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Old before their time: The role of employers in retirement decisions

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Abstract Do elderly workers retire early voluntarily, or are they induced to retire by their employers? We consider an exogenous shock due to a trade agreement between Switzerland and the EU – the Mutual Recognition Agreement (MRA), which improved access to the EU market for Swiss firms. A vast literature suggests that these trade liberalization episodes lead firms to relocate and to innovate in order to increase productivity. This may lead to lower demand of skill obsolescent elderly workers and to higher demand of skilled workers. We use a difference in differences approach on Swiss Labor Force Survey data to compare early retirement behavior in treated (MRA) and control (non-MRA) industries in three periods (pre-liberalization, announcement, and implementation). We find an increase in early retirement in the MRA sector during the announcement period, which is stronger for larger firms, for exporting firms and for firms with a large age wage gap. We also find an increase in the share of graduates in all age groups. Wages are largely unaffected.

JEL classification J14 · J23 · J26 · H55

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1 Introduction

The existing literature on early retirement focuses mostly on the workers' incentives to retire (Gruber and Wise, 2008; Costa, 1998; Blöndal and Scarpetta, 1999; Henriques, 2017;

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Friedberg and Webb, 2005; Mastrobuoni, 2009; Staubli and Zweimüller, 2013; Currie and Madrian, 1999). Yet, survey evidence suggests that workers' early retirement may not represent their voluntary decision, but rather their employers' choice (Dorn and Sousa-Poza, 2010; Marmot et al., 2002). The seminal paper by Lazear (1979) provides the theoretical background for understanding which incentives firms may have to terminate the job match with their elderly workers in normal times. If firms need to restructure in order to become more competitive in new or existing markets, additional incentives to accommodate their elderly workers out of the labor marker may arise. In countries featuring strict employment protection legislations, high firing costs or steep seniority wages, early retirement may thus represent an affordable solution for the firm. The empirical evidence of the effect of labor demand on early retirement is scant.[1] Yet, there are important reasons to investigate this channel. First, the initial adoption of generous early retirement provisions in the sixties and seventies was largely due to workers' dismissals (Conde-Ruiz and Galasso, 2003). Second, and more importantly, the increasing trend in retirement age since the mid-nineties, driven by a change in the pension policy paradigm, may create concerns for firms' productivity.

In this paper, we aim at addressing the relevance of labor demand shocks in retirement decisions. In particular, we analyze how trade liberalization – by modifying domestic firms' opportunities in foreign markets – may affect the transition to early retirement among elderly employees. The novelty of this paper is to exploit as a source of exogenous variation a shock to the manufacturing sector in Switzerland, consisting of the introduction of bilateral trade agreements with the EU, which enhanced foreign market access for some (but not all) Swiss firms. Trade liberalization episodes are known to induce important reallocation effects (see Melitz and Trefler, 2012, for a review). Improved access to foreign markets leads existing and newly-created firms to exploit this new opportunity to improve their competitiveness. Firms may choose to undergo a restructuring process (see Bustos, 2011a) that modifies their labor demand. In particular, firms seek more skilled workers and may dismiss elderly workers, who show skill obsolescence and lower adaptability (Aubert et al., 2006).

Our identification strategy relies on the sectorial variation embedded in one element of the EU-Switzerland Bilateral Agreements I, known as the Mutual Recognition Agreement (MRA), which reduced technical barriers to trade between Switzerland and the EU for some, but not all, industries in the manufacturing sector. MRA introduced the mutual recognition of conformity assessments of standards, such as certificates, tests, product authorizations, across a wide range of industrial products, thereby simplifying procedures and reducing costs for producers in both markets. This liberalization episode is of relevance, since the EU is by far the largest Swiss trading partner. Since 1996, Switzerland had already moved towards this mutual recognition by unilaterally opening the Swiss market to products holding a EU conformity certification. Hence, while de-iure the MRA affected all imports and exports between Switzerland and the EU, de-facto its actual implementation only affected the Swiss exports to the EU. The elimination of the additional controls obtained through the MRA reduced the total cost of the products and the time delay due to double testing. Crucially for our research design, this Mutual Recognition Agreement did not affect all the industries in the manufacturing sector. The MRA between the EU and Switzerland included sectors typically covered by the conformity agreements (see De Brito et al., 2016), such as telecoms

[1] Empirical evidence shows that a rise in the non-wage labor cost increases the retirement rate (Hallberg, 2011); that firms with higher labor costs feature a lower retirement age among their workers (Frimmel et al., 2018); and that recessions in countries featuring a strict employment protection legislation are associated with a higher share of involuntary retirement (Dorn and Sousa-Poza, 2010). On the other hand, the introduction of partial experience rating in unemployment benefits for large Finnish firms reduced the unemployment risk of their older workers (Hakola and Uusitalo, 2005). See also early work by Osberg (1993), using Canadian survey data, and by Abbring et al. (2002), on US and Dutch data.

equipment, good manufacturing practices for medicines and electronic goods, because of compatibility or interoperability requirements, but also other sectors such as medical devices, pressure equipment or machinery. The selection of the sectors to be included in the MRA strictly followed the decisions previously taken by the EU for the creation of the European Economic Area. The Bilateral Agreements I were signed, and publicly announced in 1999. Besides the MRA, the Bilateral Agreements I included also other treaties. Yet, the sectorial variation is exclusive to MRA. The agreements were approved by the Swiss citizens in 2000 with a referendum, and were finally implemented in June 2002. The magnitude of the liberalization was sizable, as Swiss exports to the EU increased by 9% more in the MRA than in the non-MRA sector until 2013 (see Abberger et al., 2015b).

The timing of the MRA and its sectorial variation allow us to identify a treatment and a control group in the manufacturing sector. The treatment consists of providing firms in the sectors covered by the MRA a more simplified and less costly access to the EU market than firms in the control group.[2] As reviewed in details at Section 2, these liberalization episodes produce both within-sector reallocation and within-firm productivity changes, with large effects on the labor demand. We are interested in analyzing the effect on early retirement of a reduction in the labor demand of elderly workers, due to firms' organizational changes. If firms choose to adopt new technologies with the goal of becoming more efficient to compete in the EU market, they modify also the composition of their labor force. The demand of elderly workers, who typically feature lower adaptability and skill obsolescence, drops and the demand of younger and more skilled workers increases. We expect these effects to be present in the Swiss labor market, in which seniority wages and collective bargaining lead to a large labor cost for elderly workers.

We distinguish between two moments in our treatment: an announcement effect, which occurred between the signature of the agreement in 1999 and its implementation in 2002; and the implementation effect, since 2002. During the announcement period, some firms in the affected manufacturing industries had an incentive to begin to restructure their labor force (Costantini and Melitz, 2007). Once the implementation took place, in 2002, the more efficient firms were able to exploit this enlargement opportunity. We use a diff-in-diff approach that exploits these two thresholds: 1999 and 2002. We study the retirement behavior of male individuals aged between 56 and 64 years. The Swiss pension system allows these individuals to claim their occupational pensions, even if eligibility for statutory pensions has not yet been reached (see Bütler et al., 2004).

