Capital Account Opening and Wage Inequality

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Opening the capital account allows financially constrained firms to raise capital from abroad. Since capital and skilled labor are relative complements, this increases the relative demand for skilled labor versus unskilled labor, leading to higher wage inequality. Using aggregate data and exploiting variation in the timing of capital account openings across 20 mainly European countries, I find that opening the capital account increases aggregate wage inequality. In order to identify the mechanism, I use sectoral data and exploit variation in external financial dependence and capital-skill complementarity across industries. I find that capital account opening increases sectoral wage inequality, particularly in industries with both high financial needs and strong complementarity. (*JEL* F32, J31)

In the last four decades, many developed and developing countries have opened their capital accounts, lifting legal restrictions imposed on international capital transactions. Although there is a growing consensus that capital account liberalization leads to higher economic growth (Quinn and Toyoda 2008), it is still unclear whether liberalization benefits the whole population equally, or whether it disproportionately benefits the rich or the poor. This paper attempts to fill this gap by analyzing the effect of capital opening on the relative wage between skilled and unskilled workers.

Opening the capital account allows financially constrained firms to raise funds from abroad to finance fixed-capital expenditures. The new capital, in particular machinery and equipment, embodies new technology that is more complementary with skilled workers than with unskilled workers (Krusell et al. 2000). I argue that, as a result, capital opening increases the relative demand

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for skilled workers, leading to higher wage inequality. Using data for 20 mainly European economies from 1975 through 2005, I provide evidence that capital opening increases the relative wage between workers with college education and those with high school education.

This paper makes two contributions. First, it provides the first piece of evidence on the effects of capital account policy on wage inequality. From a policy perspective, it is important to understand both the efficiency and the distributional consequences of opening the capital account. Second, wage inequality has increased in several countries in recent decades (Katz and Autor 1999). The most common explanation is technological change biased toward skilled labor (Katz and Murphy 1992). This paper argues that capital account opening is a specific policy leading to skill-biased technological change. Therefore, this paper highlights the role of capital opening in contributing to rising inequality.

I follow a twofold empirical strategy. First, I use aggregate data and exploit the variation in the timing of capital account openings across countries and conduct a generalized difference-in-differences test. I calculate the pre-post change in wage inequality of a country opening its capital account and compare it to the same change in countries not implementing capital account adjustments during that period. I find evidence that capital account opening increases aggregate wage inequality by 5%.[1] Put differently, capital opening explains 18% of the variation in aggregate inequality after controlling for country and year fixed effects, which is a sizable fraction. I trace the year-by-year effect of capital opening on wage inequality and find that the effect on inequality is permanent.

To identify the mechanism driving this effect, the second part of the empirical strategy uses more disaggregated sector-level data. According to the capital-skill complementarity channel, capital account opening allows financially constrained firms to raise capital, which, in turn, increases the relative demand for skilled labor. I take advantage of the fact that both effects vary across industries. Firms producing in industries more dependent on external finance should raise more capital. Likewise, firms producing in industries with stronger complementarity between capital and skills should demand labor that is more skilled. If labor mobility across sectors is limited, then opening the capital account should increase wage inequality, particularly in industries with *both* high financial needs and strong complementarity.[2]

I rank industries with respect to external financial dependence and capital-skill complementarity. I use the Rajan and Zingales (1998) financial dependence

[1] As explained below, I define *capital account opening* as a one-standard-deviation increase in the Chinn and Ito (2006) capital account openness index.

[2] If workers accumulate sector-specific human capital, labor will not be fully mobile across industries and wages will not be equalized across sectors. See Helwege (1992) for evidence on the relationship between worker immobility and inter-industry wage differentials.

index to identify an industry's need for external finance. *Financial dependence* is the fraction of capital expenditures not financed with internal cash flows. To obtain a measure of capital-skill complementarity, I estimate a skilled-labor-share equation for each industry. I define *complementarity* as the elasticity of the share of wages of college-educated workers with respect to capital intensity. I conduct a generalized difference-in-differences test, in which I exploit the within-country cross-sectoral variation in industry characteristics.

I start by exploiting the variation in financial dependence across sectors and analyze the effect on the capital stock per unit of skilled labor. I calculate the pre-post change in the capital stock in industries with high external dependence in a country opening its capital account and compare it to the same change in industries with low dependence within the same country. I find that capital account opening increases the capital stock in industries that are highly dependent on external finance (seventy-fifth percentile in the index) by 10% more than in industries with low dependence (twenty-fifth percentile). This means that capital opening explains 37% of the variation of the sectoral capital stock after controlling for country, industry, and year fixed effects.

Next, I exploit the cross-sectoral variation in both financial dependence and capital-skill complementarity and analyze the effect on sectoral wage inequality. Within above-median dependence industries, capital opening increases wage inequality in industries with strong complementarity (seventy-fifth percentile in the index) by 3% more than in industries with weak complementarity (twenty-fifth percentile). In other words, capital opening explains 21% of the variation in sectoral inequality after controlling for fixed effects, which is a sizable fraction. Within below-median dependence industries, the effect is the same across sectors with different degrees of complementarity. I also pool all industries and find that capital opening increases wage inequality in industries with high financial dependence and strong complementarity by roughly 2% more than in industries with low dependence and weak complementarity.

Finally, I undertake a series of additional robustness tests. First, I show that capital account opening increases skilled wages at the expense of unskilled wages. Second, I find that the effect of capital opening on relative wages is stable over time. Third, I conduct an instrumental variables estimation to provide evidence against a reverse causality story. Fourth, I show that the results are not driven by trade or financial sector liberalization. Fifth, I show that my results are robust to alternative capital openness measures and capital-skill complementarity measures.

This paper contributes to a growing literature analyzing the real effects of capital account liberalization.[3] Whereas the literature usually focuses on emerging markets, I work with a sample of more-developed countries

[3] There is a group of papers that uses cross-sectional data to analyze the relationship between the level of capital account openness and economic growth across countries (Edwards 2001; Klein and Olivei 2008). Another group

primarily from Europe, because of the lack of sectoral wage inequality data for emerging economies. Nevertheless, the sample includes four peripheral countries (Portugal, Ireland, Greece, and Spain) and five transition countries (Czech Republic, Hungary, Poland, Slovakia, and Slovenia), all of which are relatively capital-scarce economies. I use a time-varying index of capital account openness provided by Chinn and Ito (2006). The index exhibits large changes, but it is not a binary measure of liberalization, which makes it harder to disentangle capital account policy changes from other policy changes. My methodology uses large changes in the openness index, which I refer to as *capital account opening*, to identify the effects of changes in capital account policy.

The primary focus of the capital account liberalization literature has been economic growth.[4] There is only one paper that analyzes the distributional consequences of liberalization: Das and Mohapatra (2003). The authors use aggregate data and find a positive effect of stock market liberalization on the share of income held by the top quintile of the income distribution. Other papers have studied the broader link between financial deregulation and income inequality, with mixed results. Beck, Levine, and Levkov (2010) find that bank deregulation in the United States decreases inequality, whereas Jerzmanowski and Nabar (2013) find the opposite result.[5] Unlike all of these papers, my work pins down a specific mechanism by which capital opening affects wage inequality, which provides a better understanding of the link between finance and inequality.

The mechanism relies on the "capital-skill complementarity hypotheses." Griliches (1969) was the first to provide evidence that capital is more substitutable for unskilled workers and more complementary to skilled workers.[6] Krusell et al. (2000) show that capital deepening, with capital-skill complementarity, leads to skilled-biased technological change, and it explains a large part of the variation of wage inequality in the United States. In this paper, I focus on one particular policy that leads to technological change. I argue that capital account opening allows firm to raise capital that embodies superior technology. This can be the result of higher imports of machinery and equipment (Alfaro and Hammel 2007) or foreign direct investment involving

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of papers uses time-series data to analyze whether countries grow faster after a radical change in the degree of capital openness (Henry 2000; Bekaert, Harvey, and Lundblad 2005). My paper belongs more naturally to the second group, because I analyze how a change in the degree of capital openness affects wage inequality.

[4] Chari, Henry, and Sasson (2012) analyze the effect of capital market integration on the level of wages.

[5] My results can differ from Beck, Levine, and Levkov (2010) because we study different reform episodes and/or because we use different methodologies. Different methods must be part of the explanation, because Jerzmanowski and Nabar (2013) study the same episode as Beck, Levine, and Levkov (2010) and find opposite results.

[6] See Duffy, Papageorgiou, and Perez-Sebastian (2004) for recent international evidence on capital-skill complementarity.

technological diffusion (Alfaro et al. 2004). I highlight that capital account openness is a relevant driving force behind inequality.

Finally, the strategy of exploiting cross-sectoral heterogeneity to identify the mechanism comes from Rajan and Zingales (1998). Gupta and Yuan (2009) use cross-country, cross-industry, cross-time data to analyze the relationship between capital account liberalization and growth. They find that stock market liberalization increases growth, particularly in industries heavily dependent on external finance. I also use cross-country, cross-industry, cross-time data. I contribute to this literature by showing that the benefits of capital account liberalization do not affect the entire population equally; they favor skilled workers at the expense of unskilled workers.

