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WAGES AND HUMAN CAPITAL IN THE U.S. FINANCIAL INDUSTRY: 1909-2006

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ABSTRACT

We use detailed information about wages, education and occupations to shed light on the evolution of the U.S. financial sector over the past century. We uncover a set of new, interrelated stylized facts: financial jobs were relatively skill intensive, complex, and highly paid until the 1930s and after the 1980s, but not in the interim period. We investigate the determinants of this evolution and find that financial deregulation and corporate activities linked to IPOs and credit risk increase the demand for skills in financial jobs. Computers and information technology play a more limited role. Our analysis also shows that wages in finance were excessively high around 1930 and from the mid 1990s until 2006. For the recent period we estimate that rents accounted for 30% to 50% of the wage differential between the financial sector and the rest of the private sector.

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We study the evolution of human capital in the U.S. financial industry over the past century. Our analysis sheds light on how the financial sector performs its economic role, on its interactions with the rest of the economy, and on the consequences of financial regulation. We make three contributions. First, we document a set of new, interrelated stylized facts about the evolution of skill intensity, wages, organization, and occupational complexity in the financial industry. Second, we identify the forces that determine these evolutions. We find that tighter regulations reduce the demand for skilled workers, while complex corporate activities (IPOs, credit risk) increase the demand for skills. Finally, we analyze the sustainability of high wages in finance, and we find that 30% to 50% of wage differentials observed in the past 10 years can be attributed to rents, and can be expected to disappear.

An industry can be studied from the perspective of the output it produces (products and innovations) or from the perspective of the inputs it uses (labor, capital, intermediate inputs). For manufacturing industries, as well as many services industries (e.g. health care), researchers can obtain reasonably accurate data both on the input and on the output sides. For example, one can measure the number of cars being produced, or the health of various individuals. For the financial services industry, however, the output side offers limited information. Most of the literature relies on simple ratios to measure financial output: credit relative to GDP, loans per employee, etc. These measures are useful to study the impact of financial development on economic growth (see Levine (2005) for a survey); however, they tell us little about the evolution of the financial sector, its organization, or even its efficiency. For example, changes in the volume of loans per-employee do not contain much information about the evolution of the financial industry if we cannot control for the complexity of the loans being processed by the employees. It is easier to make loans against tangible assets than against intangible assets, or to assess the credit worthiness of a well established firm than the credit worthiness of a new, innovative firm.

Another way to look at the output side of an industry is to study new products and innovations. Indeed, the importance of financial innovation has been emphasized by Silber (1983), Miller (1986), Tufano (1989), Merton (1992), and Lerner (2006), among others. Unfortunately, studying financial innovation is just as difficult as obtaining sensible measures of financial productivity. There are thousands of studies of innovation in manufacturing industries, but Frame and White (2004) find only 39 empirical articles on financial innovation.

This dearth of empirical evidence is certainly due to the fact that two major sources of data on manufacturing innovation, namely R&D spending and patents, are mostly useless for studying financial innovation. Financial firms typically do not report any R&D spending, and, until recently, could not protect their new ideas through patents (Lerner (2006)).

These difficulties in measuring financial output limit our understanding of financial development. While it is well established that financial development matters for growth (Levine (2005)), researchers have not yet been able to describe systematic changes in the nature and delivery of financial services. Consider the U.S. experience: how should one compare the financial industry of 1920s with that of the 1960s or 1990s? We know that macroeconomic conditions and financial regulation have changed, but we do not know if and how they have affected the financial industry because we do not know how to measure what happens inside the black box of this industry. This inability to measure financial activity limits our understanding of the effects of regulation and technological change. Ultimately it also limits our understanding of how financial and economic development interact.

In this paper we propose using the input side of the financial industry in order to understand its evolution. In equilibrium, input and output choices are linked by the common objective of profit maximization. We argue that the choice of skill intensity and the set of tasks performed shed light on the evolution of the financial industry. Our strategy is akin to that of researchers in physics who, knowing that they cannot directly observe some particle, focus on outside interactions and indirect evidence in order to improve their understanding of the particle of interest.

Our analysis reveals a set of new stylized facts. First, the relative skill intensity and relative wages of the financial sector exhibit a U-shaped pattern from 1909 to 2006. From 1909 to 1933 the financial sector was a high skill, high wage industry. A dramatic shift occurred during the 1930s: the financial sector rapidly lost its high human capital and its wage premium relative to the rest of the private sector. The decline continued at a more moderate pace from 1950 to 1980. By that time, wages in the financial sector were similar, on average, to wages in the rest of the economy. From 1980 onward, another dramatic shift occurred. The financial sector became once again a high skill, high wage industry. Strikingly, by the end of the sample relative wages and relative education levels went back almost exactly to their pre-1930s levels.

Using micro data on occupations, we create indices to measure the complexity of the tasks performed by the financial industry. Using this index, we document a similar U-shaped pattern over the past century: financial jobs were relatively more complex and non-routine than non-financial jobs before 1930 and after 1980, but not in the middle of the sample.

We then seek to explain these new stylized facts. In particular, we try to identify the forces responsible for the evolution of human capital in the financial industry. Our investigation of the causes of this pattern reveals a very tight link between deregulation and human capital in the financial sector. Highly skilled labor left the financial sector in the wake of the Depression era regulations, and started flowing back precisely when these regulations were removed. This link holds both for finance as a whole, as well as for subsectors within finance. Along with our relative complexity indices, this suggests that regulation inhibits the ability to exploit the creativity and innovation of educated and skilled workers. Deregulation unleashes creativity and innovation and increases demand for skilled workers.

The second set of forces that appear to have a large influence on the demand for skills in finance are non-financial corporate activities: in particular, IPOs and credit risk. New firms are difficult to value because they are often associated with new technologies or new business models, and also for the obvious reason that they do not have a track record. Similarly, pricing and hedging risky debt is an order of magnitude harder than pricing and hedging government debt. Indeed, we find that increases in aggregate IPO activities and credit risk predict increases in human capital intensity in the financial industry. Computers and information technology also play a role, albeit a more limited one. Contrary to common wisdom, computers cannot account for the evolution of the financial industry. The financial industry of the 1920s appears remarkably similar to the financial industry of the 1990s despite the lack of computers in the early part of the sample.

Having documented the evolution of human capital and jobs in the financial industry, as well as the set of factors that can explain this evolution, our last contribution is to study the sustainability of the high wages observed in the financial industry. Has financial creativity been over compensated? We construct a benchmark series for the relative wage in finance, controlling for education and employment risk as well as time varying returns to education. Our benchmark wage accounts well for the observed relative wage between 1910 and 1920, and from 1950 to 1990. From the mid-1920s to the mid-1930s, and from the mid-1990s to 2006, however, the compensation of employees in the financial industry appears to be too high to be consistent with a sustainable labor market equilibrium. Moreover, in the recent period, we show that this result remains even if we control for unobserved individual heterogeneity. This finding is *prima facie* evidence that the financial sector is not in a sustainable labor market equilibrium, and that short term rents are likely to diminish.

Our main contribution is to shed light on the inner evolution of the financial industry. Our work also contributes to the understanding of relative demand for skilled labor and income inequality (see Goldin and Katz (2008a)). Katz and Murphy (1992) study the secular growth in the demand for educated workers from 1963 to 1987, while Autor, Katz, and Krueger (1998) and Acemoglu (1998), among others, discuss the role of technological improvements that are biased in favor of skilled workers.[1] By taking a longer perspective than most previous studies and focusing on a particular sector, we show that computers and information technology are not the only source of increased demand for (and returns to) skilled workers.[2]

We also contribute to the literature on the allocation of talent. Economic growth requires the allocation of talent to socially productive activities. Baumol (1990) argues that the allocation of talent across occupations is more readily influenced by institutions and private economic incentives than the overall supply of talent. Murphy, Shleifer, and Vishny (1991) make a similar point, and also discuss the role of increasing returns to ability in determining the careers of talented individuals. Our results support these arguments since we show the first order effects of regulations on the human capital intensity of the financial industry. Our findings are also consistent with Kostovetsky (2007), who presents evidence about brain drain of top managers from mutual funds to less-regulated hedge funds, starting in the early 1990s. Kaplan and Rauh (2007) study the evolution of earnings of individuals with very high incomes with a particular emphasis on the financial sector, and Goldin and Katz (2008b) document a large increase in the fraction of Harvard undergraduates who work in the financial sector since 1970. Frydman and Saks (2007) share our long run perspective

[1] Acemoglu (2002) reviews the literature on skill biased technological change. For other explanations for the increase in demand for skilled workers see Card (1992), Card and Lemieux (2001), Acemoglu, Aghion, and Violante (2001) and Buera and Kaboski (2006).

[2] Krueger (1993) reports evidence that shows that workers who used computers in 1984-1989 earned more.

in their study of executive compensation. Our analysis highlights more specifically the role of regulation and corporate finance in determining the relative demand for skilled labor in finance.

The rest of the paper is organized as follows. Section 1 describes the new stylized facts that we have discovered. Section 2 provides historical evidence on the effect of regulation, technology and financial innovation on wages and skill composition. Identification and causality are discussed in Section 2.6. Section 3 addresses the question of whether financiers are overpaid. Section 4 concludes. In the text we restrict descriptions of data sources and series construction to the minimum; detailed descriptions of data sources and methodologies can be found in the appendix.

1 New stylized facts

In this section we describe the evolution of wages, education and jobs in the U.S. financial sector from 1909 to 2006. The financial sector is comprised of three subsectors: Credit Intermediation (by banks, savings institutions, and financial companies providing credit services), Insurance (life and property), and Other Finance (securities, commodities, venture capital, private equity, hedge funds, trusts, and other financial investment industry, as well as investment banks).[3] Our examination of the historical data from 1909 to 2006 reveals a U-shaped pattern for education, wages, and the complexity of tasks performed in the financial industry – all relative to the nonfarm private sector. These facts have not been previously documented.

1.1 Education and wages

Education: 1910-2005

We construct our education series for the nonfarm private sector and for the financial sector using U.S. Census data, and using the Current Population Survey (henceforth CPS). Census data covers the period 1910-2000 and the CPS covers the period 1967-2005. Our concept of education is the share of employees with (strictly) more than high school education.[4] For the

[3] We do not include the real estate sector because it is conceptually different from credit intermediation or investment banking. Our results on wages and education would not change if we included real estate, however, because it is a small fraction of wages and employment.

[4] The results are virtually unchanged if we use the share of college graduates. The share of employees

period 1910-1930, where schooling data is not available, we impute the share of employees with more than high school education by occupation, and then aggregate separately for the nonfarm private sector and for the financial sector.[5] For the period 1940-1970 we use the Census data directly. For the period 1970-2005, we use CPS data[6].

Let $high$ denote high skill workers and let $high_{i,t}$ be a dummy variable for having strictly more than high school education for employee i at time t. Then the share of high skilled employees, those with more than high school education, in sector s is given by

$$high_{s,t} = \frac{\sum_{i \in s} \lambda_{i,t} \ high_{i,t}}{\sum_{i \in s} \lambda_{i,t}} \ , \tag{1}$$

where $\lambda_{i,t}$ is the sampling weight for employee i in period t and $i \in s$ means that individual i works in sector s. The relative education of the financial sector is defined as the difference between this share in finance ($s = fin$) and the corresponding share in the nonfarm private sector ($s = nonfarm$):

$$\rho_{fin,t} \equiv high_{fin,t} - high_{nonfarm,t} \ . \tag{2}$$

Wages: 1909-2006

We construct a full time equivalent wage series for the period 1909-2006. The full time equivalent concept implies that variation in hours worked does not play a role. For the period 1929-2006, we construct full-time equivalent wages from the Annual Industry Accounts of the United States, published by the Bureau of Economic Analysis (BEA). We extend the series using data from Kuznets (1941) and Martin (1939) for the period 1909-1929. The data are described in details in the appendix. The average wage in the financial industry relative to the average wage in the non-farm private sector is

$$\omega_{fin,t} \equiv \frac{wage_{fin,t}}{wage_{nonfarm,t}} \ . \tag{3}$$

U-shape over the 20th century

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with more than high school education is a more relevant concept of skill for the entire sample.

[5] See the appendix for details. In this construction have assumed that the average educational attainment within occupations has not changed from 1910 to 1940. While this is certainly a strong assumption, we believe that it is made less critical by the fact that we focus on *relative* education of finance versus the nonfarm private sector. By construction, our measure is not affected by a general drift in educational attainment in all occupations over time.

[6] For the overlapping period 1970-2000 the differences between the Census and CPS data are negligible.

Figure 1 shows the evolution of the relative wage, $\omega_{fin,t}$, and relative education, $\rho_{fin,t}$, over the 20th century. The pattern that emerges is U-shaped, and suggests three distinct periods. From 1909 to 1933 the financial sector was a high-education, high-wage industry. It had 17 percent points more educated workers relative to the private sector; these workers were paid at least 50% more than in the rest of the private sector, on average. A dramatic shift occurred during the 1930s. The financial sector started to lose its human capital and its high wage status. Most of the decline occurred by 1950, but continued until 1980. By that time, the relative wage in the financial sector was approximately the same as in the rest of the economy. From 1980 onwards another dramatic shift occurred. The financial sector became a high-skill high-wage industry again. In a striking reversal, its relative wage and education went back almost exactly to their levels of the 1930s.[7]

1.2 Subsectors

In this section we investigate the role of the subsector composition of finance on the patterns of Figure 1. The source for full time equivalent employment and wages for each subsector is the Annual Industry Accounts of the United States.

Panel A of Figure 2 depicts the evolution of employment shares within the financial industry. The shares of Credit Intermediation and Other Finance decline relative to Insurance during the Great Depression. In the post-War period the share of Insurance declines linearly. Credit Intermediation gains in importance until 1980 and declines afterwards. Other Finance grows more rapidly after 1980.

Panel B of Figure 2 depicts the evolution of relative wages. These were calculated as the ratio of the wage bill share in each subsector relative to its full-time-equivalent employment share. Once again, we see a common downward trend in relative wages starting in the late 1930s. The decline continues more moderately for Credit Intermediation and Insurance until 1985, where a steady recovery commences. The pattern is slightly different for Other Finance, where the initial decline is deeper, but stops completely by 1940. In 1980 the relative wage in Other Finance starts a steep increase, until it completely dwarfs those of the other two subsectors.

[7] We find the tight relationship between the relative education series and the relative wage series an indication that the data sources are consistent, in particualr in the begining of the sample. If skilled workers command higher wages, then this is exactly what you would expect.

We wish to evaluate the relative role of changes in the subsector composition on the relative wage of finance. To do so we decompose the change in the relative wage of finance (relative to the private sector, as defined in (3)), $\Delta\omega_{fin}$, using the following formula

$$\Delta\omega_{fin} = \sum_i \Delta\omega_i \overline{n}_i + \sum_i \Delta n_i \overline{\omega}_i \ , \tag{4}$$

where i is an index for subsectors. $\Delta\omega_i$ is the change of the relative wage of subsector i, $\overline{n}_i$ is the average employment share of i within finance, Δn_i is the change in the employment share of i within finance, and $\overline{\omega}_i$ is the average relative wage of i in the sample. The first sum captures the contribution of within-categories changes in the relative wage, while the second sum is the the contribution of employment reallocation between subsectors.[8]

We report the results of the decomposition in Table 1. The message is clear: almost all of the changes in relative wages come from the 'within' component. Thus, changes in sectorial composition do not account for changes in the relative wage of the financial industry.

1.3 Education and occupations

Economic theory calls for decompositions based on tasks and occupations.[9] Indeed, we will show that tasks and occupations paint a much more relevant picture of the evolution of the financial industry than the more usual sectorial decompositions.

We first revisit the within-between decomposition of equation (4) using CPS data over 1980-2005. The CPS data allow us to break down the financial industry not only by subsectors, but also by education and occupations groups. The educational categories we chose are "Less than 12 years of schooling", "High School Graduate", "13-15 Years of Schooling", "College Graduate" (4-year college) and "More than College" (graduate degrees, such as JD, MBA, Ph.D.). Our classification of occupations attempts to group employees according to the tasks that they perform. We use seven occupational categories: "Managers and Professionals", "Mathematics and Computers", "Insurance Specialists", "Brokers and

[8] We use this decomposition in three subsamples: 1933-1960, 1960-1980 and 1980-2005. We choose 1933 as the starting point because of the importance of the Glass-Steagall Act, which was legislated in that year. 1960 marks the beginning of the most regulated period in finance, while 1980 marks the beginning of the least regulated one.

[9] While sectorial analysis is common in economics, this is mostly because sectorial data are readily available. It is not clear, however, whether distinctions based on SIC codes are relevant or arbitrary. For instance, does it really matter whether a trader works for an insurance company, a commercial bank, or a hedge fund?

Traders", "Bank Tellers", "Administration, Including Clerks", and "All the Rest" (janitors, security and miscellaneous).[10] We focus on the 1980 to 2005 period where the most important changes take place.

