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Wages and Human Capital in Finance: International Evidence, 1970–2011*

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Abstract

We study the allocation and compensation of human capital in the finance industry in a set of developed economies in 1970–2011. Finance relative wages generally increase—but not in all countries, and to varying degrees. Trading-related activities account for 50% of the increases, despite accounting for only 13% of finance employment, on average. Financial deregulation is the most important factor driving up wages in finance; it has a larger effect in environments where informational rents and socially inefficient risk taking are likely to be prevalent. Differential investment in information and communication technology does not have causal explanatory power. High finance wages attract skilled international immigration to finance, raising concerns for "brain drain."

JEL classification: G2, J2, J3

Keywords: Financial regulation, Informational rents, Allocation of talent, Wage inequality

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1. Introduction

High wages in finance have received significant attention following the 2007–2008 financial crisis, due to the perceived centrality of finance as the cause, catalyst, or propagator of the Great Recession in the USA and in Europe. There are four underlying reasons for this. First, the persistence of high wages in finance after the crisis, while growth and employment in many economies remain depressed, begs the question whether social returns are dwarfed

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by private returns to workers in finance—especially given the public support for financial institutions in distress during the crisis. Second, socially inefficient high wages in finance may draw talent from other more productive sectors of the economy. Third, financial development has an important role in explaining economic development in broad cross-sections of countries and, therefore, it is important to understand the internal organization of finance, as well as the indirect effects of financial development.[1] Fourth, high wages in finance contribute significantly to overall inequality, as we demonstrate below.

Although rising wages in finance have been documented in several countries, the causes and mechanisms are not well-understood. Philippon and Reshef (2012) argue that the most important factor affecting wages in finance in the USA is financial deregulation. We introduce better identification strategies and bring new data to bear on this claim.[2] Our findings support the paramount importance of financial deregulation on finance relative wages in a broader set of countries. Figure 1 illustrates this relationship. In addition, we investigate the channels through which deregulation increases finance wages. We show that the effect of deregulation on wages is largest in environments where it is likely to be associated with socially inefficient risk taking and informational rents. Another novel aspect of our work is to investigate whether high wages in finance attract skilled workers across international borders. We find that they do, raising concerns for allocative efficiency and potential "brain drain."

We study wages in finance—relative to the rest of the non-farm private sector—in a set of twenty-three industrialized and transition economies in 1970–2011. We show that changes in educational composition explain little of the evolution of finance wages. In contrast, changes in relative wages of highly educated finance employees (relative to educated workers employed elsewhere) explain more than all of the increases in finance relative wages overall. We estimate that wages of skilled workers in finance account for 31% of increases in skill premia for countries with overall skill premia increases; this is striking given that finance accounts for only 5.4% of all skilled workers in private sector employment, on average.[3] Fifty percent of the increase in finance relative wages is accounted for by workers that are focused on trading (but not originating) securities and related activities, such as financial advising—despite the fact that these activities employ only 13% of finance workers, on average. These findings motivate examining mechanisms that operate particularly on skilled workers and on non-traditional banking and trading activities.

We confirm that the most important causal driver of finance relative wages is deregulation, and the economic effect is large. This causal interpretation is supported by estimates

1 See Rousseau and Sylla (2003) and Levine (2005) on the link between financial development and economic growth. It is important, however, to distinguish between human capital and wages within finance, and its overall size. Juxtaposing findings in Philippon and Reshef (2012) with those in Philippon and Reshef (2013) we see that the growth of finance and its internal organization are not the same phenomena, and follow different—although not independent—paths.

2 By using panel data for several countries over time, and by employing IV regressions, we try to identify the causal relationship between financial regulation and wages in finance. Our paper has two shortcomings compared with Philippon and Reshef (2012). First, our sample is shorter. Second, the consistency across countries of the financial regulation variables may neglect country-specific features of legislation; we elaborate on the last point below.

3 Tanndal and Waldenstrom (2015) use synthetic control group methodology and find that financial deregulation affects overall top income shares; they do not study finance wages directly and do not discuss causality. See also Godechot (2016) on the relationship between inequality and other finance-related correlates.

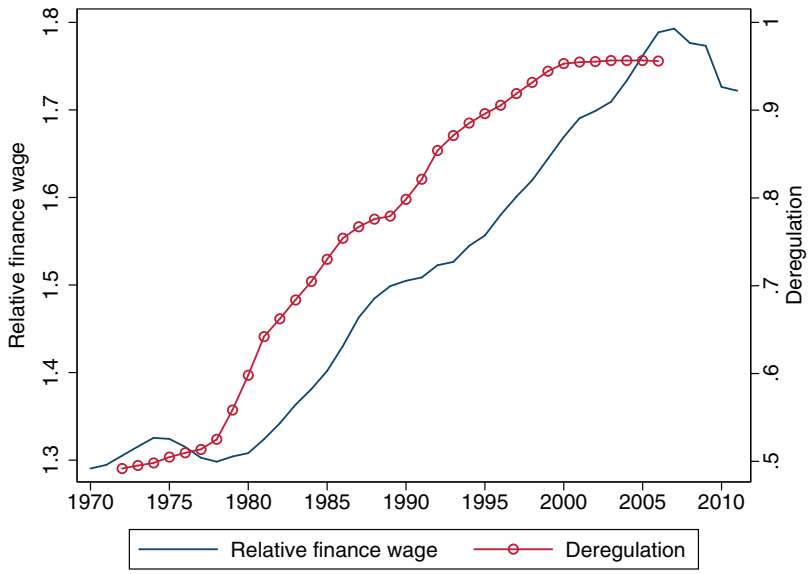

Figure 1. Finance relative wages and financial deregulation.
Notes: This figure plots the average across countries of their finance relative wage and financial deregulation index. Averages are weighted, with total employment in finance as weights. Relative finance wage in each country is constructed as the average wage in finance divided by the average wage in the non-farm, non-finance private sector. The financial deregulation index is the sum of seven deregulation indices: Directed credit/reserve requirements, Interest rate controls, Entry barriers, Banking supervision, Privatization, International capital flows, and Securities market policies. Each index takes values between 0 and 3, where higher values indicate lower regulation. We normalize the index to be between 0 and 1. The sample includes: Austria, Belgium, Canada, Czech Republic, Denmark, Germany, Spain, Finland, France, Hungary, Japan, Netherlands, Norway, UK, and the USA. The plotted series are 3-year moving averages. Data on wages until 2005 are from EU KLEMS; from 2006 and on wage data are from STAN. Norway series uses only STAN data. See complete details in text. Financial regulation data are from Abiad, Detragiache, and Tressel (2008), and are available until 2005.

of the dynamic effect of deregulation on wages, instrument variables analyses, and an event study approach. We do not find evidence for a causal relationship for other factors, such as changes in information technology intensity, financial globalization, and expansion of domestic credit.

Financial regulation affects wages in finance through limits on the scope and scale of financial activity within the financial sector, in particular activity that is more prone to asymmetric information and risk taking. This is particularly true for highly skilled individuals, because rules and restrictions on the range and nature of their activities reduce the need for incentive pay (Philippon and Reshef, 2012).[4] Goodhart *et al.* (1998) illustrate that the

4 Guadalupe (2007) provides evidence that competition in the product space increases demand for skill. Wozniak (2007) studies the effect of banking deregulation in the USA on the structure of compensation within banking; she finds that within-establishment inequality dropped, while between-establishment inequality increased. This reflects the effect of deregulation on industry organization.

pervasiveness of asymmetric information in finance leads to a different effect of deregulation there versus other industries, where we expect—and usually find—wage reductions, not increases.[5]

A few recent papers have studied individual level micro data on finance wages. However, none of them studies directly the underlying determinants of the rise in finance wages, which lie at the industry level. Our work aims to fill this gap. At the micro level, wages in finance may increase through three channels: (1) an increase in skill, unobserved quality or "talent" of workers in the sector (changes in composition); (2) an increase in the returns to skill or talent in finance, holding constant the composition; and (3) industry rents, defined as compensation that is over and above a competitive wage. The last channel may not be empirically distinguishable from the second if skilled or talented individuals capture higher shares of industry rents.

Using data on French engineers in 1983–2011, Célérier and Vallée (2015) estimate that the entire increase in finance wages in their sample is explained by differential increases in returns to talent in finance. They speculate that the increase in returns to talent is driven by technology and scale effects. In contrast, Bohm, Metzger, and Stromberg (2015) find that the increase in relative wages in finance in Sweden in 1991–2010 cannot be explained by changing returns to talent. Moreover, they show that average talent—measured by cognitive test scores and high-school grades—has not increased in finance relative to other sectors. Their findings imply that the entire increase in finance wages must be attributed to rents. Lindley and McIntosh (2014) study a sample of 378 workers in finance in the UK and—similar to Bohm, Metzger, and Stromberg (2015)—do not detect an increase in talent (measured as numeracy). Although changing job characteristics and technological change go some way in explaining the rise in finance wages within their sample, a large residual is left unexplained.

Whether increasing wages in finance accrue due to more talented workers, greater returns to talent, or increases in rents, equally or unequally distributed—the factors that cause these changes operate at the industry level. This is where our paper makes its contribution.

We find greater effects of financial deregulation on wages in countries with more complex financial systems, or with more opaque trading activities. Indeed, deregulation allows more financial activity to occur outside of the traditional regulatory sphere (shadow banking).[6] In particular, we find that deregulation has a greater effect on finance wages in countries with financial systems that rely more on non-bank credit markets (versus bank loans) and stock markets, where there is greater trading intensity in "Over the Counter" (OTC) securities, and where the sector is less competitive. This is consistent with recent theories that stress the role of asymmetric information and complexity in giving rise to informational rents, and in causing excessive risk taking in finance, for example, Korinek and Kreamer (2014). Axelson and Bond (2015) study a model in which the threat of moral

5 Peoples (1998) discusses the effects of product market deregulation on wages in the American trucking, railroad, airline, and telecommunications industries, where unionization played a major role. There regulation—and deregulation—of entry and prices in these industries followed a pattern similar to that suggested in the classic Stigler (1971) paper.

6 For example, Ben Bernanke, the former Chairman of the Federal Reserve, defines shadow banking as "a diverse set of institutions and markets that, collectively, carry out traditional banking functions—but do so outside, or in ways only loosely linked to, the traditional system of regulated depository institutions"; Bernanke (2013).

hazard is associated with high wages and rents in finance. Closely related, Biais and Landier (2015) and Bolton, Santos, and Scheinkman (2016) study models in which more opaque activities are related to higher informational rent extraction.[7] In line with this, Efing *et al*. (2015) find that incentive pay (bonuses) is positively correlated with trading volume and volatility in a set of 66 Austrian, German, and Swiss banks. Cheng, Hong, and Scheinkman (2015) find that residual compensation of chief executive officers (CEOs) and risk-taking are positively correlated across American finance firms in 1992–2008.[8]

We also find that the effect of deregulation on finance wages is stronger in countries with more flexible labor markets. This is consistent with recent theories that stress the role of firm-to-firm mobility of finance workers, which is likely to be easier in such environments. For example, Acharya, Pagano, and Volpin (2016) study a model in which an increase in firm-to-firm mobility causes employers to provide excessive short-term compensation, while the employees take excessive long-term risk. Bijlsma, Zwart, and Boone (2012); Thanassoulis (2012); and Benabou and Tirole (2016) study models in which competition between banks leads to competition for banker talent, which manifests in high banker compensation and incentive pay (bonuses) and unnecessarily high (long-run) risk for banks. In a similar vein, Glode and Lowery (2016) argue that competition for traders—as opposed to bankers, who increase surpluses—is associated with higher rents and reduced social efficiency.[9] These mechanisms can be triggered, or intensified, by deregulation, with stronger effects in environments that facilitate firm-to-firm mobility.

We document that finance increased its relative intensity of information and communication technology (ICT), and we estimate that ICT is relatively more complementary to skill in finance than in other sectors. ICT may drive increases in relative wages for skilled labor in finance as suggested by Autor, Katz, and Krueger (1998) and Autor, Levy, and Murnane (2003).[10] Within finance, Autor, Levy, and Murnane (2002) document how

7 Bolton, Santos, and Scheinkman (2016) stress the social inefficiency caused by informational rents in opaque "OTC" markets versus transparent organized markets. While Axelson and Bond (2015) highlight differences in the threat of moral hazard across industries, Biais and Landier (2015) characterize conditions (within an overlapping generations model) under which opacity and rent extraction increase over time.

8 This is consistent with evidence in Philippon and Reshef (2012), who show that scale effects explain little of the wage differential of CEOs in finance versus CEOs in other sectors after 1990, leaving other mechanisms, such as risk taking, to play an important role.

9 See also Godechot (2008), who performs a case study where two traders obtained large bonuses after making credible threats to leave their French bank employer; he interprets this as a consequence of classic hold up, which is possible due to asset specificity.

10 The overall rise in relative demand for more educated workers in developed countries, as well as the increase in their relative wages, is well documented; see for example, Machin and Van Reenen (1998). Berman, Bound, and Machin (1998) attribute this to skill-biased technological change. See Acemoglu (2002b) for a review of the early literature on skill biased technological change. Acemoglu and Autor (2011) highlight these and other forces that may affect relative demand, in particular globalization and offshoring; they also provide an up-to-date report on empirical findings and theoretical considerations. Acemoglu (2002a) argues that the increase in supply of more educated workers biases innovation toward equipment that is more complementary to their skills. For other explanations for the increase in demand for skilled workers see Card (1992); Card and Lemieux (2001); and Acemoglu, Aghion, and Violante (2001).

computerization affects demand for labor and job complexity in two large banks.[11] Morrison and Wilhelm (2004) and Morrison and Wilhelm (2008) argue that investment in ICT affected the optimal organization of investment banks in the USA. Although we find that the increase in relative ICT intensity in finance is positively correlated with relative skilled wages in finance, this relationship is not causal.[12] In contrast, the relationship of finance relative wages with financial deregulation is robust and causal. These results contribute to the understanding of demand for skill and income inequality.

One concern about high wages in finance is that they attract skilled workers from other parts of the economy, where they may be more productive socially. If competition for talent is fierce, the same forces may manifest themselves across international borders. Here, it is plausible that attracting skilled workers from other countries has detrimental effects on the country of origin via brain drain. In order to address this issue, we ask whether high wages in finance attract skilled workers across international borders. We use bilateral immigration data in a sample of fifteen industrialized countries, where immigrants in each destination are differentiated by level of education and industry. We fit regression models that resemble gravity equations from the international trade and finance literatures (e.g., Ortega and Peri, 2014) and find that high wages in finance do attract skilled workers across borders. This raises concerns that high wages in finance may lead to brain drain. This effect is not present for unskilled workers, which is likely due to higher barriers for low skilled workers to immigrate relative to the pecuniary benefit of doing so.

These findings contribute to the literature on the allocation of talent. Both Baumol (1990) and Murphy, Shleifer, and Vishny (1991) stress the importance of allocating the most talented individuals in society to socially productive activities. Policies and institutions that can readily influence this allocation can be much more important for welfare than the overall supply of talent.[13] Goldin and Katz (2008) document increasing shares of Harvard University undergraduates who choose a career in finance since 1970, as well as an increasing wage premium that they are paid relative to their peers.[14] Wurgler (2009) and Cahuc and Challe (2012) argue that the existence of financial bubbles can attract skilled workers to finance, and Oyer (2008) shows that during financial booms more Stanford MBAs are

11 Autor, Levy, and Murnane (2002) focus on digital imaging technology. A more recent technology in banking is Internet-based services, that can replace low- and medium-skilled employees, and leverage the skills of highly skilled employees who design these services.