1. Analytical Framework

In this section, I present a very simple framework to understand the relationship between capital account opening and wage inequality.

1.1 Capital-skill complementarity

According to Violante (2006), skilled-biased technological change is a shift in production technology that favors skilled over unskilled labor by increasing its relative productivity. There are several mechanisms through which technological change works. I follow Krusell et al. (2000) and assume that the capital stock embodies superior technology. I develop a framework in which technological change biased toward skilled labor reflects a capital stock increase, combined with the different ways capital interacts with skilled and unskilled labor in the production function. According to Krusell et al. (2000), "skill-biased technological change reflects the rapid growth of the stock of equipment, combined with the different ways equipment interacts with different types of labor in the production technology."

Consider an economy in which firms produce with a three-factor production function: $y = f(k, s, u)$, where y denotes output, k capital, s skilled labor, and u unskilled labor. Denote by $\sigma_{i,j}$ the elasticity of substitution between factors i and j. The "capital-skill complementarity hypothesis" states that capital is more complementary to skilled labor than to unskilled labor (i.e., $\sigma_{k,u} > \sigma_{k,s}$).[7] In other words, capital and skilled labor are relative complements while capital and unskilled labor are relative substitutes.

If labor markets are competitive, firms demand labor until the point where the marginal product of labor equals the wage: $\partial f/\partial s = w_s$ and $\partial f/\partial u = w_u$, where w_s denotes the skilled wage and w_u the unskilled wage. I define *wage inequality* as the relative wage between skilled and unskilled workers (i.e., w_s/w_u). The

[7] Technically, the elasticity of substitution between capital and unskilled labor is defined as: $\sigma_{k,u} = \Delta\%(k/u)/\Delta\%(f_u/f_k)$. Likewise, the elasticity of substitution between capital and skilled labor is defined as: $\sigma_{k,s} = \Delta\%(k/s)/\Delta\%(f_s/f_k)$.

capital-skill complementarity hypothesis implies that $\frac{\partial(w_s/w_u)}{\partial k} > 0$. Intuitively, given that capital embodies new technology, an increase in the capital stock increases the relative demand for skilled labor. Because labor is paid its marginal product, this leads to higher wage inequality.

As an example, consider the following standard, two-level constant elasticity of substitution (CES) production function (Krusell et al. 2000):

$$y = \left[u^{\sigma} + (\lambda k^{\rho} + (1-\lambda)s^{\rho})^{\frac{\sigma}{\rho}} \right]^{\frac{1}{\sigma}}, \tag{1}$$

where $\lambda \in (0,1)$ is a parameter that governs income shares and $\sigma, \rho < 1$ are parameters that govern the elasticities of substitution. The elasticity of substitution between capital and unskilled labor is $\frac{1}{1-\sigma}$, and the elasticity of substitution between capital and skilled labor is $\frac{1}{1-\rho}$. Capital-skill complementarity requires that $\sigma > \rho$. With this specification, I can log-linearize the ratio between the skilled and unskilled wage and obtain the following expression for wage inequality:

$$\log\left(\frac{w_s}{w_u}\right) \simeq \left(\frac{\sigma-\rho}{\rho}\right)\left(\frac{k}{s}\right)^{\rho} + (1-\sigma)\log\left(\frac{u}{s}\right). \tag{2}$$

From Equation (2), I can calculate the effect of an increase in capital on wage inequality as follows:

$$\frac{\partial \log(w_s/w_u)}{\partial(k/s)} = (\sigma-\rho)\frac{k^{\rho-1}}{s^{\rho}}. \tag{3}$$

Equation (3) makes it clear that the response of wage inequality to a capital stock increase depends crucially on whether capital is more complementary to skilled labor or to unskilled labor. Under capital-skill complementarity, capital is more complementary with skilled labor than with unskilled labor, which implies that $(\sigma-\rho) > 0$. Thus, an increase in the capital stock per unit of skilled labor increases the relative demand for skilled labor, leading to higher wage inequality.[8]

1.2 Capital account opening and wage inequality

In the economy, there are legal restrictions imposed on international capital transactions. Let θ denote the parameter that summarizes the degree of international capital mobility. Capital account opening is a policy that increases θ. This policy allows financially constrained firms to raise capital abroad, which embodies superior technology and requires skilled labor. I model capital account opening through the function $k = k(\theta)$, where $\partial k/\partial\theta > 0$. I also assume that both types of labor are supplied inelastically. This simple framework delivers a series of testable implications.

[8] In the empirical analysis, I use the capital stock per unit of skilled labor as the relevant measure of capital.

Prediction 1. *Capital account opening increases wage inequality.*

Intuitively, the policy leads to capital accumulation. Because capital and skilled labor are relative complements, this increases the relative demand for skilled labor. In equilibrium, this increases the relative wage between skilled and unskilled workers. I can decompose the effect of capital opening on wage inequality into a "capital effect" and a "complementarity effect":

$$\frac{\partial(w_s/w_u)}{\partial\theta} = \underbrace{\frac{\partial(w_s/w_u)}{\partial k}}_{\text{Complementarity-effect}} * \underbrace{\frac{\partial k}{\partial\theta}}_{\text{Capital-effect}} .$$

The capital effect measures capital deepening, whereas the complementarity effect measures the extent to which capital deepening increases the relative demand for skilled labor. For a given complementarity effect, the effect on wage inequality is increasing in the capital effect. Likewise, for a given capital effect, the effect on inequality is increasing in the complementarity effect. In fact, if the capital effect is absent, there will be no complementarity effect. Within an economy, the strength of both effects varies across firms and industries.

Prediction 2. *Capital account opening increases the capital stock more in industries with high external financial dependence.*

For technological reasons, firms in some industries require more external finance to produce output. For example, firms in some industries face higher fixed costs, and thus operate at larger scales of production, than in other industries. It follows that firms in these industries depend more on external financing and will be more financially constrained. Because capital opening allows firms to raise capital abroad, firms in industries with high external financial needs will benefit the most. Therefore, the "capital effect" will be stronger in industries with higher needs for external finance.

Prediction 3. *Capital account opening increases wage inequality more in industries with high external financial dependence and with strong capital-skill complementarity.*

Again for technological reasons, the production functions in some industries exhibit stronger complementarity between capital and skills than in other industries. For example, in some industries workers carry out a limited set of activities, which can be accomplished by following explicit rules. Because capital can more easily substitute for unskilled labor when unskilled workers conduct routine tasks, the production functions in these industries will exhibit strong capital-skill complementarity. Under specification (1), a higher degree of complementarity corresponds to a larger value of $(\sigma - \rho)$. Thus, the relative demand for skilled labor responds strongly to an increase in the capital stock.

Therefore, for a given "capital effect," the "complementarity effect" will be stronger in industries with stronger complementarity between capital and skills.

If labor is fully mobile across industries, then skilled labor will flow toward the industry with stronger complementarity until the relative wage is equalized across sectors. However, although all workers have the opportunity to switch sectors, not all do so, and wages do not equilibrate across sectors. Workers with sufficiently accumulated sector-specific human capital will not find the higher relative wage attractive enough to switch.[9] Thus, capital account opening will increase wage inequality particularly in industries in which the "capital effect" and the "complementarity effect" are strong. In the long run, new generations of workers enter the labor force and relative wages are equalized across sectors.

2. Empirical Strategy

To estimate the effect of capital account opening on wage inequality, I follow a two-fold empirical strategy. First, I use aggregate data and exploit the variation in the timing of capital account openings across countries. Second, to identify the transmission mechanism, I use sectoral data and exploit the variation in external financial dependence and capital-skill complementarity across sectors.

2.1 Aggregate analysis

For the aggregate analysis, I exploit the cross-country, cross-time variation in the timing of capital account openings. This allows me to identify the effect in a difference-in-differences setup. To understand the intuition, consider a country opening its capital account ("treatment group"). I can compute the pre-post change in wage inequality around that date. However, this estimate could be affected by other global shocks taking place at the same time, so the simple difference would not capture the causal effect of the policy. In order to address this issue, I need a control group of countries that are exposed to similar shocks.

Given that my sample includes countries opening at different moments of time, I conduct a difference-in-differences test in a multiple-treatment-groups and multiple-time-periods setting. The estimation procedure considers that the opening events are *staggered* over time. A similar research design has been used in several studies (e.g., Bertrand and Mullainathan 2003).[10] According to this procedure, the "control group" in a certain year consists of the countries that do not make changes to their capital account in that year. This includes countries that opened before that year, as well as countries that opened afterwards. As long as global shocks are common across countries, the difference between the pre-post change in the treatment group and the pre-post change in the control

[9] Helwege (1992) shows that differences in wages across industries arise from lack of worker mobility, particularly among more-experienced workers.