To address these issues, we exploit two distinct datasets. Information on the individual retirement decisions are obtained from the Swiss Labor Force Survey, which covers a representative sample of the Swiss population, and provides information on workers' characteristics (sex, age, education level, current wage) and on firms' characteristics (industry, location and size). Our sample consists of 19,432 (3,056) observations of male individuals aged 18-64 (56-64), in 1996-2005. Data on firms' exporting behavior are obtained from the Swiss Business Census, which covers the universe of plants in the manufacture and service sectors in Switzerland.

Our paper contributes to understanding early retirement decisions. Unlike other papers in this empirical literature (see Section 2), our analysis provides a causal estimate of the effect of the labor demand shock induced by the trade liberalization that increases access to EU

[2] This trade liberalization episode has been analyzed in other papers. Buehler and Burghardt (2015) focus on the MRA and show that this agreement reduced the treated plants' probability of being vertically integrated by about 10 percent, Buehler et al. (2013) and Helm (2013) study, instead, the overall effects of the Bilateral Agreements I. They show respectively that the Bilateral Agreements I increased the employment growth of affected plants by 1-2 percentage points and decreased the exit rates of about 1.5 percentage points.

market for Swiss firms on early retirement. We find that more elderly workers retire early in the affected manufacturing industries during the announcement period. This effect is sizable: elderly workers in the treatment group (MRA) are 7 percentage points more likely to retire early, which corresponds to 49 thousands more retirees over an elderly population (aged 56-64) of almost 700 thousand individuals.[3] As expected, the impact is stronger in large firms, in exporting firms and in firms featuring large wage differences between young and elderly workers. The share of graduate workers in most age groups increases at implementation in the MRA sectors. Individual wages by age are largely unaffected.

The paper is structured as follows. Section 2 discusses the literature on trade liberalization and retirement. Section 3 describes the Swiss institutional framework and the Mutual recognition Agreement. Section 4 presents the methodology and the results of our empirical analysis. Section 5 concludes.

2 Trade Liberalizations and Retirement

Why does a trade liberalization that increases access to foreign markets, such as the Mutual Recognition Agreement between Switzerland and the EU, affect early retirement decisions? The existing theoretical literature (see Melitz and Trefler, 2012, for a review) suggests that this trade liberalization leads to important firm-level reallocations, which trigger changes in labor market outcomes, including early retirement. The within sector reallocation that follows a trade liberalization induces sorting among existing firms (Melitz, 2003; Bernard et al., 2003). The main channel of interest for our paper is increased access to foreign markets.[4] This induces firms reallocation. Existing more productive domestic firms enter into exports and new (productive) firms emerge that find it profitable to enter the market, and in particular the export sector. Moreover, a trade liberalization that encourages firm to export stimulates also within-plant changes aimed at increasing productivity (Verhoogen, 2008; Lileeva and Trefler, 2010; Bustos, 2011b; Aw et al., 2011). By reducing the cost of access to foreign markets, a trade liberalization thus provides an incentive for firms to innovate, in order to succeed in exporting. The empirical literature has largely validated these theoretical predictions. Evidence that trade liberalization episodes, by improving export opportunities, lead firms to invest in productivity and to innovate is in Lileeva and Trefler (2010), Baldwin and Gu (2004), Lileeva (2008), Bustos (2011b) and Van Biesebroeck (2005). Lileeva and Trefler (2010) uncover also heterogenous effects: among the plants that begin to export after the liberalization, the largest gains in productivity are for those which were initially least productive. Closely related to our study, De Loecker (2007) shows that entry into the EU induced Slovenian firms to innovate, in order to take advantage of the new trading opportunities.

Why do innovation and within plan gains in productivity matter for early retirement? Part of the productivity gains induced by a trade liberalization that increases access to foreign markets comes from skill upgrading and from the increase in the relative demand

[3] According to the Federal Population Census, in Switzerland, in 2000, the total population was 7,288,000 and there were 700,720 individuals aged 56 to 64.

[4] Another type of sorting discussed in the literature is due to the increase in internal competition induced by the entrance of foreign firms. As a result, domestic firms relinquish part of their domestic market and the least productive firms are forced to exit the market. This effect is not very important for our analysis, since Switzerland unilaterally anticipated the recognition of the conformity test on imported EU products already in 1996, i.e., three years earlier than the trade agreements were signed. Hence, our analysis of the 1999 announcement and of the 2002 implementation of the Swiss-EU Mutual Recognition Agreement will not capture any effect on imports.

of skilled labor (see Bustos, 2011a, for the effect of a free trade agreement in Argentina). An additional mechanism is product quality upgrading, as productive firms are induced to produce a larger share of higher-quality goods and thus to improve their workforce (see Verhoogen, 2008, for the effects of the Mexican peso devaluation in 1994). These changes may have negative implications for the elderly workers, since the process of skill upgrading typically affects the age composition of the labor force. In fact, sudden organizational changes induced by the adoption of new technologies are typically detrimental to elderly workers (see Bartel and Sicherman, 1993, Ahituv and Zeira, 2010), who may feature skill obsolescence and lower adaptability (see Aubert et al., 2006, for evidence of an anti-age bias of innovative firms in France). Hence, firms may have an incentive to induce their elderly workers to retire. The extent to which firms rely on early retirement provisions depends also on the relative labor costs of the elderly, on labor market institutions and on how much firms internalize the retirement cost. With collective bargaining agreements and steep seniority wages, the labor cost of elderly workers is much higher than that of young workers. If elderly workers do not compensate with a higher productivity – but rather post lower productivity with the newly introduced technology – firms may have an incentive to fire them or, if the labor market is highly regulated, to induce them to retire. On the other hand, faced with the need to learn new technologies, older workers may choose not to learn, not to take the risk of being fired and to retire. In fact, reallocation from job to job is more difficult for displaced elderly workers who incur higher income losses (Hijzen et al., 2010), who have acquired firm or industry specific human capital (Rogerson, 2005), who have make irreversible occupational choices (Matsuyama, 1992), or who may have strong reasons not to move, such as owning a house or having a spouse working in the same location (Groot and Verberne, 1997).

To summarize, the existing literature suggests that the Swiss-EU trade liberalization, which increased foreign market access to Swiss firms, should induce these firms to innovate. As a result, the demand of elderly workers – and possibly also their supply – should decrease, while the demand of skilled workers should increase.

3 Institutional Background

In this section, we provide some basic information on the history of the institutional relations between Switzerland and the EU, and some data on the magnitude of their trade flows. How Swiss firms – and workers – adjusted to the external demand shock induced by the trade agreements largely depends on the characteristics of the Swiss labor market, and on the pension system. These aspects are discussed later in this section.

3.1 The MRA between Switzerland and the European Union

The extent to which the trade liberalization policy, which occurred with the Mutual Recognition Agreement, is relevant to the Swiss labor market crucially depends on the magnitude of the trade flows between Switzerland and the EU. Switzerland is one of the four most important trading partners for the EU, together with the US, China, and Russia, while the EU is by far the most important trading partner for Switzerland. The initial basis of the economic trade relationship between Switzerland and the European Union was placed in 1972, when Switzerland and the other EFTA (European Free Trade Association) states approved the Free Trade Agreement with the European Community, which eliminated quotas and customs duties on industrial goods. In 1987, however, the European Single Act envisaged the creation of a single market in Europe to be achieved by 1992, with both EC and EFTA

countries joining a European Economic Area. On December 1992, with a referendum the Swiss electorate declined to join the European Economic Area. As a result, the Swiss Federal Council decided to pursue its economic relations with the EU on a bilateral basis, following a pattern that other countries, such as Canada in 1998 and the US in 1999, had already undertaken. Two packages of bilateral agreements were negotiated and signed respectively in 1999 and in 2004.