12 For example, does ICT make skilled workers in investment banking more productive than skilled workers at Google? The results suggest that the answer is no. Morrison and Wilhelm (2004) and Morrison and Wilhelm (2008) argue that investment in ICT affected the optimal organization of investment banks in the USA: Codification of activities reduced the incentives for accumulation of tacit human capital through mentorship, which led to change from partnerships to joint stock companies. This change would also lead to higher wage compensation versus illiquid partnership stakes that are "cashed in" only upon retirement. Although this argument is germane only to American investment banks—while we study twenty-three countries—our results are not inconsistent with it.

13 See also the equilibrium model of Acemoglu (1995), where both the allocation of talent and relative rewards are endogenously determined.

14 Shu (2013) finds no increase in the proportion of graduates from M.I.T. working in finance in 2006–2012, but this sample is already at the end of a long process of increasing shares of graduates from elite American universities working in finance, for example in Harvard University (Goldin and Katz, 2008).

attracted to finance.[15] Kneer (2013) argues that financial deregulation is detrimental to other skill intensive sectors, while Cecchetti and Kharroubi (2013) argue that credit growth hurts disproportionately R&D-intensive manufacturing industries. Although direct evidence is not provided, these authors interpret their findings as indicating a brain drain from the real economy into finance. Here, we provide direct evidence that internationally, high wages in finance attract highly educated immigrants.

In the next section, we document a set of facts about wages and skill intensity in finance. In Section 3, we entertain explanations for the rise in relative wages in finance. In Section 4, we show how high wages in finance attract skilled workers across borders (skilled immigration). In Section 5, we offer concluding remarks.

2. The Evolution of Finance Relative Wages

There are a number of notable phenomena in the international development of finance wages over the past 40 years, which we investigate in this section. First, we observe significant heterogeneity across countries in the trends and levels of relative wages in finance. Second, we find that the increases in skilled finance workers' wages account for all of the increases in finance relative wages and then some; changes in relative skill intensity explain little of the overall evolution of relative wages in finance. Third, we show that finance skilled relative wages explain on average 31% of increases in overall skill premia across countries in our sample, thus contributing significantly to wage inequality. This is striking given the size of the sector in total private sector employment, which is on average only 5.4%. Fifty percent of increases in finance relative wages are driven by trading (but not originating) securities and related activities, such as financial advising—despite the fact that these activities employ only 13% of finance workers, on average. These findings motivate examining mechanisms that operate particularly on skilled workers and on the non-traditional banking sector.

2.1 Data

Our sample is a set of twenty-three industrialized and transition economies in 1970–2011. This is based on data for twenty-two countries in 1970–2005 from the EU KLEMS dataset, March 2008 release.[16] We extend this source until 2011 using the OECD's Structural Analysis (STAN) database; this adds Norway to our sample, to make twenty-three countries.[17] We use STAN data to compute the overall finance relative wage, defined below in Equation (1). We do not use STAN data for any other purposes because of compatibility issues with EU KLEMS, because STAN does not report wages and employment by skill levels, and because several of our explanatory variables are missing for Norway. In the Online Appendix, we detail the years in which we supplement EU KLEMS with STAN data. Although we use all twenty-three countries for descriptive analysis, our regressions below are estimated in a sample of fifteen countries for which we have sufficient data.

15 Using survey data for the USA, UK, Germany, and France, and controlling for observables, Wurgler (2009) finds similar trends to our wage series for these countries.

16 See the Online Appendix for list of countries and years covered for each country. See O'Mahony and Timmer (2009) for more detailed documentation.

17 STAN is available from http://stats.oecd.org.

Finance is comprised of three subsectors: Financial intermediation, except insurance and pension funding (including central banking, banking and savings institutions, other sources of credit, and investment in securities); Insurance and pension funding, except compulsory social security; and other activities related to financial intermediation [administration of financial markets, trading activities (but not originating), financial advising, mortgage and insurance advisers, actuaries, etc.]. We provide complete details on these subsectors' definitions in the Online Appendix. For notational simplicity, we refer to this whole sector as "Finance."

We analyze the evolution of time series in finance relative to the non-farm, non-finance, private sector, which we denote as NFFP. All labor concepts are in terms of full time equivalents.[18] The EU KLEMS also reports wages and employment by skill levels. The definition of high skilled workers is consistent across countries and time, and implies a university-equivalent bachelors degree.

We provide additional detail on data and definitions in the Online Appendix.

2.2 Finance Relative Wages

The finance relative wage is defined as

$$\omega_t = \frac{w_{\text{fin},t}}{w_{\text{nffp},t}}, \tag{1}$$

where $w_{s,t}$ is the average wage across all workers in each sector $s \in \{\text{fin}, \text{nffp}\}$, calculated as total compensation of employees divided by the total hours worked by employees. Figure 2 depicts the finance relative wage in our sample, where we group countries based on whether ω is increasing, decreasing, or exhibits a mixed trend. We split the countries where ω is increasing into two separate panels in order to ease the exposition. Overall, there is significant heterogeneity in the trends of ω across countries: twelve countries see increases, while the remaining eleven are split between decreases and mixed trends.[19]

18 We use data on employees, rather than the more comprehensive concept of "persons engaged", which includes proprietors and non-salaried workers in addition to employees, because we regard the wage series based on this concept to be misleading. Total compensation of persons engaged is calculated in the EU KLEMS by total compensation of employees multiplied by the ratio of hours worked by persons engaged to hours worked by employees. This implies the same average wage for salaried and non-salaried workers, which is woefully inadequate when comparing finance to other sectors of the economy. In addition, compensation data for persons engaged is missing in many more cases, relative to employees. On average, there are fewer "persons engaged" who are not employees in finance than in NFFP. The trends for wage series for "persons engaged" are virtually identical to those based on employees, while the levels differ slightly, as can be seen by comparing Figure 2 to Figure A1 in the Online Appendix. This small difference in levels is inconsequential for our regression analyses, because we always include country-fixed effects.

19 Notable here is the UK, where ω fluctuates substantially. We also computed ω using data from the OECD STAN database and the series are very similar to what we find here using EU KLEMS, in particular for the UK. It is the real average wage in finance w_{fin} that explains most of the mixed pattern, not the average real wage in the rest of the economy w_{nffp}. As we show below, the UK relative wage of skilled workers in finance behaves less erratically, that is, it increased substantially during the sample period, in a similar fashion to other countries.

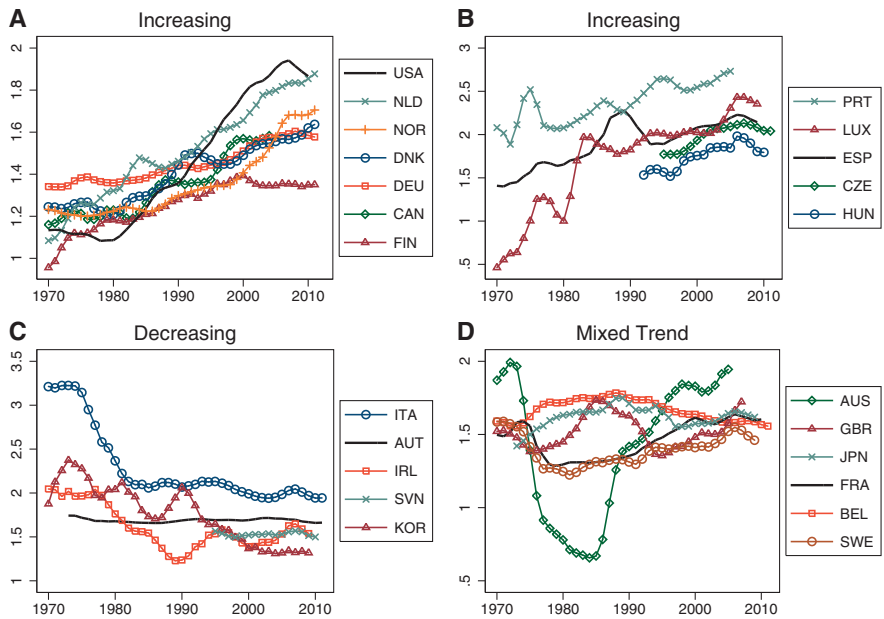

Figure 2. Finance relative wages.
Notes: Finance relative wage is the average wage in finance divided by the average wage in the non-farm, non-finance private sector. Average wages are computed by dividing employee compensation by hours worked. Data: EU KLEMS until 2005; STAN from 2006 onwards. Norway series uses only STAN data. See complete details in text. Series are 3-year moving averages. Panels A and B group countries that exhibit an increasing trend. Panel C groups countries that exhibit a decreasing trend, and Panel D groups countries that exhibit a mixed trend.

Figure 2 also reveals that finance relative wages plateau or even decrease slightly after 2007 for several countries that saw significant increases until then (Panels A and B)—notably the USA. Table A1 in the Online Appendix provides more details on this trend reversal. However, we are cautious in making general statements about this due to the short time span after the financial crisis.

We now ask, what is the importance of changes in the skill (education) composition of finance for the relative wage of finance? We decompose changes in ω into within and between skill group changes using the formula

$$\Delta\omega = \sum_i \Delta\omega^i \bar{n}^i_{\text{fin}} + \sum_i \Delta n^i_{\text{fin}} \bar{\omega}^i, \tag{2}$$

where $i \in \{\text{skilled, unskilled}\}$ denotes skill groups. Here, $\Delta\omega^i$ is the change over some period of the relative wage of skill group i in finance, w^i_{fin}, compared with w_{nffp} (the average wage in the NFFP sector), $\bar{n}^i_{\text{fin}}$ is the average employment share of skill group i in finance, Δn^i_{fin} is the change in the employment share of skill group i within finance, and $\bar{\omega}^i$ is the average relative wage of skill group i in finance compared with the average wage in the NFFP sector.[20] The first sum captures the contribution of wage changes within groups,

20 Averages are over beginning and end of period of change.

while the second sum captures the contribution of changes of skill composition (the "between" component). We compute this decomposition for each country in the sample.

Table I reports $\Delta\omega$, the within share ($\sum_i \Delta\omega^i \bar{n}^i_{\text{fin}}/\Delta\omega$) and the between share ($\sum_i \Delta n^i_{\text{fin}} \bar{\omega}^i/\Delta\omega$) for all countries, sorted by $\Delta\omega$. The within share is on average much larger than the between share, 167% versus −67%, respectively. Even after dropping the UK and Austria, whose tiny $\Delta\omega$ in this period inflates their within share, the within share is on average 78% versus 22% for the between share.

We rearrange the components of Equation (2) in order to describe how much skilled workers account for changes in the finance relative wage

$$\Delta\omega = (\Delta\omega^{\text{skilled}} \bar{n}^{\text{skilled}}_{\text{fin}} + \Delta n^{\text{skilled}}_{\text{fin}} \bar{\omega}^{\text{skilled}}) + (\Delta\omega^{\text{unskilled}} \bar{n}^{\text{unskilled}}_{\text{fin}} + \Delta n^{\text{unskilled}}_{\text{fin}} \bar{\omega}^{\text{unskilled}}). \quad (3)$$

The last column in Table I reports the share of changes in the finance relative wage that are due to skilled workers alone from Equation (3), $(\Delta\omega^{\text{skilled}} \bar{n}^{\text{skilled}}_{\text{fin}} + \Delta n^{\text{skilled}}_{\text{fin}} \bar{\omega}^{\text{skilled}})/\Delta\omega$. In countries that saw significant increases in finance relative wages, skilled workers account for more than the total increase, 131%. Interestingly, the three largest decreases in ω are not accounted for by skilled workers, but by unskilled workers' wages.

Overall, within group wage changes matter much more than changes in skill composition for explaining the finance relative wage, and skilled workers' wage increases account for all of the overall finance increases and then some.

To illustrate this point in a different way we examine the finance excess wage, which we define as the difference between the actual relative wage, ω, and a benchmark relative wage, $\hat{\omega}$:

$$\omega^{\text{excess}}_t = \omega_t - \hat{\omega}_t.$$

The benchmark wage $\hat{\omega}$ is defined as the finance relative wage that would prevail if skilled and unskilled workers in finance earned the same as in the NFFP sector:

$$\hat{\omega}_t = \frac{(1 - n^{\text{skilled}}_{\text{fin},t}) \cdot w^{\text{unskilled}}_{\text{nffp},t} + n^{\text{skilled}}_{\text{fin},t} \cdot w^{\text{skilled}}_{\text{nffp},t}}{(1 - n^{\text{skilled}}_{\text{nffp},t}) \cdot w^{\text{unskilled}}_{\text{nffp},t} + n^{\text{skilled}}_{\text{nffp},t} \cdot w^{\text{skilled}}_{\text{nffp},t}}. \quad (4)$$

Here, $n^j_{s,t}$ is the employment share of type $j \in \{\text{unskilled, skilled}\}$ workers in sector s, and $w^j_{\text{nffp},t}$ is the wage of type $j \in \{\text{unskilled, skilled}\}$ workers in the NFFP sector.

Figure 3 reports ω^{excess}_t using the same country groupings as Figure 2. The sample is restricted relative to Figure 2 due to availability of data on wages and employment by skill level. The trends in ω^{excess} are almost identical to those of ω, with few exceptions. This reinforces the point made above: Most of the variation in the finance relative wage is due to within-skill wage shifts. A closer inspection of the data shows that most of the excess wage is due to the relative wage of high skilled workers in finance. The relative wage of skilled workers in finance tracks ω very closely, as we illustrate next.

The relative wage of skilled workers in finance is defined as

$$\omega^{\text{skilled}}_t \equiv \frac{w^{\text{skilled}}_{\text{fin},t}}{w^{\text{skilled}}_{\text{nffp},t}}, \quad (5)$$

where $w^{\text{skilled}}_{s,t}$ is the average wage of skilled workers in sector $s \in \{\text{fin, nffp}\}$, calculated as total compensation of skilled employees divided by the total hours worked by skilled

Table I. Decomposition of changes in finance relative wages: skilled versus unskilled

Notes: Countries are sorted by the change in the finance wage relative to the non-farm, non-finance private sector. The decomposition for each country is based on Equation (6) in the text. NFFP is the non-farm, non-finance private sector. The within share captures the contribution of wage changes within sectors (Finance, NFFP); the between share captures the contribution of changes in the allocation of skilled workers across sectors (Finance, NFFP); the finance share captures the overall contribution of finance, whether from within-finance changes or changes in the allocation of skilled workers to finance, and is based on Equation (7) in the text. Data: EU KLEMS.

Country	Sample	Change in finance relative wage	Within skill group share	Between skill group share	Skilled share
Australia	1982–2005	1.30	0.87	0.13	0.58
USA	1970–2005	0.78	0.65	0.35	1.13
Spain	1980–2005	0.52	0.76	0.24	1.79
Netherlands	1979–2005	0.45	0.52	0.48	0.95
Canada	1970–2004	0.43	0.64	0.36	1.25
Luxembourg	1992–2005	0.42	0.76	0.24	1.18
Finland	1970–2005	0.40	0.50	0.50	1.41
Hungary	1995–2005	0.38	0.56	0.44	0.97
Denmark	1980–2005	0.36	0.78	0.22	0.56
France	1980–2005	0.32	0.57	0.43	1.07
Czech Republic	1995–2005	0.32	0.59	0.41	0.97
Sweden	1981–2005	0.30	0.61	0.39	1.30
Portugal	1992–2005	0.29	0.67	0.33	1.97
Japan	1973–2005	0.26	0.10	0.90	2.67
Ireland	1988–2005	0.26	0.04	0.96	2.31
Germany	1991–2005	0.12	0.81	0.19	0.81
UK	1970–2005	−0.02	16.39	−15.39	−33.28
Austria	1980–2005	−0.04	4.70	−3.70	−6.57
Belgium	1980–2005	−0.11	2.42	−1.42	−2.72
Slovenia	1995–2005	−0.21	1.49	−0.49	0.06
South Korea	1970–2005	−0.52	1.18	−0.18	0.06
Italy	1970–2005	−1.20	1.03	−0.03	0.09

employees. Figure 4 depicts ω^{skilled}, where we group countries based on whether they are increasing, decreasing, or exhibit a mixed trend. The sample is again restricted relative to Figure 2 due to data availability. As with relative average wages, there is significant heterogeneity in the trends of ω^{skilled} across countries: twelve countries see increases, three see decreases, and seven exhibit mixed trends. Australia exhibits the largest increase (but recall the drop in ω until 1985), followed by the UK, the USA, and Canada. In these countries, skilled workers in finance command a wage premium of 50–80% relative to similarly educated workers in the NFFP sector.