[10] See Imbens and Wooldridge (2009) for a detailed explanation of the methodology.

group yields an unbiased estimate of the effect. An important implication of the staggered reform setting is that the control group is *not* restricted to countries that have never implemented capital account openings. The specification can be estimated even if all countries eventually open their capital accounts. The identification assumption is that the control countries, independently of whether they have already opened or have not, are exposed to similar global shocks as the treated country around the opening date. I believe this is a plausible assumption given the fairly homogeneous nature of my sample, conformed primarily by European countries.[11]

The empirical specification is estimated in levels, because my aim is to calculate the before-after change in the level of wage inequality of a country opening its capital account, relative to the same change in the control group. The specification includes country fixed effects, which control for time-invariant country characteristics. It also includes year fixed effects, which control for aggregate shocks. The difference-in-differences cancels out any global shocks that are common to the treatment and control groups. However, there might be other factors affecting wage inequality that are specific to the treatment group. I address this issue by controlling for a series of time-varying factors that affect wage inequality. In particular, I control for the same set of variables used in Beck, Demirg-Kunt, and Levine (2007): relative supply of skilled labor, inflation, government expenditure to GDP, GDP per capita, and private credit to GDP. I also control for two additional potential confounding factors: trade and financial sector liberalization.[12]

2.2 Sectoral analysis

According to the analytical framework, the effect of capital account opening varies across industries. I use sectoral data and exploit the cross-sectoral variation in order to identify the channel. The first part of the mechanism works though capital accumulation, so I start by exploiting the variation in external financial dependence across industries. Consider a country opening its capital account. First, I calculate the pre-post change in the capital stock in industries with high external dependence ("treatment group"). Next, I estimate the pre-post change in industries with low dependence within the same country ("control group"). The difference between these two differences provides the differential effect of opening across sectors within a liberalizing country.

The generalized difference-in-differences specification includes country-year fixed effects, which has the benefit of allowing to control for time-varying country characteristics. Because capital openness varies at the country-year

[11] One could think that this assumption might be less plausible for countries that are open during the entire sample. Therefore, I do not include in the sample countries that are always open.

[12] I measure trade openness as the ratio of exports plus imports to GDP. I measure financial sector liberalization with the index provided by Abiad, Detragiache, and Tressel (2010), excluding the capital account-restrictions component. See Section 5 for details.

level, it will be absorbed by the country-year fixed effects. As a result, I can only estimate the differential effect of the policy across sectors, not the overall effect. Note that the purpose of the country-level analysis is to estimate the overall effect, whereas the purpose of the sector-level analysis is to identify the mechanism. To identify the channel, I analyze how the effect varies across sectors. The specification also includes country-industry fixed effects, which control for all country-varying industry characteristics. Finally, the specification includes sector-year fixed effects to alleviate the concern that the estimates are driven by global shocks affecting wage inequality within a certain subset of industries.

The final part of the mechanism works through capital-skill complementarity. Within industries with high external dependence, capital opening should increase wage inequality, particularly in industries with strong complementarity. Therefore, I exploit the cross-sectoral variation in both external dependence and capital-skill complementarity. I conduct a triple difference-in-differences estimation in which I compare wage inequality before and after opening, between industries with high and low financing needs, and between industries with strong and weak complementarity. The identification assumption is that there are not other concurrent factors that increase wage inequality particularly in the subset of industries with both high financial dependence and strong complementarity.

2.3 Reverse causality

Finally, I must address the fact that the capital opening episodes are not exogenous. Thus, reverse causality might bias my results. In particular, one could construct the argument that countries in which the industrial structure has shifted toward sectors with high financial dependence, and strong complementarity might have lobbied the government to open the capital account. If this were the case, higher demand for skilled workers (and therefore higher wage inequality) would lead to capital opening, not the other way around.

I address this problem in two ways. First, I analyze whether wage inequality in sectors with high financial dependence and strong complementarity prior to capital account opening explains the timing of the opening across countries. In order to obtain a precise opening date, I define the opening year as the year in which the Chinn and Ito (2006) openness index of a country increases by more than one standard deviation across all countries and years. In the spirit of Beck, Levine, and Levkov (2010), I regress the year of capital opening on the preexisting average wage inequality in the aforementioned sectors. The effect of inequality is not statistically different from zero (t-statistic of 0.22). I do the same for the rate of change of wage inequality and find the same result.[13] Therefore, the timing of capital account opening does not vary with

[13] The results of these regressions are reported in Table A.3 of Section A.2 of the Online Appendix.

the degree of preexisting wage inequality in sectors with high dependence and strong complementarity. Second, in Section 5, I conduct an instrumental variables approach using lagged values of the openness index as instruments for opening. I find results very similar to the main sectoral analysis results. These two sets of findings suggest that the timing of opening across countries was unaffected by sectoral inequality and therefore provide evidence against the reverse causality story.

3. Data

3.1 Capital account opening

The traditional approach to measuring financial openness is to use the information provided by the IMF's "Annual Report on Exchange Arrangements and Exchange Restrictions" (AREAER), which reports the extent of rules and regulations affecting cross-border financial transactions. In this paper, I use the index of capital account openness developed by Chinn and Ito (2006), which captures both the extent and intensity of capital mobility restrictions. The Chinn and Ito data allows me to maximize the number of countries in the sample. In Section 5, I show that the results are robust to using alternative *de jure* and *de facto* capital openness measures.

The Chinn and Ito measure is based on a set of four AREAER measures for capital mobility restrictions: (1) openness of the capital account, (2) openness of the current account, (3) stringency of requirements for repatriation of export proceeds, and (4) existence of multiple exchange rates. These binary variables are set equal to one when restrictions are nonexistent and zero otherwise. This index is the first principal component of the four binary variables. The index has a higher value for countries that are more open to cross-border financial transactions and is constructed such that the series has a mean of zero.

The sample consists of 20 mainly European countries from 1975 to 2005.[14] Its composition is the result of intersecting the wage dataset described below with the Chinn and Ito data. Unfortunately, wage-inequality data are unavailable for emerging markets. Table 1 reports the summary statistics of the openness index for each country. The overall average score of the index is 0.89, with a standard deviation of 1.4. Table A.1 of the Online Appendix reports the evolution of the openness index across countries and decades. Eastern European countries opened very quickly toward the end of the sample. Some countries (e.g., Denmark and Italy) opened in the 1980s. Other countries opened in the 1990s (e.g., Portugal and Spain).

[14] I do not include in the analysis the three countries whose accounts have been open since the start of the sample: Germany, the Netherlands, and the United States. However, I do include these countries in the calculation of the capital-skill complementarity index, explained below.

Table 1
Summary Statistics of Capital Account Openness Index

	(1) Mean	(2) Median	(3) StdDev.	(4) Min.	(5) Max.
Australia	1.245	1.132	1.041	−0.106	2.456
Austria	1.687	1.132	0.628	1.132	2.456
Belgium	1.471	1.662	0.860	0.521	2.456
Czech Republic	1.042	0.910	1.180	−0.106	2.456
Denmark	1.296	1.926	1.235	−0.106	2.456
Finland	1.647	1.132	0.700	−0.106	2.456
France	0.977	0.158	1.288	−1.159	2.456
Greece	−0.147	−1.159	1.327	−1.159	2.456
Hungary	−0.368	−0.633	1.534	−1.856	2.456
Ireland	0.858	−0.106	1.302	−0.803	2.456
Italy	0.616	0.158	1.735	−1.856	2.456
Japan	2.157	2.456	0.472	1.132	2.456
Korea	−0.548	−0.106	0.528	−1.159	−0.106
Poland	−1.120	−1.159	0.768	−1.856	0.079
Portugal	0.441	−0.106	1.623	−1.159	2.456
Slovakia	−0.629	−1.159	0.863	−1.159	0.873
Slovenia	0.690	1.132	0.993	−1.159	1.926
Spain	0.772	−0.106	1.254	−1.159	2.456
Sweden	1.602	1.132	0.606	1.132	2.456
United Kingdom	1.950	2.456	1.105	−0.803	2.456
All countries	0.894	1.132	1.398	−1.856	2.456

The table reports summary statistics for the capital account openness index for the 20 countries in the sample during the period 1975–2005. The openness index comes from Chinn and Ito (2006). The last row reports the statistics for the average across all countries. Column (1) reports the mean; Column (2) the median; Column (3) the standard deviation; Column (4) the minimum; and Column (5) the maximum.

3.2 Wage inequality

The data on wage inequality comes from the EU-KLEMS dataset, a statistical and analytical research project financed by the European Commission.[15] EU-KLEMS provides sectoral data on capital stock, hours worked, and wages by skill level. I define *skilled labor* as the labor force with some college education and *unskilled labor* as the labor force with high school education. Wage inequality is the ratio between the wage of workers with college education and those with high school education. The wage data are available for 20 countries, primarily European, from 1975 to 2005. There is information for 15 industries at the 2-digit level of aggregation. Six industries are manufacturing, ranging from wood to machinery. The remaining 9 industries are nonmanufacturing, ranging from retail to construction. The physical-capital data are available for a subset of only 14 countries.

Table 2 reports the summary statistics of aggregate wage inequality for each country. On average, overall wage inequality is 1.68, which means that wages of college-educated workers are 68% higher than wages of high school-educated workers. Wage inequality is highest in Eastern European countries, where wages of college-educated workers are more than twice the wages

[15] EU-KLEMS stands for European Union level analysis of capital (K), labor (L), energy (E), materials (M), and service (S) inputs.