The Bilateral Agreements I signed by the EU and Switzerland in 1999 included seven treaties.[5] They pertain the free movement of persons, which became fully effective only in 2007, mutual recognition agreement (MRA), public procurement markets, agriculture, overland transport, civil aviation and research. Crucially for our identification strategy, only the MRA featured some sectorial variation. In the Bilateral Agreements I, the Swiss government (and thus the Swiss firms) had little negotiation power, and thereby little influence on the selection decision of the sectors into covered (MRA) or not (non MRA) by the agreement. The negotiation started immediately after the 1992 referendum over the EEA access with a request by the Swiss government to discuss fifteen areas of interest for agreements. A year later, the EU responded with a list of the seven areas. Only these seven areas were eventually regulated under the Bilateral Agreements I. The negotiation process featured joint EU-Switzerland committees, which met regularly to discuss the different issues. Meanwhile, during this period, Switzerland was unilaterally adopting regulations, which were making the country immediately compliant with the future agreements. For instance, a 1996 law on international trade was approved in Switzerland, which allowed products with EU certifications to be imported with no need of further recognition or certification. The Swiss-EU negotiation did not start from scratch. The decision over the mutual recognition procedures and the selection of the sectors to be included in the MRA strictly followed the blueprints previously laid down by the EU for the creation of the European Economic Area. The selection of MRA and non-MRA sectors was largely based on compatibility, interoperability and safety requirements, and Switzerland had little negotiation power. Indeed, the overall negotiation power for Switzerland was quite limited in this respect, due also to a guillotine clause imposed by the EU, according to which all seven agreements had to be approved or the entire package of the Bilateral Agreements I would fail. The partition of sectors into covered by the MRA or not was thus largely exogenous for the Swiss firms. Nevertheless, the characteristics of these two groups of firms differ. Data from the 1995 Swiss Business Census show in fact that firms in MRA were larger – the average size of a plant was 26 workers in MRA and 13 workers in non-MRA. Moreover, the share of exporting firms was 39.7% in MRA and 20.4% in non-MRA, while the share of importing firms was 44.6% in MRA and 28.1% in non-MRA.

The MRA was signed and made public in 1999, but it was implemented only in 2002 – after the approval by the Swiss electorate in a referendum that featured 67.2% of favorable votes. In our empirical analysis, we will thus distinguish three periods: before the agreement (up to 1998), an announcement period (1999-2001) and an implementation period (from 2002). This time structure allows us to test the existence of an announcement effect in the trade liberalization (see Costantini and Melitz, 2007). Figure 1 shows the trend of the Swiss exports towards the EU fifteen countries (EU15) from 1996 to 2005 for MRA and non-MRA sectors.[6] MRA and non-MRA sectors display slightly diverging dynamics, with volumes of

[5] A second group of agreements, the Bilateral agreements II, were signed in 2004 but the time of implementation differs across single agreements. These treaties extend political cooperation to other areas, such as culture, pension and the environment.

[6] For this figure product-level data from the Swiss-Impex database are used. The State Secretariat for Economic Affairs (SECO) helped us classify the tariff codes into our two groups of industries.

exports being stable, or somewhat increasing. After 2002, exports towards the EU in the MRA strongly increased, whereas those in non-MRA sectors remained stable.[7] A report issued by the KOF Swiss Economic Institute (Abberger et al., 2015a), which analyzes the 1992-2013 period, suggests that the probability of a product in MRA sector being exported to the EU increased by around 5% with respect to a product in non-MRA sector. Moreover, exports to the EU increased on average by 9% in MRA with respect to non-MRA sectors.

3.2 The Swiss Labor Market and Pension System

The labor demand of elderly workers, and the extent to which firms may find it convenient to retire elderly workers, depends on several features of the labor market. In particular, steep seniority wages increase the cost for firms of retaining elderly workers, at times when their productivity drops. Yet, tight labor market regulations may make it costly for firms to dismiss them. The Swiss labor market is characterized by collective bargaining agreements, typically at sectoral level, and strong seniority wages (OECD, 2011). The labor earnings of males aged 55-59 is in fact 50% higher than those of male workers in the 25-29 age group. Compared to other OECD countries, Switzerland is in the same range as Italy or the US, but higher than most Scandinavian countries (around 25% higher wages for the elderly) and than UK and Australia (around 15%). On the contrary, the degree of labor market regulation, as measured by the OECD's Employment Protection Regulation index, is rather low: around 1.6 for regular workers – thereby higher than in the UK (1.1) or the US (0.25), but substantially lower than in Italy, France or Germany (between 2.4 and 2.7). Despite the high labor cost for the elderly workers, and the flexibility of the labor market that would allow for easy dismissals, Swiss firms refrain from massive layoffs of costly elderly workers, in part because of social concerns. Firms involved in within-plant reallocations, which affect the age composition of the labor force, may prefer to induce workers to use early retirement options. This is what the individuals' responses to a question on the reasons for taking early retirement, which was asked in the 2002 and 2005 waves of the Swiss Labor Force Survey, suggests. The most common reason for early retirement among male workers was company reorganization (21.6%), followed by bad health (16%), and leisure motives (14%). Overall, employers driven motivations – namely, company closing down, company reorganization, and attractiveness of the retirement package offered by the employer – accounted for more than one third of the early retirement.

In Switzerland, retirement gives access to two types of pension benefits, since the pension scheme is based on two pillars. The first pillar consists of the state-run basic PAYG old age system. This scheme is mandatory for all employees, self-employed, and unemployed individuals over the age of 20. This unfunded system is financed by payroll taxes, which amount to 9.8% of the individual's labor market income. The general retirement age is currently 65 for men and 64 for women.[8] The option of drawing an early retirement pension was introduced in the system in 1997, with the 10th AHV revision. After this reform, individuals were allowed to claim benefits up to one year (and after 2001 to two years) prior to the general retirement age. The benefits are actuarially adjusted in case of early retirement. Pension benefits are reduced by an amount between 3.4% and 6.8% for each year of early withdrawal. On the other hand, pension benefits increase by over 5.2% per year if a pension

[7] We do not report data on import, since Switzerland unilaterally anticipated the recognition of EU products for its internal market.

[8] The normal retirement age for women was raised in two steps from 62 to 63 years in 2001, and to 64 years in 2005.

is drawn after the normal retirement age (but within a five year period). There are no special retirement provisions according to working conditions.

The second pillar consists of fully-funded company pension plans. They are compulsory for these employees, whose income exceeds a minimum threshold. Employees, whose income is below the threshold, and self-employed persons may choose to self-insure. The total contribution to be shared between employers and employees amounts on average to 17% of the individual wage. The minimum age of entitlement varies across pension plans. However, many plans allow early retirement, by offering an option for early withdrawal from employment with actuarially fair reductions. Other private plans may even provide supplementary pensions to bridge the gap until the individual is eligible to receive his public first pillar pension. On average, the observed retirement in occupational plans is substantially below the statutory age even in funds that do not explicitly subsidize early retirement (see Bütler et al., 2004).