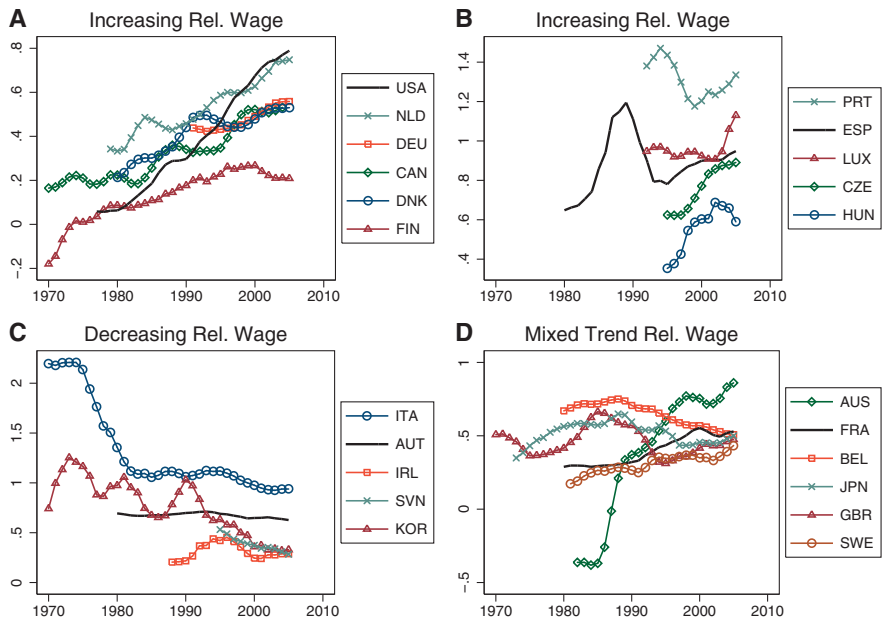

Figure 3. Finance excess wages.

Notes: The finance excess wage is the finance relative wage minus the benchmark wage. The benchmark assumes that the wages to low skilled and high skilled workers are the same across the finance and non-farm, non-finance private (NFFP) sectors, allowing for skill composition differences between the two sectors. Data: EU KLEMS. Series are 3-year moving averages. Panels A and B group countries that exhibit an increasing trend in the finance relative wage. Panel C groups countries that exhibit decreasing finance relative wages, and Panel D groups countries that exhibit a mixed trend in finance relative wages.

2.3 Finance Relative Skill Intensity

We define the relative skill intensity in finance as

$$\eta_t \equiv n^{\text{skilled}}_{\text{fin},t} - n^{\text{skilled}}_{\text{nffp},t},$$

where $n^{\text{skilled}}_{s,t}$ is the employment share of high skilled workers in sector $s \in \{\text{fin, nffp}\}$. Figure 5 depicts η_t for two groups of countries. In Panel A, we group countries that see relative skill intensity in finance consistently increasing. Spain and Japan see the largest increases, where finance becomes almost 30 percentage points more skill intensive than the rest of the economy in 2005.

It is interesting to compare the changes in relative skill intensity to changes in finance relative wages. Spain and the Netherlands see significant increases in both. But Luxembourg and the USA, while exhibiting the largest increases in ω, see only very modest increases in η. This is manifested in the poor ability of the benchmark wage, $\hat{\omega}_t$, to track the finance relative wage, especially in the countries and periods when the increase in the finance relative wage is large.

What does relative skill intensity in finance, η_t, capture? Using Swedish data, Bohm, Metzger, and Stromberg (2015) show that relative skill (education) in finance is a poor measure of relative ability—measured as cognitive and non-cognitive test scores at age 18 years. While relative education increases, relative ability—thus measured—does not follow

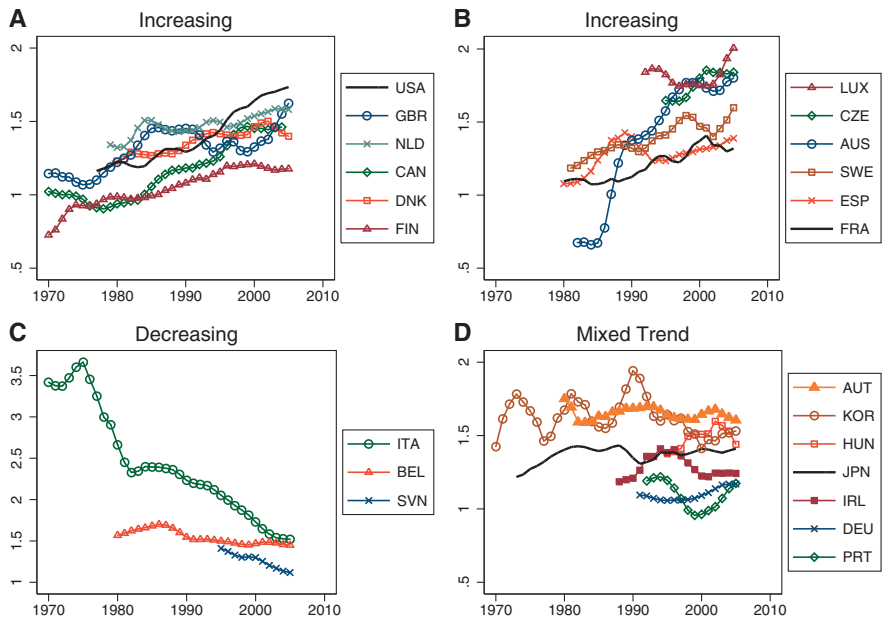

Figure 4. Finance relative skilled wages.
Notes: Finance relative skilled wage is the average wage of skilled workers in finance relative to the average wage of skilled workers in the rest of the non-farm, non-finance private sector. Average wages are computed by dividing employee compensation by hours worked. Data: EU KLEMS. The definition of skilled workers in the EU KLEMS is consistent across countries, and implies a university-equivalent bachelors degree or greater. Series are 3-year moving averages. Panels A and B group countries that exhibit an increasing trend. Panel C groups countries that exhibit a decreasing trend, and Panel D groups countries that exhibit a mixed trend.

a similar trend. If so, why does finance become so much more education-intensive over time in some countries? One reason may be barriers to entry: If there are industry rents, tertiary and even post-graduate education may serve only as a screening device. The authors find that returns to ability in finance have not increased over time, and therefore cannot explain the increase in finance wages in Sweden.[21] Alternatively, certain types of fields of study may be relatively more important in finance, given ability. Our findings are consistent with both hypotheses: Increasing relative skilled wages in finance may reflect skilled workers capturing most of the industry's rents, as well as heterogeneity in fields of study.

Whatever the reason may be, variation in skill composition in finance does not help much explain the variation in relative finance wages, as we saw above. Therefore, we do not explore in detail its determinants in the regression analysis below.

2.4 Contribution of Finance Wages to Inequality

Changes in the relative wage of skilled workers are an important dimension of overall changes in wage inequality. Therefore, we wish to assess how much finance contributes to

21 This contrasts with Célérier and Vallée (2015), who find that differentially increasing returns to ability of French engineers fully explains increases in their wages in finance. However, Célérier and Vallée (2015) do not address the overall composition of ability in finance.

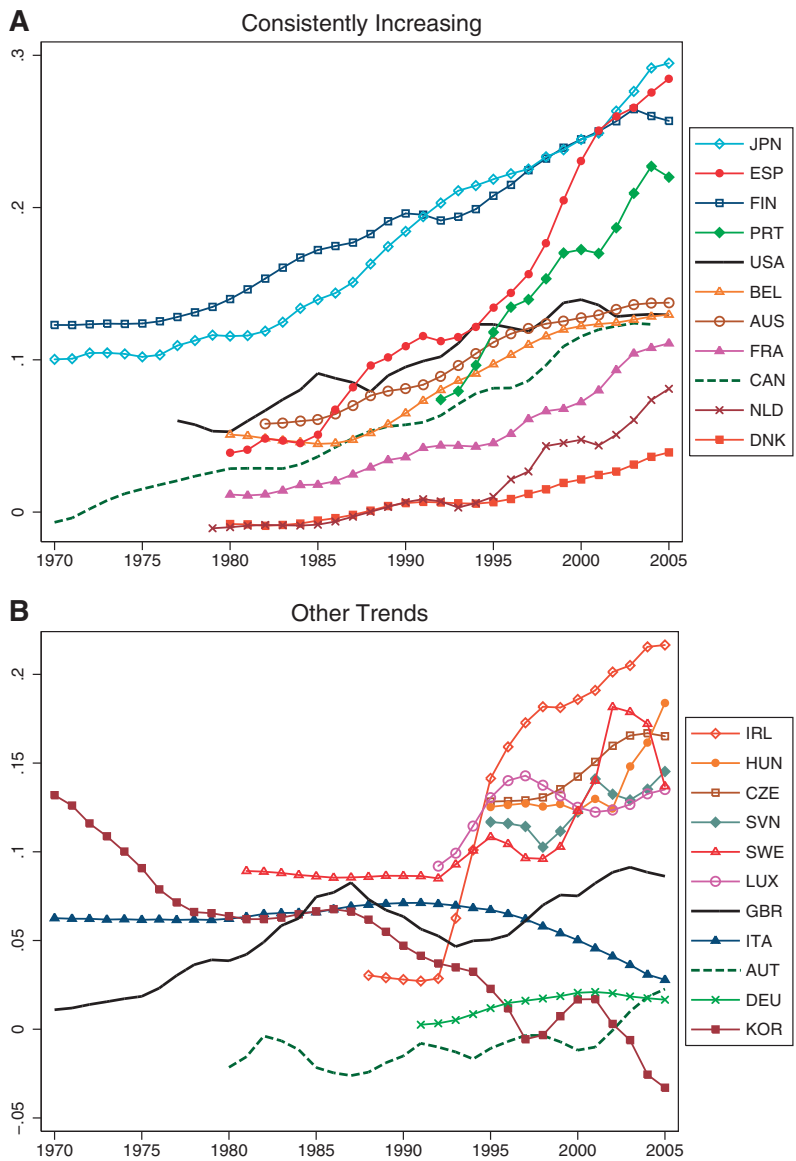

Figure 5. Finance relative skill intensity.
Notes: Finance relative skill intensity is the share of skilled workers in finance relative to the share of skilled workers in the rest of the non-farm, non-finance private sector. These shares are computed using hours worked. Data: EU KLEMS. The definition of skilled workers in the EU KLEMS is consistent across countries, and implies a university-equivalent bachelors degree or greater. Series are 3-year moving averages. Panel A groups countries that exhibit an increasing trend. Panel B groups countries that exhibit a mixed trend.

changes in the relative wage of skilled workers in the non-farm private sector (including finance), denoted here as $\Delta\pi$.[22] We decompose $\Delta\pi$

$$\Delta\pi = \sum_s \Delta\pi_s \bar{n}_s + \sum_s \Delta n_s \bar{\pi}_s, \tag{6}$$

where $\Delta\pi_s$ is the change over some period in the relative wage of skilled workers in sector $s \in \{\text{fin}, \text{nffp}\}$ relative to the overall average wage of unskilled workers in the non-farm private sector, denoted w_t, $\pi_s = w_{s,t}^{\text{skilled}}/w_t$, and $\bar{\pi}_s$ is the average relative wage of skilled workers in sector s, thus defined.[23] Here, $\bar{n}_s$ is the average share of skilled workers employed in sector s out of total skilled non-farm private sector employment and Δn_s is the change in that share for sector s. The first sum captures the contribution of wage changes within sectors, while the second sum captures the contribution of allocation of skill across sectors (the "between" component). We compute this decomposition for each country in the sample.

Another way to arrange the elements of Equation (6) is

$$\Delta\pi = (\Delta\pi_{\text{fin}}\bar{n}_{\text{fin}} + \Delta n_{\text{fin}}\bar{\pi}_{\text{fin}}) + (\Delta\pi_{\text{nffp}}\bar{n}_{\text{nffp}} + \Delta n_{\text{nffp}}\bar{\pi}_{\text{nffp}}). \tag{7}$$

We focus on the first term in parentheses, which captures the contribution of finance, due to both the effect of changes in finance skilled wages, and the effect of changes in allocation of skilled workers to finance. Table II reports $\Delta\pi$, the within share $\sum_s \Delta\pi_s\bar{n}_s/\Delta\pi$, the between share $\sum_s \Delta n_s\bar{\pi}_s/\Delta\pi$, and the finance share $(\Delta\pi_{\text{fin}}\bar{n}_{\text{fin}} + \Delta n_{\text{fin}}\bar{\pi}_{\text{fin}})/\Delta\pi$ for all countries, sorted by $\Delta\pi$ in decreasing order, based on Equations (6) and (7). We see that π has increased in several countries in our sample, while in others it has not, and in some cases even declined.[24]

The first message from Table II follows from the fact that the within share is always very close to one: Changes in relative skilled wages overall—not changes in allocation of skilled workers to finance (despite $\bar{\pi}_{\text{fin}} > \bar{\pi}_{\text{nffp}}$)—drive $\Delta\pi$.

The second message is that finance contributes disproportionately to the skill premium, relative to its size in employment. When the overall skill premium increases, finance contributes in the same direction in all but one case (Italy, where finance relative wages decline sharply, albeit from a high level). The average contribution of finance when $\Delta\pi > 0$ is 31%.[25]

22 Using survey data and corrections for top coding, Philippon and Reshef (2012) find that finance accounts for 15–25% of the overall increase in wage inequality in the USA in 1980–2005. Roine and Waldenstrom (2014) show how close the finance relative wage in Philippon and Reshef (2012) tracks the share of income of the top percentile in the USA over the entire twentieth century. In line with this, Bakija, Cole, and Heim (2012) document that financial professionals increased their representation in the top percentile of earners (including capital gains) from 7.7% in 1979 to 13.2% in 2005, while their representation in the top 0.1 percentile of earners increased from 11.2% in 1979 to 17.7% in 2005 (see also Kaplan and Rauh, 2010). For similar evidence for the UK and France, see Bell and Reenen (2013) and Godechot (2012). In line with these studies, Denk (2015b) shows that, with some variation, finance is over-represented in the top 1% of earners across all European countries in 2010.

23 Averages are over beginning and end of period of change.

24 Countries that see a large decrease in π are those who expanded educational attainment rapidly in this period. For example, see Verdugo (2014) for the case of France.

25 This amounts to an 8.5 percent points increase in skilled relative wages on average for countries seeing skill premium increases, compared with an average decrease of 0.30% points across countries in our sample.