Table 2
Summary Statistics of Aggregate Wage Inequality

	(1) Mean	(2) Median	(3) StdDev.	(4) Min.	(5) Max.
Australia	1.490	1.467	0.044	1.440	1.593
Austria	1.577	1.582	0.075	1.476	1.729
Belgium	1.502	1.507	0.031	1.438	1.557
Czech Republic	2.263	2.246	0.033	2.226	2.319
Denmark	1.492	1.498	0.084	1.384	1.633
Finland	1.652	1.593	0.125	1.504	1.885
France	1.849	1.851	0.074	1.620	1.949
Greece	1.552	1.540	0.035	1.505	1.626
Hungary	2.404	2.451	0.110	2.200	2.547
Ireland	1.826	1.844	0.066	1.690	1.922
Italy	1.264	1.254	0.099	1.133	1.480
Japan	1.673	1.662	0.045	1.608	1.757
Korea	1.780	1.753	0.217	1.491	2.123
Poland	1.558	1.560	0.027	1.511	1.600
Portugal	2.307	2.322	0.106	2.118	2.430
Slovakia	1.785	1.775	0.068	1.692	1.905
Slovenia	2.119	2.119	0.057	2.031	2.215
Spain	1.558	1.587	0.112	1.356	1.707
Sweden	1.522	1.529	0.041	1.435	1.604
United Kingdom	1.829	1.841	0.076	1.574	1.942
All countries	1.687	1.611	0.275	1.133	2.547

The table reports summary statistics for aggregate wage inequality for the 20 countries in the sample during the period 1975–2005. *Wage inequality* is defined as the relative wage between workers with college and high school education. The last row reports the statistics for the average across all countries. Column (1) reports the mean; Column (2) the median; Column (3) the standard deviation; Column (4) the minimum; and Column (5) the maximum.

of high school-educated workers. Wage inequality tends to be the lowest in Scandinavian countries. Table A.2 of the Online Appendix reports the evolution of wage inequality across countries and decades. During the sample period, wage inequality increased in more than half of the countries. Inequality increased particularly in Eastern European countries, heavily influenced by its increase in the manufacturing sector.

3.3 Sectoral indexes

To conduct the sectoral analysis, I rank industries based on the two cross-sectoral characteristics: external financial dependence and capital-skill complementarity.

External financial dependence. I use the external financial dependence index developed by Rajan and Zingales (1998) to identify an industry's intrinsic need for external finance. The index is defined as the fraction of capital expenditures not financed by cash flow from operations for the median publicly traded firm in each industry in the United States. I calculate the index using data from Compustat from 1975 through 2005. Table 3 reports the external financial dependence measure for the industries in the sample. There is substantial cross-sectoral variation in the index. Chemicals manufacturing presents the highest need for external finance. Within the nonmanufacturing sectors, post

Table 3
Sectoral Index of External Financial Dependence

Industry name	(1) Industry ISIC code	(2) Ext. financial dependence
Manufacturing of wood	20	0.283
Manufacturing of coke, refined petroleum	23	0.694
Manufacturing of chemicals	24	1.000
Manufacturing of rubber, plastics	25	0.296
Manufacturing of nonmetallic mineral products	26	0.380
Manufacturing of machinery and equipment	29	0.269
Construction	45	−0.228
Sale, maintenance, repair motor vehicles	50	−0.475
Wholesale trade and commission trade	51	−0.399
Retail trade, except of motor vehicles	52	0.065
Hotels and restaurants	55	0.370
Post and telecommunications	64	0.476
Real estate activities	70	0.511
Education	80	−0.383
Health and social work	85	−0.344

The table reports the external financial dependence index for the 15 2-digit industries in the sample. ISIC denotes International Standard Industry Classification. *External financial dependence* is defined as the fraction of capital expenditures not financed by cash flow from operations (Rajan and Zingales 1998). The index is calculated as the median of this fraction across U.S. publicly traded firms for each industry.

and telecommunications presents the highest external dependence. Service sectors such as education and health exhibit low external dependence.

The purpose of using data from large publicly traded companies is to obtain an accurate measure of the demand for external funds. These firms are large and well-established, with better access to well-developed capital markets than firms in other countries. Therefore, the external dependence index should provide a precise measure of the demand for external finance, not influenced by supply side constraints. For identification purposes, I do not require each country to have the same value of financial dependence in each sector. The identification assumption is that the *ranking* of financial dependence across sectors is the same in each country.

Capital-skill complementarity. I need to construct an index of sectoral capital-skill complementarity. For this, I estimate a standard skilled-labor-share equation for each industry.[16] I assume that capital is a quasi-fixed factor and that skilled and unskilled labor are variable factors. If the variable cost function is translog and production exhibits constant returns to scale, cost minimization yields the following skilled-labor-share equation for each industry:

$$ShareSkilled = \alpha + \beta \log(Inequality) + \gamma \log(CapIntensity), \tag{4}$$

where *ShareSkilled* denotes the share of wages paid to skilled labor (i.e., $w_s s/(w_s s + w_u u)$), *Inequality* denotes the relative wage between skilled and unskilled workers (i.e., w_s/w_u), and *CapIntensity* denotes capital intensity

[16] Berman, Bound, and Griliches (1994) introduced this methodology to the literature of wage inequality.

(i.e., k/y). A positive coefficient for γ in Equation (4) implies the capital-skill complementarity. Intuitively, when capital and skilled labor are relative complements, an increase in capital intensity leads to an increase in the relative demand for skilled labor, causing the wage share of skilled workers to increase. The stronger the complementarity, the larger the effect. Therefore, I use the γ elasticity as a measure of complementarity.

Ideally, I would estimate this equation using data from the United States, as in the case of external dependence, to capture the technological component of the elasticity and not other distortions. Unfortunately, there is no micro-level dataset for the United States containing information on wages by skill level for manufacturing and non manufacturing sectors. Therefore, I estimate Equation (4) for each industry, using data from a panel of countries across time[17]:

$$ShareSkilled_{ct} = \alpha + \beta \log(Inequality)_{ct} + \gamma \log(CapIntensity)_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct}, \tag{5}$$

where c indicates country and t indicates year. α_c and α_t are country and year fixed effects. To estimate Equation (5), I must deal with the fact that capital intensity might be endogenous. For example, skilled-biased technological change, which is unobserved, could increase both capital intensity and the relative demand for skilled labor. To obtain an exogenous source of variation of capital intensity, I use lagged values of capital intensity as internal instruments.[18] I estimate Equation (5) in first differences to eliminate the country fixed effects:

$$\Delta ShareSkilled_{ct} = \beta \Delta \log(Inequality)_{ct} + \gamma \Delta \log(CapIntensity)_{ct} + \Delta \alpha_t + \Delta \varepsilon_{ct}, \tag{6}$$

where Δ denotes the time difference operator. Next, I estimate Equation (6) using generalized method of moments (GMM) with the following moment conditions: $\mathbb{E}[z_{ct-j} \cdot \Delta \varepsilon_{ct}] = 0$ for $j \geq 2, t \geq 3$, where $z = [ShareSkilled, Inequality, CapIntensity]$. The identification assumption is that the error term in Equation (5) is not serially correlated and that the explanatory variables are weakly exogenous (i.e., uncorrelated with future realizations of the error term). Intuitively, I assume that capital intensity does not adjust to future technological shocks.

I estimate the complementarity index using the complete sample period in order to maximize the sample size per estimation. However, if I were to use only use pre opening data, I could obtain a more exogenous measure. In Section 5, I show that the results are robust to using a complementarity index estimated with pre opening data or pre-1990 data. In Section A.3 of the Online Appendix (Tables A.4 and A.5), I show that the results are robust to performing the

[17] In Section 5, I show that the results are robust to using a complementarity index estimated excluding the transition economies, which are likely the countries presenting the most frictions and distortions.

[18] Duffy, Papageorgiou, and Perez-Sebastian (2004) use the same instrumental variable approach to estimate capital-skill complementarity in aggregate production functions.

estimation with system GMM, which uses Equation (5) to obtain a system of two equations, one in differences and one in levels.

Table 4 reports the estimates of Equation (6) for each industry. Column (4) shows the capital-skill complementarity elasticity. Complementarity is statistically different from zero in all but two industries (hotels and real estate). Capital and skilled labor are relative complements in all industries except retail, education, and health. All manufacturing industries exhibit complementarity, which is intuitive, because unskilled workers tend to perform tasks that are more routine in manufacturing. The industry with the strongest complementarity is post and telecommunications. The telecommunications industry is highly intensive in skilled labor, where computer capital strongly complements skilled workers in doing nonroutine tasks.

Finally, the correlation between the financial dependence and complementarity indexes is positive but not statistically different from zero. This is important for identification, because it provides sufficient cross-industry variation across these two dimensions. Chemicals and telecommunications are examples of industries that exhibit both high external financial dependence and strong complementarity. Capital account opening should have a particularly strong effect on wage inequality in these industries.

