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High-Skill Migration to Canada and Switzerland: *Retention, Attraction and Competition with the United States through Policy*

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HIGH-SKILL MIGRATION TO CANADA AND SWITZERLAND: RETENTION, ATTRACTION AND COMPETITION WITH THE UNITED STATES THROUGH POLICY

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ABSTRACT

Small high-income countries have been particularly worried about losing their best brains to the United States at a time when industrialised economies have had to re-invent their comparative advantage in order to foster economic growth. Yet, little is known about the true magnitude of these flows, their evolution in recent years, and the role of policies in shaping them. This paper analyses the bilateral brain flows between Canada, Switzerland, and the United States. The three countries are linked through brain exchanges as well as by brain gains/losses, depending on occupations and partners. Canada and Switzerland can improve retention and attraction of foreign brains by implementing skill-oriented policies such as R&D spending. However, while Switzerland has successfully implemented such policies, Canada does not appear to have used that opportunity, instead continuing to rely on supply-driven immigration policy.

1. INTRODUCTION

With increased globalization, the nature and magnitude of migration have changed. The lowering of barriers to good and capital flows and the re-distribution of world production mostly toward low-income countries have forced high-income countries to redirect their comparative advantage toward knowledge and innovation. However, the globalization of knowledge has started to weaken rich countries' base for comparative advantage (Freeman 2010). As a consequence, they have entered a stiff competition for highly skilled people and have thus simultaneously increased the average domestic level of education¹ and turned to immigration to raise the skill content of their labour force. Yet, many countries often feel helpless toward the perceived natural attractiveness of the United States for high-skill migrants (Cervantes and Goldstein 2008), and they have developed various targeted policies both to keep their brains and to attract others. Nevertheless, these policies are often seen as either insufficient or not strategically developed and thus inefficient (OECD 2008a).

In this paper, I investigate the factors and policies that influence the location decision of highly skilled people.² The focus is on two small economies, i.e., Switzerland and Canada, in competition with the United States, and two questions are investigated: First, what type of brain flows exist bilaterally between these countries? Second, what generates these flows, and in particular, are the two countries' domestic skill-oriented policies—beyond their immigration policies—effective in retaining and attracting brains? The choice of these three countries for this study is in part guided by their apparent success in

1 In 2002, the share of population with tertiary education was 32 percent for the age cohort 55–64 and 51 percent for the age cohort 25–34 in Canada; 21 percent and 26 percent in Switzerland; and 33 percent and 39 percent in the United States (OECD 2004, Table A.3.3.).

2 The expressions "skilled expatriates," "skilled migrants/immigrants," and "brains" are used interchangeably in this paper.

attracting skilled immigrants; however, the two small countries have become increasingly concerned about losing their attractiveness to skilled immigrants in comparison to the United States,³ and they have approached the challenge of innovation very differently.

Between 1990 and 2000, while starting from very different levels, the skill content of Canadian, Swiss and American expatriates in the three countries increased drastically. In Canada and the United States, about three-quarters of expatriates from the other two countries have tertiary education while in Switzerland, this figure is closer to one-half (Docquier and Marfouk 2005). This growth has been realised under very different immigration policies and policies for innovation. Canada and the United States are settlement countries (i.e., they rely on the supply of immigrants), but only Canada targets explicitly skilled candidates; in Switzerland, immigration is strictly driven by labour market demand. At the same time, Canada's performance in innovation is close to the worst among industrialized countries (fourteenth out of seventeen countries) while Switzerland and the United States rank first and third, respectively (Conference Board of Canada 2010).

This study shows that despite the United States being a magnet for brains, some of the reasons why Canadian and Swiss brains migrate there originate in their home country. Skill-oriented policies of small countries, such as R&D spending, which create an attractive environment for technicians and professionals, are as important for skill retention as they are for skill attraction. The exception is academics who are irremediably attracted to the United States. Hence, in the race for maintaining comparative advantage through innovation, Canada appears to lose ground compared to Switzerland, and this is perhaps

³ Canada's concerns about brain flight to the United States peaked in the 1990s (Helliwell 1999) while the Swiss concerns are more recent (Wadhwa et al. 2009; Swiss American Chamber of Commerce and Boston Consulting Group 2008).

also illustrated by the difficulty highly skilled immigrants to Canada experience in finding jobs in their occupation of choice.