We decompose the increase in the relative wage of the financial industry using equation (4). The index i now varies across either subsectors, education categories or occupations. The subsector and occupation categories are described above.

We report the results of the decomposition in Table 2. Panel A confirms our previous finding regarding changes in the relative wage: composition effects across subsectors are dominated by within-sector effects. By contrast, in Panels B and C we see that most of the increase in the relative wage in finance is due to reallocation of labor across education and occupation categories: the "between" component is much higher in Panels B and C than in Panel A. Organizational changes within each subsector are therefore more important than changes in sectorial composition. This provides strong support for our focus on occupations in the following section.

But before continuing, it is worth pointing out a shortcoming of CPS data: wages are top coded. Top coding is twice as likely in Credit Intermediation and Insurance relative to the private sector; in Other Finance it is 13 times as likely. This leads to under estimation of relative wages in the financial sector.[11] Thus, while in the Industry Accounts the relative wage of finance increases by 0.65 from 1.03 in 1980 to 1.68 in 2005, in the CPS it increases only by 0.43.[12] Therefore, the wages that we report may not be accurate for certain occupations, Brokers and Traders in particular. We refer the reader to Kaplan and Rauh (2007) for a detailed analysis of the highest incomes inside and outside finance. Top coding also probably explains the differences between Panel C of Table 1 and Panel A of Table 2, since very high incomes contribute more to the 'within' component.

1.4 Complexity

The analysis in Table 2 underscores the importance of changes in the set of occupations within the financial industry. The next step is to link occupations to the tasks performed

[10] Unfortunately, it is hard to find consistent definitions of occupations over time. The appendix explains in details what we did, the constraints we faced and the reasons for our choices.

[11] For technical reasons, the problem is more acute after 1996. See the appendix for complete details.

[12] The problem is most severe in Other Finance, where the Industry Accounts show an increase in relative wages of 2.5 from 1.1 in 1980 to 3.6 in 2005, in the CPS it increases only by 0.38.

by the industry. The challenge is to construct a consistent and informative measure over the whole sample. This is what we turn to now.

We rely on the Dictionary of Occupational Titles (DOT) to study the nature of occupations. Each occupation is characterized by a vector of five DOT task intensities: Finger Dexterity (routine manual tasks); Set Limits, Tolerances and Standards (routine cognitive tasks); Math Aptitude (analytical thinking); Direction, Control and Planning (communication and decision making); and Eye-Hand-Foot Coordination (non-routine manual tasks).[13] Each task intensity is a number between 0 and 10. The DOT task intensities were calculated by a panel of experts from the National Academy of Sciences based on information about occupations in 1970.[14]

While every occupation may combine all five tasks to some degree of intensity, the following examples can help fix ideas and facilitate the interpretation. Production line workers have high Finger Dexterity intensity; clerks and administrative workers have high Set Limits, Tolerances and Standards intensity; economists exhibit high Math Aptitude; mangers and sales persons have a high Direction, Control and Planning intensity; truck drivers and janitors have high Eye-Hand-Foot Coordination intensity.

We match the DOT task intensities to individuals in the U.S. Censuses from 1910 to 2000 and in the 2008 March Current Population Survey (which pertains to 2007) by occupation. In order to match the DOT task intensities to individuals we created a consistent occupational classification throughout the sample.[15] In doing so we assume that occupations' characteristics are stable over our sample. While this is certainly a strong assumption, we believe that it is made less critical by the fact that we focus on the *relative* DOT scores of finance versus the nonfarm private sector. By construction, our measure is not affected by a general drift in DOT scores over time.

We restrict our attention to workers of age 15 to 65, who are employed in the nonfarm private sector.[16] Each individual in this sample is characterized by the five task indices.

[13] Each one of the five indices was detected as a principal component for indices that are similar in nature. For more details see Autor, Levy, and Murnane (2003).

[14] We thank David Autor for sharing with us data on occupational task intensities. The DOT indices that we use are based on the 1990 Census occupational classification, and are further differentiated by gender. See the appendix for a complete description.

[15] We further differentiate by gender. See appendix for complete details.

[16] Due to data limitations, in 1920 we could only restrict to individuals who were in the labor force, whether employed or not.

For each task and year we create an average intensity by sector

$$task_{s,t} = \frac{\sum_{i \in s} task_i \ \lambda_{i,t} \ hrs_{i,t}}{\sum_{i \in s} \lambda_{i,t} \ hrs_{i,t}} \ ,$$

where i denotes a particular individual, t denotes the year, λ are sampling weights and hrs are annual hours worked. The notation $i \in s$ means that individual i works in sector s, where $s = fin$ corresponds to the financial sector and $s = nonfarm$ corresponds to the nonfarm private sector.[17] The generic '$task$' varies over all five tasks described above. Relative task intensity for finance in a given year is given by

$$rel\_task_{fin,t} \equiv task_{fin,t} - task_{nonfarm,t} \ .$$

Figure 3 reports the evolution of four relative task intensities (the fifth, relative Eye-Hand-Foot Coordination, does not change much throughout the sample and is dropped from the analysis). The figure conveys a clear message: finance was relatively more complex and non-routine in the beginning and end of the sample, but not so in the middle.

Panel A focuses on relative complexity. Finance lost much of its relative analytical complexity (Math Aptitude) from 1910 to 1950. At that point a slow recovery started, which accelerated in 1990. Decision making (Direction, Control and Planning) suffered even more in relative terms, but the recovery was much stronger. Panel B conveys the same message. Routine task intensity became higher in finance from 1910 to 1930, and started to decline from 1980 onward. In results that we do not report here, we observe virtually the same patterns within all three subsectors of finance.[18]

1.5 Taking stock of the new facts

Uncovering the historical evolution of wages, education and job complexity in the financial industry is the first contribution of our paper.[19] In the remainder of the paper, we seek to explain these new stylized facts. In particular, we try to identify the forces responsible for the evolution of human capital in the financial industry.

[17] In the 1910-1930 and 1960-1970 Censuses the underlying data used to calculate hrs is missing. Therefore, in those years we assign $hrs = 1$ for all individuals. See the appendix for complete details.

[18] The relative decrease and increase in complexity is strongest within Other Finance. However, data is noisy for routine tasks in Other Finance, due to few observations of workers who perform those tasks most intensively in that subsector. The pattern for Direction, Control and Planning in Insurance slightly differs from the aggregate pattern for finance. These results are available by request.

[19] This pattern is similar to the one for CEO compensation documented by Frydman and Saks (2007).

It is worth mentioning at the outset that the historical evidence places strong restrictions on the set of plausible explanations for the evolution of skill and wages in the financial sector. The fact that relative wages and education in finance were just as high in the 1920s as in the 1990s rules out technology – in particular information technology – as the main driving force. There were no computers in private use before 1960. Therefore, the idea that the growth of wages in finance is simply the mechanical consequence of the IT revolution is inconsistent with the historical evidence.

Autor, Levy, and Murnane (2003) argue that computers are complementary to complex tasks (non-routine cognitive) and substitutes for routine tasks. Therefore, the argument goes, we should see increases in complexity (non-routine cognitive intensity) and decreases in routine task intensity in industries that exhibit increases in IT and software intensity. Figure 3 shows that for finance this cannot be the main driving force, because this theory cannot explain the decline in complexity in the earlier part of the sample.

The historical stylized facts also rule out some simple macroeconomic explanations. For instance, the average price/earnings ratio and the ratio of stock market to GDP are not very correlated with the relative wage series.[20] The same is true of the ratio of trade to GDP.

We proceed as follows. We first provide a simple economic framework to think about the demand for skill in financial services. Then we try to identify the forces that determine wages and education in the financial industry. Finally, we ask whether the high wages observed in the early 2000s are sustainable.

2 Determinants of relative education and wages

In this section we provide a simple economic framework to think about the demand for skill in financial services. We then present evidence on the determinants of relative education and wages in the historical perspective.

[20] There is a stock market boom in the 1960s, and a collapse after 2001. Overall, the correlation with the relative wage series is small.

2.1 A simple framework

We use a simple model of the demand for skill to organize the discussion. Suppose that there are two education levels, *high* and *low*, and that the production function of sector s is

$$y_{s,t} = A_{s,t} f\left(\mu_{s,t} h_{s,t}, l_{s,t}\right) \ , \tag{5}$$

where $A_{s,t}$ measures the productivity of sector s at time t, and h and l are hours worked by high education and low education workers, respectively. The parameter $\mu_{s,t}$ captures the relative productivity of highly educated workers in sector s at time t. Let $w_{h,t}$ and $w_{l,t}$ be the hourly wages for high and low education workers. Assuming that the function f is homogenous of degree one, cost minimization implies that the relative demand for skilled labor is of the form

$$high_{s,t} = \frac{h_{s,t}}{h_{s,t} + l_{s,t}} = \phi\left(\mu_{s,t}, w_{h,t}/w_{l,t}\right) \ . \tag{6}$$

The demanded share of educated workers depends negatively on the education wage premium, and positively on the relative efficiency of skilled labor μ.

The parameter μ can be affected by technological innovations and organizational choices. There is strong evidence of a secular trend in μ for the aggregate economy (see Goldin and Katz (2008a)). However, we are interested in the behavior of the financial sector relative to the rest of the economy. A linear approximation to equation (6) leads to

$$\rho_{fin,t} = \alpha + \beta\left(\mu_{fin,t} - \mu_{nonfarm,t}\right) + \varepsilon_t \ , \tag{7}$$

where $\rho_{fin,t}$ is defined above in (2) and β is positive.[21] We now turn to the potential determinants of $\mu_{fin,t} - \mu_{nonfarm,t}$. Note that if $w_{h,t} > w_{l,t}$, then an increase in $\rho_{fin,t}$ will be reflected in an increase in $\omega_{fin,t}$ as well. In what follows, we investigate the determinants of both.

It is worthwhile noting at this point that changes in the aggregate skill premium *cannot* be the driving force behind $\rho_{fin,t}$. If this were the case, then we would expect a hump shape, not a U-shape in relative education over the sample. Historically, the aggregate skill premium declined from 1915 to 1950 and then increased until today, with a brief, small

[21] We have assumed here that the aggregation function is similar across sectors. We can relax this assumption and control for the education wage premium to allow for different elasticities. The results are unchanged and available upon request.

decline in 1970-1980 (see Goldin and Katz (2008a), page 300). We observe an increase in relative education in finance exactly when the aggregate skill premium increases most rapidly, staring in 1980: finance hires relatively more educated people exactly when they are most expensive. The correct explanations must therefore rely on the relative demand for skills, which is driven by $\mu_{fin,t} - \mu_{nonfarm,t}$.[22]

2.2 Explanatory Variables

We investigate the determinants of the skill composition of the workforce in the financial sector. Equation (7) makes it clear that we need to think about what determines the comparative advantage of skilled labor in finance relative to the rest of the economy.

Information technology *(IT)*

It is widely acknowledged that computers can affect the demand for skills. As we mention above in section 1.5, computers are complementary to complex tasks (non-routine cognitive) and substitutes for routine tasks (Autor, Levy, and Murnane (2003)). As a result, employees in complex or analytical jobs become relatively more productive, the relative demand for routine jobs decreases, while manual jobs are less affected. The financial sector has been an early adopter of information technologies. We therefore consider the share of IT and software in the capital stock of financial sector minus that share in the aggregate economy.[23]

Our measure of relative IT intensity is displayed in Figure 4. This series does not capture investments in telephones and telegraphs in the early part of the sample.[24] We could not obtain data on the relative stock of telephones in the financial industry, but it is difficult to imagine this stock shrinking from the 1920s to the 1970s, even relative to the private sector. For lack of data on the pre-War period, we do not use the relative IT and software share in our time series regression. We will provide evidence on the role of IT at the sub-sector level in Section 2.4 below.

Financial patents *(pat)*

[22] The aggregate supply of educated workers does not determine the evolution of $\rho_{fin,t}$ because it has increased thoughout the sample.

[23] The capital stock data are from the BEA's fixed assets tables by industry.

[24] Michaels (2007) argues that the advent of early information technology – telephones, typewriters, and improved filing techniques – in the early 20th century increased the demand for office workers in manufacturing. His data on telephones and typewriters is on production, not use by sector.

New financial products are likely to increase the required skills of finance employees in the financial industry.[25] For instance, pricing and hedging futures and option contracts is more difficult than pricing and hedging spot contracts. In addition, financial innovations often expand the span over which individuals can apply their skills, making the financial sector more attractive to highly talented individuals, as emphasized by Murphy, Shleifer, and Vishny (1991).

We use patents used in finance to measure financial innovation. We obtain data on new patents used in finance for the period 1909-1996 from the Historical Statistics of the United States.[26] We extend the series to 2002 using data from Lerner (2006). We then normalize by the total number of patents. The series is displayed in Figure 4.

Corporate finance activity: IPOs and credit risk *(ipo, def)*

The entry of new firms increases the informational requirements from financial analysts. New firms are difficult to value because they are often associated with new technologies or new business models, and also for the obvious reason that they do not have a track record. We therefore expect the intensity of IPOs to increase the returns to skill in the financial sector. We measure IPO activity from 1900 to 2002 using data from Jovanovic and Rousseau (2005). Specifically, we use the market value of IPOs divided by the market value of existing equities. As Jovanovic and Rousseau (2005) have shown, IPO activity was strong during the Electricity Revolution (1900-1930) and during the current IT Revolution.

Another area where financial activity has changed dramatically over long periods is credit risk. Corporate defaults were common until the 1930s, and the market for high yield debt was large. This market all but disappeared for 30 years, until "junk" bonds appeared in the 1970s. Pricing and hedging risky debt is an order of magnitude harder than pricing and hedging government debt. Risky debt affects all sides of the financial sector. It is used to finance risky firms with high growth potential. Rating risky debt requires skilled analysts: this explains the dynamics of rating agencies, which were important players in the interwar period, small and largely irrelevant in the 1950s and 1960s, and growing fast from

[25] Silber (1983) reviews new financial products and practices between 1970 and 1982. Miller (1986), reflecting upon the financial innovations that occurred from the mid 1960s to the mid 1980s, argues that the development of financial futures was the most significant one. Tufano (2004) argues that other periods have witnessed equally important innovations.

[26] Carter, Gartner, Haines, Olmstead, Sutch, and Wright (2006).

the 1970s until today (Sylla (2002)). To measure credit risk, we use a three year moving average of the U.S. corporate default rate published by Moody's.

For ease of comparison, we normalize the IPO and credit risk series to have a mean of zero and unit standard deviation over the sample period. Our measures of non financial corporate activity are displayed in Figure 5.

Deregulation *(dereg)*

The optimal organization of firms, and therefore their demand for various skills, depends on their competitive and regulatory environment, for at least two reasons. First, there is evidence that competition increases the demand for skill (see Guadalupe (2007) and the references therein). There is also evidence that organizational change can be skill-biased (Bresnahan and Trajtenberg (1995), Bresnahan, Brynjolfsson, and Hitt (2002) and Caroli and Van Reenen (2001)). In addition, a regulated financial sector might not be able to take advantage of highly skilled individuals because of rules and restrictions on the ways firms organize their activities. As a result, demand for skill labor is reduced. Deregulation, on the other hand, increases the scope for skilled workers to operate freely and therefore makes them relatively more productive.

We construct a measure of financial deregulation that takes into account the following:

1. Bank branching restrictions. We use the share of the U.S. population living in states that have removed intrastate branching restrictions. It is a continuous variable from 0 to 1.

2. Separation of commercial and investment banks. The Glass-Steagall act was legislated in 1933 and was gradually weakened starting in 1987 until the final repeal in 1999. The variable is between 0 and 1.

3. Interest rate ceilings. Legislation was introduced in 1933 and was removed gradually between 1980 and 1984. The variable is between 0 and 1.

4. Separation of banks and insurance companies. Legislation was introduced in 1956 and was repealed in 1999. The variable is between 0 and 1.

See the appendix for complete details. The deregulation index is given by $(1)-(2)-(3)-(4)$ and is displayed in Figure 6.

2.3 Time series regressions

We regress the relative wage and relative education on the variables described above. To mitigate endogeneity we use a five year lag for the dependent variables. The relative education equation is

$$\rho_{fin,t} = \alpha + \beta^{d} \times dereg_{t-5} + \beta^{p} \times pat_{t-5} + \beta^{ipo} \times ipo_{t-5} + \beta^{def} \times def_{t-5} + \beta^{time} \times t + \varepsilon_t$$

and the relative wage equation is

$$\omega_{fin,t} = \alpha + \beta^{d} \times dereg_{t-5} + \beta^{p} \times pat_{t-5} + \beta^{ipo} \times ipo_{t-5} + \beta^{def} \times def_{t-5} + \beta^{time} \times t + \varepsilon_t \ .$$

We do not include the IT variable here because it is not available before 1960. We will present IT evidence at the subsector level in the next section. The equations include a time trend and the standard errors are corrected for up to 10 years of autocorrelation.