4. Main Results

4.1 Aggregate results

First, I use country data and analyze the effect of capital account opening on aggregate wage inequality:

$$\log(Inequality)_{ct} = \beta_1 Openness_{ct} + \beta_2 X_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct}, \tag{7}$$

where $Inequality_{ct}$ denotes the ratio of skilled to unskilled wages in country c in year t. *Openness* denotes the Chinn and Ito (2006) capital openness index and X is a vector of time-varying country controls.[19] In all regressions, I rescale all regressors by their respective standard deviations. Thus, the regression coefficient on a given regressor can be interpreted as a percentage change in wage inequality if that regressor is increased by one standard deviation.[20]

The specification includes a set of country fixed effects (α_c) and year fixed effects (α_t). ε is a disturbance term. I cluster standard errors at the country level, which controls for the within-country correlation across time (Bertrand, Duflo, and Mullainathan 2004). The parameter of interest is β_1, which is identified from the variation in the timing of capital account opening across countries. It estimates the pre-post change in wage inequality in a country opening its capital account, relative to the pre-post change in countries that are not changing capital account policy.

[19] The data on the controls come from the World Bank's "World Development Indicators" (WDI).

[20] This allows one to calculate more easily the economic magnitude of the different regressors.

Table 4
Sectoral Index of Capital-skill Complementarity

Industry name	(1) Industry ISIC code	(2) Coeff. beta	(3) StdDev. beta	(4) Coeff. gamma (CSC index)	(5) StdDev. gamma	(6) Number of observations
Manufacturing of wood	20	0.522***	0.067	0.073**	0.034	303
Manufacturing of coke, refined petroleum	23	1.189***	0.094	0.049***	0.015	303
Manufacturing of chemicals	24	1.305***	0.078	0.214***	0.041	303
Manufacturing of rubber, plastics	25	0.288***	0.086	0.365***	0.036	303
Manufacturing of nonmetallic mineral products	26	0.839***	0.099	0.302***	0.035	303
Manufacturing of machinery and equipment	29	0.606***	0.082	0.044*	0.023	303
Construction	45	1.231***	0.114	0.134***	0.036	303
Sale, maintenance, repair of motor vehicles	50	0.279***	0.03	0.378***	0.024	303
Wholesale trade and commission trade	51	1.895***	0.086	0.336***	0.039	303
Retail trade, except of motor vehicles	52	2.258***	0.074	−0.088***	0.032	303
Hotels and restaurants	55	1.287***	0.058	0.037	0.041	303
Post and telecommunications	64	1.192***	0.079	0.470***	0.04	303
Real estate activities	70	1.755***	0.050	−0.05	0.036	303
Education	80	0.766***	0.053	−0.070***	0.013	303
Health and social work	85	0.696***	0.061	−0.039*	0.021	303

The table reports the estimates of the skilled labor share equation for each of the 15 two-digit industries in the sample. Columns (2) and (3) report the coefficient and standard deviation of the elasticity of the share of wages paid to skilled labor with respect to relative wages; Columns (4) and (5) report the coefficient and standard deviation of the elasticity with respect to capital intensity. The coefficient of column (4) corresponds to the capital-skill complementarity index. Standard errors are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

Table 5
Effect of Capital Account Opening on Aggregate Wage Inequality

	(1)	(2)	(3)	(4)
Capital openness	0.064***	0.057***	0.050***	
	(0.010)	(0.009)	(0.010)	
Post				0.048***
				(0.013)
Relative labor supply		−0.148***	−0.148***	−0.152***
		(0.033)	(0.031)	(0.032)
Inflation		−0.011	−0.009	−0.009
		(0.007)	(0.007)	(0.007)
Gov. exp. to GDP		−0.068***	−0.059***	−0.045**
		(0.017)	(0.019)	(0.019)
GDP per capita		−0.113***	−0.108***	−0.128***
		(0.017)	(0.016)	(0.017)
Credit to GDP		0.052***	0.052***	0.050***
		(0.012)	(0.012)	(0.012)
Trade openness			0.017	0.041
			(0.025)	(0.026)
Fin. liberalization			0.044***	0.057***
			(0.014)	(0.014)
Fixed effects				
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Observations	381	369	369	370
R-squared	0.899	0.926	0.928	0.923

The table reports the estimates of the effect of capital account opening on aggregate wage inequality. Column (1) estimates the effect without controls; Column (2) controls for the relative supply of skilled labor, inflation, ratio of government expenditure to GDP, GDP per capita, ratio of private credit to GDP; Column (3) further controls for trade and financial liberalization; Column (4) replaces the capital openness variable with a dummy variable equal to one after the openness index of a country increases by more than one standard deviation and zero otherwise. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

Table 5 reports the results. Column (1) estimates the effect without controls, Column (2) controls for the regressors used in Beck, Demirg-Kunt, and Levine (2007), and Column (3) further controls for trade and financial sector liberalization. The effect is significant and stable across specifications. The coefficients of the control variables all exhibit the expected signs. I define *capital account opening* as a one-standard-deviation increase in the Chinn and Ito (2006) openness index. According to the results of Column (3), the preferred specification, opening the capital account increases wage inequality by 5%. Following Beck, Levine, and Levkov (2010), to assess the importance of the effect, I calculate the variation in aggregate wage inequality after controlling for fluctuations accounted for by country and year fixed effects. The standard deviation of aggregate (log) wage inequality after controlling for fixed effects is 27%. This means that opening explains 18% of the variation in aggregate inequality (=5%/27%). Therefore, the economic magnitude is consequential.

Next, I examine the dynamics of the relationship between capital account opening and wage inequality. To obtain a precise opening date, I define the *opening year* as the year in which the capital openness index of a country increases by more than one standard deviation. In Column (4) of Table 5,

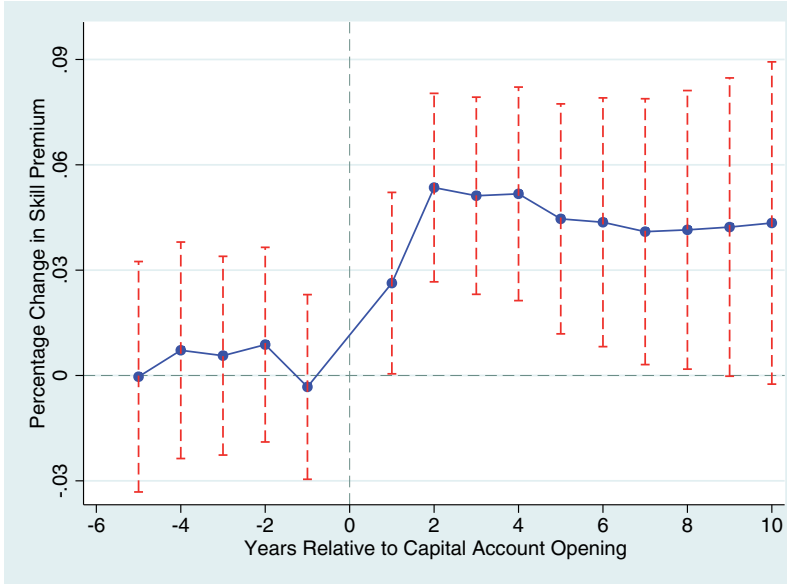

Figure 1
Dynamic Effect of Capital Account Opening on Aggregate Wage Inequality
The figure plots the dynamic impact of capital account opening on aggregate wage inequality. In order to obtain a precise opening date, I define the *opening year* as the year in which the Chinn and Ito (2006) openness index of a country increases by more than one standard deviation. I consider a 15-year window, spanning from 5 years before opening until 10 years after opening. I exclude the year of opening, thus estimating the dynamic effect of capital account opening relative to that year. The dashed lines denote 95% confidence intervals, where standard errors have been clustered at the country level.

I replace the capital openness variable with a post-opening dummy that is equal to one after the opening year and zero otherwise. According to the results, wage inequality increases by 4.8% after the capital opening year, which is consistent with the result obtained in Column (3). In order to trace the year-by-year effects of opening, I follow Beck, Levine, and Levkov (2010) and include a series of dummy variables in Equation (7):

$$\log(Inequality)_{ct} = \beta_1 D_{ct}^{-5} + \beta_2 D_{ct}^{-4} + \cdots + \beta_{15} D_{ct}^{+10} + \beta_2 X_{ct} + \alpha_c + \alpha_t + \varepsilon_{ct}, \quad (8)$$

where the opening dummy variables equal zero, except as follows: D^{-k} equals one for countries in the kth year before opening, while D^{+k} equals one for countries in the kth year after opening. I exclude the opening year, therefore estimating the dynamic effect relative to that year.[21] Note that estimates for the end points are measured with less precision. Figure 1 plots the coefficient estimates and the 95% confidence intervals, which are adjusted for country-level clustering. According to the figure, the coefficients on the opening dummy

[21] At the end points, D^{-5} equals one for all years that are 5 or more years before opening, while D^{+10} equals 1 for all years that are 10 or more years after opening.

variables are not significant for all years before opening. As shown, the effect of capital account opening on wage inequality materializes rather quickly. Finally, the effect on wage inequality 2 years after opening levels off, indicating a permanent increase in inequality.

