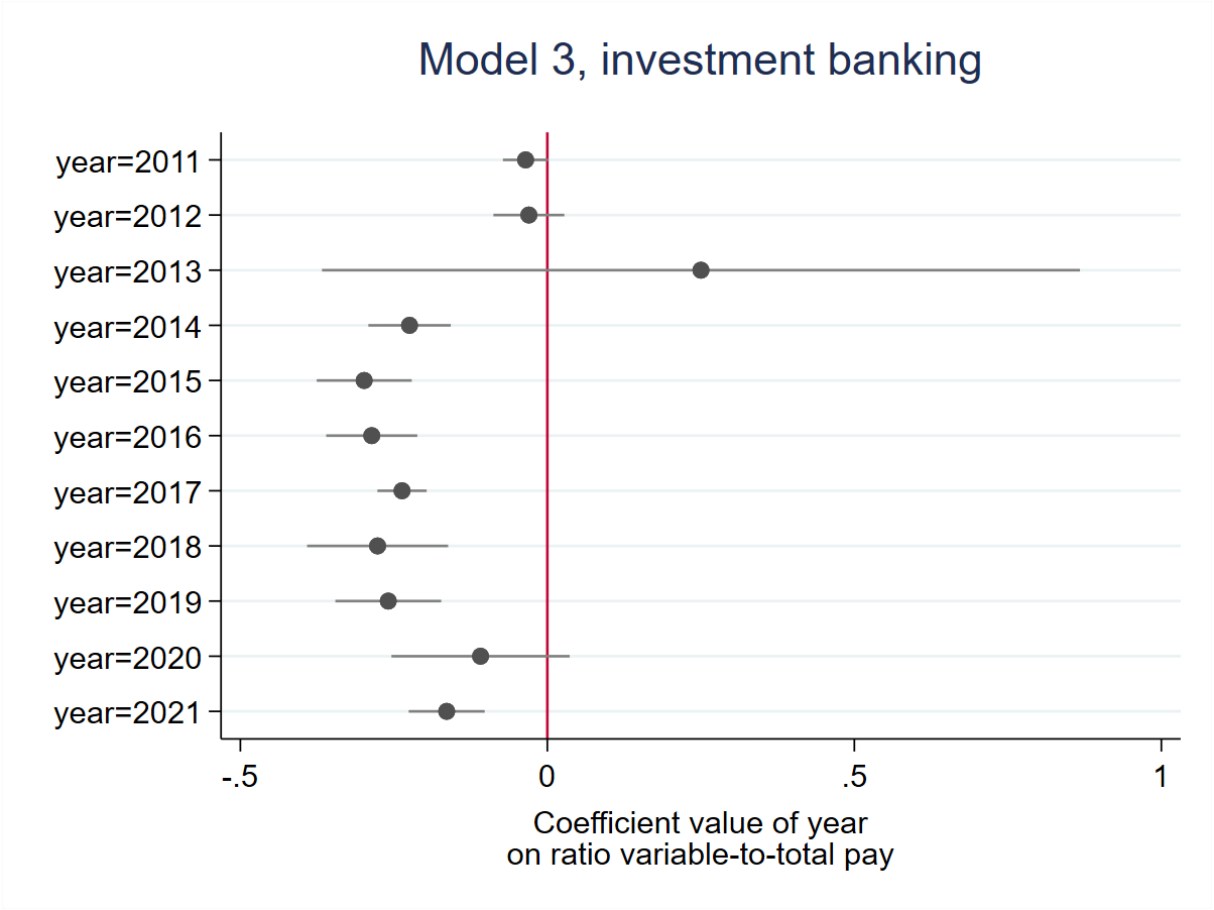

Figure E2. Year-fixed effects coefficient for investment banking, model 3 country-fixed effects panel regression

Table E2. Country-fixed effects panel regression results on variable-to-total pay, heterogeneity analysis model 3

Ratio variable-to-total pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.010	0.011	-0.055	-0.013	0.007	0.010	0.010	0.013	0.014**
	(0.008)	(0.011)	(0.036)	(0.013)	(0.010)	(0.007)	(0.009)	(0.020)	(0.005)
Output gap	0.002	0.011	-0.005	0.010	0.006	-0.008	-0.010	0.007	0.003
	(0.003)	(0.011)	(0.013)	(0.009)	(0.006)	(0.045)	(0.009)	(0.009)	(0.005)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.823***	0.496***	1.050***	0.888***	0.432***	0.230	0.434***	0.498**	0.550***
Observations	16	16	14	18	21	11	18	19	22
Number of countries	128	105	65	168	144	42	163	120	213