Table 3 reports the results of the regression. The most robust determinant of both relative education and relative wages appears to be deregulation. In all specifications in Table 3 its effect is stable and always statistically significant, and the economic magnitude is large. In columns (1) and (4), deregulation alone accounts for 90% of changes in education and 83% of changes in wages.

When adding to our specification financial innovation in columns (2) and (5) we detect a significant effect on relative education but not on relative wages. In columns (3) and (6), we find a positive effect of corporate finance activity on the demand for skill and on relative wages, but the effects are only significant for wages. It seems that demand for financial skills that are harder to learn (IPO valuation and pricing risk) result in higher wages to those who have obtained these skills, whereas working with new technologies *per se* only increases demand for skilled workers in general. The effect of deregulation is robust to adding these control variables.

The financial deregulation index varies over a span of 4 units over the sample. Using the estimates from column (3), this translates into 7 percentage points of relative education. Recall that in Figure 1 relative education varies by slightly less than 10 percentage points. Similarly for wages, we find that deregulation appears to be the most important factor. None of the other controls comes close to having an effect of such large magnitude.

The time series regressions confirm the strong link between deregulation and skill upgrading in finance visible in Figure 6. The timing of the shift suggests a distinct role for deregulation, because the IT share in the capital stock of the financial sector actually starts increasing in the 1960s. The large organizational changes seem to have waited for deregulation to take place in 1980.[27]

2.4 Panel regressions: deregulation and information technology

Our main finding so far is the importance of deregulation in the determination of the evolution of relative education and relative wages in finance as a whole. In this section we investigate whether this result holds for the three subsectors that comprise the financial sector, namely Credit Intermediation, Insurance and Other Finance.

Unfortunately, we could not obtain time series data on innovations specific to these subsectors. We discuss the role of financial innovation below, but do not carry out statistical tests. In contrast, IT and software capital data is available by subsector from the BEA. In addition, we construct a deregulation index by sector. We exploit these two series in a panel of three subsectors within finance, which we currently turn to.

In order to construct a deregulation index that varies by sector, as well as by time, we use the components of the deregulation index from section 2.2. These components were (1) Branching restrictions; (2) Separation of commercial and investment banks (Glass-Steagall); (3) Interest rate ceilings; and (4) Separation of banks and insurance companies. Our sector-varying financial deregulation index is constructed as follows:

- For Credit Intermediation the index is equal to $(1) - (2) - (3)$.
- For Insurance the index is equal to $-(2) - (4)$.
- For Other Finance the index is equal to $-2 \times (2) - (3)$.

[27] Previous studies have attempted to address organizational change due to bank deregulation across states in the U.S. The results of these studies are inconclusive. Black and Strahan (2001) show no effect of branching deregulation across states on the share of managers in banking, whereas Wozniak (2007) does find such an effect, although her set of control variables is not as elaborate as Black and Strahan (2001). In untabulated results, we replicate both studies. In addition, we find that following branching deregulation the share of managers in banking employment decreases only in states that had strict unit banking laws relative to banking in other states. This is what one should expect if branching restrictions prevented reaping economies of scale in management. This result should be interpreted with caution, since it does not capture the effect of deregulation on the long run trend for more managers in banking.

Branching affects only Credit Intermediation because it is the subsector that includes banks. Glass-Steagall affects all subsectors, but we allow the effect to be twice as large for Other Finance because it changed both the organization of investment banking and competition within the sector and therefore should have a bigger impact. Interest rate ceilings should not affect Insurance, while the separation of banks and insurance companies affects insurance companies more strongly than it affects Credit Intermediation and Other Finance.[28]

For each subsector we now have a measure of relative wage, relative education, deregulation and the IT and software share in capital by subsector. We use this data to fit panel regressions with subsector fixed effects and year dummies over the post war period.

We report the results in Table 4. We find that IT and software intensity is linked to skill upgrading but the effect on wages is not significant. Once again, we find that deregulation has a large effect both on relative education and relative wages. In fact, the effect of deregulation is economically 1.5 times larger than that of the IT share.[29]

2.5 Financial innovation

Ideally, we would like to perform for financial innovation the same type of cross-sectional tests that we have just performed for IT in Section 2.4. Unfortunately, we do not have data on financial innovation at the subsector level, and we can only offer anecdotal evidence by looking at the insurance sector. In terms of wages and education, the insurance sector has been relatively stable (relative to the rest of the economy). Moreover, one might think that improvements in computers by themselves affected the insurance sector as much as the other financial sectors, and indeed the IT share in insurance is significantly higher than in the rest of the economy and, if anything, its growth has been faster than in the Credit Intermediation subsector. Nevertheless, the evolution of wages in Insurance does not suggest strong skill bias. This is inconsistent with IT being the main driving force behind the evolution of skills and wages.

The relative stability of the insurance sector is consistent with the role of financial – as

[28] We have performed robustness checks on the construction of these indices. The results in Table 3 below are robust to these checks.

[29] The deregulation variable ranges from -3 to 1 (with a standard deviation of 1.05), while the IT share variable ranges from 0 to 0.21 (with a standard deviation of 0.06). Combining these with the coefficient estimates gives a 1.5 larger effect to IT (also, the beta coefficient to deregulation is 1.33 larger than the coefficient to IT).

opposed to technological – innovations. Among the 38 new financial products and practices introduced between 1970 and 1982 listed in Silber (1983), only 2 or 3 are related to Insurance. This is also consistent with the argument in Miller (1986) on the ultimate importance of financial futures markets relative to other financial innovations. These innovations had a larger impact on other financial subsectors, in which we observe stronger relative wage growth, faster skill upgrading and faster occupational changes.[30]

2.6 Interpretation of our results

We have entertained other possible determinants for the evolution of relative education and relative wages over this long horizon. In particular, we have considered international trade, stock market capitalization (as percent of GDP) and stock returns. None of these variables has a significant effect on the skill composition of the financial sector. We also looked at the allocation of value added between labor and capital within the financial industry. The labor share is stable over time. The evolution of relative wages is therefore not driven by variations in the bargaining power of financial workers.[31]

On the other hand, we would not argue that regulations are exogenous to economic shocks. Depression era regulations are called that way for a reason. We would nonetheless argue that the evidence points clearly towards a causal role for regulation, for at least two reasons. First, while legislators and regulators react to economic shocks, they do not do so in a mechanical way. Following the crisis of 1929-1933, regulations were tightened and financial wages went down, but following the crisis of 1973-1981, regulations were loosened, and financial wages went up. Therefore, the occurrence of a crisis, high unemployment, bank failures, or a long bear market have no predictive power for relative wages and skills employed in finance, while regulation does.

Second, the timing of changes also suggests a causal role for regulations. The relative wage did not drop in 1929, or in 1930 following the stock market crash. The relative wage dropped only after 1934, when new regulations were enforced. Similarly, there was no sudden change in IT use around 1980, and it is only after deregulation took place that the relative wage started to increase. The pattern across subsectors is consistent with our

[30] Tufano (2004) argues that the more recent decades have also witnessed important financial innovations, but does not provide a breakdown by subsector.

[31] All these facts can easily be checked using NIPA data. Regressions are available upon request.

previous historical evidence. First, the subsector most responsible for the increase in the relative education and the relative wage, Other Finance, is the least regulated one. This is consistent with evidence from Kostovetsky (2007), who presents evidence for a brain drain of top managers from mutual funds to less-regulated hedge funds starting in the early 1990s.[32] Second, we find that the role of IT and software is limited. The IT share in the capital stock of Insurance and in Credit Intermediation has increased just as much as Other Finance, but the wage gains are much more modest.

Apart from regulation, we find an important role for corporate finance activities linked to IPOs and credit risk. Once again, we would not argue that IPOs are exogenous, but historical research suggest that they are exogenous enough for our purpose. Jovanovic and Rousseau (2005) have shown that IPO waves follow the introduction of General Purpose Technologies (GPT), such as electricity (1900-1930) or IT (1970-today). The timing of these technological revolutions is exogenous, and it explains the bulk of historical fluctuations in IPOs. Credit risk also increases during and after IPO waves, because young firms are volatile, and because they challenge established firms.

That the quality of human capital employed in the financial industry is determined by the needs of the corporate sector is also important in the current context, because it suggests that at least some of the observed high wages represent an efficient market response to a change in the economic environment. In the last section of this paper, we study the extent to which employees of the financial industry earn rents.

3 Are high wages in finance sustainable?

In the long run, it appears that the most important factors driving the relative skill demand and relative wages in the financial sector are regulation and corporate finance activity, followed by financial innovation. Our analysis so far, however, says nothing about the sustainability of the wages paid in the financial industry.

Whether financiers are overpaid is a very difficult question to answer. The basic issue is to find a benchmark with which to compare the actual wages received by financiers. In other words, financiers might be overpaid, but overpaid relative to what? There are two

[32] Kostovetsky (2007) argues that this lowered returns in mutual funds.

possible benchmarks. First, one could assess whether financiers are paid more than what that they would be paid under a properly defined "social optimum." Research in economics and finance is not yet at the stage where we can answer that question from first principles. One step towards answering such a question is presented in Philippon (2007), where the optimal allocation of talent is analyzed in a dynamic general equilibrium model with credit constraints, career choices and industrial innovations. In that model, the financial sector can drain resources from entrepreneurial activities with positive externalities, but it can also alleviate the financial constraints facing the would-be entrepreneurs. This trade-off is important in practice. Unfortunately, many critical inputs of the model are not directly observable, which makes it impossible to measure the discrepancy between private and social returns to financial jobs. More research is clearly needed in this area.

We therefore consider the following, simpler question: is the financial sector in a sustainable labor market equilibrium? Or, equivalently: are financiers overpaid relative to other employees with similar characteristics? We have seen that the wages of employees in the financial sector have increased relative to the rest of the private sector. This increase has been accompanied by an increase in the share of college graduates working in the financial sector. In this section we ask whether the change in the composition of the labor force, in particular its education, can account for all of the observed increase in wages.

There are two ways to address this question. The first is to compare groups of workers who are presumably equally educated and have equal innate ability – one inside and the other outside of finance. We therefore compare financiers with engineers, all of which have the same level of education. Given the attraction of many engineers into finance in recent years (National Academy of Sciences (2007)) we would expect that these two groups should be similar, at least at the margin. The other way is to fit wage regressions, where we include a finance indicator, as well as educational and demographic characteristics of the workforce. We then try to assess whether increases in wages in finance can be attributed to increases in unemployment risk. Finally, we propose an estimate that is robust to unobserved heterogeneity.

3.1 Financiers and engineers

In this section, we focus on a particular comparison, namely that between engineers and financiers with similar levels of education. Figure 7 shows the evolution of the average annual wages of employees in finance with a college degree or more, and of engineers employed in the private sector (but not in finance). The wages are in constant 2000 prices and the averages take into account sampling weights (data is taken from the March CPS). The left panel exhibits wages of individuals with exactly a college degree, and the right panel exhibits wages of individuals with a post graduate degree. In both cases, the wage of finance employees relative to engineers was constant until the 1980s, and then started to increase faster than the wage of engineers with the same level of education. The picture is particularly striking for post graduates, a category that includes MBA and Ph.D. graduates.

This situation, in which we find that individuals with similar abilities earn different wages points out that wages in the financial sector might be in excess of long run equilibrium wages. We now examine this hypothesis more systematically, using wage regressions.

3.2 Wage regressions

We fit a series of cross sectional regressions, one for each year in our sample. For each year we estimate

$$\log(w_i) = \alpha + \phi 1_i^{\phi} + X_i' \beta + u_i \ , \tag{8}$$

where X_i is a vector of individual characteristics that includes controls for educational categories as in section 1.3, as well as indicators for race, sex, marital status, urban residence, and (potential) experience and its square. 1_i^{ϕ} is an indicator for working in finance. w_i is the hourly wage of individual i. Notice that since these regressions are fit year by year, they take into account, *inter alia*, the changing returns to education.

Figure 8 displays estimates of the coefficients of interest, ϕ, plotted against the year in which they were estimated. All estimates were statistically different from zero.[33] The figure confirms that individuals working in finance indeed earn more than observationally equivalent workers. However, the premium was quite small until 1980, around 5%, at which point it started to increase dramatically until it reached 20% at the turn of the century. In

[33] We do not tabulate the results, but they are available upon request.

untabulated results we find a similar pattern for subsectors within finance.

The beginning of the increase in ϕ matches the timing of the reduction of regulation. Since we are controlling for education, this increase cannot be interpreted as an increase in the (average) returns to education, or skill biased technological change. Thus, we find some more support for wages in excess of equilibrium levels.

3.3 Employment risk and wage differentials

In the previous section we found that wages in finance are higher than in other sectors, even after controlling for education levels. That two individuals with the same education and observable characteristics earn such different income can be explained in one of four ways: compensating differentials, employment and wage risk, unobserved heterogeneity and rents.

We did not find direct evidence for an increase in wage volatility, so we focus on employment risk. If finance workers are more likely to loose their jobs they would have to be compensated for this extra risk. To test this explanation, we proceed as follows.

Let emp_{it} be an indicator for being employed at time t. We fit the following logit regressions of the likelihood of becoming unemployed

$$\Pr\left(emp_{it+1} = 0 \mid emp_{it} = 1\right) = f\left(1_{it}^{\phi},\ \log\left(w_{it}\right),\ X_{it}\right) \tag{9}$$

where f is the logistic function, X_{it} contains the same vector of observables we used in the previous section and 1_{it}^{ϕ} is an indicator for working in finance. We add $\log\left(w_{it}\right)$, the log of the hourly wage, in an attempt to capture unobserved heterogeneity. We fit this regression for eight subsamples of equal size in 1967-2005, $\{[1967, 1970], [1971, 1975], \ldots [2001, 2005]\}$, and we include year dummies within each subsample.[34] The coefficient to the indicator 1_{it}^{ϕ} captures the additional risk of unemployment for workers in finance.

The estimation of equation (9) requires a longitudinal dimension. Therefore we use the Matched CPS in 1967-2005, which allows us to observe each individual in the CPS twice, in two consecutive years.[35]

Figure 9 summarizes the evolution of unemployment risk in the financial sector relative to the private sector, as captured by the marginal effect of 1_{it}^{ϕ} from (9) in each of the

[34] The first period includes only the first four years of data, 1967 to 1970. All the rest are 5-year intervals.

[35] See the appendix for a complete description of the methodology involved in matching observations on individuals from consecutive surveys. For a complete documentation of the variables and output results see Philippon and Reshef (2007).

eight subsamples.[36] Although finance employees had safer jobs until the early 1980s, the relative stability of finance jobs has decreased over time.[37] The timing of the decrease in unemployment risk coincides with the timing of financial deregulation.

We use these results in order to gauge the effect of the rise of unemployment risk on wages. By calibrating a simple income fluctuations model (see details in the appendix), we find that the increase in unemployment risk could account for 6 percentage points of the increase in relative wages. We compare this to our estimates of the finance dummy, ϕ, from section 3.2, depicted in Figure 8. It follows that unemployment risk could account for up to 40% of the increase in the excess wage between 1980 and 2005 $(6\%/(20\% - 5\%) = 40\%)$. This still leaves much scope for excess wages, over and above observable characteristics and unemployment risk.

3.4 A benchmark for the relative wage

Using historical data on the returns to education from Goldin and Katz (2008a), our estimates of the relative education in the financial sector, and assuming that relative unemployment risk was the similar in the 1930s and 1990s, we can construct a benchmark relative wage series for the financial sector. Deviations from this benchmark can be driven by unobserved heterogeneity, or by short term rents (overpay) in the financial sector.

The benchmark relative wage in finance versus the nonfarm private sector is given by

$$\widehat{\omega}_{fin} = \rho_{fin} \cdot (1 + \pi) + \theta \ ,$$

where ρ_{fin} is the relative education level in finance defined in (2), π is the skill premium, and θ captures the effect of differential unemployment risk. We use our estimates of ρ_{fin}, the estimates of π from Goldin and Katz (2008a) and our own calculations to estimate θ over time.[38]

[36] The probability of becoming unemployed is evaluated for the average worker, i.e., it is evaluated at the means of all other variables.

[37] We also fit (9) for three wage groups in order to better capture unobserved heterogeneity. The upward trend in unemployment risk is maintained for all wage groups that we entertained. See Philippon and Reshef (2007) for complete details.

[38] We use the calibration which is described in the appendix to gauge θ under the following assumptions about the relative risk unemployment. We rely on our estimates for the 1968-2005 period directly. We assume that from 1950 to 1970 the risk factor was the same as in 1970. We assume that in 1920-1935 there was no additional risk to work in the financial sector, as in the 1990s. Between 1935 and 1950 we interpolate linearly.

Figure 10 shows the actual and benchmark relative wage series. The benchmark relative wage tracks the actual relative wage well in the middle of the sample. It is important to remember that in the late 1970s the relative wage is one, but finance workers are more educated than in the rest of the economy (see Figure 1). The negative differential appears to be well explained by the lower employment risk that finance workers enjoy. This differential disappears over the 1990s, as shown in Figure 9. In 1910-1920 the large returns to education documented by Goldin and Katz (2008a) account well for the relative wage.