4.2 Sectoral results

To identify the channel leading to higher wage inequality, I use sectoral data and explore how the effect varies across industries. I start by tracing the effect on sectoral capital stock per unit of skilled labor:

$$\log(Capital)_{cit} = \beta_1 Openness_{ct} + \beta_2 FinDep_i + \beta_3 Openness_{ct} * FinDep_i + \alpha_{ct} + \alpha_{ci} + \alpha_{it} + \varepsilon_{cit}, \quad (9)$$

where $Capital_{cit}$ denotes the capital stock per unit of skilled labor in country c in industry i in year t. $FinDep_i$ denotes the external dependence index of industry i. The specification includes a set of country-year (α_{ct}), country-industry (α_{ci}), and industry-year (α_{it}) fixed effects. I cluster standard errors at the country level to control for the country-industry correlation across time and the country-year correlation across industries. The parameter of interest is β_3, which is identified from the within-country variation in financial dependence across industries. It estimates the before-after change in wage inequality in industries with high dependence in a country opening the capital account, relative to the before-after change in industries with low dependence within the same country.

I report the results in Table 6. The columns include a progressively broader set of fixed effects. Column (1) includes country and year fixed effects. The main effect of the policy is not statistically different from zero, the effect of financial dependence is positive and significant, and the interaction term is positive but insignificant. In order to control for country-sectoral characteristics and sectoral time trends, Column (2) includes country-industry and industry-year fixed effects. Because the financial dependence index varies at the sectoral level, it will be absorbed by the country-industry fixed effects. The main effect remains insignificant, whereas the interaction term becomes significant at the 5% level. Next, Column (3) includes country-year fixed effects to control for time-varying country characteristics, in addition to country-industry effects. Because the openness term varies at the country-year level, it will be absorbed by the country-year fixed effects. The interaction term is no longer significant. This highlights the importance of controlling for industry-specific trends.

Finally, Column (4), which is the preferred specification, includes the full set of fixed effects. The effect is statistically and economically significant. To calculate the magnitude of the effect, consider an industry at the seventy-fifth percentile of the external financial index (0.475) and an industry at the twenty-fifth percentile (-0.343). From Equation (9), the differential effect across sectors of a one-standard-deviation increase in the openness index is $\beta_3 * (FinDep_{75th} - FinDep_{25th})$. According to Column (4), capital opening increases the capital

Table 6
Effect of Capital Account Opening on Sectoral Capital Stock

	(1)	(2)	(3)	(4)
Capital openness	0.033	0.044		
	(0.053)	(0.058)		
Fin. dep.	0.064***			
	(0.003)			
Capital openness * fin. dep.	0.058	0.123**	0.058	0.123**
	(0.046)	(0.051)	(0.047)	(0.053)
Fixed effects				
Country	Yes	No	No	No
Year	Yes	No	No	No
Country-year	No	No	Yes	Yes
Country-industry	No	Yes	Yes	Yes
Industry-year	No	Yes	No	Yes
Observations	4,095	4,095	4,095	4,095
R-squared	0.575	0.975	0.981	0.982

The table reports the estimates of the effect of capital account opening on the sectoral capital stock per unit of skilled labor. Column (1) includes country and year fixed effects; Column (2) includes country-industry and industry-year fixed effects; Column (3) includes country-year and country-industry fixed effects; Column (4) includes country-year, country-industry, and sector-year fixed effects. Fin. dep. stands for external financial dependence. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

stock in industries that are highly dependent on external finance by 10% more than in industries with low dependence.[22] The standard deviation of the sectoral (log) capital stock after controlling for country, sector, and year effects is 27%. Because the differential effect is 10%, capital opening explains 37% of the variation in sectoral capital (=10%/27%).

Next, I analyze the effect on sectoral wage inequality. I divide the sample into industries with external financial dependence above and below the median of the index across all industries. For each subset of industries, I estimate:

$$\log(Inequality)_{cit} = \beta_1 Openness_{ct} + \beta_2 Comp_i + \beta_3 Openness_{ct} * Comp_i + \alpha_{ct} + \alpha_{ci} + \alpha_{it} + \varepsilon_{cit}, \quad (10)$$

where $Inequality_{cit}$ denotes the relative wages of skilled and unskilled workers in country c in industry i in year t. $Comp$ denotes the capital-skill complementarity index of industry i. Table 7 reports the results. As in Table 6, the columns include a progressively broader set of fixed effects. Panel A includes the sample of industries with dependence above the median and Panel B contains industries below the median. Within above-median dependence industries, opening increases wage inequality particularly in industries with strong complementarity (Panel A). The double interaction term is significant across specifications. Within below-median dependence industries, the effect is the same across sectors with different degrees of complementarity (Panel B).

[22] The differential effect is computed as $0.123^*[0.475-(-0.343)]=10\%$.

Table 7
Effect of Capital Account Opening on Sectoral Wage Inequality: Subsample Analysis

	(1)	(2)	(3)	(4)
	A. Above-median financial dependence industries			
Capital openness	0.000	0.007		
	(0.019)	(0.021)		
Comp.	−0.089			
	(0.052)			
Capital openness * comp.	0.042	0.080*	0.098**	0.080*
	(0.039)	(0.043)	(0.042)	(0.046)
Observations	3,456	3,456	3,456	3,456
R-squared	0.726	0.900	0.940	0.943
	B. Below-median financial dependence industries			
Capital openness	0.019	0.011		
	(0.012)	(0.012)		
Comp.	0.209**			
	(0.085)			
Capital openness * comp.	−0.077	−0.019	−0.040	−0.019
	(0.048)	(0.035)	(0.026)	(0.038)
Fixed effects				
Country	Yes	No	No	No
Year	Yes	No	No	No
Country-year	No	No	Yes	Yes
Country-industry	No	Yes	Yes	Yes
Industry-year	No	Yes	No	Yes
Observations	3,024	3,024	3,024	3,024
R-squared	0.559	0.896	0.927	0.928

The table reports the estimates of the effect of capital account opening on sectoral wage inequality. Panel A contains the subsample of above-median external financial dependence industries; Panel B the subsample of below-median dependence industries. Column (1) includes country and year fixed effects; Column (2) includes country-industry and industry-year fixed effects; Column (3) includes country-year and country-industry fixed effects; Column (4) includes country-year, country-industry, and sector-year fixed effects. Comp. stands for capital-skill complementarity. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

This confirms that if the "capital effect" is absent, there is no "complementarity effect."

To calculate the magnitude of the effect, consider an industry at the seventy-fifth percentile of the complementarity index (0.336) and one at the twenty-fifth percentile (−0.039). From Equation (10), the differential effect of capital account opening is $\beta_3 * (Comp_{75th} - Comp_{25th})$. According to Column (4) of Panel A, capital opening increases wage inequality in industries with strong complementarity by 3% more than in industries with weak complementarity.[23] The standard deviation of sectoral (log) wage inequality after controlling for country, sector, and year effects is 14%. This means that capital opening explains 21% of the variation in sectoral inequality (=3%/14%). Thus, the economic magnitude of the effect is sizable.

[23] I calculate the differential effect as 0.080*[0.336-(-0.039)]=3%.

Table 8
Effect of Capital Account Opening on Sectoral Wage Inequality

	(1)	(2)	(3)	(4)
Capital openness	0.010	0.006		
	(0.014)	(0.012)		
Fin. dep.	−0.019*			
	(0.011)			
Comp.	0.189***			
	(0.022)			
Capital openness * fin. dep.	−0.047*	−0.026	−0.047*	−0.026
	(0.026)	(0.027)	(0.027)	(0.028)
Capital openness * comp.	0.013	0.022	0.013	0.022
	(0.022)	(0.028)	(0.023)	(0.029)
Capital openness * fin. dep. * comp.	0.192***	0.135*	0.192**	0.135*
	(0.066)	(0.072)	(0.068)	(0.074)
Fixed effects				
Country	Yes	No	No	No
Year	Yes	No	No	No
Country-year	No	No	Yes	Yes
Country-industry	No	Yes	Yes	Yes
Industry-year	No	Yes	No	Yes
Observations	6,480	6,480	6,480	6,480
R-squared	0.900	0.898	0.932	0.933

The table reports the estimates of the effect of capital account opening on sectoral wage inequality. Column (1) includes country and year fixed effects; Column (2) includes country-industry and industry-year fixed effects; Column (3) includes country-year and country-industry fixed effects; Column (4) includes country-year, country-industry, and sector-year fixed effects. Fin. dep. stands for external financial dependence and Comp. for capital-skill complementarity. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

Finally, as an alternative to splitting the sample, I pool all industries and estimate a triple difference-in-differences specification:

$$\begin{aligned}\log(Inequality)_{cit} = {} & \beta_1 Openness_{ct} + \beta_2 Comp_i + \beta_3 FinDep_i \\ & + \beta_4 Openness_{ct} * Comp_i + \beta_5 Openness_{ct} * FinDep_i \\ & + \beta_6 Openness_{ct} * Comp_i * FinDep_i \\ & + \alpha_{ct} + \alpha_{ci} + \alpha_{it} + \varepsilon_{cit}. \end{aligned} \tag{11}$$

The parameter of interest is β_6, which is identified from the within-country variation in both external dependence and complementarity across industries. The coefficients of the double-interaction terms, unlike the triple-interaction term, are not scale invariant. That is, they depend on the units in which the sectoral indices are measured. Table 8 shows that the triple-interaction term is significant across all specifications. From Equation (11), the differential effect of capital opening is $\beta_6 * (Comp * FinDep_{75th} - Comp * FinDep_{25th})$. As seen in Column (3), opening increases wage inequality in industries with high dependence and strong complementarity (seventy-fifth percentile in the product