4 Empirical Analysis

4.1 The data

In our analysis, we use data from the Swiss Labor Force Survey (SLFS), a rotating panel with up to five interviews per person, which covers a representative sample of the Swiss population. Since 1991, the Federal Statistical Office has conducted the SLFS on an annual basis. The data provide information on sex, age, education level, and current wage, as well as detailed information on industry, location and size of the firm in which the individual is/was employed. In particular, the industry is identified by the NOGA 2002 (Swiss) classification.[9] We use the Directive 98/37/EC, as provided in EC (2002) and EC (2003), to match the sectors covered by the MRA with the corresponding four-digit industries of the NOGA code (see also Buehler and Burghardt, 2015).[10]

Our empirical analysis concentrates on the effects of the trade liberalization on early retirement. To analyze the individual retirement behavior, we use a sample of about 3,056 observations of men aged from 56 to 64 years in the years 1996-2005. Since 1996, the SLFS provides information on the actual labor market activity of the respondents, who are working at the time of the survey, but also on their previous job, for those out of the labor force. Using this information, we define early retirement to occur when an individual aged from 56 to 64 is currently out of the labor force, but was working in the previous year.[11] Due to this retrospective information on the employment status, we can use the survey cross-sectionally – thereby obtaining more observations than we would using only the (rotating) panel component of the dataset. We concentrate on male workers only, since social security requirements for women are less stringent and have been modified over the time span of our analysis. To analyze the impact of the change in trade policy originated by the Bilateral Agreements on the probability of early retirement, we identify male individuals employed in industries, which were subject to the Mutual Recognition Agreement (MRA), as the treatment group and we compare them to a control group composed of individuals employed in manufacturing

[9] The classification used in the EU, which corresponds to the Swiss 4-digit NOGA, is the 4-digit NACE.

[10] A list of industrial products and corresponding Swiss NOGA 2002 industry codes for which the MRA between the EU and Switzerland is operational is in the appendix (Table 9).

[11] Since our dataset does not allow us to know whether an individual collects pension benefits on the first and/or second pillar, we use this definition in order to exclude elderly individuals, who are still looking for a job. We instead include all the elderly individuals, who are out of the labor force, regardless of whether they actually receive a pension benefit.

industries, which were not covered by the MRA (non-MRA). Table 1 provides the summary statistics for our variables of interest over the entire (1996-2005) period, overall and separately for the two groups (Panel 1 for elderly men aged 56-64 and Panel 2 for men aged 18-64). For the period prior to the approval of the Bilateral Agreements (1996-1998), Table 2 compares the descriptive statistics for treatment (MRA) vs control (non-MRA) group in the pretreatment period (1996-98). Again, Panel 1 for elderly men aged 56-64 and Panel 2 for men aged 18-64. Prior to the shock, elderly individuals in these groups did not differ in education, nationality and marital status, but individuals in the treatment group were employed in larger firm plants than those in both control group. This is consistent with the differences at firm level between MRA and non-MRA sector induced by the selection criterion followed by the EU, but exogenous to the Swiss firms (see Section 3.1). We control for these variables in our regressions.

As discussed in section 2, trade liberalization episodes induce a decrease in the demand of elderly workers and an increase in the demand of skilled workers. Besides early retirement, we thus analyze the effect of the trade liberalization also on wages and on the skill composition of the workforce. To examine these effects, we consider a sample of 19,432 observations of male individuals aged 18 to 64 over the 1996-2005 period. As before, individuals employed in industries subject to the Mutual Recognition Agreement (MRA) belong to the treatment group, which we compare to our control group – non-MRA. Table 1 (Panel 2) provides the summary statistics for our variables of interest over the 1996-2005 period for these two groups.

4.2 Empirical Strategy

To investigate the impact of the trade liberalization on the early retirement of the elderly workers, we use a difference in differences estimation approach, which compares the pretreatment period (1996-1998) to the announcement period (1999-2001) and to the after implementation period (2002-2005). Table 3 summarizes levels and changes in the average share of early retirees across the two groups of industries in these three periods. These averages are calculated using data in the years before the Bilateral Agreements were signed (years 1996-1998, *Before*), in the years between the signature and the implementation (1999-2001, *Announcement*), and in the years after the implementation (2002-2005, *After*). The statistics show that before the treatment period the probability of opting for early retirement was on average the same in the treatment and in the control group. In the Announcement period, a significant difference emerges across groups. In fact, against a generalized reduction in the use of early retirement, which drops from 0.074 in 1996-98 to 0.032 in 1999-2001 in the MRA sectors (our control group shown in Table 3) and from 0.079 to 0.043 in the service sector (that was also unaffected by the MRA), early retirement increases from 0.054 to 0.084 in the MRA sectors. After 2002, i.e., in the implementation period, the difference disappears as early retirement in the treatment and in the control groups reverts to its previous level. We then run individual-level linear regressions to compare changes in the early retirement take-up between the two groups of individuals during these three periods. We use this linear regression model also to identify the effects of the liberalization on the wages and on the skill composition of the workforce.[12] In the early retirement regressions, the dependent variable is operationalized as a dummy variable, which is equal to one for those who are out of the labor force in the year of the survey and employed the year before, and to zero for those who are working in the year of the survey and in the previous year. In the wage regressions,

[12] All results are robust to using a probit estimator. Results are available upon request.

we use as dependent variable the log of the individual net hourly wage, defined as the log of the ratio between the total net annual compensation and the average hours worked per week times 48 weeks per year. Finally, in the skill composition regressions, the dependent variable is a dummy taking value one for graduates.

The baseline difference in differences estimator is the following:

$$Y_{it} = \alpha + \gamma Treat_i + \varphi_1 Ann_t + \varphi_2 After_t + \beta_1 Treat_i * Ann_t + \beta_2 Treat_i * After_t + \delta X_{it} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome of interest (early retirement, log of hourly wage and graduate education), the variable $Treat_i$ accounts for average permanent differences between treatment (MRA) and control group (non-MRA), whereas Ann_t and $After_t$ capture the temporal trends common to both groups during the announcement and the implementation period. $Treat_i * Ann_t$ and $Treat_i * After_t$ are the interaction terms between the two respective dummies and measure the true effect of the respective treatments: announcement and implementation. X_{it} is a vector of covariates controlling for firms' and individuals' characteristics. In the regressions, we include dummies for self-employment, size of the firm in which the individual is employed, marital status, macro-region of residence and nationality.[13] Age fixed effects are included in the early retirement regressions. Dummy variables for secondary and postsecondary education are included in regressions on early retirement, but not in those on skill composition of the workforce and on wages. Finally, ε_{it} is an error term. We present different specifications, in which industry, year and region fixed effects are used. Standard errors are clustered at 4-digit industry level, which correspond to our level of sorting in the MRA sectors.