Table II. Decompositions of changes in non-farm private sector skilled relative wages: finance versus NFFP

Notes: Countries are sorted by the change in skilled relative wage, which is defined as the wage of university-educated workers divided by the wage of other workers in the non-farm private sector (including finance). The decomposition for each country is based on Equation (6) in the text. NFFP is the non-farm, non-finance private sector. The within share captures the contribution of wage changes within sectors (Finance, NFFP); the between share captures the contribution of changes in the allocation of skilled workers across sectors (Finance, NFFP); the finance share captures the overall contribution of finance, whether from within-finance changes or changes in the allocation of skilled workers to finance, and is based on Equation (7) in the text. Data: EU KLEMS.

Country	Sample	Change in skilled relative wage	Within sector share	Between sector share	Finance share
USA	1980–2005	0.58	0.98	0.02	0.22
Luxembourg	1992–2005	0.55	0.87	0.13	0.65
Portugal	1992–2005	0.33	0.98	0.02	0.19
Canada	1980–2004	0.33	0.98	0.02	0.30
Hungary	1995–2005	0.32	1.03	−0.03	0.01
Ireland	1988–2005	0.28	0.91	0.09	0.56
Germany	1991–2005	0.26	1.00	0.00	0.10
Italy	1980–2005	0.20	1.19	−0.19	−0.61
Czech Republic	1995–2005	0.08	1.05	−0.05	0.16
Australia	1982–2005	0.08	1.05	−0.05	1.57
Japan	1980–2005	−0.04	0.80	0.20	0.73
Sweden	1981–2005	−0.08	1.02	−0.02	−0.33
Spain	1980–2005	−0.10	1.05	−0.05	−0.48
Slovenia	1995–2005	−0.12	1.04	−0.04	0.11
Belgium	1980–2005	−0.14	1.03	−0.03	0.10
Finland	1980–2005	−0.15	0.98	0.02	0.23
Austria	1980–2005	−0.19	1.15	−0.15	−0.22
UK	1980–2005	−0.23	1.00	0.00	−0.08
Denmark	1980–2005	−0.32	1.03	−0.03	−0.13
Netherlands	1980–2005	−0.44	1.07	−0.07	−0.19
France	1980–2005	−0.55	1.01	−0.01	−0.03
South Korea	1980–2005	−0.74	1.01	−0.01	0.07

Given that the average employment share of finance in total skilled employment is 5.4% (excluding Luxembourg, which employs 20% of its skilled workers in finance)—this is a large contribution to the skill premium.[26] When the skilled relative wage decreases, finance skilled wages often counter this and increase, making for a negative finance share and contribution to increasing inequality. Overall, in sixteen out of twenty-two countries finance contributes to

26 Denk (2015a) calculates more modest contributions of finance wages to inequality. The main reason for this is that his measure of inequality is the Gini coefficient, which is inadequate when most of the finance wage premium is concentrated at the top of the distribution. In addition, his analysis is based on employer survey data, which may not include all relevant wage concepts.

increased inequality. When taking into account negative contributions to declines in skilled relative wages, the contribution of finance is a positive 15%.[27]

The between component attributed to finance, $\Delta n_{\text{fin}}\bar{\pi}_{\text{fin}}$, is very small (not reported); almost all of the finance share is explained by increases in relative skilled wages within finance, that is, $\Delta\pi_{\text{fin}}\bar{n}_{\text{fin}}$.

2.5 Finance Subsectors and Relative Wages

In this section, we ask which types of financial activity drive finance relative wages. For example, does traditional banking intermediation or trading activity explain the rise? Our data allow us to investigate this by looking at three subsectors within the finance industry: financial intermediation; insurance and pension funding, except compulsory social security; and other financial activities that are related to trading and advising.

The three subsectors may not capture precisely the same activities to the same extent across countries, due to variation across countries in activities within subsectors. Therefore, the subsectors should be considered as coarse indicators of activity types.[28] An additional limitation of the analysis here is that the sample is restricted due to data availability across countries and time. For example, Canada does not report subsector data in any of the sources we use, and Japan does not report separately financial intermediation; therefore, these two important countries are dropped from the analysis altogether.

To begin our analysis, we decompose changes in finance relative wages $\Delta\omega$ along the subsector dimension using Equation (2), except that now the index runs over the three subsectors, $i \in \{\text{int, ins, oth}\}$, rather than skill types. Here, "int" stands for financial intermediation; "ins" stands for insurance and pension funding; and "oth" stands for other financial activities. By rearranging Equation (2), one can describe the contribution of each subsector in the overall change,

$$\Delta\omega = (\Delta\omega^{\text{int}}\bar{n}^{\text{int}}_{\text{fin}} + \Delta n^{\text{int}}_{\text{fin}}\bar{\omega}^{\text{int}}) + (\Delta\omega^{\text{ins}}\bar{n}^{\text{ins}}_{\text{fin}} + \Delta n^{\text{ins}}_{\text{fin}}\bar{\omega}^{\text{ins}}) + (\Delta\omega^{\text{oth}}\bar{n}^{\text{oth}}_{\text{fin}} + \Delta n^{\text{oth}}_{\text{fin}}\bar{\omega}^{\text{oth}}). \quad (8)$$

The results of this analysis are presented in Table III, where we report the within share, the between share, and the share of each finance subsector $((\Delta\omega^{i}\bar{n}^{i}_{\text{fin}} + \Delta n^{i}_{\text{fin}}\bar{\omega}^{i})/\Delta\omega,\ i \in \{\text{int, ins, oth}\})$ for all countries, sorted by $\Delta\omega$ in decreasing order. The first message from the table is that within sector changes are driving the evolution of the relative skilled wage series, not changes in subsector composition. Second, when focusing on countries that saw significant increases in finance relative wages (at least 0.08, the case of the UK), the average contributions of both financial intermediation and other activities are 50% each. These results suggest that it was increases within these two subsectors—and not in insurance and pension funding—that drove up relative skilled wages. The employment share of other activities in financial employment is small relative to the other two activities, at 13.6% on average (Table A3 in the Online Appendix). This means that relative wage increases within this subsector were much larger than in other subsectors of finance, which is evident in Table A2 in the Online Appendix. In addition, we see that when finance wages decrease ($\Delta\omega < 0$), the contribution of other activities is more often negative than positive.

27 This implies multiplying the finance contributions by –1 when skilled relative wages decline, and then averaging.

28 While aggregation always masks composition within aggregates, this issue is particularly important here, as our data indicate. See the Online Appendix for complete details on activities within each subsector.

Table III. Decompositions of changes in finance relative wages: finance subsectors

Notes: Countries are sorted by the change in finance relative wage. The decomposition for each country is based on Equation (6) in the text, applied to subsectors of finance (Financial Intermediation, Insurance and Pensions, Other Finance). The within share captures the contribution of wage changes within subsectors of finance; the between share captures the contribution of changes of subsector composition. The Intermediation, Insurance and Pensions, and Other Finance shares capture the overall contribution of each subsector of finance, whether from within-subsector changes or changes in the size of the subsector, and are based on Equation (8) in the text. Canada and Japan are omitted because they do not report sufficient subsector data. Data: EU KLEMS.

Country	Sample	Change in finance relative wage	Within subsector share	Between subsector share	Intermediation share	Insurance and pension share	Other finance share
Australia	1980-2005	1.21	0.90	0.10	0.27	0.16	0.56
USA	1980–2005	0.81	0.87	0.13	0.27	0.21	0.52
Spain	1980–2005	0.52	1.54	−0.54	0.60	0.26	0.14
Luxembourg	1995–2004	0.40	0.99	0.01	−0.08	0.33	0.75
Hungary	1992–2005	0.40	1.00	0.00	0.92	−0.19	0.27
Netherlands	1987–2005	0.37	1.04	−0.04	0.68	0.05	0.27
Denmark	1980–2005	0.36	0.97	0.03	0.31	0.40	0.29
France	1980–2005	0.32	1.06	−0.06	0.30	0.25	0.45
Czech Republic	1995–2005	0.32	1.10	−0.10	0.40	0.50	0.10
Sweden	1980–2005	0.29	1.00	0.00	0.58	0.01	0.41
Germany	1980–2005	0.21	1.01	−0.01	0.67	0.15	0.18
Finland	1983–2005	0.16	0.96	0.04	−0.28	0.41	0.87
UK	1980–2005	0.08	0.93	0.07	1.95	−2.60	1.64
Portugal	1995–2005	0.01	−0.35	1.35	0.78	−3.06	3.29
Austria	1980–2005	−0.04	0.76	0.24	1.13	1.19	−1.31
Belgium	1980–2005	−0.10	1.00	0.00	1.23	0.45	−0.68
Italy	1995–2005	−0.14	0.56	0.44	1.26	0.11	−0.37
Slovenia	1995–2005	−0.27	1.11	−0.11	0.30	−0.07	0.77
Ireland	1980–2005	−0.28	1.07	−0.07	−1.19	0.88	1.30
South Korea	1986–2005	−0.33	0.93	0.07	1.56	−0.48	−0.07

This means that wages in other activities tend to increase even when the overall relative wage in finance decreases. Overall, in all but two countries (Slovenia and Ireland) the contribution of other activities is to increase finance relative wages. When taking into account negative contributions to declines in finance relative wages, the contribution of other activities is a positive 50%.[29] Ignoring Slovenia and Ireland, this contribution increases to 68%.

We further explore the evolution of subsector wages, but in order to conserve on space we relegate the underlying tables to the Online Appendix. We find significant heterogeneity in the levels of finance subsector relative wages across countries and subsectors, and over time (Table A2). From 1985 to 2005, there are sizeable increases in all three of the subsector averages across countries. Fitting with the conclusions in the previous paragraph, the

29 This implies multiplying contributions by –1 when $\Delta\omega < 0$ and then averaging.

average rise in the relative wages for financial intermediation is twice that of the insurance and pension funding subsector, while other activities' increase is three times as great. These results fit with the idea that improved opportunities for bank profit via deregulation and greater market concentration drove the rise in the finance relative wage, as one would expect those two sectors to benefit more from an environment allowing for broader investment opportunities under increased market power.

We also find significant heterogeneity in employment shares within finance (Table A3). The employment share for financial intermediation within finance drops between 1985 and 2005 from about 67–59%, on average. Insurance and pension funding generally accounted for about 23% of workers within finance, on average, with no apparent trend. The decline in the employment share of financial intermediation within finance is mirrored by a commensurate increase in the other activities subsector of about 8%, from 10% to 18% on average.

Although there is significant heterogeneity across countries, on average the results presented in this subsection are consistent with those in Philippon and Reshef (2012) about the important role of "other finance", which includes mainly trading-related activities, in explaining the increase in finance relative wages.[30]

3. Explaining the Evolution of Finance Relative Wages

We entertain five theories for explaining variation in finance relative wages: technology adoption; financial deregulation; domestic credit expansion; financial globalization; and banking competition. This section motivates each one of these and the explanatory variables used to measure them, followed by our analysis.

We stress that we wish to explain the differential part of the rise in wages in finance, that is, relative to the NFFP sector. Some of the forces that affect wages in finance operate in analogous ways in the NFFP sector; for example, the precipitous drop in the price of computing power. Here, we estimate the differential effects on finance.

3.1 Explanatory Variables

3.1.a. Financial deregulation

The optimal organization of firms, and therefore their demand for various skills, depends on the competitive and regulatory environment. Tight regulation inhibits the ability of the financial sector to take advantage of highly skilled individuals because of rules and restrictions on the ways firms organize their activities, thus lowering demand for skill in finance. Philippon and Reshef (2012) argue that financial deregulation is the main driver of relative demand for skill in finance, and that technology and other demand shifters play a more modest role.

In order to capture the regulatory environment we rely on widely used data on financial reforms from the Abiad, Detragiache, and Tressel (2008) dataset. The dataset includes measures of financial reform along seven dimensions: (1) credit controls, (2) interest rate controls, (3) entry barriers/pro-competition measures, (4) banking supervision, (5) privatization, (6) international capital flows, (7) and securities market policies. We provide more details on these indices in the Online Appendix. We use the aggregate measure of financial

30 Panel D of Table II and Figure V of Philippon and Reshef (2012); our calculations based on EU KLEMS data for the USA broadly corroborate those numbers.

deregulation that is the sum of all indices, normalized to be between 0 and 1. Larger values of the deregulation index mean fewer restrictions. Although the word "deregulation" implies changes in the regulatory environment toward fewer restrictions, we keep this wording in order to avoid awkward terms like "unregulation."

One shortcoming of using the deregulation index is that none of its subcomponents addresses insurance services, which are an important part of the financial system. This may not be a major drawback, because insurance services exhibit the least change in our sample (Tables A2 and A3). A more substantial shortcoming is that these measures, by virtue of being standardized across countries, miss country-specific differences in intensities of reform and of responses of financial institutions, although they capture accurately the timing of reforms.[31] Table IV summarizes levels of the deregulation index in 1973 and 2005, together with its change over this period.

3.1.b. Information and communication technology

The strong complementarity of ICT with non-routine cognitive skills—such as those valued in the financial sector—may be able to help explain changes in finance relative wages. Autor, Katz, and Krueger (1998) and Autor, Levy, and Murnane (2003) highlight the role of ICT in changing demand for skill—in particular, replacing routine tasks and augmenting non-routine cognitive skills. If highly educated workers possess such non-routine cognitive skills, then higher ICT intensity in finance can help explain the higher wages that highly educated workers in finance command, relative to similar workers in the rest of the economy.

It is generally accepted that ICT capital is more complementary with skilled workers than with unskilled workers (e.g., Griliches, 1969; Berman, Bound, and Griliches, 1994), and indeed, we find this to be the case (see details in the Online Appendix). We also estimate that ICT capital is differentially more complementary with skilled workers in finance than in the NFFP sector. This, together with the increase in relative ICT intensity in finance, can be a mechanical force driving demand for skill and wages in finance. Below we test whether stronger complementarity of ICT with skill in finance, together with the increase in relative ICT intensity in finance, drove demand for skill and wages in finance.

We consider the share of computers, software, and ICT in the capital stock of the financial sector minus that share in the aggregate economy. Investment in ICT should have a big return for finance, which is an industry that relies almost entirely on gathering and analyzing data.[32] The return may be greater than in the NFFP sector, leading to relatively more ICT investment and higher stocks in finance than in the rest of the economy.

The EU KLEMS dataset provides data on real capital stocks by industry (in 1995 prices), the share of ICT in the real capital stock, and quantity indices for the total industry capital stock, ICT capital and non-ICT capital. Not all countries in the sample report data on real capital stocks, although all report quantity indices (we use the latter, see details in the

31 For example, the Abiad, Detragiache, and Tressel (2008) indices for the USA are not easily comparable to the deregulation measure in Philippon and Reshef (2012), which captures profound changes in the financial regulatory environment and removal of restrictions on organization and financial activities.

32 Indeed, the financial sector has been an early adopter of ICT. According to US fixed asset data from the Bureau of Economic Analysis, finance was the first private industry to adopt ICT in a significant way. In the EU KLEMS data, the average ICT share of the capital stock in finance is 2.6% in 1970, double the 1.3% share in the NFFP sector.

Table IV. Financial regulation

Notes: The table reports financial deregulation indicators and changes. Higher values indicate less restrictions or financial liberalization.

[a]Data for the Czech Republic and Hungary start in 1990. Data for Luxembourg and Slovenia are not available.

Source: Abiad, Detragiache and Tressel (2008).