Table 9
Effect of Capital Account Opening on Level of Wages

	(1) Skilled wages	(2) Unskilled wages	(3) Average wages
Capital openness	0.021***	−0.025***	0.012*
	(0.006)	(0.009)	(0.007)
Relative labor supply	0.023	0.039	0.062*
	(0.028)	(0.029)	(0.032)
Trade openness	−0.002	−0.037*	0.006
	(0.014)	(0.020)	(0.013)
Inflation	−0.034***	−0.020***	−0.019***
	(0.006)	(0.007)	(0.006)
Gov. exp. to GDP	−0.010	0.027*	0.034***
	(0.013)	(0.016)	(0.012)
GDP per capita	−0.132***	−0.124***	−0.144***
	(0.007)	(0.012)	(0.007)
Credit to GDP	−0.003	−0.059***	−0.035***
	(0.007)	(0.009)	(0.007)
Fin. liberalization	−0.029**	−0.034**	−0.035***
	(0.013)	(0.014)	(0.012)
Fixed effects			
Country	Yes	Yes	Yes
Year	Yes	Yes	Yes
Observations	369	338	338
R-squared	0.997	0.997	0.998

The table reports the estimates of the effect of capital account opening on the level of wages. Column (1) estimates the effect for the level of skilled wages; Column (2) for unskilled wages; Column (3) for the average wage, which is defined as the weighted average of skilled and unskilled wages, where the weights are given by the relative number of workers by skill level. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

of both indexes) by almost 2% more than in industries with low dependence and weak complementarity (twenty-fifth percentile).[24]

5. Additional Results

5.1 Levels of wages

In the previous section, I provided evidence that opening the capital account leads to higher wage inequality. This can be the result of two alternative scenarios. First, wages of both skilled and unskilled workers are increasing, but skilled wages increase at a higher rate. Second, skilled wages are increasing, while unskilled wages decrease. From a policy perspective, it is important to disentangle both scenarios. In this section, I estimate the effect of capital opening on the *level* of wages.

In particular, I reestimate Equation (7) separately for skilled wages, unskilled wages, and overall wages. Table 9 reports the results. According to Column (1), capital opening increases the wages of skilled workers by 2.1%. As seen

[24] I rank all industries according to the product of both sectoral indices. The seventy-fifth and twenty-fifth percentile of this product is 0.107 and -0.025, respectively. The differential effect is 0.135*[0.107-(-0.025)]=1.8%.

in Column (2), opening decreases unskilled wages by 2.5%. In Column (3), I estimate the effect on the *average wage*, which is defined as the weighted average of skilled and unskilled wages, where the weights are the relative number of skilled and unskilled workers. According to the results, opening increases overall wages by 1.2%. In sum, opening the capital account increases overall wages, which is consistent with the evidence provided by Chari, Henry, and Sasson (2012). However, skilled wages increase at the expense of unskilled wages, which leads to higher wage inequality. Thus, the distributional consequences of capital opening should be an important concern for policy makers.

5.2 Stability of effect over time

Given that the sample period under study is relatively long (1975–2005), I analyze whether the relationship between capital account opening and wage inequality documented in the previous section varies over time. To do this, I add an interaction term between the capital openness index and a dummy indicator for different decades to Equation (7). The results are reported in Table 10. In Column (1), I add an interaction term between capital account opening and a post opening dummy equal to one after 1980 and zero otherwise. In Columns (2) and (3), I replicate the exercise using a post dummy for 1990 and 2000. In Column (4), I include all three post dummies simultaneously. According to the results, the effect of capital account opening on wage inequality remains unchanged across all specifications. The coefficients for all post dummies are not significant.

5.3 Reverse causality

As discussed in Section 2, the fact that capital opening is not exogenous can lead to a problem of reverse causality. In this section, I address this issue by using an instrumental variables approach. Several papers studying the effect of opening on growth have used some type of instrumental variables analysis to deal with endogeneity. The instruments used range from legal origin to distance to the equator. The problem is that these instruments do not have a time-series dimension. To address this problem, I follow the work of Quinn and Toyoda (2008) and use lagged values of the capital-openness index as internal instruments.

I estimate Equation (11) in first differences using GMM. I use the following moment conditions: $\mathbb{E}[z_{cit-j} \cdot \Delta\varepsilon_{cit}] = 0$ for $j \geq 2, t \geq 3$, where $z = [Inequality, Openness, Openness * Comp]$. The identification assumption is that the error term in Equation (11) is not serially correlated and that the explanatory variables are weakly exogenous. Intuitively, I assume that lagged values of the openness index affect wage inequality only through their effect on current openness. Table 11 reports the results. According to the results of Column (4), the triple interaction term is positive and significant. The size of the coefficient (0.158) is very similar to the size of the coefficient of the benchmark estimation

Table 10
Effect of Capital Account Opening on Aggregate Wage Inequality: Stability Over Time

	(1)	(2)	(3)	(4)
Capital openness	0.060***	0.052***	0.051***	0.059***
	(0.018)	(0.015)	(0.009)	(0.019)
Capital openness * post1980	−0.013			−0.015
	(0.019)			(0.019)
Capital openness * post1990		−0.003		0.005
		(0.016)		(0.016)
Capital openness * post2000			−0.004	−0.004
			(0.012)	(0.012)
Relative labor supply	−0.152***	−0.149***	−0.150***	−0.153***
	(0.031)	(0.031)	(0.033)	(0.032)
Trade openness	0.020	0.018	0.017	0.019
	(0.025)	(0.025)	(0.025)	(0.025)
Inflation	−0.011	−0.010	−0.009	−0.010
	(0.007)	(0.007)	(0.007)	(0.007)
Gov. exp. to GDP	−0.061***	−0.060***	−0.060***	−0.061***
	(0.019)	(0.019)	(0.019)	(0.019)
GDP per capita	−0.111***	−0.109***	−0.110***	−0.111***
	(0.017)	(0.019)	(0.017)	(0.019)
Credit to GDP	0.054***	0.052***	0.052***	0.054***
	(0.013)	(0.013)	(0.012)	(0.013)
Fin. liberalization	0.043***	0.044***	0.044***	0.043***
	(0.014)	(0.014)	(0.014)	(0.014)
Fixed effects				
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Observations	369	369	369	369
R-squared	0.928	0.927	0.927	0.927

The table reports the estimates of the effect of capital account opening on aggregate wage inequality for different time periods. Columns (1), (2), and (3) include an interaction term between the capital openness index and a dummy equal to one after 1980, 1990, 2000, and zero otherwise, respectively; Column (4) includes all three interaction terms simultaneously. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

of Table 8 (0.135). This finding provides further evidence against a reverse causality story.

5.4 Alternative explanations

A potential confounding factor is trade liberalization. According to the Stolper-Samuelson Theorem, trade opening increases the relative price of a country's abundant factor. Given that my sample is composed of more-developed (and skill-abundant) countries, simultaneous changes in trade policy might increase the relative wage of skilled labor.[25] To control for trade opening in the sectoral analysis, I reestimate Equation (11) and control for trade openness and its interaction with the two sectoral indexes. I use two alternative measures of trade: the ratio of exports and imports to GDP and the simple mean applied

[25] In addition, since reductions in trade costs make it cheaper to import capital equipment, trade openness can lead to higher wage inequality through capital deepening and capital-skill complementarity (Parro 2013; Raveh and Reshef 2014).

Table 11
Effect of Capital Account Opening on Sectoral Wage Inequality: Instrumental Variable Approach

	(1)	(2)	(3)	(4)
Capital openness	0.001	0.000		
	(0.007)	(0.002)		
Capital openness* fin. dep.	−0.014	−0.039***	−0.036***	−0.088***
	(0.014)	(0.005)	(0.005)	(0.011)
Capital openness * comp.	−0.013	−0.016**	0.006	−0.139***
	(0.020)	(0.008)	(0.006)	(0.025)
Capital openness * fin. dep. * comp.	0.098*	0.192***	0.151***	0.158***
	(0.058)	(0.019)	(0.018)	(0.033)
Fixed effects				
Country	Yes	No	No	No
Year	Yes	No	No	No
Country-year	No	No	Yes	Yes
Country-industry	No	Yes	Yes	Yes
Industry-year	No	Yes	No	Yes
Observations	6,180	6,180	6,180	6,180

The table reports the estimates of the effect of capital account opening on sectoral wage inequality, using lagged values of the capital openness index as internal instrumental variables. Column (1) includes country and year fixed effects; Column (2) includes country-industry and industry-year fixed effects; Column (3) includes country-year and country-industry fixed effects; Column (4) includes country-year, country-industry, and sector-year fixed effects. Fin. dep. stands for external financial dependence and Comp. for capital-skill complementarity. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

tariff. I report the results in Columns (1) and (2) of Table 12.[26] The table shows that the triple-interaction term of capital opening remains unchanged. The triple-interaction term using either trade-opening measure is not statistically significant.