The difference-in-differences approach requires a common trend assumption. In the absence of the trade agreements, the difference in the outcome between the treatment and the control group should have been the same. We can test for these differences in the pre-treatment trends. Table 4 presents the results of the regressions in which, for the individual early retirement decision, in the pre-treatment (1996-98) period, we compare the year by year difference between treatment (MRA) and control group (non-MRA). No significant differences emerge.[14]

As discussed in section 2, the effects of an increased access to foreign markets – induced by the trade liberalization – on early retirement may differ according to the firms' characteristics. In particular, we expect these effects to be stronger for larger firms, for exporting firms and for firms operating in sectors in which elderly workers' wages are higher, relative to younger workers. To test these hypotheses, we run the following triple difference in differences regressions:

$$\begin{aligned} Y_{ijt} = \alpha + \gamma Treat_i + \varphi_1 Ann_t + \varphi_2 After_t + \beta_1 Treat_i * Ann_t + \beta_2 Treat_i * After_t + \\ + \beta_3 Index_j + \beta_4 Treat_i * Index_j + \beta_5 Ann_t * Index_j + \beta_6 After_t * Index_j + \\ + \beta_7 Treat_i * Ann_t * Index_j + \beta_8 Treat_i * After_t * Index_j + \delta X_{it} + \varepsilon_{ijt} \end{aligned} \quad (2)$$

[13] We consider five different levels of firm size (n).The variable is equal to 1 if $n <= 10$; = 2 if $n > 10$ and $n < 20$; = 3 if $n >= 20$ and $n < 50$; = 4 if $n >= 50$ and $n < 99$; = 5 if $n > 99$. Moreover, seven macro-regions are identified. Macro-region 1 includes Vaud, Valais, and Geneva; macro-region 2 includes Bern, Fribourg, Solothurn, Neuchatel, and Jura; macro-region 3 includes Basel City, Basel Land, and Argovia; macro-region 4 includes Zurich; macro-region 5 includes Glarus, Schaffhausen, Appenzell O. Rh., Appenzell I. Rh., St. Gall, Grisons, and Thurgovia; macro-region 6 includes Lucerne, Uri, Schwyz, Nidwald, Obwald, and Zug; macro-region 7 includes Ticino.

[14] Tables 10 to 11 in the appendix present the same analysis for individual wage, age and skill composition. No difference emerges in the pre-treatment period, except for the wages of the younger workers.

where $Index_j$ is respectively a dummy variable for large firms (with 100 or more workers)[15], a pre-liberalization sectoral index of exports (constructed using 1995 Swiss Business Census data)[16] and a measure of the wage gap between elderly and young workers. This last index is computed using hourly wages in the 1990s and estimating the following equation:

$$HourlyWage_{ijt} = \alpha + \beta * old_i + \theta_j + \gamma_j * old_i * \theta_j + \delta X_{it} + \varepsilon_{ijt} \quad (3)$$

where old_i is a dummy for individuals aged above 50, θ_j are job fixed effect (industry x occupation) and X_{it} are our individual control variables previously described. Hence, γ_j represents an estimate of the wage gap between elderly and young workers in each sector.

4.3 Results

Table 5 presents our results on individual retirement. We analyze the announcement and implementation effect of the Bilateral Agreement by comparing the early retirement behavior in the treatment group (MRA manufacturing industries) with our control group (non-MRA manufacturing industries). Column (1) reports the estimates of equation 1 with no control variables; in column (2) control variables, age, year and region fixed effects are included, and in column (3) the results include also firm size and industry dummies. More early retirement takes place in the affected sectors during the announcement period. In fact, the coefficient on the interaction term *Treatment*Ann* is statistically significant and positive in all columns. The signature of the agreement is indeed associated with an increase of approximately 7 percentage points in early labor force withdrawal. With a Swiss population in the age group 56-64 of almost 700 thousands, the effect induces 49 thousands workers to retire earlier, which corresponds to 1 per cent of the entire working age population. The coefficient on the interaction term *Treatment*After* is never statistically significant: the actual implementation of the MRA does not seem to induce early labor force withdrawal. All the adjustements to the labor force have already taken place. We expect these effects to be stronger in larger and exporting firms, which are more exposed to the effect of the trade liberalization, and thus induced to make larger adjustments to their labor force. But also in firms with a large wage cost for elderly workers, relative to the young. In Table 6, Panel 1, we show the results of the regressions in equation 2, in which we interact our treatment with the size of the firms.[17] The increase in early retirement at announcement is particularly strong in large firms, where it is 0.13 percentage points larger than in small firms. Table 6, Panel 2, reports the results of the regressions, in which our treatment is interacted with the export index. Our empirical results show a much larger use of early retirement at announcement in firms operating in more exporting sectors. A raise in the export index of one standard deviation[18] induces an additional increase in early retirement of 7.4 percentage points. In Table 6, Panel 3, we show the results of the regression at equation 2, when our treatment is interacted

[15] In the analysis on firm size, we includes in equation 3 also a dummy variable for medium firms (having between 20 and 99 workers) and the relative interactions.

[16] The Swiss Business Census, compiled by the Swiss Federal Statistical Office, covers the universe of plants with more than 20 weekly aggregate working hours in the manufacture and service sectors. It contains detailed information on location, sector of activity, number of employees of about 300,000 firms. We aggregate our firm-level observations to the 4-digit NOGA industry level and calculate the share of exporting firms by industry level. We then assign this index to each individual in the sector.

[17] We construct three firm size dummies: small firms (the omitted variable in Table 6) have less than 20 workers; medium firms have between 20 and 99 workers, and large firms have 100 or more workers.

[18] The mean of the export index over the sample is 0.49 with a standard deviation of 0.26.

with our measure of the wage gap between elderly and young workers. As expected, firms in sectors with a higher wage gap between the elderly and younger workers feature more early retirement at announcement. In particular, in sectors where elderly employees earn 4 Swiss francs (per hour) more than young (corresponding to one standard deviation of the variable)[19], early retirement increases an additional 5.2 percentage points.

To provide a visual analysis of the transformation of the workforce induced by the liberalization, we exploit the individual data for the sample of male individuals aged 18 to 64 in the 1996-2005 period. We construct the empirical kernels of the male workers' distribution by age in the MRA and non-MRA sectors in 1998, 2001 and 2004, corresponding respectively to the last year prior to the announcement, to the last year prior to the implementation and to last year prior to the Bilateral Agreements II. These three distributions are suggestive of the age composition at three points in time: prior to the trade agreement, after an initial adjustment induced by the announcement has taken place, and after the adjustment driven by the implementation has had some time to become effective. Figure 2 shows that in 1998, the age distributions in treatment (MRA) and control (non-MRA) were very similar (there is no significant difference according to the Kolmogorov Smirnov test), but they diverged in 2001, as the share of elderly workers decreased and the share of individuals in their thirties increased relatively to the non-MRA sector. In 2004, they were still different: much fewer individuals in their late 50s and early 60s were employed in the MRA sectors, due to the labor force adjustments made in the announcement period.[20]

This empirical evidence thus suggests that the trade liberalization had an impact on the age composition of the workforce. To assess whether the entire effect was driven by labor demand shift, we analyze the impact on the hourly wages. We consider workers in four age groups (18-30, 31-45, 46-55 and 56-64) and compare the log of their hourly wages in the treatment (MRA manufacturing industries) and in the control group (non-MRA manufacturing industries). The results in Table 7 suggest that individual wages by age groups were not affected by the trade liberalization, with the exception of an increase in the wages of the 46-55 years old workers. This evidence is consistent with a reduction in the labor demand of the elderly workers accompanied by a drop in their labor supply and with an increase in the demand of adult workers in the closest age bracket (46-55).