Figure 11 shows the excess relative wage, defined as the difference between the actual and benchmark relative wages in Figure 10. The late 1920s-early 1930s, and the post 1990 periods stand out as times where wages in the financial sector are high relative to the benchmark. It follows that something other than returns to education, skill intensity and risk factors have caused the actual wage to deviate from the benchmark. Compensating differentials are unlikely to explain the evolution of the excess wage, because financial innovations over the past 30 years have made jobs in the financial sector more interesting, not less. We are therefore left with two explanations: rents, and unobserved heterogeneity. We address this in the next section.

3.5 Controlling for individual heterogeneity

In this section, we ask how much of the increase of relative wages in finance can be attributed solely to working in the financial sector, over and above education, occupation and innate ability. To answer this question we estimate the following equation

$$\log(w_{it}) = \alpha_i + \varphi 1_{it}^{\phi} + X_{it}'\beta + \delta_t + u_{it} \ , \tag{10}$$

where w_{it} are hourly wages, α_i is an individual fixed effect, 1_{it}^{ϕ} is an indicator for working in finance, X_{it} is a vector of individual characteristics, δ_t are year dummies and u_{it} is the error term.[39] The coefficient φ measures the extent to which every finance employee receives a higher wage, controlling for all other things, including innate ability.

X_{it} includes indicators for marital status, urban residence, and continuous variables (potential) experience and its square. We do not include in X_{it} educational categories

[39] We use hourly wages for w_{it} in order to prevent φ from capturing potentially longer working days in finance relative to the rest of the private sector. Using annual wage earnings delivers similar results. In fact, the magnitudes of the results using hourly wages stronger.

because we restrict attention to individuals who have completed their formal education and therefore their years of education are fixed and their returns to education are absorbed in α_i.[40] For the same reason, we do not include in X_{it} indicators for race and sex.

Equation (10) can only be estimated with longitudinal data. We therefore use the 1967-2005 Matched CPS, which allows us to observe each individual in the March CPS twice, in two consecutive years.[41] As before, we restrict attention to full time workers in the private sector, aged 15 to 65, who reported wages greater than 80% of the federal minimum wage. Since each individual is observed only in two consecutive years, α_i captures the trends in the returns to education and experience, as well as all other factors that are individual specific and time invariant.

Table 5, column 1, displays the results of fitting (10). We find that finance employees' hourly wages are 4.4% higher than in the private sector. Since wages are top coded, this it is unlikely to capture the largest wage increases for people switching jobs into the financial sector. Moreover, the correct comparison of the estimate of φ is to the finance dummy from section 3.2, depicted in Figure 8. There, we saw that finance workers earn on average 10% more than observationally equivalent workers in the private sector, in the entire sample. 4.4% out of 10% is 44% of the excess wage, which is a large number economically.

Next we ask whether the finance premium varies by educational attainment. To answer this question we allow φ in (10) to vary by educational attainment. These results are reported in column 2 of Table 5: the finance premium is higher for higher levels of education. College graduates earn 5.8% more, over and above their individual characteristics, and individuals with more than college degrees earn 8.3% more. It seems that rents are concentrated on highly educated people. Note that this does not capture higher returns to education, which are absorbed in α_i.

We also fitted (10) to each subsector separately. In those regressions, the indicator 1_{it}^{ϕ} takes value one for working in one of the finance subsectors. We estimate that the premium is 2% in Credit Intermediation, 4.7% in Insurance and 9% in Other Finance.[42] The premium

[40] We excluded a small number of individuals which increased their educational attainment while still working full time in both years that they were observed. The results are robust to including all these observations, whether we control for education or not.

[41] See the data appendix for a complete description of the methodology involved in matching observations on individuals from consecutive surveys.

[42] We drop the other two finance subsectors from the analysis in order to capture only the effect of working

is highest in the least regulated sector.

Since we saw in Figures 8 and 11 that the excess wage is increasing over time, it is only natural to ask whether the finance wage premium is also increasing. We address this question by estimating (10) for eight subsamples in 1967-2005, $\{[1967, 1970]$, $[1971, 1975]$, ... $[2001, 2005]\}$.[43]

The results are graphed in Figure 12. The finance premium did not exist before 1986, but from that point in time it is positive, and on average 6%. Recall that the increase in φ does not capture the increase in returns to education, because all the effect of an individual's educational attainment is absorbed in α_i. Comparing the increase in the estimates of φ after 1986 to the finance dummy in Figure 8, we see that 30% to 50% of the excess wage can be explained by factors other than individual ability.[44]

The magnitude of the increase in the excess wage in Figure 12 is smaller than in Figure 11 (in the 1990s), part of which is due to top coding in the CPS data. However the timing of the increase in both Figures is remarkably similar. In both cases, excess wages in the financial sector appear only from the mid 1980s onward. Overall, this validates our strategy of using different data sources. The Industry Accounts data is more comprehensive, but does not allow us to rule out unobserved heterogeneity. The CPS data suffers from top coding, but it gives us better identification. We conclude that a large part of the excess wage in Figures 11 and 12 is due to rents.

4 Conclusion

While previous analyses of the financial sector have focused on financial assets, we focus on the dimension of human capital. In particular, we examine the financial sector in terms of

in the particular finance subsector in focus relative to the private sector, not relative to other subsectors in finance. These results are available by request.

[43] We make sure that within each subsample there are only pairs of observations from each individual. Individuals whose incidence is at the end of one subsample and at the begining of the following subsample are excluded. Nevertheless, the results are robust to including these observations.

[44] In order to make sure that our results are not driven by positive shocks to individuals who switch into finance or negative shocks to individuals who leave the sector, we performed two robustness checks. First we estimated all the specifications using a sample that includes only individuals who started in the private sector in the first year in which they were observed. In the second robustness check we used a sample of individuals who all ended up in the private sector in the second year in which they were observed. The first sample includes switchers into finance, whereas the second includes switchers out of finance. The results are all qualitatively the same and quantitatively similar. The estimates from the pooled sample are weighted averages of the estimates from the two robustness samples. All these results are available upon request.

its skill composition and relative wages from 1909 to 2005, and we propose explanations for their evolution.

We document a set of new interrelated, stylized facts: the skill intensity and the complexity of jobs in the financial sector relative to the nonfarm private sector exhibit a U-shape from 1909 to 2006. Our main conclusion from the analysis of the determinants of the evolution of education and wages in the financial sector is that deregulation and corporate finance played dominant roles. We find a robust and economically significant positive effect of deregulation on skill and wages in the financial sector, both in the aggregate time series and across subsectors. Moreover, we show that the nature and timing of regulatory changes point toward a causal role for deregulation.

We also find that corporate finance activities linked to IPOs and credit risk increase the demand for skilled labor. Historical evidence on general purpose technologies allows us to claim that there is a causal impact of corporate finance on the demand for skills in the financial industry. Linking IPOs and credit risk to technological revolutions is also an interesting way to conclude our discussion of the IT revolution. We show that the direct impact of IT is limited: the use of computers by the financial industry does not explain its use of human capital. We also argue, however, that the indirect impact of IT is important: the creative destruction that IT induces in the *non financial* corporate sector is a key driver of the demand for skills in the financial industry.

Finally, we address the issue of the level of compensation in the financial industry. On the one hand, the change in the relative wage of finance employees is part of an efficient market response to a change in the economic environment. We show in particular that corporate finance needs from the non financial sector help explain the demand for skills in the financial industry. On the other hand, we find that rents account for 30% to 50% of the wage differentials observed since the late 1990s. In that sense, financiers are overpaid.

Our research has two important implications for financial regulation. First, tighter regulation is likely to lead to an outflow of human capital out of the financial industry. Whether this is desirable or not depends on one's view regarding economic externalities. Baumol (1990), Murphy, Shleifer, and Vishny (1991) and Philippon (2007) argue that the flow of talented individuals into law and financial services might not be entirely desirable, because social returns might be higher in other occupations, even though private returns are not. Our results quantify the rents earned by employees in the financial industry in the late 1990s and early 2000s. These rents explain the large flow of talent into the financial sector. At this stage, however, we cannot assess whether the inflow was too large from a social perspective.

Our results have another important implication for regulation. Following the crisis of 1930-1933 and 2007-2008, regulators have been blamed for lax oversight.[45] In retrospect, it is clear that regulators did not have the human capital to keep up with the financial industry, and to understand it well enough to be able to exert effective regulation. Given the wage premia that we document, it was impossible for regulators to attract and retain highly-skilled financial workers, because they could not compete with private sector wages. Our approach therefore provides an explanation for regulatory failures.[46]

[45] The Pecora Hearings of 1933 and 1934 documented such lax oversight and made the case for financial regulation; this led to the Glass-Steagall Act, Securities Act of 1933 and the Securities Exchange Act of 1934.

[46] Of course, regulators will be able to hire cheap skilled labor in 2009, just as they were able to in the 1930s.

Appendix

A Data

A.1 Wages

The data come from the Industry Accounts, Kuznets (1941), and Martin (1939). The industry accounts are prepared by the Current Industry Analysis Division, Bureau of Economic Analysis (BEA), U.S. Department of Commerce. The only issue here is to obtain a consistent industry classification. From 1987 to 2006, we use the NAICS classification for "Compensation of employees" (wages and salaries, and supplements) and for "Full-time equivalent employees." From 1947 to 1987 we use the SIC classification, which itself changes in 1972. From 1929 to 1946, we use tables 6.2A and 6.5A from the Income and Employment by Industry, also published by BEA. Mapping the data before and after 1946 requires adjusting for changes in the classification of real estate activities.

Kuznets (1941) gives estimates of net income, wages and salaries and number of employees separately for banking, insurance, and real estate, over the period 1919-1938. The banking category, however, covers only commercial banks, savings banks, and federal reserve banks. Brokerage, investment banking, and other financial activities are not included. As a result, the size of the industry is smaller than the one implied by BEA data. Fortunately, there is large overlap of 10 years with the BEA data, over which the correlation between the two series is 96.6%. It seems therefore quite safe to impute values for the period 1919-1928 using Kuznets' data.

Martin (1939) provides data for the finance, insurance and real estate, but not for finance and insurance only. For the period 1909-1929, the estimates are based on data collected from banking, insurance and real estate. For the period 1899-1908, however, the 1909 estimate was "projected to 1899 on the basis of other data indicating a probable trend for this period." We find this procedure questionable, so we truncate our sample in 1909. For the period 1909-1919, we also collected data from Mitchell (1921) for the banking sector. The implied banking wage from Mitchell (1921) is quite similar to the implied wage from Martin (1939) and the Census data to measure the number of employees, except that it grows slightly faster.

As we have mentioned, the data from Martin (1939) includes real estate. This does not appear to raise a problem for the long run trends. Using BEA data for the period 1929-2005, we find a correlation of 0.993 between the relative wage series including real estate the and the wage series excluding real estate .

A.2 Imputing education shares for 1910-1930

For the period 1910-1930, where schooling data is not available we impute the share of employees with more than high school education by occupation, separately for each sector (nonfarm private sector and for the financial sector). Although occupational classifications change across Censuses, IPUMS provides a consistent classification for occupations that is based on the 1950 Census. Essentially, occupational classifications from other years are matched with the classification of 1950.

We calculate the share of employees with more than high school education in each occupation c separately for each sector s according to this classification in 1950, $\alpha_{c,s}^{1950}$. We use 1950 as a base year rather than 1940 because 1950 contains all possible occupations according to this classification, whereas 1940 is missing several. We use $\alpha_{c,s}^{1950}$ as a base to impute the share in each sector in 1910-1930 by using the distribution across occupations in each sector, $\lambda^t_{c,s}$, and then aggregating up,

$$educ_{s,t} = \sum_c \lambda^t_{c,s} \alpha^{1950}_{c,s} ,$$

where $t = 1910, 1920, 1930$; $\lambda^t_{c,s} = \sum_{i \in c} \omega_{i,s,t} \,/ \sum_i \omega_{i,s,t}$ is the share of workers in occupation c in sector s in Census t; and $\omega_{i,t}$ is the sampling weight for that observation.

A.3 Financial deregulation

We construct a measure of financial deregulation that takes into account branching restrictions, the Glass-Steagall act, interest ceilings, the separation of insurance companies from banks, and restrictions on the investment opportunities of insurance companies and banks.

(i) Branching
We use the share of the U.S. population living in states that have removed branching restrictions via mergers and acquisitions. The data is from Black and Strahan (2001). Our branching deregulation indicator is a continuous variable. It starts at 16.7% in 1960 and increases to 100% by 1999. We set our indicator at 16.7% from 1927 to 1960. The McFadden Act of 1927 prevented branching of nationally chartered banks. Before the McFadden Act branching was less clearly limited. To capture this, we set our indicator to 0.3 in the years 1909-1926.

(ii) Separation of commercial and investment banks
The Glass-Steagall indicator is a continuous variable between 0 and 1. It is 0 until 1932, 0.5 in 1933 and 1 from 1934 to 1986. The Glass-Steagall act is relaxed in 1987, 1989, 1997 and was finally repealed in 1999, by the Gramm-Leach-Bliley Act. In 2000 this indicator is back to zero.

(iii) Interest rates ceilings
Ceilings were introduced in 1933 and removed after 1980. Our indicator variable is 0 until 1932, 0.5 in 1933 and 1 from 1934 to 1980. S&Ls were further deregulated by the Garn-StGermain Depository Institutions Act of 1982. To capture these features, our index moves gradually to zero between 1980 and 1983.

(iv) Separation of banks and insurance companies
The Bank Holding Company Act of 1956 prohibited a bank holding company from engaging in most non-banking activities and from acquiring voting securities of certain companies. It was repealed in 1999. The Armstrong investigation of 1905 took place before the beginning of our sample and therefore is not directly relevant.

The deregulation index is given by

$$deregulation = (i) - (ii) - (iii) - (iv)$$

A.4 Relative task intensity indices

In order to construct our relative task intensity indices we matched occupational task intensity indices from the Dictionary of Occupational Titles (DOT) into individual occupations in the US Censuses from 1910 to 2000 and in the 2008 March CPS (which pertains to 2007). Five DOT task intensities by occupation (373) and gender (2) were obtained from David Autor, to which we are grateful for sharing this data. The occupations are classified according to the 1990 Census system. The task intensity measures vary over the [0,10] interval. We call this data DOT1990. Census and CPS data were extracted from IPUMS.

DOT task intensities

The DOT task intensities were originally calculated in 1977 by a panel of experts from the National Academy of Sciences for 3886 DOT occupations. Each occupation was assigned a vector of characteristics. From this vector we use only five elements that sufficiently characterize each occupation: Finger Dexterity (routine manual tasks), Set Limits, Tolerances and Standards (routine cognitive tasks), Math Aptitude (analytical thinking), Direction, Control and Planning (decision making) and Eye-Hand-Foot Coordination (captures non-routine manual tasks).

The 3886 DOT occupations were allocated across 411 occupations of the 1970 Census classification. The task intensity for each 1970 Census occupation is a weighted average over the tasks of the original DOT occupations that were allocated to it, where the weights are CPS sampling weights. This was done using the April 1971 CPS (which pertains to 1970). The averages were different for men and women, hence the separation by gender. Each one of the five indices was detected as a principal component for indices that are similar in nature (see Autor, Levy, and Murnane (2003)). The 1970 Census classification was matched into the 1990 Census classification using information based on the OCC1990 variable in IPUMS (this was done by Peter Meyer from the Bureau of Labor Statistics).

Consistent occupational classification

In order to match the DOT1990 data to occupations in 1910-2007 we had to create a consistent classification system for the entire period. For 1960-2007 we could use the 1990 Census classification directly, using the OCC1990 variable in IPUMS. For 1910-1950 we used the 1950 Census classification, using the OCC1950 variable in IPUMS. We created a crosswalk for OCC1950 into OCC1990 using the 1950 Census, the first year for which OCC1990 exists. We used 1950 as a base for the crosswalk because all Census 1950 occupations appear in 1950. Another option we tried was to use the 1990 Census as the base for the crosswalk; this had no effect on our results.

When matching the DOT1990 data we had to make a few modifications. These modifications are due to the fact that not all of the 1990 Census occupations are represented in DOT1990. Therefore, we allocated task intensities to these occupations using data for other occupations that we thought were very similar in nature, *a priori*. The only substantial modification was to allocate task intensities to "Professionals, not elsewhere classified" according to the average task intensity for professionals by year, 2-digit industry and gender. Our results are not affected by dropping all the occupations that were not matched or to modifications of these allocations.

Eventually, we constructed a data set with a consistent classification of occupations. The DOT1990 information was then matched into this data set, using the 1990 Census classification and gender. Thus, every individual in the data set has five task intensity indices that characterize her occupation.