Another alternative story is that capital account opening was closely associated with financial sector liberalization. According to Kneer (2013), financial liberalization and the consequent financial-sector growth increases the demand for highly skilled workers, which in turn increases the wage gap between skilled and unskilled labor. To rule out this possibility, I reestimate Equation (11) and control for financial liberalization and its interaction with the two sectoral characteristics. I use the same measure of financial liberalization as Kneer (2013), which is based on an index provided by Abiad, Detragiache, and Tressel (2010).[27] The results are reported in Column (3) of Table 12. Even though the triple interaction term of financial liberalization is statistically significant, the triple interaction term of capital account opening barely changes. In sum, my results are not driven by either trade or financial sector liberalization.

A final alternative story is that capital opening induces skill-intensive firms to expand. This would change the within-industry composition of firms toward

[26] To preserve space, all estimations from here onward include the full set of fixed effects.

[27] The index takes into account 7 different components of financial reform: credit controls, interest rate controls, barriers to entry into the financial sector, state ownership of banks, securities market policies, banking regulation and supervision, and capital account restrictions. Because my focus is on capital account opening, I subtract the last component from the overall index.

Table 12
Effect of Capital Account Opening on Sectoral Wage Inequality: Controlling for Trade and Financial Liberalization

	(1) Trade openness	(2) Average tariff	(3) Financial liberalization
Capital openness * fin. dep.	−0.027	−0.023***	−0.027***
	(0.023)	(0.008)	(0.009)
Capital openness * comp.	0.038	0.018	0.033***
	(0.033)	(0.016)	(0.012)
Capital openness * fin. dep. * comp.	0.150*	0.074*	0.152***
	(0.085)	(0.040)	(0.037)
Trade openness * fin. dep.	0.005		
	(0.032)		
Trade openness * comp.	−0.026		
	(0.047)		
Trade openness * fin. dep. * comp.	−0.077		
	(0.120)		
Average tariff * fin. dep.		0.002	
		(0.007)	
Average tariff * comp.		0.001	
		(0.007)	
Average tariff * fin. dep.* comp.		−0.009	
		(0.014)	
Fin. liberalization * fin. dep.			0.000
			(0.010)
Fin. liberalization * comp.			0.019
			(0.018)
Fin. liberalization * fin. dep. * comp.			0.096**
			(0.048)
Fixed effects			
Country-year	Yes	Yes	Yes
Country-industry	Yes	Yes	Yes
Industry-year	Yes	Yes	Yes
Observations	4,440	3,465	4,440
R-squared	0.950	0.954	0.950

The table reports the estimates of the effect of capital account opening on sectoral wage inequality, controlling for trade and financial liberalization. Columns (1), (2), and (3) control for the interaction between the two sectoral indices and the ratio of exports and imports to GDP, average import tariff, and financial liberalization index, respectively. All specifications include country-year, country-industry, and industry-year fixed effects. Fin. dep. stands for external financial dependence and Comp. for capital-skill complementarity. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

more skill-intensive firms, increasing the relative demand for skilled labor. This compositional effect could lead to higher wage inequality, even if firms do not exhibit capital-skill complementarity. In Section A.4 of the Online Appendix, I use firm-level data from an emerging market and provide evidence against this between-firm composition channel (see Table A.6).

5.5 Robustness checks

Different capital openness measures. I show that the results are robust to using alternative capital account-openness indicators. First, I use three *de jure* measures. The Quinn (1997) index scores the intensity of controls for capital account receipts and capital account payments separately. Abiad, Detragiache, and Tressel (2010) take into account restrictions on capital inflows, capital

Table 13
Effect of Capital Account Opening on Sectoral Wage Inequality: Robustness Checks

	Alternative capital account openness measures				Alternative complementarity measures		
	(1) Quinn capital openness index	(2) Abiad et al. openness index	(3) Kaminsky Schmukler openness index	(4) Lane Milesi-Ferreti openness index	(5) Preopening cap-skill comp. index	(6) Pre-1990 cap-skill. comp. index	(7) No-transition cap-skill comp. index
Capital openness * fin. dep.	−0.033**	−0.035*	−0.038***	−0.028**	−0.014	−0.034*	−0.042**
	(0.015)	(0.020)	(0.007)	(0.013)	(0.011)	(0.017)	(0.018)
Capital openness * comp.	−0.004	−0.014	0.003	0.011	0.001	0.041*	0.013
	(0.023)	(0.018)	(0.008)	(0.020)	(0.043)	(0.022)	(0.029)
Capital openness * fin. dep. * comp.	0.127**	0.120	0.149***	0.108**	0.182*	0.095*	0.202**
	(0.058)	(0.071)	(0.025)	(0.045)	(0.102)	(0.053)	(0.079)
Fixed effects							
Country-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,850	5,730	5,040	6,525	6,480	6,480	6,480
R-squared	0.939	0.942	0.910	0.939	0.939	0.939	0.939

The table reports the estimates of the effect of capital account opening on sectoral wage inequality for alternative capital openness measures and capital-skill complementarity measures. Column (1) uses the Quinn (1997) openness index; Column (2) the Abiad, Detragiache, and Tressel (2010) openness index; Column (3) the openness Kaminsky and Schmukler (2008) index; Column (4) the Lane and Milesi-Ferretti (2007) openness index; Column (5) uses a complementarity index estimated using preopening data; Column (6) uses a complementarity index estimated using pre-1990 data; Column (7) uses a complementarity index estimated excluding transition economies. All specifications include country-year, country-industry, and industry-year fixed effects. All specifications include country-year, country-industry, and industry-year fixed effects. Fin. Dep. stands for external financial dependence and Comp. stands for capital-skill complementarity. Standard errors in parentheses are clustered at the country level. ***, **, * denote statistical significance at 1%, 5%, and 10%.

outflows, and unification of the exchange rate system. Kaminsky and Schmukler (2008) create an index based on restrictions on borrowing abroad. Finally, I use the *de facto* measure of financial integration developed by Lane and Milesi-Ferretti (2007), which equals the sum of foreign assets and liabilities as a fraction of GDP. Table 13 reports the results (Columns 1–4). Each column shows the results for a different capital openness measure. The triple interaction term is statistically significant across all measures.

Different measures of complementarity. In Section 3, I estimated the capital-skill complementarity index using data for the whole sample period 1975-2005. This allows me to maximize the number of observations per estimation. However, because the index is calculated with post-opening data, it is not fully exogenous. To address this issue, I provide two alternative measures of the complementarity index. First, I reestimate the index using only preopening data. As before, I obtain a precise opening date by defining the *opening year* as the year in which a country's capital openness index increases by more than one standard deviation. Second, I reestimate the index using data from prior to 1990. In addition, I reestimate the index excluding the transition economies. The idea is to exclude the countries presenting the most distortions and frictions. Table 13 (Columns 5–7) shows the results of estimating Equation (11) using these alternative indexes. The results remain statistically significant.

Others. In Section A.5 of the Online Appendix, I show that the differential effect of capital account opening across industries is particularly strong for older workers and female workers (see Table A.7). Since these workers have relatively low sectoral mobility, this result highlights the importance of imperfect industry mobility for the sectoral analysis. Finally, in Section A.6 of the Online Appendix, I reestimate the sectoral regressions excluding the most developed countries from the sample. According to the analysis (see Table A.8), the results are driven by the less-developed, capital-scarce economies of the sample.

6. Conclusions

Capital account opening affects both economic growth and income inequality. Even though economists have thoroughly studied the effects of capital liberalization on growth, the potentially enormous effect of such a policy on inequality has been underappreciated. The three volumes of the *Handbook of Income Distribution*, for example, do not mention any possible connections between inequality and capital account policy. In this paper, I provide evidence that capital account opening increases wage inequality in a sample of 20 primarily European countries from 1975 through 2005.

I conduct a twofold empirical strategy. First, I use aggregate data and exploit the variation in the timing of capital account openings across countries. Second, I focus on a specific mechanism, which works through technology embodied

in the capital stock. When capital and skilled labor are relative complements, the capital that financially constrained firms raise from abroad increases the relative demand for skilled labor. This enlarges the wage gap between skilled and unskilled workers. The effect should be stronger for firms in industries that are heavily dependent on external finance and for firms in industries with strong complementarity between capital and skills. To identify the mechanism, I use sectoral data and exploit the variation in external financial dependence and complementarity across sectors.

I find that capital opening increases aggregate wage inequality by 5%, which explains 18% of the variation in aggregate wage inequality after accounting for fixed effects. Regarding the mechanism, I find that opening the capital account increases the capital stock in industries with high financial dependence by 10% more than in industries with low dependence. Within above-median dependence industries, opening increases wage inequality in industries with strong complementarity by 3% more than in industries with weak complementarity. This explains 21% of the variation in sectoral wage inequality after accounting for fixed effects. Within below-median dependence industries, the effect is uniform across sectors with different degrees of complementarity.

This paper's findings can be extended in several directions. First, the results are driven by a relatively small set of more-developed countries, which may not be representative of a larger set of countries. It would be interesting to extend the analysis to a broader group of more capital-scarce emerging markets. Second, because the mechanism examined in this paper works within a firm, it would be useful to conduct a firm-level analysis, using a cross-country firm-level dataset. Finally, this paper focuses exclusively on one aspect of income inequality, the wage gap between skilled and unskilled workers. Capital-market integration could also affect cross-dynastic income differences through human-capital accumulation. Extending the analysis to other inequality dimensions represents an interesting direction for further research.

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