The rest of the paper is organized in the following way: Section 2 briefly surveys the existing literature. Section 3 details the immigration policies in place as well as some definitional differences, and also develops a comparable measure for skilled flows between the three countries. Section 4 provides a description of the brain flows, and Section 5, an empirical analysis of a flow model between Canada, Switzerland, and the United States between 1990 and 2000. The policy implications are derived in Section 6, and Section 7 concludes.

2. IMMIGRATION OF BRAINS

While policymakers have been focusing on stimulating skilled migration for years, the literature on what drives brains across borders is relatively sparse. Questions are explored using very different set-ups and definitions, and research is difficult to reconcile and compare; however, Koser and Salt (1997) and OECD (2008) are useful reviews of the main questions and arguments.

Until recently, the brain drain and its cost to source and destination countries have been the main research issues.⁴ The focus, however, has started to shift from the issue of losses to that of the benefits resulting from the flow of brains and to high-skill migrants' contribution to the host economy in innovation or productivity (Maskus, Mobarak, and Stuen 2010; Hunter, Oswald, and Charlton 2009; Ackers 2005). Finally, there is a growing literature on the location decision process of high-skill migrants to which this paper is a contribution because understanding what drives skilled migrants to move among

⁴ There is also a vast literature on the impact of all types of immigrants on the domestic labour market (see Okkerse 2008).

rich countries is fundamental to designing policies that will better lure them. Where the standard push and pull model is used, a certain consensus has emerged that the most important drivers behind high-skill migration are those related to economic and labour market characteristics, i.e., work conditions, professional opportunities, career prospects, and financial prospects, while cultural networks, past colonial ties, and language are more likely to influence low-skill migration (Gross and Schmitt 2010, for France; Docquier, Lohests, and Marfouk 2006, for OECD countries; Cheng and Yang 1998, for the United States).⁵ Some factors are obviously outside the scope of policy, but others can be targeted to attempt to attract more skilled immigrants. For example, most OECD countries have developed strategies to encourage mobility of the highly skilled by stimulating research and development spending through various tax schemes or promoting international activities in research (see OECD 2008a, Table 4.1).

One of the major problems in the analysis of skilled migration is how to define who is considered *skilled* as there is no universally accepted definition with readily available data (OECD 2008; Koser and Salt 1997). The most widely used reference is tertiary education completion (for example Docquier and Marfouk 2006; Dumont and Lemaître 2005). Yet, national systems of higher education are often not directly comparable, and some have studied only members of specific occupations, such as elite scientists (Ioannidis 2004; Hunter, Oswald, and Charlton 2009) or PhDs (Regets 2001). Others have combined education with occupation (Mahroum 2001) or looked at professionals (Iredale 2001; Cheng and Yang 1998). Entrepreneurs are sometimes also

⁵ Surveys about why brains migrate identify reasons similar to analytical studies. Gibson and McKenzie (2009) find that personal preferences such as risk aversion and topic studied matter for emigration of top New-Zealand students. IMIA (2005) finds that temporary skilled migrants to high-income countries rank life-style and international experience first; career development and better job opportunity rank third to sixth depending on source countries.

classified under the skilled category, and recently students have been added as a special category of skilled migration as more countries allow them to work and stay after they graduate (see for example Baruch, Budhwar, and Khatri 2007; Borjas 2006, 2005).

One reason why a precise definition of skill matters is that different occupations imply different motives for mobility. Individual decision is much less relevant for internal mobility (i.e., intra-firm mobility) than for external mobility. Intra-firm migration of managers or scientists are usually initiated by employers, and the migration of professionals, academics, or technology specialists more often reflects individual choices (Auriol and Sexton 2002; Mahroum 2000). In these instances, professional networks, high quality research infrastructures, leading technology clusters, and amenities⁶ are likely to influence whether or not an individual chooses to move (Gibson and McKenzie 2009; Ali et al. 2007; Mahroum 2001). Hence, domestic policies beyond immigration policy which influence foreign direct investment and R&D spending have been identified as factors driving internal and external brain migration, respectively (Buch, Kleinert, and Toubal 2006; Hunter, Oswald, and Charlton 2009).