Aggregation

We restrict attention to workers age 15 to 65, who are employed in the nonfarm private sector (in 1920 we could only restrict to individuals who were in the labor force). For each task and year we aggregate up by sector as follows

$$task_{s,t} = \frac{\sum_{i \in s} task_i \ \lambda_{i,t} \ hrs_{i,t}}{\sum_{i \in s} \lambda_{i,t} \ hrs_{i,t}} \ ,$$

where i denotes a particular individual, t denotes the year, λ are sampling weights and hrs are annual hours. $i \in s$ means that individual i works in sector s, where $s = fin$ corresponds to the financial sector and $s = nonfarm$ corresponds to the nonfarm private sector. The generic'$task$' varies over all five tasks described above.

Unfortunately, it is not possible to calculate hrs for all years. In the 1910-1930 and 1960-1970 Censuses the underlying data to do so is missing. Therefore, in those years we treat $hrs = 1$ for all individuals. The underlying data that is used to calculate hrs is the number of weeks worked times the number of hours worked per week. The 1910-1930 Censuses do not contain such information at all. In 1940-1950 we use data on hours worked in the week before the census. The 1960-1970 Censuses contain only categorical data on weeks and hours worked, according to some ad hoc intervals; we could not calculate hours worked because we could not adjust for longer hours or more weeks accurately. In the 1980-2000 Censuses, as well as the 2008 March CPS, we use data on usual hours worked per week. Our attempts to gauge hours and weeks worked in 1960-1970 by using data from 1950, 1980 or both resulted in severe jumps in the $task$ series in those years.

Relative task intensity for finance for each year is given by

$$rel\_task_{fin,t} \equiv task_{fin,t} - task_{nonfarm,t} \ .$$

A.5 The Current Population Survey

Our data on individuals comes from the March supplement of the Current Population Survey (Annual Social and Economic Study) from survey years 1968-2006, which pertain to 1967-2005 actual years. A CPS year refers to data of the preceding year, i.e. March CPS 2006 documents annual data from calendar year 2005. We therefore adopt the following taxonomy: We call "year" the actual year that the survey pertains to, while a CPS year is denoted as "survey year". The Current Population Survey (CPS) is a monthly survey of about 50,000 households conducted by the Bureau of the Census for the Bureau of Labor Statistics. Currently, there are more than 65,000 participating households. The sample is selected to represent the civilian non-institutional U.S. population. The CPS includes data on employment, unemployment, earnings, hours of work, and other demographic characteristics including age, sex, race, marital status, and educational attainment. Also available are data on occupation, industry, and class of worker. We choose to use only one particular month survey, the March supplement, for two reasons. First, this supplement contains more demographic details, in particular on work experience and income sources and amounts. Since 1976, the survey has also been supplemented with a sample of Hispanic households (about 2,500 interviewed). Second, it has been extensively used in the empirical labor and macro-labor literature, which lends to the comparability of our results. Let us now define the groups that we use in our empirical analysis. We restrict attention to individuals who are in the labor force, of at least 15 years of age.

Occupations

Examining the distribution of occupations within finance and its three subsectors lead us to choose seven occupation groups (henceforth, "occupations"), which describe the major occupational groups in our sample. These are: "Managers and Professionals", "Mathematics and Computers", "Insurance Specialists" (insurance sales persons, statisticians and actuaries), "Brokers and Traders", "Bank Tellers", "Administration, Including Clerks", and "All the Rest" (janitors, security and miscellaneous). As with industry classifications, major occupational re-classifications occurred in survey year 1983, from the Census 1970 system to the 1980 system, and in survey year 2003, from the Census 1990 system to the 2000 system. Of these two re-classifications, the latter was more substantial. We examined the occupational crosswalks, which are provided by the Census Bureau to make sure that our occupational groups are consistently defined over time (Census Bureau (1989), Census Bureau (2003)). Our criteria for grouping occupations under one title was stability in occupational shares and relative wages. In some cases we could not consistently separate "managers" from "professionals" due to re-classifications in survey years 1983 and 2003; some occupations that were defined as "professional" were split and re-classified as "managerial" and vice versa. However, these two groups together are consistently identified, without any "jumps" or "drops" in their employment shares over time, or in their relative wages. Much effort was devoted to making sure that the other occupation groups are also consistently defined throughout our sample. Note that some of these occupations potentially mean different things in different industries. For instance, in Credit Intermediation the "Managers and Professionals" include "bank officers", but these officers do not exist in the two other industries. The composition of "Administration, Including Clerks" also varies across subsectors of finance. However, our more narrowly defined occupations, "Mathematics and Computers", "Insurance Specialists", "Brokers and Traders" and "Bank Tellers" are consistently defined.

Industry Classification
The financial sector includes three industries: "Credit Intermediation", "Other Finance Industries", and "Insurance". To define the private sector, we exclude all government employees, as well as employees of the United States Postal Services. Banks, thrift and saving institutions are included in "Credit Intermediation". Securities, commodities, funds, trusts, and other financial investments as well as investment banks are all included in "Other Finance Industries". These sectors are consistently identified, without any "jumps" or "drops" in their shares of total employment, despite changes in industrial classifications in the CPS in our sample, which occur following each decennial census. The major industrial re-classifications occurred in survey year 1983, from the Census 1970 system to the 1980 system; and in survey year 2003, from the Census 1990 system to the 2000 system. Of these two re-classifications, the latter was more substantial overall, yet it does not affect our sectors. The Census Bureau provides industrial crosswalks for the 1970-1980 systems and for the 1990-2000 systems, from which one can gauge how some industries are split or merged into others (Census Bureau (1989), Census Bureau (2003)). These crosswalks are basically a transition matrix for all industries from one classification to the other. A close examination of these transition "probabilities" lead us to conclude that our industries are consistently defined throughout our sample. In the transition from the 1970 system to the 1980 system 99.9% remain inside each industry; and for the transition from the 1990 system to the 2000 system over 95% of workers remain inside each industry. This is due to the fact that the functions of our three industries are narrowly and well defined, and due to the fact that they are not too large.

Education and experience
Educational Categories are "Less than 12 years of schooling", "High School Graduate", "13-15 Years of Schooling", "College Graduate" (4-year college), "More than College" (graduate degrees, such as JD, MBA, Ph.D.). Until survey year 1991 years of education are reported in annual steps, starting with 0 years till 18 years (which also absorbs instances of more than 18 years). Also until survey year 1991 we correct years of schooling for individuals who did not complete the last year in school by subtracting one year. This correction is not needed after survey year 1992. From survey year 1992 and on early school attainment is lumped into groups: 0 years, 1-4 years, 5-6 year and 7-8 years. Also starting in survey year 1992 school attainment starting with high school is marked by degrees, not years, therefore it is not possible to distinguish between, e.g., 13, 14 and 15 years of school. To make our education variable consistent throughout our sample, we adopt the coding that starts in survey year 1992, i.e., we group early school attainment into brackets for all the sample and assign maximal values to each bracket. Also, we group 13, 14 and 15 years of school together and assign 14 years for all individuals within that bracket in all years. In

addition, we lump 17 years of schooling together with 16 years, for similar reasons. This makes the educational shares smooth throughout the sample, and in particular around the 1991-1992 surveys. Experience is potential labor market experience. It is measured as $min\{age - edu - 6; age - 18\}$, where '$edu$' is years of schooling. The CPS does not contain data on job spells.

Wages and top-coding
We deflate all wages reported in the CPS using the deflator for personal consumption expenditures from the Bureau of Economic Analysis. The reference year is 2000. Hourly wages are calculated by dividing annual wage income by number of hours worked. The CPS underestimates the income of individuals who earn very high salaries, due to top-coding of income. Therefore, the wages that we report may not be accurate for certain occupations, Securities and Financial Asset Sales in particular. In our sample, the percent of top-coded observations in the private sector increases from 0.06% in 1967 to 1.1% in 1980, after which it fluctuates in the range 0.38%-1.6%, due to secular adjustments of the top-coding income limit. However, in the financial sector there are many more incidents of top-coding: in Credit Intermediation there are on average twice as many top-coded observations, in Insurance there are on average 2.4 as many top-coded observations, whereas in Other Finance Industries there are on average 13 times as many top-coded observations. This leads to an under-estimation of relative wages in the financial sector. In an attempt to compensate for this, we multiply top-coded incomes in all survey years until 1995 by a factor of 1.75. From survey years 1996 and on, top-coded incomes are average amounts of actual earnings for 12 socioeconomic cells; therefore we do not adjust them.

A.6 Construction of Matched CPS

We thank Donghoon Lee for providing us with his methodology. The "Matched CPS" takes advantage of the fact that households in the CPS are sampled for more than a year, in the following pattern. Each household that enters the survey at any given month is sampled for four months, leaves for eight months, and then returns for four more months, after which it exits. Therefore, theoretically, every household that is surveyed in March of any given year must have been surveyed in the previous March, or will be surveyed in the next. Of course, in practice not all individuals get surveyed twice due to survey attrition, non-compliance, etc.'.

Unfortunately, the CPS does not hold a definitive person ID, by which one could easily match two observations on the same individual from two consecutive surveys. The following methodology is used to match observations on the same individual from two consecutive surveys. We match individual observations from two consecutive surveys by household ID, their "line" within the household (which is an intra-household identifier), state of residence, race, sex and year of birth. These are supplemented with a few more identifiers generated by the CPS (segment number, serial number and a random cluster code). We make sure that there are only two observations within each cell defined by these identifiers and drop all other cells.

Some survey years cannot be matched. Survey year 1968 cannot be matched backwards, because our sample starts with that survey year. Likewise, survey year 2006 cannot be matched forward, because our sample ends with that survey year. Other survey years that cannot be matched for technical reasons are 1971, 1972, 1976, 1985, 1995 and 2001. Approximately 93% of all observations are actually matched from within survey years that can be matched.

Definition of unemployment

Here we give the exact definition of our unemployment indicator. A person would get a positive indication of unemployment if:

1. did not work last year and reported: could not find work, looking for work or on layoff.
2. in survey years 1968-1993 major activity in the week before the survey was looking for work.
3. in survey years 1968-1993 did not work last week due to being laid-off.
4. in survey years 1994-2006 reported being on layoff or looking for work.
5. in survey years 1968-1988 reported reason for working part year was looking for work or being unemployed.
6. reported positive number of weeks looking for work last year.
7. reported positive number of weeks being unemployed last year.

Since the sample for our transition regressions includes only people that were not unemployed in the first year they were surveyed, this eventually reduces our sample.

B Unemployment risk calibration

Based on the evidence presented so far, we can propose a first interpretation of the data. Regarding the level of compensation, a constant compensating differential appears to be required, since even in the more recent years, the unemployment risk in the finance industry is not higher than in the rest of the economy. It has merely converged to the same level. The increase in the relative unemployment risk in the financial sector can however account for some of the increase in relative wages. Ruhm (1991) finds that layoffs lead to temporary unemployment and long lasting decreases in earnings: "Displaced workers were out of work eight weeks more than their observably similar counterparts in the year of the separation, four additional weeks in period $t+1$, and two extra weeks at $t+2$. By year $t+3$ they were jobless only 1.5 weeks more than the peer group, and the $t+4$ increase was just six days." By contrast, "almost none of the $t+1$ wage reduction dissipated with time. The earnings gap remained at 13.8 percent and 13.7 percent, respectively, in years $t+3$ and $t+4$."

A complete study of the effects of unemployment risk on the level of compensation that is needed to keep workers indifferent between different jobs is clearly beyond the scope of this paper. Nonetheless, we think it is useful to provide some simple benchmark calculations. We do so in the simplest framework possible and we assume that labor income is the only source of risk and that the utility function has constant relative risk aversion. We set the personal discount rate and the market rate both equal to 3% per year. We assume that workers live and work for 40 years, and that the labor income process, y_t, is given by

$$y_{t+1} = \left\{ \begin{array}{c} 1.02\ y_t \text{ with probability } 1-p \\ 0.9\ y_t \text{ with probability } p \end{array} \right\}, \text{ and } y_1 \text{ given.}$$

The increase of 2% captures the normal increase in real labor income. The drop by 10% captures the income loss from displacement documented by Ruhm (1991). This process implies that shocks are permanent, which makes the effect of unemployment risk more important, so we are likely to obtain an upper bound for the impact on the relative wages.

We perform the following experiment. First, we set $p = 4.41\%$ and $y_1 = 1$, we solve and simulate the model with a coefficient of relative risk aversion equals to 2. We then increase the unemployment risk to $p = 6.91\%$. This increase of 2.5 points corresponds to the increase in relative unemployment risk that we have documented earlier. In order to keep workers indifferent, the new starting wage should be $y_1 = 1.063$, an increase of 6%. If we lower the calibrated risk aversion to 1, the required increase in wages is 6%. If we increase risk aversion to 3, the required increase in wages is 6.6%.

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Table 1: Decomposition of Increase in Relative Wage of Finance by Industry: 1933-2005, Industry Accounts

	Wages (within)			Employment (between)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Relative Wage	Average Employment Share	Within (=1*2)	Change in Employment Share	Average Relative Wage	Between (=4*5)
A. 1933-1960						
Credit Intermediation	-0.571	0.402	-0.230	0.031	1.411	0.043
Other Finance	-0.933	0.118	-0.110	-0.039	1.339	-0.053
Insurance	-0.488	0.480	-0.234	0.009	1.333	0.011
			-0.574			0.002
				-0.571		
B. 1960-1980						
Credit Intermediation	-0.149	0.452	-0.068	0.070	1.050	0.073
Other Finance	0.259	0.100	0.026	0.003	1.002	0.003
Insurance	-0.005	0.448	-0.002	-0.073	1.087	-0.079
			-0.044			-0.003
				-0.047		
C. 1980-2005						
Credit Intermediation	0.308	0.481	0.148	-0.012	1.130	-0.014
Other Finance	2.494	0.125	0.313	0.048	2.379	0.114
Insurance	0.333	0.394	0.131	-0.036	1.251	-0.045
			0.592			0.056
				0.648		

Notes: The relative wage in finance versus the private sector decreased by 0.57 from 1.65 in 1933 to 1.08 in 1960, it further decreased by 0.05 to 1.03 in 1980, and then increased by 0.65 to 1.68 in 2005. Panels A, B and C decompose the increase by finance subsectors in 1933-1960, 1960-1980 and 1980-2005, respectively. Columns (1)-(3) report the contribution of changes in relative wages within categories, while holding the composition fixed at the average for the period. Columns (4)-(6) report the contribution of reallocation of employment between categories in finance, while holding relative wages fixed at the average for the period. Together, columns (3) and (6) must sum up to the total change, acording to the decomposition equation in the text. The highlighted numbers denote the most important factros that contributed to the increase in the relative wage. Source: Annual Industry Accounts of the United States.

Table 2: Decomposition of Increase in Relative Wage of Finance: 1980-2005, CPS

	Wages (within)			Employment (between)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Relative Wage	Average Employment Share	Within (=1*2)	Change in Employment Share	Average Relative Wage	Between (=4*5)
A. Industries						
Credit Intermediation	0.412	0.492	0.203	-0.024	1.090	-0.027
Other Finance	0.383	0.130	0.050	0.107	2.271	0.242
Insurance	0.160	0.378	<u>0.060</u>	-0.082	1.195	<u>-0.098</u>
			0.313			0.117
				0.430		
B. Education						
<12 Years	0.068	0.021	0.001	-0.019	0.626	-0.012
High School	0.067	0.315	0.021	-0.219	0.787	-0.172
13-15 Years	0.060	0.295	0.018	0.017	0.972	0.016
College Graduate	0.208	0.280	0.058	0.155	1.772	0.274
More than College	0.607	0.088	<u>0.054</u>	0.066	2.593	<u>0.172</u>
			0.152			0.278
				0.430		
C. Occupations						
Other	-0.043	0.026	-0.001	0.002	0.919	0.002
Managers and Professionals	0.229	0.371	0.085	0.181	1.687	0.305
Math and Computer	0.402	0.032	0.013	0.039	1.477	0.058
Insurance Specialists	0.067	0.087	0.006	-0.062	1.390	-0.086
Brokers and Traders	-0.167	0.066	-0.011	0.067	2.670	0.180
Bank Tellers	0.002	0.076	0.000	-0.053	0.521	-0.028
Administrative	0.100	0.341	<u>0.034</u>	-0.174	0.725	<u>-0.126</u>
			0.126			0.304
				0.430		

Notes: In the CPS data the relative wage in finance versus the private sector increased by 0.43 from 1.07 in 1980 to 1.503 in 2005. Panel A decomposes the increase by occupations, Panel B decomposes the increase by industries and Panel C decomposes by education categories. Columns (1)-(3) report the contribution of changes in relative wages within categories, while holding the composition fixed at the average for the period. Columns (4)-(6) report the contribution of reallocation of employment between categories in finance, while holding relative wages fixed at the average for the period. Together, columns (3) and (6) must sum up to the total change, acording to the decomposition equation in the text. The highlighted numbers denote the most important factros that contributed to the increase in the relative wage.