	Financial deregulation index		Change in index, 1973–2005
	1973[a]	2005	
Australia	0.10	1.00	0.90
Austria	0.14	0.90	0.76
Belgium	0.43	1.00	0.57
Canada	0.62	1.00	0.38
Czech Republic[a]	0.19	0.90	0.71
Denmark	0.33	1.00	0.67
Finland	0.33	0.81	0.48
France	0.29	1.00	0.71
Germany	0.62	0.90	0.29
Hungary[a]	0.33	0.95	0.62
Ireland	0.52	1.00	0.48
Italy	0.14	0.95	0.81
Japan	0.29	0.86	0.57
South Korea	0.14	0.71	0.57
Netherlands	0.62	1.00	0.38
Portugal	0.14	0.81	0.67
Spain	0.38	1.00	0.62
Sweden	0.29	0.95	0.67
UK	0.48	1.00	0.52
USA	0.62	1.00	0.38

Online Appendix). For the purpose of illustrating an increase in ICT intensity, we use the share of ICT in the real capital stock. We define the relative ICT intensity in finance as

$$\theta_{\text{fin},t} = \text{ICT\_share}_{\text{fin},t} - \text{ICT\_share}_{\text{nffp},t},$$

where $\text{ICT\_share}_{s,t}$ is the share of ICT in the real capital stock in sector $s \in \{\text{fin}, \text{nffp}\}$ at time t.

Table V reports θ_{fin} for countries that have the underlying data at four mid-decade years and decade-long changes. For almost all countries and decade intervals θ_{fin} increases over time. The changes also become bigger over time. Finance becomes more ICT-intensive relative to the NFFP sector practically everywhere, at an increasing rate. Finland exhibits by far the largest increase, followed by Denmark, Australia, and the USA. Canada exhibits a low value of θ_{fin}, but this is because ICT intensity is high in the NFFP sector there.

3.1.c. Domestic credit

When demand for credit is high, it may be necessary to employ highly skilled workers to screen potential borrowers and investments, and then to monitor them and manage risk.

Table V. Finance relative ICT capital share

Notes: The table reports Information and Communication Technology (ICT) shares in real capital stock in finance minus the ICT share in the non-farm, non-finance private sector (NFFP) in different years and the changes between those years. The total change is the sum of changes in the preceding three columns.

[a]Data for Canada in 2005 is missing and is replaced in this table by data for Canada in 2004. Data: EU KLEMS.

	Finance relative ICT share				Changes			
	1975	1985	1995	2005	1975–1985	1985–1995	1995–2005	Total
Australia	0.008	0.019	0.061	0.391	0.012	0.042	0.330	0.383
Austria		0.016	0.048	0.178		0.032	0.130	0.162
Belgium								
Canada[a]	−0.054	−0.015	0.012	−0.043	0.039	0.027	−0.055	0.011
Czech Republic			0.168	0.293			0.125	0.125
Denmark	0.006	0.041	0.125	0.592	0.035	0.085	0.466	0.586
Finland	0.075	0.146	0.350	0.836	0.071	0.204	0.486	0.761
France								
Germany			0.077	0.194			0.117	0.117
Hungary								
Ireland								
Italy	−0.005	0.004	0.014	0.137	0.009	0.010	0.122	0.141
Japan	0.046	0.047	0.122	0.306	0.001	0.075	0.184	0.260
South Korea		0.085	0.153	0.186		0.069	0.033	0.102
Luxembourg								
Netherlands	0.008	0.019	0.066	0.300	0.011	0.047	0.234	0.292
Portugal			0.112	0.101			−0.010	−0.010
Slovenia			−0.027	0.284			0.311	0.311
Spain								
Sweden			0.163	0.276			0.113	0.113
UK	0.035	0.015	0.129	0.303	−0.020	0.114	0.174	0.268
USA	0.014	0.054	0.146	0.355	0.040	0.092	0.209	0.341
Average	0.015	0.039	0.107	0.293	0.022	0.072	0.186	0.248

Monitoring may require efficiency wages in order to avoid the threat of moral hazard. We capture this using total domestic credit provided by the financial sector as a share of GDP. This concept includes gross credit to the private sector, as well as net credit to the government. The data are from the World Bank's World Development Indicators database. Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other

financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies.

We also use data from Jorda, Schularick, and Taylor (2014) (JST) on the volume and composition of domestic bank credit to the private sector for eleven countries that are in our sample, and supplement these data with domestic bank credit data from the World Bank when possible. Overall, total bank credit data from JST and from the World Bank are very close for observations that exist in both sources. We use these data to split total credit into bank credit and non-bank credit. We use JST data to split bank credit into household versus corporate credit, and into mortgage versus non-mortgage credit. These two splits are not the same: Although mortgage credit is a large part of household credit, substantial mortgage credit is obtained by the corporate sector, and households have substantial non-mortgage credit. When using World Bank domestic credit we made a few corrections for breaks in the series. See the Online Appendix for detailed descriptions of data and the corrections we made.

Although expansion of credit can be a consequence of financial deregulation, for example due to removing financial repression (McKinnon, 1973; Shaw, 1973)—the nature, quality, and riskiness of this credit is not captured by the credit volumes alone. The latter are captured by our financial deregulation index.

3.1.d. Financial globalization

Foreign investors that are represented by local financial firms may also demand high-quality services, which can be performed only by skilled workers. Likewise, investment overseas is a more complex type of activity, which also requires highly skilled workers. If the skills needed to perform these tasks are in fixed supply, or supply does not keep up with demand, then wages of those who can perform these tasks well will be bid up. We capture this using a measure of *de facto* financial globalization, namely foreign assets plus foreign liabilities as a ratio to GDP. The data are from Lane and Milesi-Ferretti (2007).

This force is largely independent of financial regulation *per se*, as Kindleberger (1987) argues, since its surge was driven mostly by lower communication and transport costs within a given regulatory framework.

3.2 Econometric Specification

We start by fitting descriptive regressions that are useful for summarizing the patterns in the data. These take the form

$$y_{c,t} = \gamma \cdot \text{deregulation}_{c,t-3} + \beta' x_{c,t-3} + \alpha_c + \delta_t + \epsilon_{c,t}, \tag{9}$$

where y is either the finance relative wage ω or the finance skilled relative wage ω^{skilled}, both from Section 2. Here, α_c and δ_t are country c and year t fixed effects, respectively, and ϵ_{ct}, is the error term. The variable deregulation is the deregulation index described above. The vector x includes explanatory variables, such as relative ICT intensity, domestic credit measures, and financial globalization. We estimate Equation (9) using OLS; identification of γ and β relies on within-country variation, relative to the average level in a particular year.

Although we lag explanatory variables in Equation (9) by three years to guard against simultaneity, we are still concerned about omitted variables that may bias our estimator.[33] The next set of regressions tries to address these concerns.

33 Using longer lag lengths yields similar results, but reduces explanatory power.

The second set of regressions contains predictive regressions. These take the following form:

$$\Delta y_{c,t+3} = \gamma \cdot \Delta \text{deregulation}_{c,t} + \beta' \Delta x_{c,t} + \alpha_c + \delta_t + \epsilon_{c,t}, \tag{10}$$

where $\Delta y_{c,t+3} = y_{c,t+3} - y_{c,t}$, $\Delta x_{c,t} = x_{c,t} - x_{c,t-3}$, and $\Delta \text{deregulation}_{c,t} = \text{deregulation}_{c,t} - \text{deregulation}_{c,t-3}$. This is a very demanding specification. For example, identification of γ relies on independent within-country variation in magnitude—but more importantly in the timing of changes in deregulation. Accounts of financial deregulation argue that the timing was indeed exogenous and independent across countries (e.g., Englund, 1990; Vives, 1990; Melitz, 1990, in Sweden, France, and Spain, respectively). Therefore, these predictive regressions permit a stronger causal interpretation by significantly alleviating concerns for omitted variables bias.[34] Omitted variables that may be correlated in levels over time are less likely to be correlated in terms of the timing of their changes. Indeed, while our set of explanatory variables exhibit sometimes non-trivial correlations among themselves in levels, their correlations in changes drop significantly in magnitude and become invariably statistically insignificant (Table A4 in the Online Appendix).

Specification (10) also allows us to use plausibly excludable instruments for financial deregulation in changes to further establish causality. We use three-year lagged financial deregulation in levels, $\text{deregulation}_{c,t-3}$, as an instrument for changes in financial deregulation over the following three years, $\Delta \text{deregulation}_{c,t}$. Abiad and Mody (2005) discuss political economy models that justify this specification.[35]

The instrument is relevant and strong; since the range of the deregulation index is limited between zero and one, a higher level (less regulation) is negatively correlated with increases in deregulation (indeed, we report strong first stage regressions in Table A7 in the Online Appendix). The instrument is plausibly excludable. It is unlikely that the level of deregulation in $t - 3$ affects changes in wages from t to $t + 3$ in a systematic way, other than through its effect through deregulation changes over $t - 3$ to t. If it did, for example, in a positive way, then we would find increasing gradients for finance relative wages, because the level of deregulation is invariably increasing over time across countries in our sample. The patterns in the data do not support this last condition.

Although the exclusion restriction is not a testable assumption, we run the following specification tests. We fit "false first-stage" regressions, in which we pretend to use $\text{deregulation}_{c,t-3}$ to instrument for other variables in $\Delta x_{c,t}$. We find that the instrument is invariably uncorrelated with elements of $\Delta x_{c,t}$ (Table A8). This is reassuring—albeit not constituting proof—because it increases our confidence that the instrument is not correlated with other, potentially omitted and relevant variables in Equation (10).

We report the levels and changes of relative finance wages and relative skilled wages in finance in Table A1; descriptive statistics and correlation tables for all regression variables are reported in Table A4.

34 One way to appreciate the importance of timing is the following thought experiment. Suppose that $\text{deregulation}_{c,t}$ is a dummy variable that changes from zero to one when country c deregulates (completely) in year t_d. Then identification of γ is only due to the timing of deregulation, since in this case $\Delta \text{deregulation}_{c,t} = 0$ in all years except for the deregulation year t_d.

35 Abiad and Mody (2005) use a nonlinear ordered logit regression, and include also the square of the level as a predictor of change. We also experimented with adding the square of the level in the first-stage regressions; doing so keeps the second stage results virtually unchanged.

All regressions report robust standard errors. The use of standard errors clustered by country is not appropriate due to the limited number of countries in our sample (Angrist and Pischke, 2008). Nevertheless, in our predictive regressions, this type of clustering does not change standard errors materially, whether we instrument or not. Clustering by country does increase substantially standard errors in the descriptive regressions, but we do not attach a causal interpretation there. These results are reported in Table A6 in the Online Appendix. Our standard errors do not change materially if we cluster by year, use Newey–West standard errors, or if we bootstrap.[36] We tested for serial correlation in all regressions using the procedure in Wooldridge (2002) (pages 310–311) and did not reject the null hypothesis of no serial correlation at conventional levels of statistical significance.[37]

We perform several other robustness checks that are not reported here. First, we control for country level macro variables that might be related to our dependent variables such as GDP growth and interest rates. Second, we drop top and bottom percentiles of the distribution of our dependent variables from the regressions and rerun the regressions. Third, we run the regressions without one country from the sample while keeping the rest; we do this for each country separately. The main results are robust to all these checks.

3.3 Finance Relative Wages Descriptive Level Regressions

Table VI reports the results from level regressions (9). First, we find that financial deregulation is positively associated both with overall finance relative wages and with relative skilled wages in finance—and the magnitude of the effects are economically significant. The estimated coefficients on the financial deregulation variable in Columns 1 and 5 imply that weakening regulation by one standard deviation of the index in this sample is associated with an increase of overall wages and relative skilled wages in finance by 0.27 and 0.20 of a standard deviation, respectively. These effects grow significantly to 0.55 and 0.31 of a standard deviation in Columns 3 and 7, respectively.

Second, we find that relative ICT intensity in finance has a positive and statistically significant correlation with relative skilled wages in finance, but not with the overall finance relative wage. These results suggest that the positive effect of relative ICT intensity on skilled workers' wages is offset by a negative effect on unskilled wages, which is in line with findings in Autor, Levy, and Murnane (2002).

Third, *de facto* financial globalization (log of international assets plus liabilities as a share of GDP) is positively correlated with the overall finance relative wage but has no significant correlation with the skilled one. A one standard deviation increase in *de facto* financial globalization increases the average relative wage in finance by 0.57 of a standard deviation. The different results for the overall and skilled relative wages are due to a strong effect on relative skill intensity in finance, that is, financial globalization is associated with higher relative skill intensity in finance (regressions not reported here, but are available upon request).

36 Cameron, Gelbach, and Miller (2008) suggest bootstrapping in the presence of a small number of clusters. However, MacKinnon and Webb (2016) show that if clusters are unbalanced, even this procedure may fail to improve inference in the presence of unbalanced clusters, and rejection rates remain high. Our panel data are also unbalanced, so we report robust standard errors instead.

37 Drukker (2003) presents simulation evidence that this test has good size and power properties. In addition, inspection of the partial autocorrelation functions also reveal no evidence of autoregression or moving averages in the errors.

Table VI. Finance relative wages: descriptive regressions in levels

Notes: The explanatory variables are lagged three periods. All regressions include country- and year-fixed effects. Deregulation data are from Abiad, Detragiache and Tressel (2008). The dependent variables, as well as relative ICT use in finance, are calculated from the EU KLEMS database. Domestic credit covers all forms of credit to the non-financial sector on a gross level, except for credit to the government, which is on a net basis; data from the World Bank World Development Indicators database. Bank domestic credit data are from Jorda, Schularick, and Taylor (2014), except for Austria and South Korea where the data are from the World Bank World Development Indicators database. Financial globalization is log((foreign assets + liabilities)/GDP); data are from Lane and Milesi-Ferretti (2007). Non-bank domestic credit is total domestic credit minus bank credit. The split of bank domestic credit to households versus corporations, and to mortgage versus non-mortgage lending is given in Jorda, Schularick, and Taylor (2014). The sample ends in 2005. We lose Austria, Czech Republic, and South Korea when we split bank credit due to data unavailability. The sample of fifteen countries is determined by ICT data availability in the EU KLEMS data; these countries are: Australia, Austria, Canada, Czech Republic, Germany, Denmark, Finland, UK, Italy, Japan, South Korea, Netherlands, Portugal, Sweden, and the USA. Robust standard errors in parentheses.

$^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Finance relative wages				Finance skilled relative wages			
Financial deregulation index, $t-3$	0.408***	0.473***	0.811***	0.552***	0.320**	0.324**	0.492**	0.390**
	(0.133)	(0.135)	(0.173)	(0.151)	(0.154)	(0.158)	(0.217)	(0.190)
Finance relative ICT intensity, $t-3$	0.287	0.200	0.168	0.0629	0.991***	0.986***	1.167***	1.073***
	(0.219)	(0.221)	(0.237)	(0.230)	(0.244)	(0.248)	(0.287)	(0.276)
Financial globalization, $t-3$	0.257***	0.270***	0.193**	0.174**	−0.0769	−0.0762	−0.0684	−0.156*
	(0.0556)	(0.0555)	(0.0814)	(0.0739)	(0.0633)	(0.0638)	(0.101)	(0.0916)
Domestic credit/GDP, $t-3$	0.265***				0.528***			
	(0.0713)				(0.0797)			

(continued)

Table VI. Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Finance relative wages				Finance skilled relative wages			
Non-bank domestic credit/GDP, $t-3$		0.341***	0.368***	0.273***		0.532***	0.682***	0.548***
		(0.0782)	(0.0933)	(0.0807)		(0.0880)	(0.113)	(0.0971)
Bank domestic credit/GDP, $t-3$		0.0937				0.518***		
		(0.103)				(0.119)		
Household bank credit/GDP, $t-3$			0.247				1.203***	
			(0.202)				(0.251)	
Corporate bank credit/GDP, $t-3$			−0.300				−0.280	
			(0.290)				(0.355)	
Mortgage bank credit/GDP, $t-3$				0.314				1.068***
				(0.213)				(0.256)
Non-mortgage bank credit/GDP, $t-3$				0.0554				0.205
				(0.218)				(0.267)
Observations	356	356	279	296	341	341	268	282
Number of countries	15	15	12	12	15	15	12	12
R-squared, within	0.303	0.315	0.371	0.369	0.211	0.211	0.262	0.251

Fourth, domestic credit supply (as a share of GDP) is positively associated with both relative finance wage measures, and the effects are economically large. A one standard deviation increase in domestic credit increases overall and skilled relative wages in finance by 0.44 and 0.83 of a standard deviation.