To assess the effects of the trade liberalization on the demand of skilled workers, we analyze the share of college graduates in four age groups (18-30, 31-45, 46-55 and 56-64) in the treatment and control groups. As shown in Table 8, the skill composition by age group does change. At announcement, the share of graduates increases among the elderly workers. This may be due to a selection effect, as mostly less educated elderly workers retire, while the more educated ones remain in the labor market. At implementation, more graduates appear in the 31-45 age group and in the 46-55 age group.

Taken together, the empirical evidence on early retirement, wages and skill composition, displayed in Figure 2 and Tables 5 to 8 suggests that firms in MRA industries reacted to the trade policy by reducing their demand of elderly workers, particularly for the non-graduate, at announcement and by replacing them with younger and more-educated individuals. These adjustments largely reshaped the age profile of the labor force in the MRA sector. As expected, the use of early retirement was stronger in larger firms, in exporting firms and in firms active in sectors featuring a larger age wage gap.

[19] The mean of the wage gap variable over the sample is 5.46 with a standard deviation of 3.97.

[20] By 2004, the age composition of the work force in the MRA sectors had become almost identical to that of the service sector.

5 Concluding remarks

Retirement is a crucial aspect of all pension policies and its determinants have long been analyzed. Most of the existing literature focuses however on the workers' choice, as if retirement were exclusively a labor supply phenomenon. Yet, decisions by the employers to retain older employees or to push them into retirement are just as relevant. Steep seniority wages, high firing costs, rigid labor market regulations and even social concerns may prevent firms from displacing elderly – and perhaps less productive – workers. Early retirement may then come as a handy solution.

However, despite supporting evidence from survey data, the role of the firms in early retirement decisions is difficult to identify empirically. The novelty of this paper is to exploit the negotiation and implementation of the Bilateral Agreements I between the EU and Switzerland as a source of exogenous variation, which affects the labor demand of Swiss firms. The Swiss-EU mutual recognition agreement effectively reduced the (fixed) cost of exporting in the EU for Swiss firms. As suggested by a vast literature, this increased access to foreign markets may induce firms to relocate – both within and across sectors – and to innovate, with important labor market effects, particularly for the elderly workers, whose labor demand may decrease.

We use a differences in differences approach to show that in firms affected by this MRA the use of early retirement provisions increased already in 1999, when the agreement was initially signed. As expected, this effect was stronger in larger firms, among exporters and in firms operating in sectors where the elderly enjoy particularly high wages (relative to younger workers).

Our results have relevant policy implications. Recent reforms, which modified individuals' incentives by penalizing early retirement, have been rather successful in raising the employment rate among the elderly workers. However, the practice by large firms of inducing elderly, less productive workers to retire is still quite common. Reforms attempting to link retirement age to individuals' longevity will have to consider this additional hurdle.

Figures and Tables

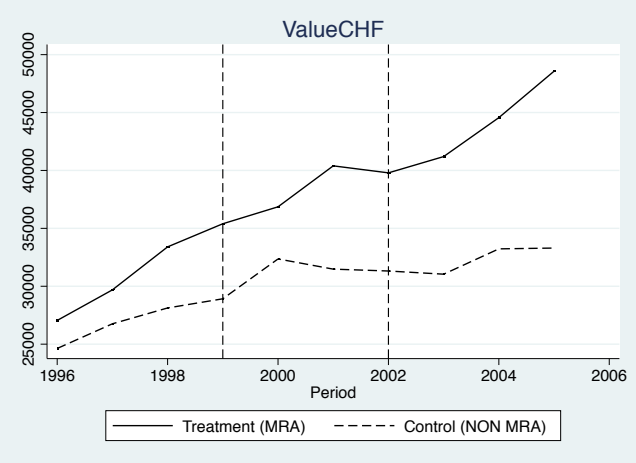
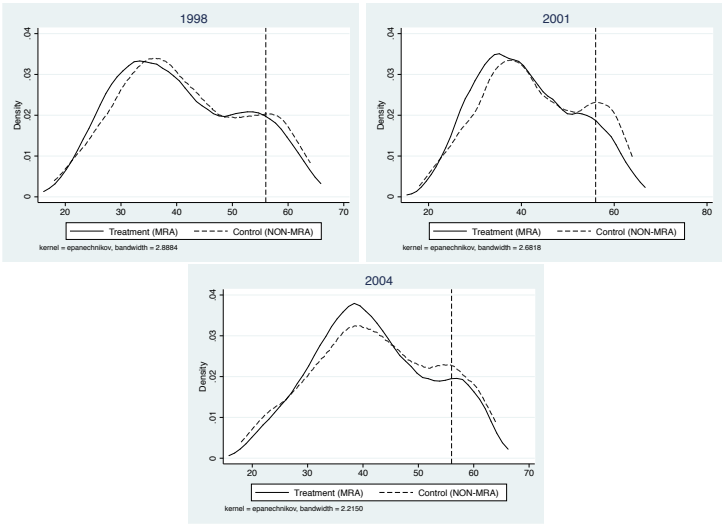


Fig. 1: Value of Swiss Exports to the EU15 (CHF, Million), Swiss-Impex data

Fig. 2: Workers Distribution by Age



(a) Workers Distribution by Age in Treatment and Control industries, SLFS

Table 1: Descriptive Statistics (Years 1996-2005)

Panel 1 (Sample: Men, 56-64)								
Group	EarlyRetirees	Age	UpperSec	Post Sec	Married	Foreigner	Size	HWage
Control (nonMRA)	0.054	59.6	0.57	0.238	0.770	0.330	3.43	37.2
sd	(0.227)	(2.49)	(0.496)	(0.426)	(0.421)	(0.47)	(1.65)	(19.9)
N	1750	1750	1750	1750	1750	1750	1730	1411
Treatment (MRA)	0.056	59.4	0.53	0.325	0.799	0.314	4.04	41.8
sd	(0.23)	(2.42)	(0.499)	(0.469)	(0.401)	(0.464)	(1.43)	(23.8)
N	1306	1306	1306	1306	1306	1306	1303	1068
Total	0.055	59.5	0.55	0.276	0.782	0.323	3.69	39.2
sd	(0.228)	(2.46)	(0.498)	(0.447)	(0.413)	(0.468)	(1.59)	(21.8)
N	3056	3056	3056	3056	3056	3056	3033	2479
Panel 2 (Sample: Men,18-64)								
Group	OlderWorkers	Age	UpperSec	Post Sec	Married	Foreigner	Size	HWage
Control (nonMRA)	0.166	42.5	.60	.233	.663	.366	3.36	34.2
sd	(0.372)	(11.3)	(0.49)	(0.423)	(0.473)	(0.482)	(1.62)	(18.3)
N	10301	10301	10301	10301	10301	10301	10191	9129
Treatment (MRA)	0.138	41.7	0.53	0.360	0.648	0.345	4.03	38.2
sd	(0.345)	(10.8)	(0.499)	(0.48)	(0.478)	(0.475)	(1.39)	(29.6)
N	9131	9131	9131	9131	9131	9131	9064	8103
Total	0.153	42.1	0.57	0.293	0.656	0.356	3.68	36.1
sd	(0.36)	(11.1)	(0.495)	(0.455)	(0.475)	(0.479)	(1.55)	(24.3)
N	19432	19432	19432	19432	19432	19432	19255	17232

Note. Means of key variables in the treatment and the control group, for the older and overall sample: share of early retirees, share of older workers, average age, share of individuals with upper-secondary education, share of individuals with post-secondary education, share of married individuals, share of foreigners, average size of enterprise ("1" if $n <= 10$; "2" if $n > 10$ and $n < 20$; "3" if $n >= 20$ and $n < 50$; "4" if $n >= 50$ and $n < 99$; "5" if $n > 99$), average hourly net wage. Sample of years 1996-2005. Standard deviations in parentheses.