Table 3: Education and Wages in Historical Perspective

	(1)	(2)	(3)	(4)	(5)	(6)
		Relative Education			Relative Wage	
Deregulation Index (t-5)	0.0215***	0.0194***	0.0177***	0.183***	0.174***	0.113***
	(0.00174)	(0.00228)	(0.00235)	(0.0140)	(0.0152)	(0.0189)
Financial Patents over Total Patents (t-5)		4.713**	4.204*		21.02	19.30
		(2.119)	(2.370)		(17.11)	(17.75)
IPO share of market capitalization (t-5)			0.00235			0.0896***
			(0.00168)			(0.0183)
Default rate (all american corporates) (t-5)			0.00168			0.0327**
			(0.00128)			(0.0154)
Time trend	0.000303***	-0.000177	-0.000180	0.00109	-0.00100	-0.00309
	(0.000073)	(0.000243)	(0.000268)	(0.000879)	(0.00182)	(0.00193)
Sample	1910-2005	1910-2005	1910-2005	1909-2006	1909-2006	1909-2006
Observations	96	96	96	98	98	98
R-squared	0.893	0.906	0.914	0.832	0.835	0.914

Notes. Newey-West Standard errors with 10 lags of autocorrelation in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Education and Wages in a Panel of Financial Sub-sectors

	(1)	(2)
VARIABLES	Relative Education	Relative Wage
Deregulation Index (t-5)	0.0206***	0.267***
	(0.00280)	(0.0991)
Share of IT in Capital Stock of Subsector (t-5)	0.252***	1.522
	(0.0388)	(1.374)
Subsector fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Sample	1951-2005	1951-2006
Observations	165	168
R-squared	0.792	0.476
Number of sectors	3	3

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Financial subsectors: Credit Intermediation, Insurance and Other Finance.

Table 5: The Finance Premium

Dependent Variable: Log of Hourly Wages	(1)	(2)
Finance Indicator	0.044***	
	(0.003)	
Finance and <12 Years		-0.001
		(0.022)
Finance and High School		0.033***
		(0.006)
Finance and 13-15 Years		0.034***
		(0.006)
Finance and College Graduate		0.058***
		(0.006)
Finance and More than College		0.083***
		(0.011)
Individual fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	793512	793512
R-squared	0.996	0.996

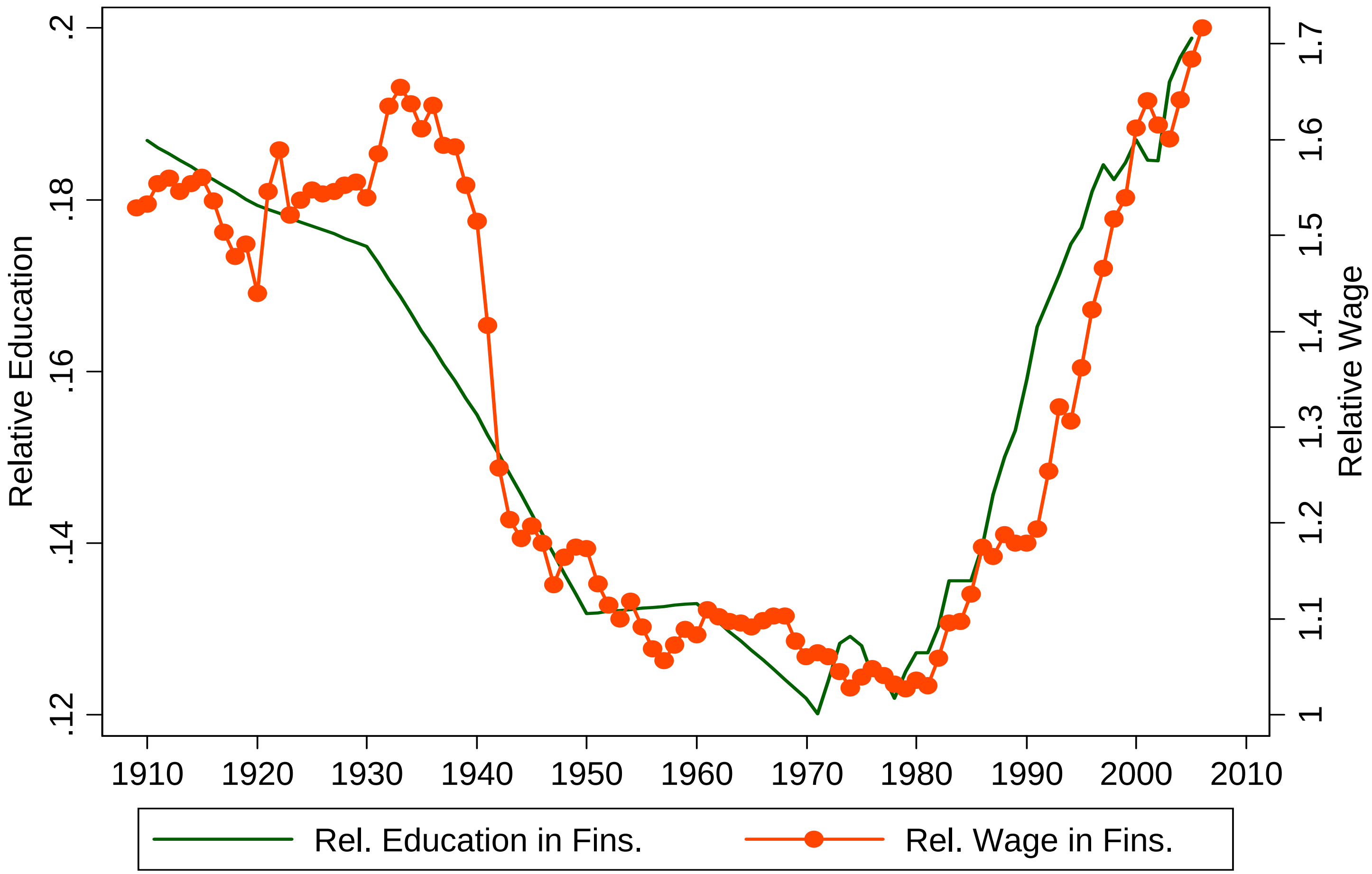
Notes: Standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All regressions include a constant, indicators for urban dwellings and marital status, experience and its square. Other demographics, like sex, race and education are not included because they do not vary over time for individuals in this sample. Data: Matched CPS.

Table 6: The Finance Premium Over Time

	Depenedent Variable: Log of Hourly Wages							
	1967-1970	71-75	76-80	81-85	86-90	91-95	96-00	2001-2005
Finance Indicator	-0.022	0.023	0.026	-0.029	0.080***	0.057***	0.038***	0.065***
	(0.019)	(0.028)	(0.018)	(0.020)	(0.014)	(0.018)	(0.014)	(0.013)
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	58134	43037	111846	100212	125733	89087	119618	145845
R-squared	0.918	0.913	0.929	0.939	0.929	0.930	0.893	0.875

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant, indicators for urban dwellings and marital status, experience and its square. We cannot include indicators for other demographics, like education, sex and race because they do not vary over time for individuals in this sample. Data: Matched CPS.

Figure 1: Relative Wage and Education in the Financial Industry

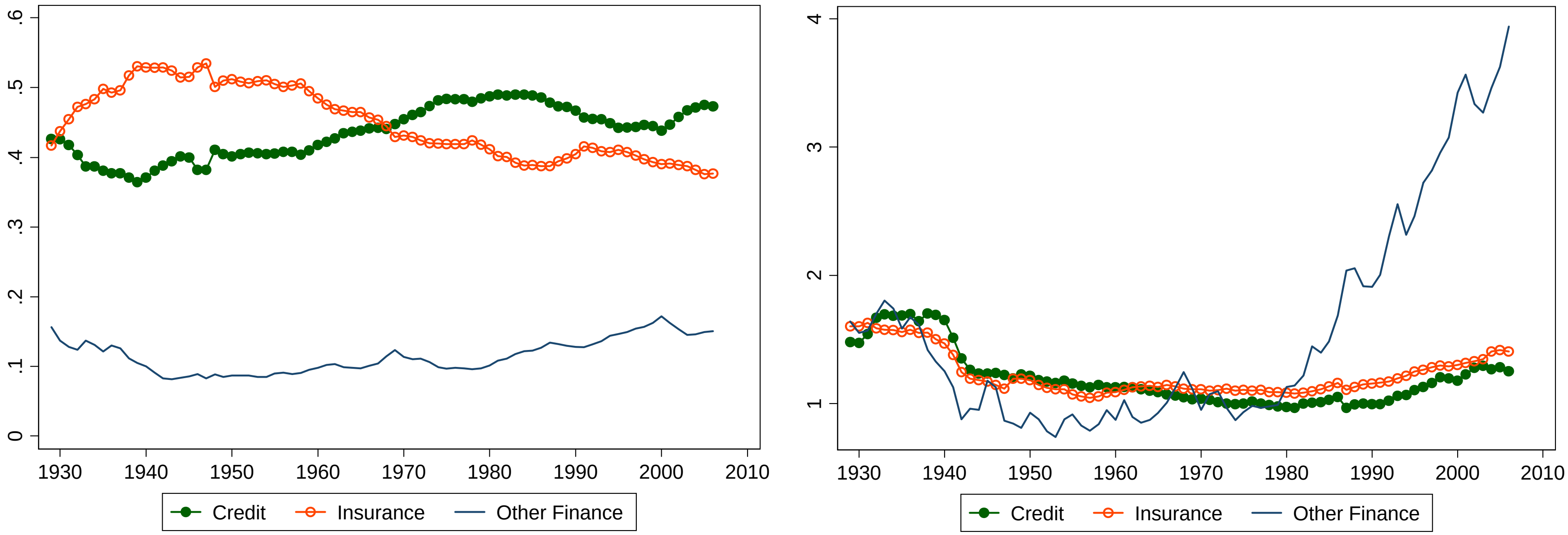


Notes: Fins. includes finance and insurance. Our concept of education is the share of employees with (strictly) more than high school education. Education (1910-2005) is computed from U.S. Census data, and from the Current Population Survey. Relative education is the difference in educated shares between Finance (Fins.) and the Non Farm Private sector. Wages (1909-2006) are computed from the Industry Accounts of the U.S., Kuznets (1941) and Martin (1939). The relative wage is the ratio of wages in Finanace (Fins.) to Non Farm Private wages.

Figure 2: Employment Shares and Relative Wages of Financial Subsectors (1929-2006)

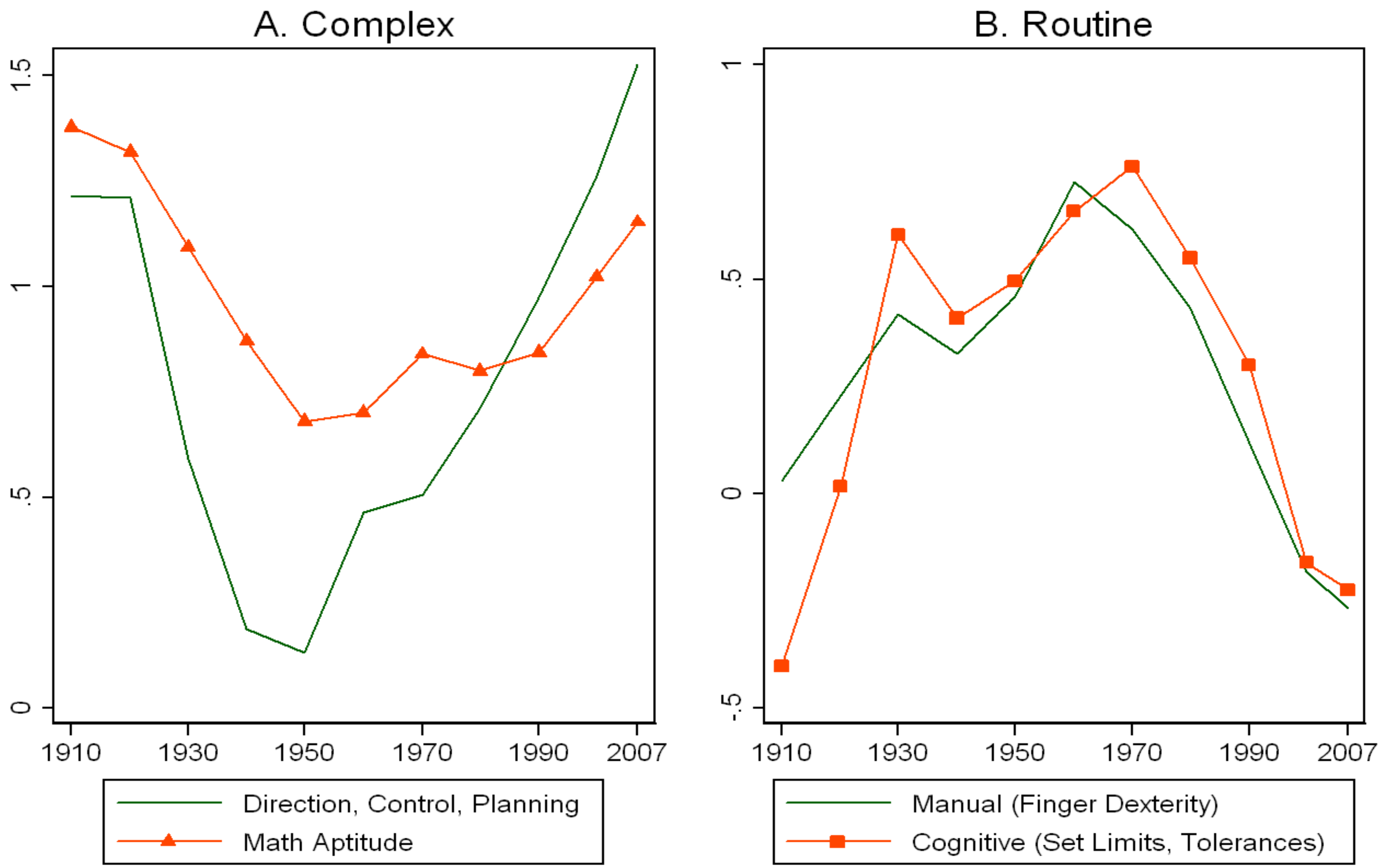
A. Full Time Equivalent Shares within Finance and Insurance

B. Wages Relative to Non Farm Private Sector



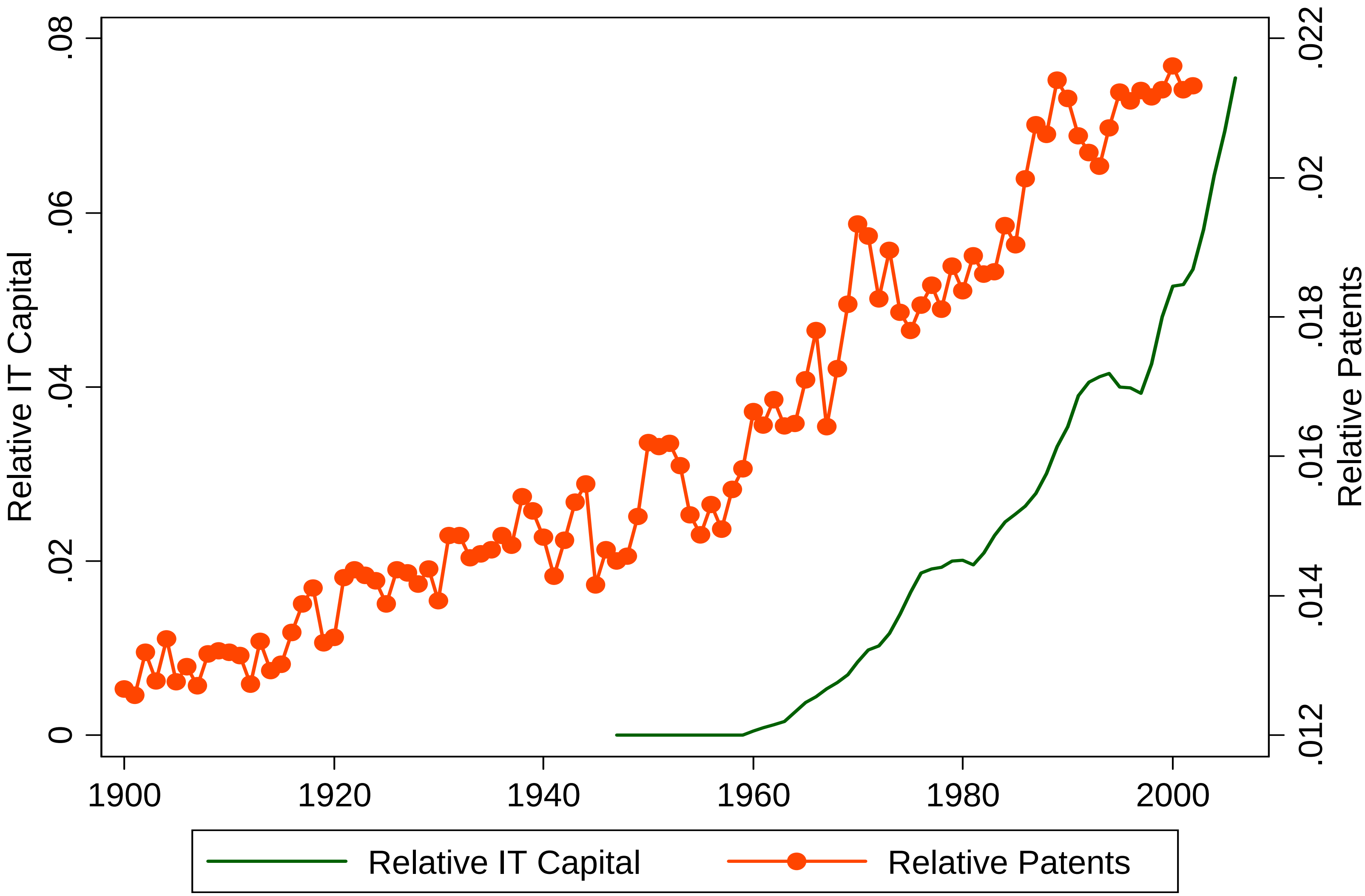
Notes: Ratio of average wage per full time equivalent in the sector to average wage in the non farm private sector. Source: Author's Calculations and Annual Industry Accounts of the United States.