3. POLICIES, SKILLS AND DEFINITIONS

The information on immigration flows for this paper is taken from border records for Canada and the United States and population records for Switzerland. The use of administrative records requires reconciling three definitional features: Who is an immigrant? What status does the immigrant have? And how is skilled defined?

⁶ Economic geography has focused on the role of cities in high-skilled immigrant decision (see Ewers 2007, for a survey).

First, countries use somewhat different concepts to define what constitutes an immigrant. Immigrants are identified by their nationality in Switzerland and by their country of birth in Canada and the United States. The latter is seen as more accurate as it is time invariant, despite the fact that the foreign-born population also includes nationals born abroad. Nevertheless, in countries where immigration is seen as a tool to solve temporary labour market shortages and where acquiring citizenship is a difficult and long process as in Switzerland,⁷ the difference between the two concepts is often small. Foreign-born people in Switzerland represent 22.4 percent of the resident population and foreign nationals, 20.5 percent (Gross 2007). Given how small the gap is, I consider the difference in definitions as unlikely to generate systematic error in measurement.

Second, the legal status of immigrants depends on the type of immigration policy in place. Canada and the United States are permanent settlement countries, while in Switzerland, immigration is driven by labour market demand. Specifically, Canada has an explicit goal of attracting highly skilled immigrants into permanent residency through its economic class⁸ immigration category, which covers individuals selected by a point system in place since 1967, with official language knowledge, education, and professional experience being the high-scoring characteristics. As time passed, however, priority was often given to family reunion, and during the 1980s, the share of skilled immigrants fell down to around 20 percent of the annual intake. Wanting to re-emphasize skilled immigration in 1995, the government decided that at least 50 percent of the yearly inflow had to come through the economic class category. The other channel for increasing skilled immigration is through tem-

⁷ The share of foreign-born individuals with citizenship is 29.3 percent in Switzerland, 46.5 percent in the United States and 72.6 percent in Canada (Dumont and Lemaître 2005, Table A.2).

⁸ The other two classes are family reunion and refugee classes. For a full description of Canadian immigration see for example DeVoretz (2006).

porary residents who obtain permanent status; however, the number is small. In 2000, 11,500 temporary skilled workers and 5,500 students obtained permanent residency in Canada compared to around 136,000 who entered under the point system (CIC 2009).

In Switzerland, the system allows for direct access to permanent residency only exceptionally. Skilled immigrants are individuals who obtained a work and residence permit for one year directly from abroad or by transformation of temporary status (i.e., less than one year). Swiss immigration policy is labour market-based and requires that a one-year-or-longer job contract be obtained prior to applying for a work/residence permit. Statistically speaking, foreigners on one-year permits and their family have always been considered permanent residents as their permits were automatically renewed, and there was no requirement to return home periodically. After a certain number of years of residence with one-year permits, immigrants could apply for an unlimited, unconstrained permit (establishment permit). From the early 1970s until 2005, the conditions have remained pretty much unchanged except that in 1995, the new circle policy advised employers to give preference to workers from the European Union; however, they could still prospect worldwide for skilled workers (see Gross 2006).

Finally, in the United States, skilled immigrants are foreigners who have obtained permanent residence status or temporary residents who obtain transformation of their status. Since 1990, a limit on the total annual intake has been set in addition to ceilings on certain classes of permanent immigrants already in place. The United States does not target skilled permanent immigrants explicitly, but category-specific quantitative restrictions reflect preferences for family reunions (i.e., family-sponsored immigrants) and needed workers (i.e., employment-based immigrants). The employment-based class

is mostly concerned with skilled applicants who may or may not have a job, with a ceiling recently set at 140,000 people annually. Applicants are classified in five skill categories with an order of preference, the first three being: persons with extraordinary ability, outstanding professors and researchers, and certain multinational executives and managers; members of the professions with advanced degrees and persons of exceptional ability; skilled workers, professionals without advanced degrees. The three categories cover approximately 84 percent of total employment-based visas (US DS2000, Appendix A, Section B). The other main avenue for skilled people to become permanent US residents is to request an adjustment in their status. It can be filed by undocumented immigrants; temporary workers such as H1B or NAFTA TN holders; foreign students; and refugees (US INS 1997, Section 1, p. 14).⁹