Table 2: Baseline Covariates (Years 1996-1998)

Panel 1: Men, 56-64			
	Treatment (MRA)	Control (nonMRA)	Difference
Age	59.299	59.514	-0.216
se	(0.172)	(0.148)	(0.228)
N	201	282	
Upper Secondary	0.627	0.606	-0.020
se	(0.034)	(0.029)	(0.045)
N	201	282	
Post Secondary	0.269	0.259	-0.010
se	(0.031)	(0.026)	(0.041)
N	201	282	
Married	0.776	0.759	0.017
se	(0.029)	(0.026)	(0.039)
N	201	282	
Foreigner	0.154	0.188	-0.034
se	(0.026)	(0.023)	(0.035)
N	201	282	
Size	4.040	3.487	0.552***
se	(0.104)	(0.100)	(0.147)
N	201	279	
Hourly Wage	36.669	36.262	-0.406
se	(1.026)	(1.447)	(0.147)
N	173	217	
Panel 2: Men, 18-64			
	Treatment (MRA)	Control (nonMRA)	Difference
Older Workers	0.136	0.150	-0.014
se	(0.009)	(0.008)	(0.012)
N	1443	1779	
Age	40.774	41.654	-0.880**
se	(0.296)	(0.267)	(0.399)
N	1443	1779	
Upper Secondary	0.604	0.638	-0.034**
se	(0.013)	(0.011)	(0.017)
N	1443	1779	
Post Secondary	0.324	0.256	0.068***
se	(0.012)	(0.010)	(0.016)
N	1443	1779	
Married	0.609	0.635	-0.025
se	(0.013)	(0.011)	(0.017)
N	1443	1779	
Foreigner	0.157	0.194	-0.038***
se	(0.010)	(0.009)	(0.014)
N	1443	1779	
Size	3.942	3.350	0.592***
se	(0.039)	(0.039)	(0.056)
N	1437	1764	
Hourly Wage	36.352	33.656	2.695*
se	(1.423)	(0.537)	(1.420)
N	1286	1560	

Note. Pre-treatment baseline covariates in the treatment and the control group and their difference, for the older and overall sample: share of early retirees, share of older workers, average age, share of individuals with upper-secondary education, share of individuals with post-secondary education, share of married individuals, share of foreigners, average size of enterprise ("1" if $n <= 10$; "2" if $n > 10$ and $n < 20$; "3" if $n >= 20$ and $n < 50$; "4" if $n >= 50$ and $n < 99$; "5" if $n > 99$), average hourly net wage. Standard errors in parentheses. The following symbols indicate different significance levels: *** - significant at 1 percent, ** - significant at 5 percent, * - significant at 10 percent. Sample of years 1996-1998.

Table 3: Descriptive Analysis: Early retirement (Sample: Men, 56-64)

	Before	Announcement	After	Diff(Before-Ann.)	Diff(Before-After)
Treatment (MRA)	0.054	0.084	0.049	-0.029	0.005
se	(0.016)	(0.018)	(0.007)	(0.025)	(0.017)
Control (nonMRA)	0.074	0.032	0.055	0.043***	0.019
se	(0.016)	(0.010)	(0.007)	(0.018)	(0.016)
Diff	-0.020	0.052***	-0.006		
se	(0.023)	(0.020)	(0.010)		
N	3056				

Note. Share of early retirement in the years before the Bilateral Agreements were signed (Before: 1996-1998), in the years between the signature and the implementation (Announcement: 1999-2001) and in the years after the implementation (After: 2002-2005), in treatment and control group. Standard errors in parentheses. The following symbols indicate different significance levels: *** - significant at 1 percent, ** - significant at 5 percent, * - significant at 10 percent.

Table 4: Pre-Treatment Trend, Early Retirement (Sample: Men, 56-64)

VARIABLES	(1)	(2)	(3)
Treatment	-0.027	-0.033	-0.054
	(0.045)	(0.046)	(0.044)
Treatment*97	-0.002	-0.011	-0.011
	(0.057)	(0.060)	(0.061)
Treatment*98	0.025	0.032	0.045
	(0.054)	(0.052)	(0.053)
Observations	483	483	480
R-squared	0.012	0.092	0.103
Controls	NO	YES	YES
age FE	NO	YES	YES
size FE	NO	NO	YES
year FE	NO	YES	YES
region FE	NO	YES	YES
1-digit NOGA FE	NO	NO	YES

Note. Dependent variable: dummy variable equal to 1 for individuals out of the labor force in t and employed the year before, 0 for those who are woking in the year of the survey and in the previous year. Controls include dummies for marital, foreign, self-employment status, and for having upper secondary education or post-secondary education. Standard errors clustered at 4-digit industry level are in parentheses. The following symbols indicate different significance levels: *** - significant at 1 percent, ** - significant at 5 percent, * - significant at 10 percent.

Table 5: Early Retirement (Sample: Men, 56-64)

	(1)	(2)	(3)
Treatment	-0.020	-0.018	-0.024
	(0.025)	(0.022)	(0.022)
Ann	-0.043**	-0.105***	-0.106***
	(0.018)	(0.023)	(0.023)
After	-0.019	-0.052**	-0.050**
	(0.018)	(0.025)	(0.025)
Treatment*Ann	0.072**	0.068**	0.070**
	(0.034)	(0.032)	(0.032)
Treatment*After	0.013	0.013	0.012
	(0.024)	(0.020)	(0.020)
Observations	3,056	3,056	3,033
R-squared	0.003	0.059	0.067
Controls	NO	YES	YES
age FE	NO	YES	YES
size FE	NO	NO	YES
year FE	NO	YES	YES
region FE	NO	YES	YES
1-digit NOGA FE	NO	NO	YES

Note. Dependent variable: dummy variable equal to 1 for individuals out of the labor force in t and employed the year before, 0 for those who are woking in the year of the survey and in the previous year. Controls include dummies for marital, foreign, self-employment status, and for having upper secondary education or post-secondary education. Standard errors clustered at 4-digit industry level are in parentheses.