Figure 3: Relative Job Complexity in the Financial Sector



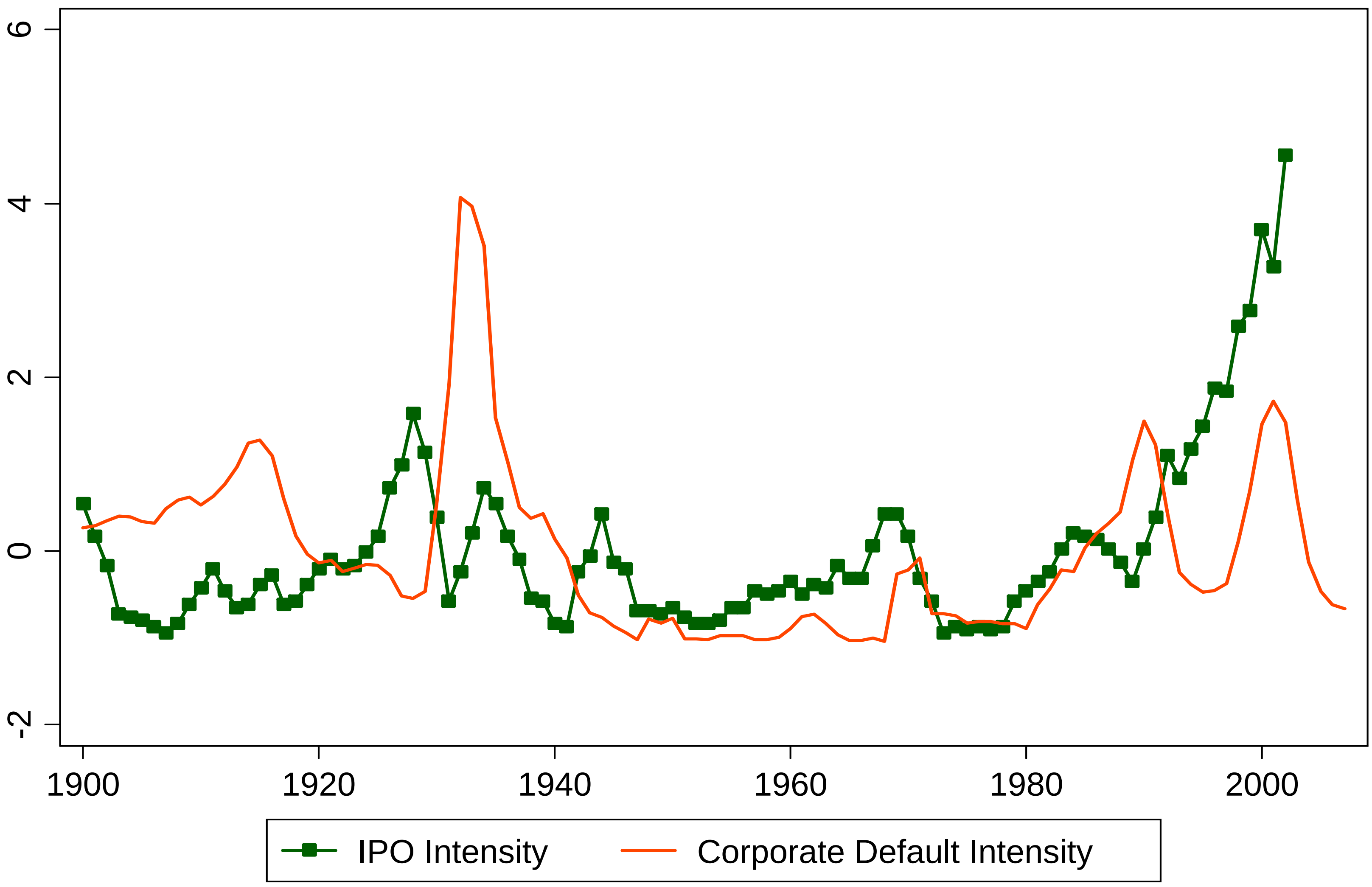
Notes: Relative task indices for finance versus the nonfarm private sector. Data: Dictionary of Occupational Titles, U.S. Censuses 1910-2000 and 2008 March CPS.

Figure 4: IT Capital and Financial Patents



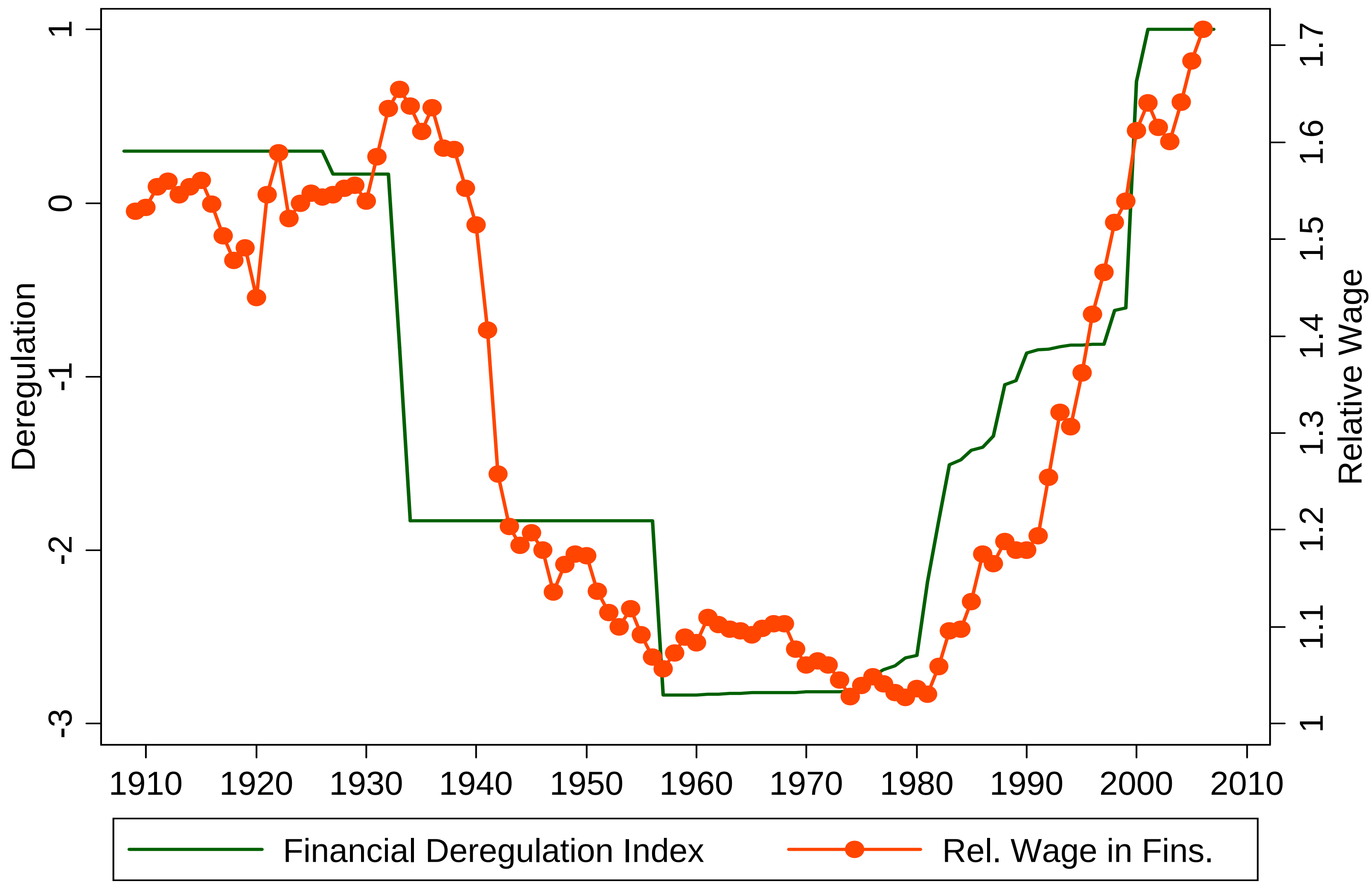
Notes: Relative IT intensity is the IT share of capital in finance minus the IT share of capital in the economy. Relative patents is the ratio of financial patents to all patents.

Figure 5: Non Financial Corporate Activities



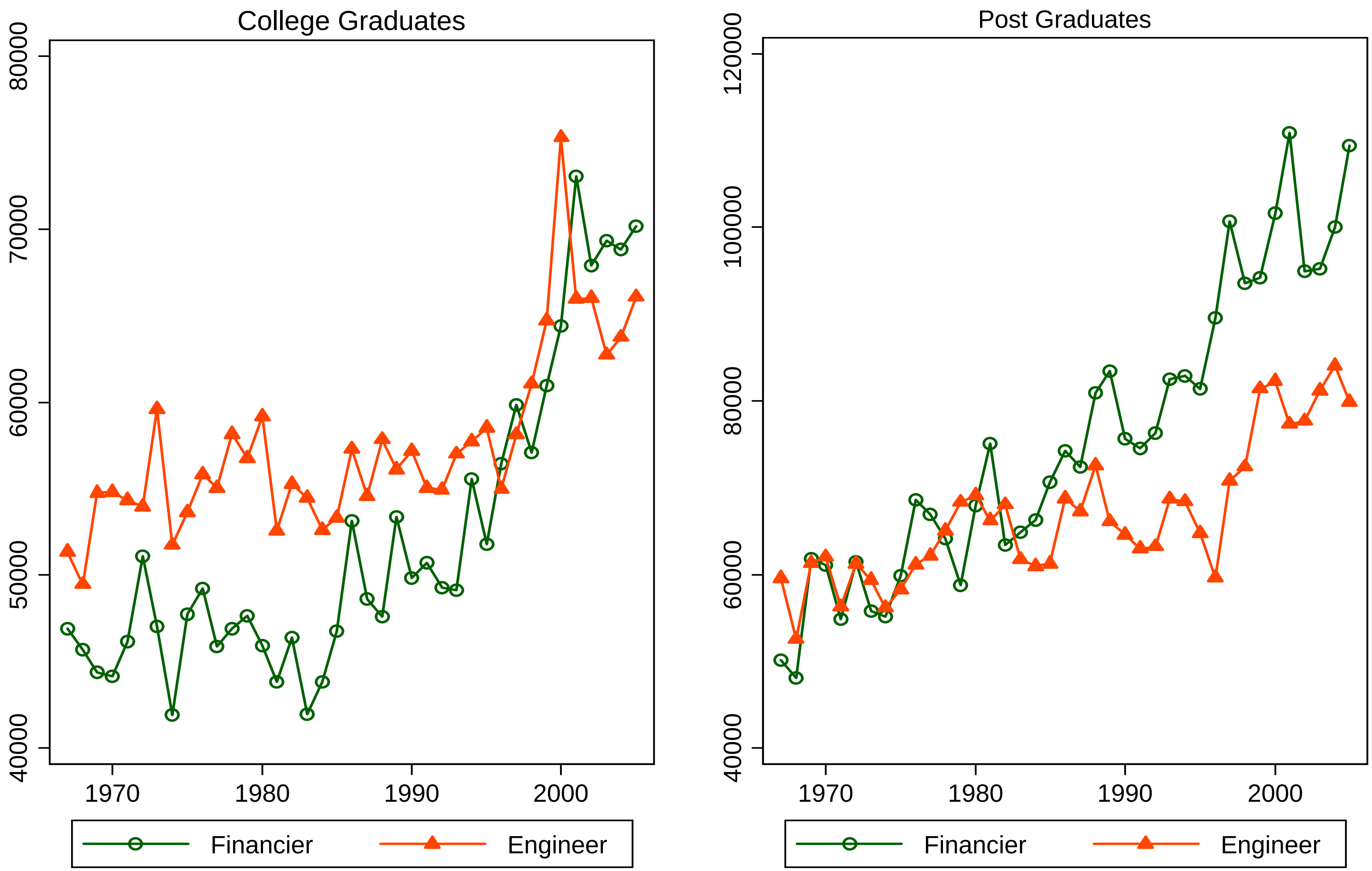
Notes: IPO is IPO value over Market Capitalization. Defaults is the 3-year moving average default rate on all corporations. Both series are normalized (mean 0, std dev 1) over the sample. Data from Jovanovic and Rousseau (2005).

Figure 6: Relative Financial Wage and Financial Deregulation



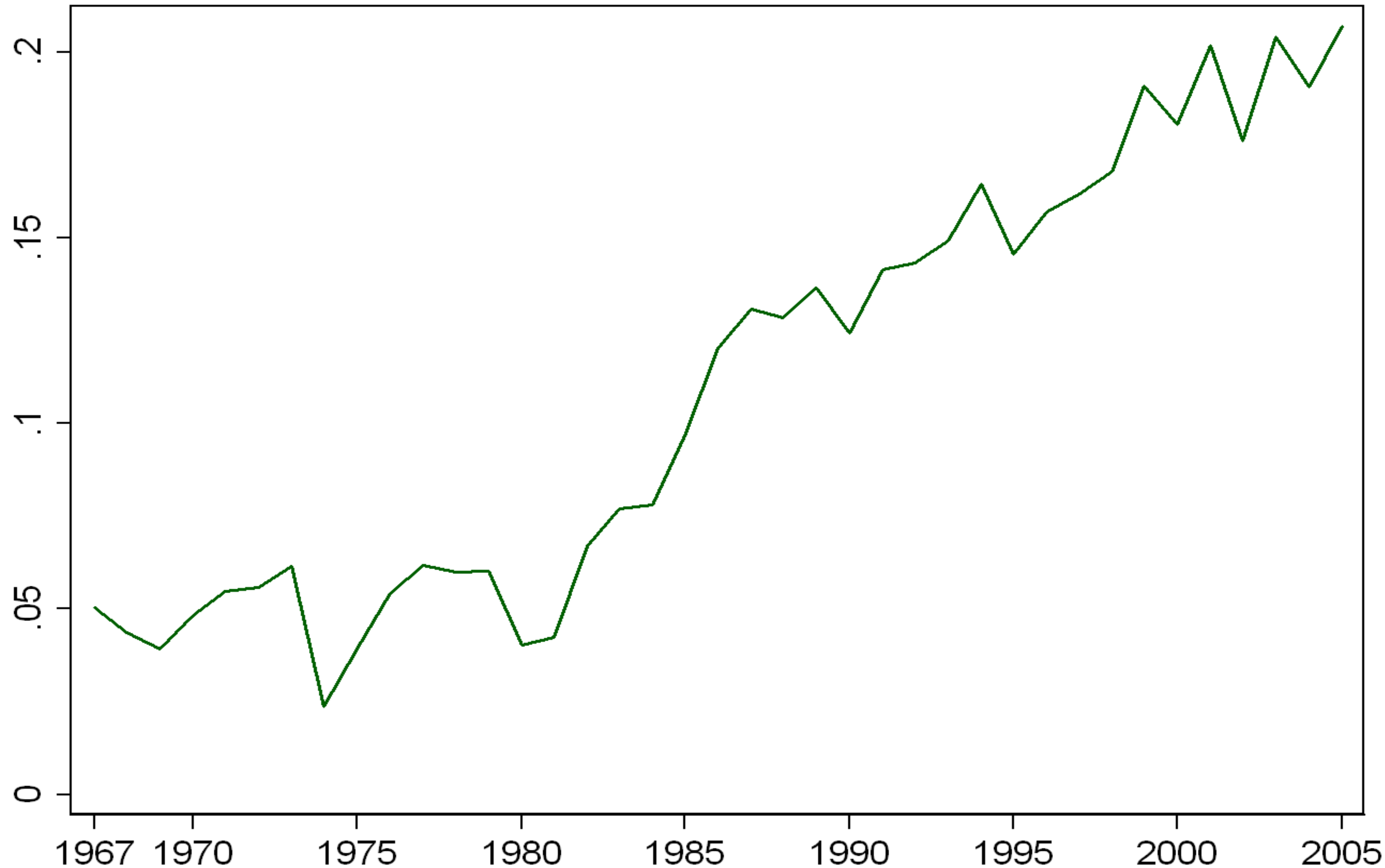
Notes: Wages are computed from the Industry Accounts of the U.S., from Kuznets (1941), and from Martin (1939). The relative wage is the ratio of Fins to Non Farm Private wages. See the text for the definition of the deregulation index.