Table E3. Country-fixed effects panel regression results on variable-to-total pay, heterogeneity analysis model 5

Ratio variable-to-total pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.029 (0.027)	-0.014 (0.030)	-0.124*** (0.028)	-0.018 (0.023)	-0.003 (0.027)	0.198*** (0.031)	0.012 (0.029)	0.008 (0.016)	0.016* (0.008)
Output gap	-0.021 (0.017)	0.037 (0.024)	0.049 (0.039)	0.009 (0.024)	0.001 (0.023)	-0.071*** (0.016)	0.035** (0.015)	0.041* (0.020)	0.017 (0.011)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year # Output gap	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country # Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	25.189**	-47.957	-89.749	-20.070	25.453	37.286	-51.410***	-5.823	-11.413
Number of countries	16	16	14	18	21	11	18	19	22
Observations	128	105	65	168	144	42	163	120	213

Table E4. Bonus cap country-fixed effects panel regression results on variable-to-total pay, model 1

Ratio variable-to-total pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.016*	0.011	-0.040	-0.008	0.010	0.027	0.007	0.014	0.016*
	(0.009)	(0.009)	(0.034)	(0.006)	(0.009)	(0.028)	(0.008)	(0.018)	(0.009)
Herfindahl index # Bonus cap	-0.007	-0.006*	-0.015***	-0.016***	-0.008***	-0.013	-0.006*	0.002	-0.013***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)	(0.017)	(0.003)	(0.003)	(0.002)
Output gap	-0.001	0.004	0.001	-0.009	0.001	-0.015	-0.005	-0.006	-0.000
	(0.003)	(0.006)	(0.004)	(0.005)	(0.003)	(0.015)	(0.006)	(0.006)	(0.003)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.849***	0.460***	0.945***	0.776***	0.361***	0.119	0.454***	0.396**	0.436***
Number of countries	16	16	14	18	21	11	18	19	22
Observations	128	105	65	168	144	42	163	120	213

Table E5. Bonus cap country-fixed effects panel regression results on variable-to-total pay, model 2

Ratio variable-to-total pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.011 (0.009)	0.011 (0.011)	-0.076* (0.038)	-0.010 (0.013)	0.005 (0.012)	0.044 (0.044)	0.010 (0.009)	0.009 (0.017)	0.014*** (0.004)
Herfindahl index # Bonus cap	-0.002 (0.007)	-0.000 (0.006)	0.018 (0.017)	0.010 (0.010)	0.003 (0.005)	-0.034 (0.045)	0.002 (0.004)	0.006 (0.004)	0.001 (0.003)
Output gap	0.002 (0.003)	0.011 (0.011)	-0.006 (0.014)	0.011 (0.008)	0.006 (0.006)	-0.011 (0.043)	-0.010 (0.009)	0.005 (0.009)	0.003 (0.005)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.827***	0.496***	1.163***	0.867***	0.451***	0.021	0.432***	0.523***	0.554***
Number of countries	16	16	14	18	21	11	18	19	22
Observations	128	105	65	168	144	42	163	120	213

Table E6. Bonus cap country-fixed effects panel regression results on variable-to-total pay, model 3

Ratio variable-to-total pay	Asset management	Corporate functions	Independent control	Investment banking	MB management	MB supervisory	Retail banking	Other areas	Total
Herfindahl index	-0.044 (0.034)	-0.005 (0.037)	-0.214*** (0.046)	-0.032 (0.033)	-0.007 (0.027)	0.180*** (0.043)	0.012 (0.030)	0.017 (0.017)	0.017* (0.009)
Herfindahl index # Bonus cap	0.011 (0.008)	-0.004 (0.006)	0.047*** (0.013)	0.011 (0.017)	0.003 (0.005)	0.012 (0.017)	-0.000 (0.004)	-0.008 (0.005)	-0.002 (0.004)
Output gap	-0.024 (0.017)	0.041* (0.022)	0.022 (0.028)	0.009 (0.025)	-0.001 (0.022)	-0.073*** (0.015)	0.035** (0.015)	0.044** (0.019)	0.018 (0.011)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year # Output gap	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country # Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	21.943**	-47.157	-128.502*	-19.771	25.817	13.738	-51.421***	-6.200	-12.208
Number of countries	16	16	14	18	21	11	18	19	22
Observations	128	105	65	168	144	42	163	120	213