Variation in different types of credit may have different effects on finance relative wages. More non-bank credit is associated both with skilled and overall finance relative wages, but bank credit only has a significant effect on finance relative skilled wages. Within bank credit, it is credit to households and mortgage credit (which significantly, but not perfectly, overlap) that drive the result for skilled finance workers. This can be explained by the following observations. Most of the increase in the ratio of bank credit to GDP since 1970 in advanced economies has been driven by the dramatic rise in mortgage lending relative to GDP (Jorda, Schularick, and Taylor, 2014). This increase in mortgage lending made the creation and marketing of mortgage-backed securities and securitization more appealing, which subsequently led to higher skilled wages in finance as these activities are relatively complex and require specific skills.

3.4 Finance Relative Wage Predictive Regressions

We now turn to the predictive regressions based on Equation (10). Although this is a very demanding specification, we also use instrumental variables as an alternative identification of the causal effect of financial deregulation on relative wages in finance, as discussed above. Table VII shows that the only robust predictor for changes in overall and skilled relative wages in finance is changes in financial deregulation. The magnitude of the effect is economically large. In the OLS specification, a one standard deviation faster increase of the financial deregulation index corresponds to a 0.18 standard deviation faster increase in relative wages in finance, and 0.21 for skilled relative finance wages.

The IV regression coefficient to deregulation is twice as large: a one standard deviation increase in $\Delta\text{deregulation}_{c,t}$ implies a 0.44 standard deviation faster increase in relative wages in finance, and 0.41 for skilled relative finance wages. This is consistent with the notion (although not a proof thereof) that upward bias in the OLS regression due to reverse causality is not an important issue. For example, if increases in finance wages capture increases in political power, which is used to influence the political system to deregulate more, then the OLS estimator would be biased upward, and the IV estimator would correct this and deliver a smaller coefficient. In fact, the opposite holds.

The regression results are similar for skilled workers and for all workers. This is because changes in the overall finance relative wage are mostly due to variation in skilled wages, as shown in Table I and discussed above, especially when finance wages increase.

The instrument in the IV regressions in Table VII is strong, with large first-stage partial *F*-stats. In the Online Appendix (Table A7) we report the first-stage regressions, where, as expected, financial regulation in levels in $t-3$ is negatively correlated with future deregulation in $t-3$ to t.

Using several specifications and estimators, we find that deregulation of financial markets is the most important factor driving overall and skilled relative wages in finance.

3.5 Finance Relative Wages around Deregulation Events

In order to strengthen the causal interpretation of our results we examine the dynamics of the relationship between deregulation and finance relative wages using an event study approach.

Table VII. Finance relative wages: predictive regressions in changes

Notes: The right-hand side variables are the three-year changes (from $t-3$ to t) for each variable. In IV regressions, we use the level of deregulation at $t-3$ as an instrument for changes in deregulation from $t-3$ to t. All regressions include country- and year-fixed effects. Deregulation data are from Abiad, Detragiache, and Tressel (2008). The dependent variables, as well as relative ICT use in finance, are calculated from the EU KLEMS database. Domestic credit covers all forms of credit to the non-financial sector on a gross level, except for credit to the government, which is on a net basis; data from the World Bank World Development Indicators database. Financial globalization is log((foreign assets + liabilities)/GDP); data are from Lane and Milesi-Ferretti (2007). The sample ends in 2005. Out of our original twenty-two countries, we do not have sufficient data for Slovenia, and we drop Luxembourg as an outlier. The sample of fifteen countries is determined by ICT data availability in the EU KLEMS data; these countries are: Australia, Austria, Canada, Czech Republic, Germany, Denmark, Finland, UK, Italy, Japan, South Korea, Netherlands, Portugal, Sweden, and the USA. Robust standard errors in parentheses.

***$p<0.01$, **$p<0.05$, *$p<0.1$.

Dependent variable: changes from t to $t+3$ in	(1)	(2)	(3)	(4)
	Finance relative wages		Finance skilled relative wages	
	OLS	IV	OLS	IV
Change in financial deregulation, $t-3$ to t	0.393***	0.971***	0.452***	0.876***
	(0.111)	(0.200)	(0.134)	(0.178)
Change in finance relative share of ICT in capital stock, $t-3$ to t	−0.436	−0.0923	−0.452	−0.0404
	(0.309)	(0.261)	(0.330)	(0.289)
Change in financial globalization, $t-3$ to t	0.0504	0.0295	0.142***	0.00844
	(0.0441)	(0.0586)	(0.0538)	(0.00519)
Change in domestic credit/GDP, $t-3$ to t	−0.127	−0.165**	−0.161*ast;	−0.0171**
	(0.0779)	(0.0645)	(0.0825)	(0.00728)
Observations	293	293	278	278
Number of countries	15	15	15	15
R-squared	0.201	0.341	0.144	0.387
First-stage partial F-stat	—	32	—	36

To this end, we fit the following regression:

$$y_{ct} = \beta_{-7}D_{ct}^{\leq -7} + \beta_{-6}D_{ct}^{-6} + \cdots + \beta_{-1}D_{ct}^{-1} + \beta_1 D_{ct}^{1} + \cdots + \beta_6 D_{ct}^{6} + \beta_7 D_{ct}^{\geq 7} + \alpha_c + \delta_t + \epsilon_{c,t}, \tag{11}$$

where y_{ct} is either the finance relative wage (1) or the finance relative skilled wage (5). The dummy variables D_{ct}^{k} indicate the time between the current year and the year of the deregulation event. For example, D_{ct}^{-1} is a dummy variable that equals one for the year before a country deregulates and zero otherwise; D_{ct}^{6} equals one for the sixth year after a country deregulates and zero otherwise. The indicator $D_{ct}^{\leq -7}$ equals one in all years that are seven or more years before the country deregulated; $D_{ct}^{\geq 7}$ equals one in all years that are seven or

more years after the country deregulated. The omitted category is the year of the deregulation event, $k = 0$, so the interpretation of the coefficients is relative to this reference year, which varies across countries.

The year of the deregulation event for each country is the year with the largest increase in the deregulation index. This decision is justified on the basis of country-specific histories of the process of financial deregulation: when countries decide to deregulate, they concentrate most of their reforms in 1 or 2 years, with some further reforms later on.[38]

We include country- α_c and year-fixed effects δ_t to control for country-specific effects and common trends. We use robust standard errors to compute confidence intervals, but clustering by country or by year yield very similar results here.

Figure 6 plots year-by-year estimates and 95% confidence intervals of the β_k coefficients. Confidence intervals mechanically increase as the time to/from the deregulation event grows due to fewer observations in those categories. The coefficient estimates for all years preceding the deregulation event are virtually zero, showing that the increase in finance relative wages did not precede deregulation. Significant increases in finance relative wages follow large deregulation events. The adjustments seem plausible because they are gradual until the 6th year, after which they become stable.[39] These relationships over time are not a result of the general upward trends in many of the dependent relative wage series. Even if large deregulation events tend to arrive earlier in the sample, before relative wages have increased, the year-fixed effects absorb this timing issue.

Overall, Figure 6 supports our causal interpretation: deregulation predicts increases in relative wages; relative wage increases do not precede major deregulation events. The estimates imply an increase of 0.34 for finance relative wages and 0.4 for finance relative skilled wages 7 years after a deregulation event. These effects are in line with the point estimates in Sections 3.3 and 3.4.

3.6 Market Structure, Financial Deregulation, and Relative Wages

We now turn to investigate mechanisms by which deregulation affects relative wages in finance. In particular, we ask whether deregulation matters more in some countries versus others, depending on their characteristics. By doing this we also try to infer when is deregulation more likely to be associated with rents and socially inefficient risk taking. We are guided by theory that is discussed in Section 1, as well as our empirical descriptive findings

38 The event years for each country are: Australia 1982, Austria 1980, Canada 1987, Czech Republic 1996, Germany 1985, Denmark 1988, Finland 1984, UK 1979, Italy 1974, Japan 1991, South Korea 1991, Netherlands 1980, Portugal 1992, Sweden 1986, USA 1980. These dates fit the histories of almost all countries, as illustrated for Sweden by Englund (1990) and Spain by Vives (1990). Although France is not in this sample due to data limitations (no ICT data), the account of Melitz (1990) supports our approach. Two exceptions are the so-called "Big Bang" reforms of the UK in 1986 and Japan in 1997–1999. This is because the Big Bang reforms in these two countries focused mostly on securities markets, while other, perhaps more fundamental dimensions of financial regulation of banking occurred earlier. Ultimately, this also reflects the limitation of our regulation indicators.

39 In untabulated results we estimate a variant of Equation (11) with $\beta_7 D^7_{ct} + \beta_8 D^8_{ct} + \beta_9 D^9_{ct} + \beta_{10} D^{\geq 10}_{ct}$ instead of $\beta_7 D^{\geq 7}_{ct}$. Our point estimates of β_7, β_8, β_9, and β_{10} are of similar magnitude, implying similar effects after the 7th year after the deregulation event and on, but confidence intervals rapidly increase due to few observations in those categories. This is why we decided to display results using only up to $\beta_7 D^{\geq 7}_{ct}$.

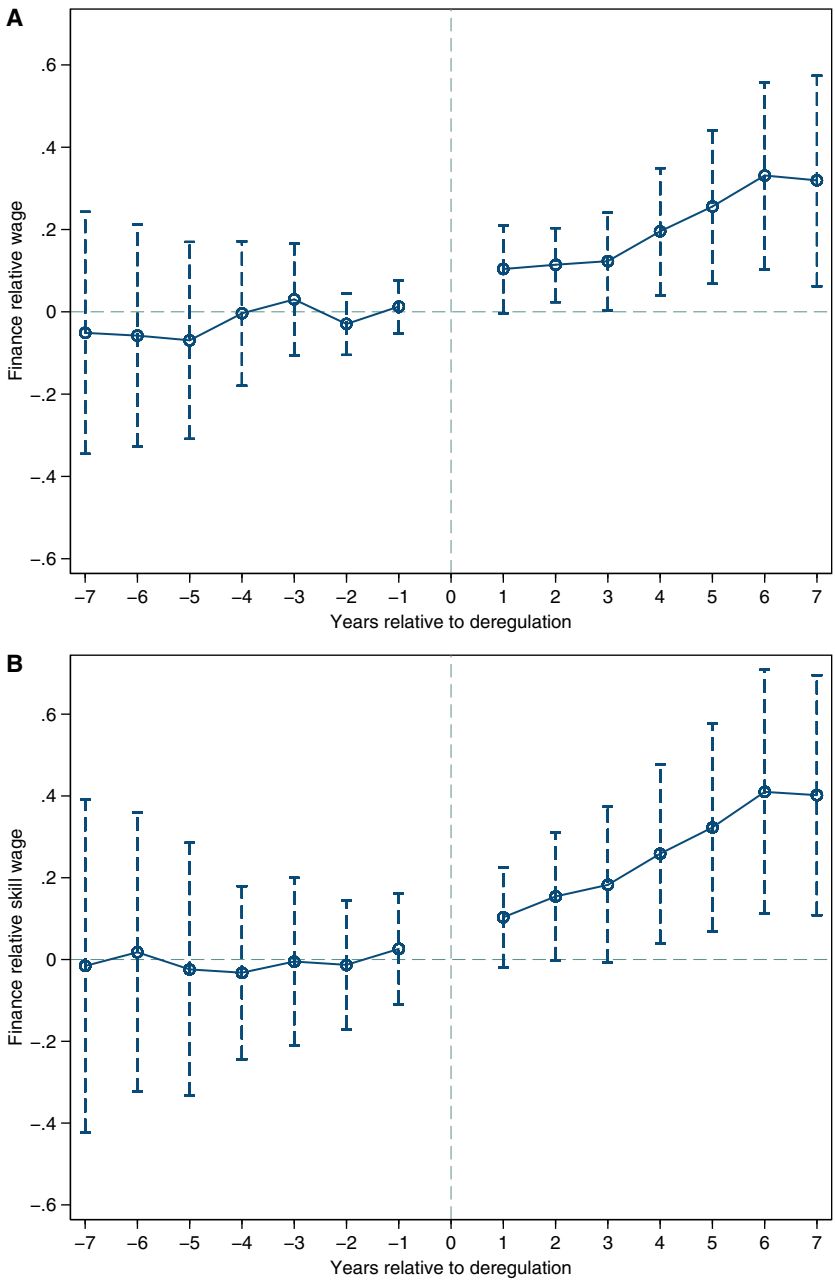

Figure 6. Finance relative wages around major deregulation events.
Notes: The figures report the regression coefficients (and confidence intervals, marked by dashed bar "whiskers") for a set of indicators for years before and after the biggest deregulation event for each country. The biggest deregulation event for each country is the year with the largest increase in its deregulation index. We regress relative wages (Panel A: finance relative wage, Panel B: finance relative skilled wage) on country dummies, year dummies, and a set of indicators for years before and years after the biggest deregulation event for each country. Minus 7 indicates seven or more years before, and plus 7 indicates seven or more years after. We use robust standard errors for computing confidence intervals.

in Section 2. Both motivate examining mechanisms that operate particularly on (typically skilled) workers in the non-traditional banking sector, where rents may accrue due to opaque activities where there is greater information asymmetry. Theory also motivates examining environments where competition for talent leads to the threat of firm-to-firm movement of workers.

Our strategy is to interact deregulation in the level and predictive regressions with time-invariant country-specific variables. In particular, we add to regressions (9) and (10) interactions with the level of deregulation and with changes thereof, respectively

$$\omega_{c,t} = \theta(z_c \cdot \text{deregulation}_{c,t-3}) + \gamma \cdot \text{deregulation}_{c,t-3} + \beta' x_{c,t-3} + \alpha_c + \delta_t + \epsilon_{c,t} \quad (12)$$

and

$$\Delta\omega_{c,t+3} = \theta(z_c \cdot \Delta\text{deregulation}_{c,t}) + \gamma \cdot \Delta\text{deregulation}_{c,t} + \beta' \Delta x_{c,t} + \alpha_c + \delta_t + \epsilon_{c,t}, \quad (13)$$

where the variables are defined above in Section 3.2. The coefficient of interest is θ. In order to conserve on space, we report regressions with the overall finance relative wage ω and $\Delta\omega^{\text{skilled}}$ as dependent variables in Table A10 in the Online Appendix; these are comparable to the results discussed below.

In order to obtain z_c for both Equations (12) and (13) we first compute the average over the first three years in which data are available for all countries, separately for each variable. Then, we standardize these averages to get z_c. This has the virtue of facilitating comparability across variables, and also maintains comparability of the magnitude of the main effect of regulation or deregulation for the average country, γ, when the value of z_c is zero. Table A9 in the Online Appendix reports the values and standardized values used for z_c, as well as correlations across all z_c's.

The choice of using averages over the first 3 years of data availability reduces noise in z_c, while capturing country characteristics as early as possible. Using averages over all available years is less desirable, but the results do not change substantively when we do this (they are typically a bit stronger), and are available upon request. This is encouraging, because it implies that country rankings and relative position are stable in each dimension, and the interaction variables pick up country-invariant characteristics. Below we report for each variable the years which are used in our analysis. These are invariably the first 3 years for which each variable is available to all fifteen countries in our regression sample.[40] We keep here details on these variables to a minimum, and report more details in the Online Appendix. The results are reported in Table VIII; Panel A reports results for (12) and Panel B for (13).