Table 6: Early Retirement, Heterogeneity (Sample: Men, 56-64)

Panel1: Size		Panel 2: Exports		Panel 3: Wage gap	
Treat	0.006	Treat	0.079	Treat	-0.013
	(0.037)		(0.062)		(0.035)
Ann	-0.078**	Ann	-0.079**	Ann	-0.108***
	(0.031)		(0.032)		(0.038)
After	-0.031	After	-0.009	After	-0.052
	(0.030)		(0.034)		(0.038)
Treat*Ann	-0.013	Treat*Ann	-0.091	Treat*Ann	-0.007
	(0.046)		(0.076)		(0.039)
Treat*After	-0.020	Treat*After	-0.070	Treat*After	0.009
	(0.039)		(0.061)		(0.026)
Treat.*Ann*Big	0.130*	Treat.*Ann*Index	0.286**	Treat.*Ann*gamma	0.013*
	(0.069)		(0.123)		(0.008)
Treat.*After*Big	0.077	Treat.*After*Index	0.151	Treat.*After*gamma	-0.001
	(0.057)		(0.098)		(0.004)
Observations	3,033	Observations	2,999	Observations	3,018
R-squared	0.069	R-squared	0.071	R-squared	0.073
Controls	YES	Controls	YES	Controls	YES
age FE	YES	age FE	YES	age FE	YES
size FE	YES	size FE	YES	size FE	YES
year FE	YES	year FE	YES	year FE	YES
region FE	YES	region FE	YES	region FE	YES
1-digit NOGA FE	YES	1-digit NOGA FE	YES	1-digit NOGA FE	YES

Note. Dependent variable: dummy variable equal to 1 for individuals out of the labor force in t and employed the year before, 0 for those who are woking in the year of the survey and in the previous year. Relevant dummies and their interactions are included in the regression, but their coefficients are not reported. Regressions in panel 1 include a dummy for individuals working in medium size companies and its interactions. Controls include dummies for marital, foreign, self-employment status, and for having upper secondary or post-secondary education. Standard errors are clustered at 4-digit industry. Data: SLFS (1996-2005).

Table 7: Log Hourly Wage by Age Group (Samples: Men; 18-30, 31-45, 46-55, 56-64)

	Men, 18-30	Men, 31-45	Men, 46-55	Men, 56-64
Treatment	0.011	0.058**	0.007	0.024
	(0.030)	(0.029)	(0.046)	(0.063)
Treatment*Ann	-0.011	0.020	-0.018	0.035
	(0.043)	(0.029)	(0.047)	(0.070)
Treatment*After	-0.001	0.022	0.103**	0.056
	(0.036)	(0.032)	(0.044)	(0.067)
Observations	2,768	8,087	3,714	2,532
R-squared	0.091	0.139	0.150	0.122
Controls	NO	YES	YES	
size FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
region FE	YES	YES	YES	YES
1-digit NOGA FE	YES	YES	YES	YES

*Note.*The sample is splitted in four groups according to the age of the individual: 18-30, 31-45, 46-55, 56-64. The analysis is conducted for each age group. Dependent variable: log of the individual net hourly wage. We control for marital, foreign, self-employment status. In these regression we do not include education level dummies. Standard errors clustered at 4-digit industry level are in parentheses. The following symbols indicate different significance levels: *** - significant at 1 percent, ** - significant at 5 percent, * - significant at 10 percent.

Table 8: Skill Composition by Age Group (Sample: Men; 18-30, 31-45, 46-55, 56-64)

VARIABLES	Men,18-30	Men, 31-45	Men, 46-55	Men, 56-64
Treatment	0.119***	0.041	-0.010	0.002
	(0.038)	(0.032)	(0.047)	(0.057)
Treatment*Ann	-0.058	0.045	0.039	0.129*
	(0.047)	(0.034)	(0.058)	(0.076)
Treatment*After	-0.030	0.110***	0.116**	0.078
	(0.045)	(0.037)	(0.048)	(0.072)
Observations	3,049	8,989	4,274	2,943
R-squared	0.083	0.077	0.058	0.053
size FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
region FE	YES	YES	YES	YES
1-digit NOGA FE	YES	YES	YES	YES

Note. Dependent variable: dummy variable for graduate workers. We control for marital, foreign, and self-employment status. Standard errors clustered at 4-digit industry level are in parentheses. The following symbols indicate different significance levels: *** - significant at 1 percent, ** - significant at 5 percent, * - significant at 10 percent.

Appendix

Table 9: Industries covered by the Mutual Recognition Agreement

Product Sector	Corresponding Swiss NOGA 2002 industry code
Machinery	29.12, 29.14, 29.2, 29.32, 29.4, 29.5, 29.72
Personal protective equipment	18.21,18.24, 25.24, 28.75, 33.40, 36.40
Toys	36.50
Medical devises	33.10
Gas appliances and boilers	28.22, 28.30
Pressure Vessels	28.30,28.71
Telecomminications terminal equipment	33.20
Equipment and protective systems	28.2, 28.3, 29.23, 29.24, 29.4, 31.61, 33.2, 33.3
Electrical equipment	30, 31, 32
Construction plants and equipment	29.52
Measuring instruments and prepackages	33.20
Motor vehicle	31.61, 34
Agricultural and forestry tractors	29.31
Good laboratory practice (GLP)	15, 24.1, 24.20, 24.42, 24.51, 24.52
Medical products and GMP inspection and Bath Certification	24.42

Note. The table lists industrial products and corresponding Swiss NOGA 2002 industry codes covered by the MRA.

Table 10: Pre-Treatment Trend, Log Hourly Wage by Age Group (Sample: Men; 18-30, 31-45, 46-55, 56-64)

VARIABLES	18-30	31-45	46-55	56-64
Treatment	-0.046	0.021	0.017	0.038
	(0.041)	(0.036)	(0.058)	(0.064)
Treatment*97	0.064	0.003	-0.014	-0.013
	(0.055)	(0.035)	(0.079)	(0.065)
Treatment*98	0.103**	0.041	-0.056	-0.045
	(0.050)	(0.041)	(0.062)	(0.076)
Observations	557	1,298	577	398
R-squared	0.125	0.172	0.176	0.219
Controls	YES	YES	YES	YES
size FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
region FE	YES	YES	YES	YES
1-digit NOGA FE	YES	YES	YES	YES

Note. Dependent variable: log of the individual net hourly wage. We control for marital, foreign, self-employment status. Standard errors clustered at 4-digit industry level are in parentheses.

Table 11: Pre-Treatment Trend, Skill Composition by Age Group (Sample: Men; 18-30, 31-45, 46-55, 56-64)

VARIABLES	18-30	31-45	46-55	56-64
Treatment	0.154***	0.033	0.040	0.035
	(0.048)	(0.044)	(0.058)	(0.074)
Treatment*97	0.032	-0.002	-0.021	-0.105*
	(0.066)	(0.037)	(0.057)	(0.061)
Treatment*98	-0.103	-0.022	-0.028	0.049
	(0.075)	(0.048)	(0.068)	(0.094)
Observations	615	1,444	683	459
R-squared	0.133	0.085	0.064	0.101
Controls	YES	YES	YES	YES
size FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
region FE	YES	YES	YES	YES
1-digit NOGA FE	YES	YES	YES	YES

Note. Dependent variable: dummy variable for graduate workers. We control for marital, foreign and self-employment status. Standard errors clustered at 4-digit industry level are in parentheses.

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