Figure 7: Annual Income of Engineers and Financiers



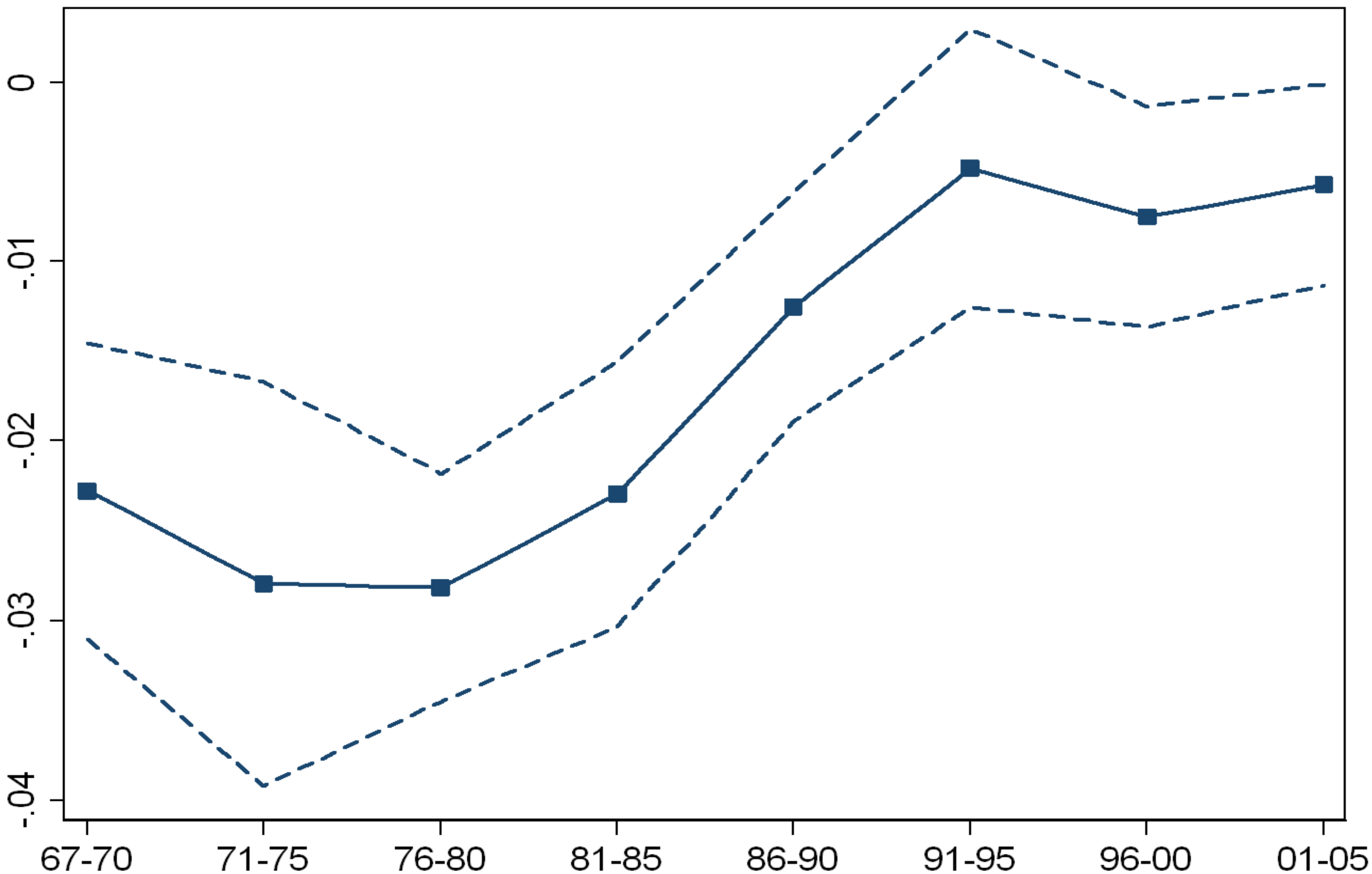
Notes: All wages are in 2000 U.S. dollars and are weighted using sampling weights. Data: March CPS.

Figure 8: Residual Wage in the Financial Sector, 1967-2005



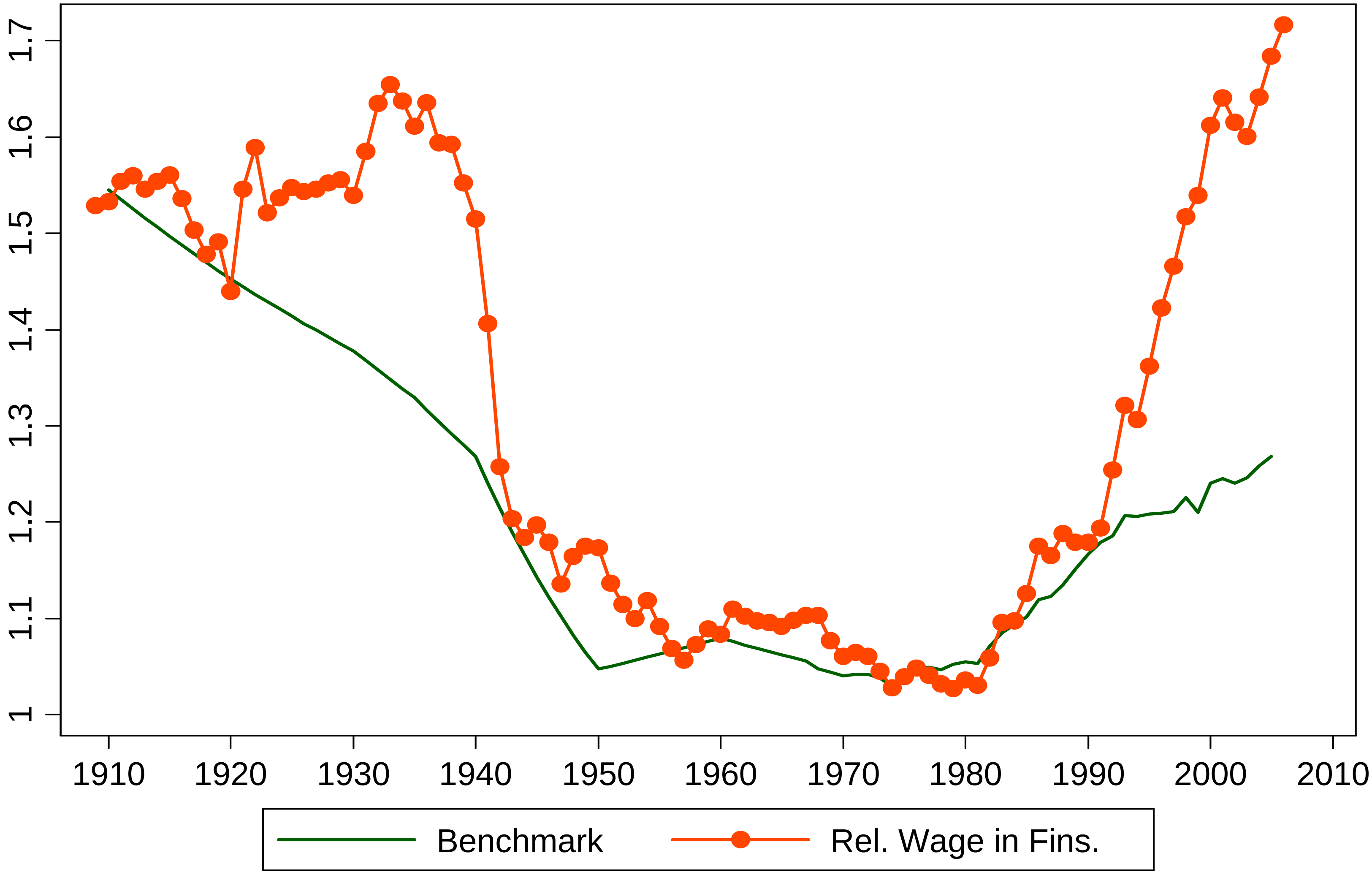
Notes: Coefficient of Finance dummy from fitting regressions of log hourly wages to individual characteristics that include race, sex, marital status, urban residence, potential experience and its square, as well as education controls. Data: March CPS.

Figure 9: Unemployment Risk in Financial Sector Relative to the Private Sector



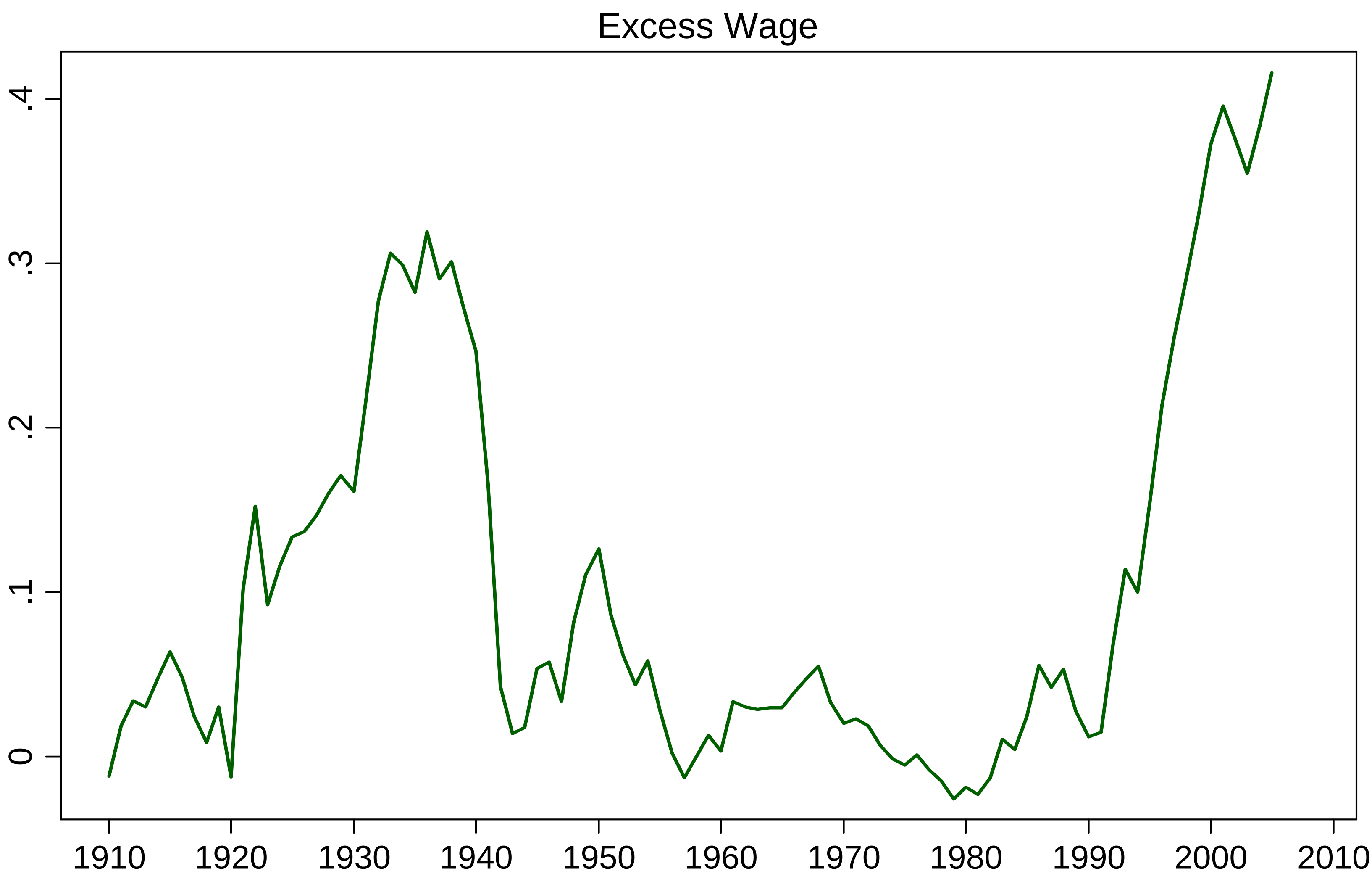
Notes: Coefficients and 95% confidence intervals of Finance dummy in logit regression of transition from Employment to Unemployment. Controls include current log hourly wage, race, sex, marital status, urban residence, potential experience and its square and education controls. Data: March CPS.

Figure 10: Actual and Benchmark Relative Wages in the Financial Industry



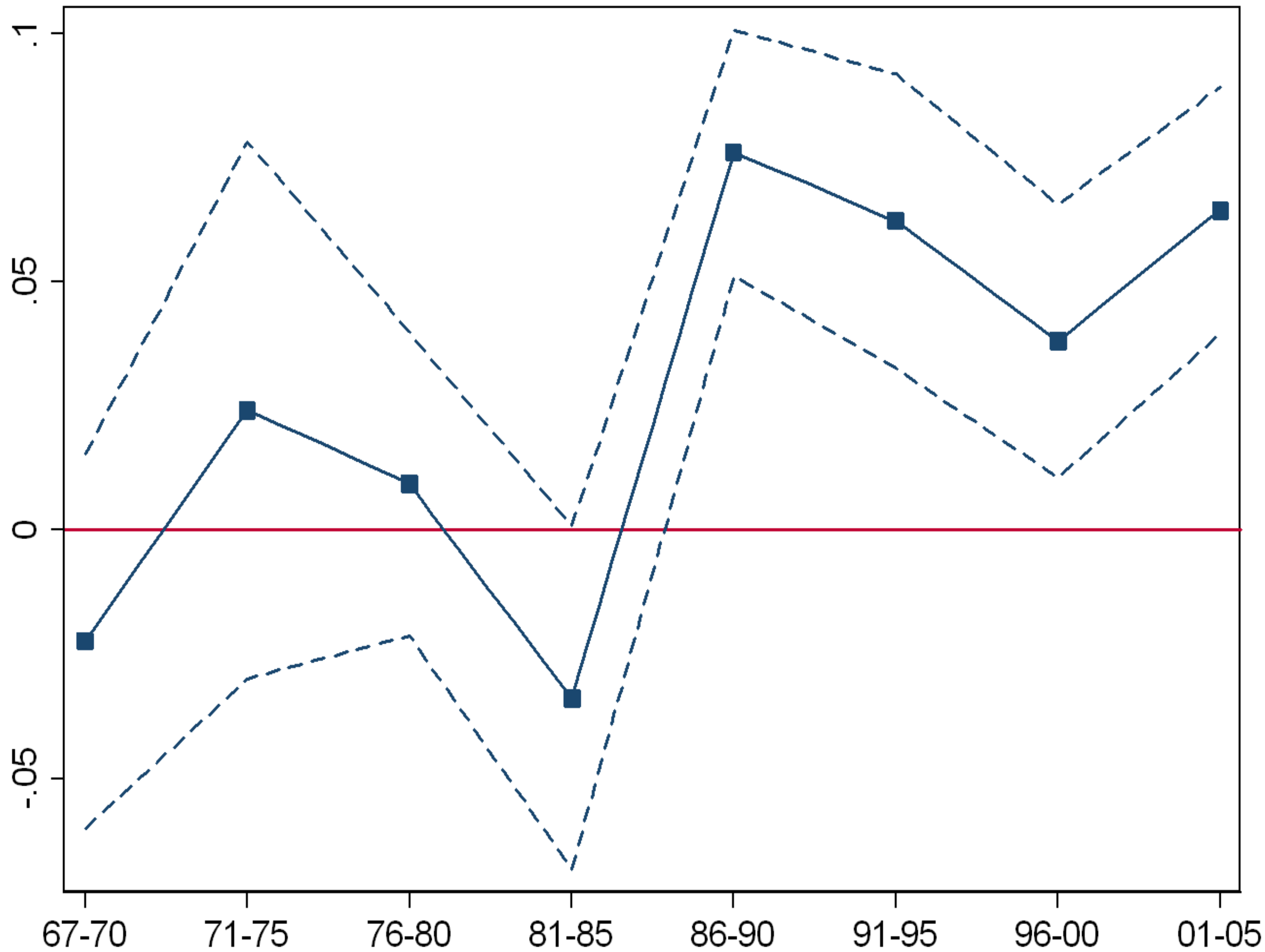
Notes: Relative wage in Finance (Fins.) is the same as in Figure 1. See text for the calculation of the Benchmark wage.

Figure 11: Historical Excess Wage in the Financial Sector



Notes: The difference between the relative wage in finance and the Benchmark wage from Figure 11.

Figure 12: Excess Wage, Fixed Effects Estimate



Notes: Coefficients and 95% confidence intervals of Finance dummy from regression controlling for individual fixed effects. See text for estimation details. Data: Matched CPS.