3.6.a. Composition of financial intermediation

We use the following variables to test whether deregulation has differential effects depending on the nature of financial intermediation. In particular, we seek indicators for trading and opaque activities: (1) Non-bank domestic credit/GDP, (2) Bank non-interest income share of total bank income, (3) Stock market capitalization/GDP, (4) OTC trading turnover ratio to total stock market turnover, (5) OTC trading turnover/GDP, and (6) Indicator for global financial center.[41]

40 This is typically after the first year in which data are available for any country.

41 Countries in our sample that have a "top 20" global financial center are Australia, Canada, Germany, UK, Japan, South Korea, and the USA.

Table VIII. Finance relative wages: interactions with deregulation

Notes: All regressions include country-fixed effects and year-fixed effects. In Panel A the explanatory variables are lagged three periods. In Panel B the explanatory variables are the 3-year changes (from $t-3$ to t) for each variable. Deregulation data are from Abiad, Detragiache, and Tressel (2008). The dependent variables, as well as relative ICT use in finance, are calculated from the EU KLEMS database. Domestic credit covers all forms of credit to the non-financial sector on a gross level, except for credit to the government, which is on a net basis; data from the World Bank World Development Indicators database. Bank domestic credit data are from Jorda, Schularick, and Taylor (2014), except for Austria and South Korea where the data are from the World Bank Development Indicators database. Non-bank domestic credit is total domestic credit minus bank credit. Financial globalization is log((foreign assets + liabilities)/GDP); data are from Lane and Milesi-Ferretti (2007). Bank non-interest income share is income generated by non-interest-related activities as a percentage of total bank income; non-interest-related income includes net gains on trading and derivatives, net gains on other securities, net fees and commissions and other operating income. OTC turnover data are from the Bank for International Settlements. The global financial center indicator takes value 1 for Australia, Canada, Germany, UK, Japan, South Korea, and the USA; data from Global Financial Centers Index, produced by the think-tank Z/Yen. The source of the index is the OECD. Bank non-interest income share, Stock market capitalization, Stock market turnover, Revenue-based competition index, and Profit-based competition index data are from the Financial Development Dataset, World Bank. The sample ends in 2005. The sample of fifteen countries is determined by ICT data availability in the EU KLEMS data; these countries are: Australia, Austria, Canada, Czech Republic, Germany, Denmark, Finland, UK, Italy, Japan, South Korea, Netherlands, Portugal, Sweden, and the USA.

[a]Global financial center indicator is not standardized. Robust standard errors in parentheses.

$^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	A. Dependent variable: Finance relative wages									
Interaction variable (standardized, except in column 6):	Non-bank domestic credit/GDP	Bank non-interest income share	Stock market capitalization/GDP	OTC turnover/ stock market turnover	OTC turnover/ GDP	Global financial center indicator[a]	Employment protection index	Bank concentration	Revenue-based competition index	Profit-based competition index
Financial deregulation index, $t-3$ * interaction variable	0.124	0.267***	0.451***	0.109**	0.147***	0.552***	−0.761***	0.201***	−0.378***	0.0278
	(0.0811)	(0.0541)	(0.0661)	(0.0503)	(0.0533)	(0.110)	(0.0665)	(0.0642)	(0.0369)	(0.0396)
Financial deregulation index, $t-3$	0.373**	0.285**	0.500***	0.353**	0.380**	0.0255	0.0835	0.440***	−0.205	0.395**
	(0.160)	(0.140)	(0.140)	(0.169)	(0.169)	(0.140)	(0.113)	(0.163)	(0.134)	(0.173)
Finance relative ICT intensity, $t-3$	0.303	0.375*	0.404**	0.289	0.274	0.401*	0.271*	0.573**	0.311	0.308
	(0.228)	(0.220)	(0.199)	(0.221)	(0.221)	(0.228)	(0.162)	(0.253)	(0.213)	(0.240)
Financial globalization, $t-3$	0.241***	0.264***	0.266***	0.263***	0.260***	0.301***	0.206***	0.240***	0.244***	0.262***
	(0.0664)	(0.0612)	(0.0572)	(0.0637)	(0.0642)	(0.0671)	(0.0480)	(0.0681)	(0.0606)	(0.0660)
Domestic credit/GDP, $t-3$	0.168	0.314***	0.0650	0.255***	0.257***	0.113	0.0403	0.216**	0.107	0.259***
	(0.105)	(0.0852)	(0.0796)	(0.0892)	(0.0905)	(0.0891)	(0.0704)	(0.101)	(0.0799)	(0.0924)
Observations	356	356	356	356	356	356	348	356	356	356
Number of countries	15	15	15	15	15	15	14	15	15	15
R-squared	0.760	0.783	0.800	0.761	0.760	0.778	0.843	0.765	0.812	0.757

(continued)

Table VIII. Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	B. Dependent variable: changes from t to $t+3$ in finance relative wages									
Interaction variable (standardized, except in Column 6):	Non-bank domestic credit/GDP	Bank non-interest income share	Stock market capitalization/ GDP	OTC turnover/ stock market turnover	OTC turnover/ GDP	Global financial center indicator[a]	Employment protection index	Bank concentration	Revenue-based competition index	Profit-based competition index
Change in financial deregulation, $t-3$ to t * interaction variable	0.282**	0.359***	0.316***	0.249***	0.232***	0.382*	−0.553***	0.305***	−0.293***	−0.193*
	(0.131)	(0.0721)	(0.0880)	(0.0734)	(0.0711)	(0.218)	(0.133)	(0.0876)	(0.0873)	(0.103)
Change in financial deregulation, $t-3$ to t	0.379***	0.319***	0.385***	0.301**	0.334**	0.186	0.230**	0.403***	0.279***	0.460***
	(0.127)	(0.114)	(0.123)	(0.134)	(0.134)	(0.113)	(0.115)	(0.129)	(0.107)	(0.142)
Change in finance relative share of ICT in capital stock, $t-3$ to t	−0.457*	−0.520**	−0.525**	−0.445*	−0.421	−0.570**	−0.464*	−0.593**	−0.498*	−0.324
	(0.262)	(0.260)	(0.258)	(0.264)	(0.264)	(0.281)	(0.248)	(0.266)	(0.276)	(0.260)
Change in financial globalization, $t-3$ to t	0.0636	0.0331	0.0510	0.0550	0.0552	0.0448	0.0528	0.0387	0.0398	0.0539
	(0.0594)	(0.0598)	(0.0607)	(0.0597)	(0.0598)	(0.0602)	(0.0585)	(0.0604)	(0.0598)	(0.0588)
Change in domestic credit/GDP, $t-3$ to t	−0.115*	−0.116*	−0.111*	−0.121*	−0.122*	−0.117*	−0.0944	−0.112*	−0.0860	−0.141**
	(0.0628)	(0.0665)	(0.0658)	(0.0668)	(0.0667)	(0.0646)	(0.0646)	(0.0633)	(0.0650)	(0.0645)
Observations	293	293	293	293	293	293	289	293	293	293
Number of countries	15	15	15	15	15	15	14	15	15	15
R-squared	0.422	0.446	0.429	0.426	0.424	0.415	0.454	0.426	0.435	0.414

The results in Table VIII, Columns 1–6, indicate that all of these variables increase the effect of deregulation on finance relative skilled wages, both in the level regressions and in the predictive regressions. As financial intermediation becomes less bank-dependent, when banks derive more of their income from non-traditional intermediation (lending), when stocks represent a larger share of the economy, and when OTC markets are more important, deregulation has a larger effect on finance wages. In Column 6, we see that the main effect of deregulation is positive and statistically significant only if a country has a global financial center. Indeed, countries that have a global financial center also have many of the other characteristics that increase the effect of deregulation (Table A9, Panels C and D).[42]

3.6.b. Labor market flexibility

Theories cited in the introduction stress the role of firm-to-firm mobility in creating rents for workers and high risk taking. We use the following measure of labor market protection to capture the possibility of labor movement across firms. When job security is higher, theory predicts less job-to-job mobility. If deregulation increases competition for talent, then this should have a stronger effect in countries that have more flexible labor markets. We use an Employment Protection Index to capture the strictness of employment protection, where higher values mean stronger job security for workers. The source of the index is the OECD, and data are available from 1985.

In Column 7 of Table VIII we see that in countries with more flexible labor markets (lower protection) the effect of deregulation is significantly larger.

3.6.c. Competitiveness and market structure

We now ask whether deregulation has different effects conditional on the competitiveness of the financial sector. We expect to find higher wages in less competitive settings, where financial firms are expected to make higher profits. If profits are shared with workers (Akerlof and Yellen, 1990), then this can lead to higher wages.[43] Highly skilled workers are almost surely more likely to capture these rents.[44] Although deregulation is associated with lowering barriers to entry, competitive pressure may lead to strategic responses like consolidation.[45]

42 In Table A11 in the Online Appendix we find that this effect is larger for Anglo-Saxon countries, all of which are global financial centers (Australia, Canada, UK, USA).

43 Azar, Raina, and Schmalz (2016) show that cross-ownership of banks in the USA is related to higher fees, some of which can be passed on to workers.

44 In Table A13 in the Online Appendix we show that indeed bank concentration is associated with higher finance relative wages, and especially for skilled workers in finance (Table A12 reports relevant descriptive statistics). We estimate descriptive level regressions of the form in Equation (9) using bank concentration instead of financial deregulation. Bank concentration data are only available from 1997 to 2005, so the regression sample is effectively 2000–2005, and we have only sixty observations. We do not have sufficient power to estimate predictive regressions with bank concentration. Overall, the results for these regressions are in line with the earlier results, in the following sense: Market structure (regulation and bank concentration) are the most important drivers of relative wages in finance.

45 For example, in Spain deregulation led big banks to respond in mergers, as the government also intervened in order to protect "national champions" (Vives, 1990). The number of US commercial banks insured by the Federal Deposit Insurance Corporation hovered around 14,000 for most of the twentieth century, but started dropping more-or-less continuously after 1984, until it reached 6,300 in 2011. Similarly, the number of FDIC-insured saving institutions dropped continuously from 3,400 in 1984 to 1,067 in 2011.

Higher concentration may create incentives to take on more risk and allocate a higher surplus to finance at the expense of the rest of the economy, as in Korinek and Kreamer (2014).

Although banks do not comprise the entire financial sector, changes in bank concentration over time are indicative of overall financial concentration, especially in countries with a universal banking sector. We use the following variables to capture competition in the banking sector: (1) Bank concentration, (2) Revenue-based competition index (H-statistic), (3) Profit-based competition index (|Boone elasticity|).

The results in Table VIII, Columns 8–10, indicate that higher concentration and weaker competition (lower value of index) are associated with a larger effect of deregulation on relative wages—both in the level regressions and in the predictive regressions—except for the profit-based competition index in the level regressions.

Overall, the results in this section imply that the effect of deregulation on wages is largest in countries with financial systems that rely more on non-traditional banking (versus bank loans) and stock markets, where there is greater trading intensity in OTC securities, in countries with more flexible labor markets, and where the sector is less competitive. Theory discussed in Section 1 implies that these are associated with greater risk taking, and socially inefficient informational rents. Although we cannot make precise statements on whether these rents accrue to more talented workers or not, we find similar results for both skilled and unskilled workers, as indicated in Table A10. The results here also strengthen our causal interpretations in the following sense: we find larger effects of deregulation in countries where we expect them, in a way that is consistent with theory.

4. Finance Wages and Brain Drain

Given the findings above, it is natural to ask whether high wages in finance attract talent from other activities and locations. Providing a complete and convincing answer to this question is well beyond the scope of this paper. The results in this section should be taken as suggestive evidence that may inspire more research in this area.

It is very difficult to empirically characterize allocative effects between activities within an economy and make the distinction between social and private returns. Instead, in this section we ask whether high wages in finance lure qualified workers from other countries. We restrict attention to immigration within a sample of fifteen industrialized countries. Among these countries remittances and backward knowledge spillovers to the country of origin are arguably not likely to be large, and therefore it is relatively clear that attracting skilled workers from other countries has detrimental effects on the country of origin, that is, brain drain.

We find that wage premiums for skilled workers in finance—over and above overall skilled wages—predict skilled immigration and employment in finance, affecting both the magnitude of immigration and its allocation. We do not find evidence of this effect for unskilled immigrants in finance. This raises concerns that high wages in finance may have implications for brain drain across borders.

4.1 Immigration Data

Ideally, we would have liked to investigate if high wages in finance in country *A* lure highly skilled workers in country *B*, who were working in other sectors, to immigrate to country *A* to work in the finance sector. Unfortunately, to the best of our knowledge, there are no comprehensive datasets that provide information on employment both before and after

immigration. Moreover, data on immigration flows, rather than stocks, are also scant. Therefore, we rely on data on bilateral immigration stocks for fifteen OECD countries in 2000.[46] All wages are calculated from the EU KLEMS database, and are converted to US dollars when needed. Immigration stocks in a given sector in a destination country are classified by source country and education level. We focus on highly educated workers (attaining a bachelors degree from a four year college or university), but we also compare these results to those for less educated immigrants.

It is informative to study the sample properties in some detail. In general, this illustrates that the determinants of skilled immigration employed in finance in destination countries are destination and sector-specific; they are not simply proportional to country and sector sizes. Table IX shows that there is considerable heterogeneity in immigration stocks by destination (Column 1 in both panels). Columns *a* and 1–4 report statistics on immigrants who work in finance in destination countries (where they immigrated to), while Columns *b* and 5–7 report statistics on those same immigrants by source country (i.e., by country from which they emigrated). Panel A reports statistics for skilled workers. The average immigrant working in finance is relatively skilled, except in France (column *a*). However, emigrants from France who work in finance in destination countries are relatively highly skilled (column *b*). Comparing Columns 4 and 7 we see that there is much more heterogeneity in the share of skilled immigration working in finance (standard deviation = 5.9) than in their shares in skilled emigration (standard deviation = 1.5). This illustrates a general pattern: The pattern of skill intensity in finance is not strongly influenced by source country characteristics. This conclusion is strengthened by Column 3, which shows that there is enormous variation in skilled immigrants working in finance as a share of total skilled employment in finance (standard deviation = 8.1). Differences between the corresponding variations for overall immigration (of which skilled immigration is a part) are markedly smaller, which indicates that finance-specific forces are less important for unskilled workers.

Larger countries attract more skilled immigrants in finance, as can be seen in Columns 1 and 2. However, attracting more skilled immigrants to finance is virtually uncorrelated with the share of skilled immigrants in total skilled employment in finance (Column 3, correlation = 0.01), and very weakly correlated with a country's share in overall skilled immigration to the destination (Column 4, correlation = 0.12). This indicates that finance-specific forces play a role in attracting skilled immigration to that sector. The same correlations for overall immigrant employment in finance in Panel B are markedly higher (0.26 and 0.65, respectively), which indicates that finance-specific forces are less important for unskilled workers.

We can summarize the descriptive analysis using terms of art taken from the international trade literature: There is relatively little variation in countries' comparative advantage in producing skilled immigrants working in finance in destination countries, relative to variation in the absorptive capacity of such workers in finance in destination countries. This statement is much weaker for unskilled immigrants. We use these findings to guide the analysis that follows.

46 The countries are: Australia, Austria, Canada, Denmark, Spain, Finland, France, Hungary, Ireland, Italy, Luxembourg, Portugal, Sweden, UK, USA. See the Online Appendix for more details on the sample. Data downloaded from: http://stats.oecd.org/Index.aspx?DatasetCode=MIG#.

Table IX. Immigration and employment in finance

Notes: Data are immigration stocks of workers that are employed in financial intermediation in the destination country, regardless of their past employment sector or employment status in the source country. Panel A reports statistics for skilled finance workers, which are consistently defined as having a university-equivalent bachelors degree or more. In this panel all statistics, except for the skill intensity, are relative to skilled finance workers. Panel B reports statistics for all finance workers. The first set of columns in each panel report the distribution of immigrants in their destination countries (where they moved to), while the latter set of columns report the distribution of those immigrants by source country (where they came from). Immigration data source: OECD. Column (3) uses employment (skilled or total) in finance from EU KLEMS in order to compute the share in total employment in finance in destinations.

A. Skilled finance workers

	Skilled immigration employed in finance, by destination					Skilled emigration employed in finance, by source			
	(*a*) Skill intensity (skilled/all finance immigrants) (%)	(1) Number of skilled immigrants in finance	(2) Share in sample finance skilled immigration (%)	(3) Share in total skilled employment in finance in destination (%)	(4) Share of skilled immigration to destination (%)	(*b*) Skill intensity (skilled/all finance emigrants) (%)	(5) Number	(6) Share in sample finance skilled emigration (%)	(7) Share in total skilled emigration from source (%)
Australia	38.1	10,458	8.2	10.97	4.67	62.6	6,697	5.27	8.50
Austria	33.7	347	0.3	2.74	2.88	51.3	1,744	1.37	5.43
Canada	51.0	19,450	15.3	10.61	5.25	59.0	17,580	13.82	6.14
Denmark	33.2	221	0.2	3.07	1.80	54.9	1,710	1.34	6.03
Spain	58.5	2,060	1.6	1.55	3.76	24.2	5,195	4.08	6.82
Finland	49.6	132	0.1	0.57	2.61	47.3	1,628	1.28	4.14
France	11.9	9,429	7.4	6.59	8.69	67.4	12,929	10.17	6.80
Hungary	67.4	58	0.05	0.27	2.84	51.4	1,790	1.41	4.34
Ireland	62.3	4,145	3.3	19.03	6.10	45.9	8,354	6.57	6.78
Italy	35.8	1,343	1.1	1.69	3.68	31.2	12,154	9.56	8.00
Luxembourg	49.3	2,261	1.8	29.44	25.65	32.4	232	0.18	8.04
Portugal	47.0	568	0.4	2.55	3.14	11.0	5,525	4.34	9.58
Sweden	32.9	775	0.6	3.04	1.93	64.7	2,735	2.15	6.73
UK	62.5	24,131	19.0	10.55	9.06	49.0	37,454	29.45	5.57
USA	56.2	51,804	40.7	1.98	6.57	71.1	11,455	9.01	5.89
Total		127,182	100				127,182	100	
Standard deviation				8.1	5.9				1.5
Correlation with Column (2), "Share in sample finance skilled immigration (%)"				0.01	0.12				

(continued)

Table IX. Continued

B. All finance workers

	Overall immigration employed in finance, by destination				Overall emigration employed in finance, by source		
	(1) Number of immigrants in finance	(2) Share in sample finance immigration (%)	(3) Share in total employment in finance in destination (%)	(4) Share of total immigration to destination (%)	(5) Number	(6) Share in sample finance emigration (%)	(7) Share in total emigration from source (%)
Australia	27,450	9.2	8.55	3.67	10,692	3.57	7.24
Austria	1,030	0.34	0.91	2.53	3,399	1.13	4.56
Canada	38,130	12.73	6.32	4.55	29,785	9.94	5.30
Denmark	666	0.22	0.84	1.92	3,112	1.04	4.82
Spain	3,520	1.18	1.08	2.06	21,483	7.17	8.71
Finland	266	0.09	0.65	1.37	3,440	1.15	2.65
France	79,074	26.40	11.33	11.36	19,177	6.40	4.38
Hungary	86	0.03	0.12	2.08	3,481	1.16	3.41
Ireland	6,649	2.22	10.07	4.44	18,194	6.07	5.00
Italy	3,752	1.25	0.72	2.57	38,993	13.02	6.06
Luxembourg	4,589	1.53	15.30	9.00	715	0.24	7.62
Portugal	1,209	0.40	1.51	1.69	50,271	16.78	7.42
Sweden	2,355	0.79	2.51	1.63	4,230	1.41	5.00
UK	38,626	12.90	3.92	6.29	76,431	25.52	4.83
USA	92,107	30.75	1.54	5.37	16,106	5.38	5.08
Total	299,509	100			299,509	100	
Standard deviation			4.8	2.9			1.6
Correlation with Column (2), "Share in sample finance immigration (%)"			0.26	0.65			

4.2 Finance Wages and Brain Drain

In this section we study the drivers of skilled immigration to finance. We start by fitting the following regression, which resembles a trade gravity equation (e.g., see Ortega and Peri, 2014):

$$\ln m_{od}^{H,\text{fin}} = \alpha_o + \beta \ln w_d^{H,\text{fin}} + \gamma \ln w_d^{H,\text{nffp}} + \delta' X_{od} + \epsilon_{od}. \tag{14}$$

Here, m_{od} denotes immigration stock (not flow) in destination d from origin o, H denotes skilled workers, fin denotes employment in finance, and nffp denotes employment outside finance and agriculture. X is a vector of standard "gravity" control variables: Common language and common border indicators, and the log of distance between origin and destination capital cities.[47] The α_o are origin fixed effects. Since we wish to estimate the effect of wages in the destination country, we cannot add destination fixed effects. We add overall skilled wages in the NFFP sector in the destination $w_d^{H,\text{nffp}}$ in order to control for the overall attractiveness of the destination for skilled immigrants. Descriptive statistics for the variables are reported in Table A14 in the Online Appendix.

Regression results of fitting Equation (14) to data are reported in Table X, Columns 1 and 2. The message from Panel A is that high skilled wages in finance predict more skilled immigration into finance, even after controlling for skilled wages elsewhere in the destination country. In Column (2) we estimate an elasticity of 2.3 between skilled finance wages and skilled immigration, controlling for NFFP skilled wages. A one standard deviation increase in log finance wages increases finance immigration by 0.54 log points, which is 23% of the standard deviation of log skilled immigration (2.32; see Table A14).

We compare this result to a similar regression for unskilled workers in Panel B (replace all H superscripts with L in Equation (14)). We find that unskilled wages in finance do not predict low skilled immigration to finance once low skilled wages elsewhere are controlled for. The coefficient on $\ln w_d^{L,\text{fin}}$ is small and statistically insignificant. This is somewhat surprising: If unskilled workers do not have specific human capital and operate in a competitive environment, then differences in industry wages should have larger effects for them—but this is not the case in the data. The results imply that only skilled workers respond more to finance wage differentials. This could be due to higher barriers of entry into finance faced by unskilled immigrants, relative to the financial benefit of doing so, over and above what is already captured at the country wide wage level.

In the next specification, we replace the bilateral finance skilled immigration stock with its share in the total skilled immigration stock, $m_{od}^{H,\text{fin}}/m_{od}^{H}$

$$100 \times \left(\frac{m_{od}^{H,\text{fin}}}{m_{od}^{H}} \right) = \alpha_o + \beta \ln w_d^{H,\text{fin}} + \gamma \ln w_d^{H,\text{nffp}} + \delta' X_{od} + \epsilon_{od}. \tag{15}$$

We multiply the dependent variable by 100 in order to make the magnitudes comparable to Equation (14). This specification is preferable for estimating the effect of finance wages on the attractiveness of the sector.[48]

The results are reported in Columns 3 and 4 of Table X and, as shown, we find a similar pattern as in Columns 1 and 2: Finance wages increase skilled finance immigration even as

47 Data from CEPII, downloaded from: http://www.cepii.fr/anglaisgraph/bdd/distances.htm#. Using different measures of distance from the CEPII dataset barely affects the results.

48 This is similar to analysis of import shares in the international trade literature.

Table X. Finance immigration versus wages in destination country

Notes: Immigration stocks and wages in 2000. High skilled is defined as four-year college or university degree or greater, and low skilled as less than that. NFFP is the non-farm, non-finance private sector. All regressions include source country-fixed effects and the following gravity variables from CEPII (but do not report coefficients for them): country contiguity indicator, common language indicator, and log distance between capital cities. Although regressions in both panels have the same number of observations, the sample varies slightly due to data availability. Robust standard errors in parentheses.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Data sources: migration data from OECD and wage data from EU KLEMS.

A. High skilled finance immigration

Dependent variable:	Log of high skilled finance immigration stock		High skilled immigrants in finance as a percentage of all high skilled immigrants		Ratio of high to low skilled immigrants in finance	
	(1)	(2)	(3)	(4)	(5)	(6)
Log of high skilled finance wage	3.783***	2.335***	16.52***	13.91***		
	(0.570)	(0.789)	(3.005)	(3.023)		
Log of high skilled NFFP wage		2.735***		4.912**		
		(0.789)		(1.912)		
Ratio of high to low skilled wages in finance					0.968***	0.983***
					(0.298)	(0.302)
Ratio of high to low skilled wages in NFFP						0.487***
						(0.141)
Observations	193	193	193	193	183	183
R-squared	0.511	0.540	0.359	0.369	0.232	0.272

B. Low skilled finance immigration

Dependent variable:	Log of low skilled finance immigration stock		Low skilled immigrants in finance as a percentage of all low skilled immigrants	
	(1)	(2)	(3)	(4)
Log of low skilled finance wage	2.562***	0.374	6.442***	3.411
	(0.398)	(0.592)	(2.247)	(2.322)
Log of low skilled NFFP wage		3.712***		5.141**
		(0.702)		(2.032)
Observations	193	193	193	193
R-squared	0.444	0.518	0.149	0.163

a share of overall skilled immigration. A one standard deviation increase in log finance wages increases the share of finance immigration by 3.2 percentage points, compared with a standard deviation of 7 percentage points (i.e., 46% of the variation). As before, when we compare this to the corresponding regression for unskilled workers in Panel B (replace all *H*

superscripts with L in Equation (15)), we find that unskilled wages in finance have no predictive power for low skilled immigration in finance once overall low skilled wages are controlled for.

Our third specification asks whether the relative skilled wage within finance has an effect on immigrant skill intensity in finance over and above the relative skilled wage in the rest of the economy:

$$\left(\frac{m_{od}^{H,\text{fin}}}{m_{od}^{L,\text{fin}}}\right) = \alpha_o + \beta\left(\frac{w_d^{H,\text{fin}}}{w_d^{L,\text{fin}}}\right) + \gamma\left(\frac{w_d^{H,\text{nffp}}}{w_d^{L,\text{nffp}}}\right) + \delta' X_{od} + \epsilon_{od}. \tag{16}$$

In Column 6 we see that relative skilled wages within finance ($w_d^{H,\text{fin}}/w_d^{L,\text{fin}}$) have a stronger effect on the skill intensity of finance immigration ($m_{od}^{H,\text{fin}}/m_{od}^{L,\text{fin}}$) than do the relative skilled wages in the NFFP sector ($w_d^{H,\text{nffp}}/w_d^{L,\text{nffp}}$). A one standard deviation increase in $w_d^{H,\text{fin}}/w_d^{L,\text{fin}}$ increases $m_{od}^{H,\text{fin}}/m_{od}^{L,\text{fin}}$ by 0.34, compared with a standard deviation of 1.24 (i.e., 28% of the variation—this compared with 21% for $w_d^{H,\text{nffp}}/w_d^{L,\text{nffp}}$).

We document that high skilled wages in finance predict skilled immigration employment in finance and this affects both the magnitude and the allocation of immigration. We do not find strong evidence for this for unskilled immigrants in finance. This is most likely due to higher barriers to entry relative to the benefits of migrating into finance faced by unskilled immigrants, who, therefore, respond more to overall wage differentials across countries.

Overall, these results raise concerns that high wages in finance may cause brain drain across borders, with detrimental effects on the countries of origin.

5. Concluding Remarks

In this paper, we study the evolution of wages in the finance industry in a set of developed economies in 1970–2011. Relative wages in finance generally increase, but there is wide variation across countries. We find that half of the countries in our sample see finance relative wage increases, while the remainder are split between decreases and mixed trends. Changes in skill composition do not explain relative wages in finance. Most of the variation is driven by within-group wage changes, in particular skilled wages in finance relative to skilled wages in the rest of the private sector. Changes in finance relative skilled wages help explain the bulk of the changes in the overall skill premium, despite a small sectoral employment share. A large part of the evolution of finance relative wages is driven by trading activities and non-traditional banking.

We find that financial deregulation is the most important causal determinant of relative wages in finance. The effect of deregulation is largest in countries with financial systems that rely more on non-traditional banking (versus bank loans) and stock markets, where there is greater trading intensity in OTC securities, in countries with more flexible labor markets, and where the sector is less competitive. These results are consistent with the view that financial regulation limits the scope and scale of financial activity within the financial sector, in particular activity that is more prone to greater risk taking, and is likely associated with socially inefficient informational rents.

Our results cannot resolve the micro-econometric debate on talent in finance. However, they are consistent with the view that a significant part of higher returns to "talented" individuals in finance reflect their disproportional share of industry rents, because: (1) most of

the increases in relative wages in finance are due to skilled workers, and (2) the effect of deregulation on skilled relative wages is larger in environments where informational rents are likely to be prevalent.

We also document that increasing wages in finance are associated with the cross border allocation of talent. We find that when finance pays higher wages, it attracts more skilled immigrants. This suggests a negative externality that countries with high finance wages impose on other countries.

Better understanding of the micro-mechanisms through which deregulation affects wages in finance is an important field of future research. In addition, although we argue that financial deregulation leads to higher wages in the financial sector, and is likely to be associated with informational rents, we cannot provide evidence on whether this outcome is socially optimal. This requires a structural model that is far beyond the scope of this paper.[49] The work of Kneer (2013); Cecchetti and Kharroubi (2012); and Arcand, Berkes, and Panizza (2012) suggests that higher wages in finance, through their effect on talent absorption, may cause potential harm to some industries (but see also Martinsson (2013) for a different view). However, these studies only identify differential effects on some sectors versus others, and they do not address general equilibrium and social incentive considerations.

Philippon (2015) and Bazot (2014) estimate that the unit cost of financial intermediation has risen in the USA and in Europe after 1980.[50] A large fraction of this rise in costs can be attributed to labor costs. Therefore, it is difficult to argue that the efficiency of labor in financial intermediation has increased markedly, in a way that can explain higher relative wages, or variation in relative wages. Part of the increase in the cost of financial intermediation can be explained by changes in the composition of financial products, in particular more market-based intermediation versus bank lending. This composition is affected by deregulation. An important and challenging task for future research is to understand the social value and cost of new financial products, their effects on labor demand and wages in finance, and how they respond to financial deregulation.

Supplementary Material

Supplementary material is available at *Review of Finance* online.

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49 Philippon (2010) analyzes the case of endogenous growth with financial intermediation and innovation in the non-financial sector. Laeven, Levine, and Michalopoulos (2015) model real and financial innovation in a symmetric way.

50 Beck, Degryse, and Kneer (2014) differentiate the functioning of financial intermediation from the effect of overall size of finance. Philippon and Reshef (2013) show that the rise of the size of finance is not correlated with growth in a set of currently industrial countries, and that the relationship of finance to income is not straightforward. The evolution of wealth accumulation, as described in Piketty (2014), may have a direct effect on the total payments to finance—and indirectly on the wage rate per worker and on organization within finance.

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