Third, there are two issues regarding who is considered skilled: comparability of classification systems and error in measurement. The countries use different skill classification systems. Switzerland uses the International Standard Classification of Occupation (ISCO) from the International Labour Office (ILO 1990); Canada and the United States use their own National Occupational Classification systems (HRDC 2006; US DJINS 2002) which are both compatible with ISCO. The United States has the classification system with the least number of occupation-related categories (i.e., twenty-five), of which nineteen are identified as skilled (one for executive, administrative, or managerial; sixteen for professional specialties; and two for technical occupations), and they are a combination of occupation and education levels. In this paper, the United States serves as the reference to define occupation categories for the other two countries, and the Canadian and Swiss skill classifications are

⁹ Since 1995, there is the so-called diversity class for which visas are allocated through a lottery. The maximum is set between 50,000 and 55,000 with a 7 percent ceiling for eligible countries, Switzerland being one of them. This class has been created to provide opportunities for applicants at any skill level and some are probably skilled.

matched with it using ISCO definitions. Unfortunately, this limits the period under investigation to the decade from 1990 to 2000.¹⁰ In total there are twelve matching categories: One for managers (F), seven for professionals only (A, C, E, I, J, K, L); two for technicians and professionals (D, H); one for technicians only (G); and one class for technicians and administrative officers (B; see Table A.I.1 in Appendix I).

Since the classification is occupation-based, there might be error in measurement as some skilled immigrants may be recorded in the wrong category. For Switzerland, this is unlikely to happen since all immigrants must have a job upon entry. Similarly, for skilled immigration to Canada and the United States following adjustment from temporary to permanent status, these errors are unlikely as individuals gaining residency through this avenue already have jobs.¹¹ One reason why immigrants may not work in an occupation corresponding to their qualifications is the lack of recognition of their degrees as there are varying degrees of internationalization of skills (Iredale 2001; Salt 1992) across different disciplines and among different countries. The three countries in this study have institutions of higher education that are mutually well recognized, which is likely to avoid occupation misclassification resulting from lack of degree recognition. Finally, permanent immigrants to Canada and the United States are not required to have a job before entering the country but in both cases, they are asked to declare at the border whether they intend to work and in what occupation. In Canada, for example, between 1997 and 2000, the share of permanent immigrants who intended to work and declared an occupation was on average around 52 percent, but it is likely that the pro-

10 While a longer time series would be desirable, stopping in 2000 allows for the examination of policies put in place since then. A description of the steps taken to build comparable occupation classes across the three countries is given in Appendix I.

11 For example, between 1984 and 2000, about 50 percent of all Swiss-born immigrants who became permanent residents in the United States were adjusted from temporary status (Gross 2007, Table 9).

portion is higher for high-skill migrants. Also, it is likely that the declaration by skilled immigrants is quite accurate, as they usually have undergone very specific training.

To summarize, the three countries run quite dissimilar immigration policies, and as a result, flows of skilled immigrants to Canada and the United States are more likely to be driven by individual choices while flows to Switzerland respond to supply and demand. Also, while definitions of skilled immigrants are different, they are all occupation-based and can be reconciled to provide reliable comparisons.

4. WHAT TYPES OF BRAINS MOVE?

In 1990, Swiss and American expatriates in Canada exhibited a very high skill content (77.6 percent of the Swiss and 64.5 percent of the Americans had tertiary education; Table 1) which increased further during the next decade, reaching 81.2 percent and 72.9 percent in 2000, respectively. Both Canadian and American expatriates in Switzerland exhibited lower skill contents in 1990, but the increase over the period is staggering: from 26.5 percent to 49.7 percent for the Canadians and from 37.5 percent to 57.6 percent for the Americans.¹² Moreover, Switzerland and the United States are identified as major importers of scientists (see Hunter, Oswald, and Charlton 2009). By 2000, Canada appeared to be the most successful of the three countries at attracting skilled immigrants, with the United States being a close second. Switzerland, with a labour market-based immigration policy, lagged somewhat behind but was closing the gap. So, a deeper look into the magnitude and composition of the skilled flows is necessary.

¹² It is interesting to note that the skill content of Swiss expatriates in the United States and Canada is rather homogenous while Canadian expatriates in the United States are much more skilled than the ones in Switzerland.

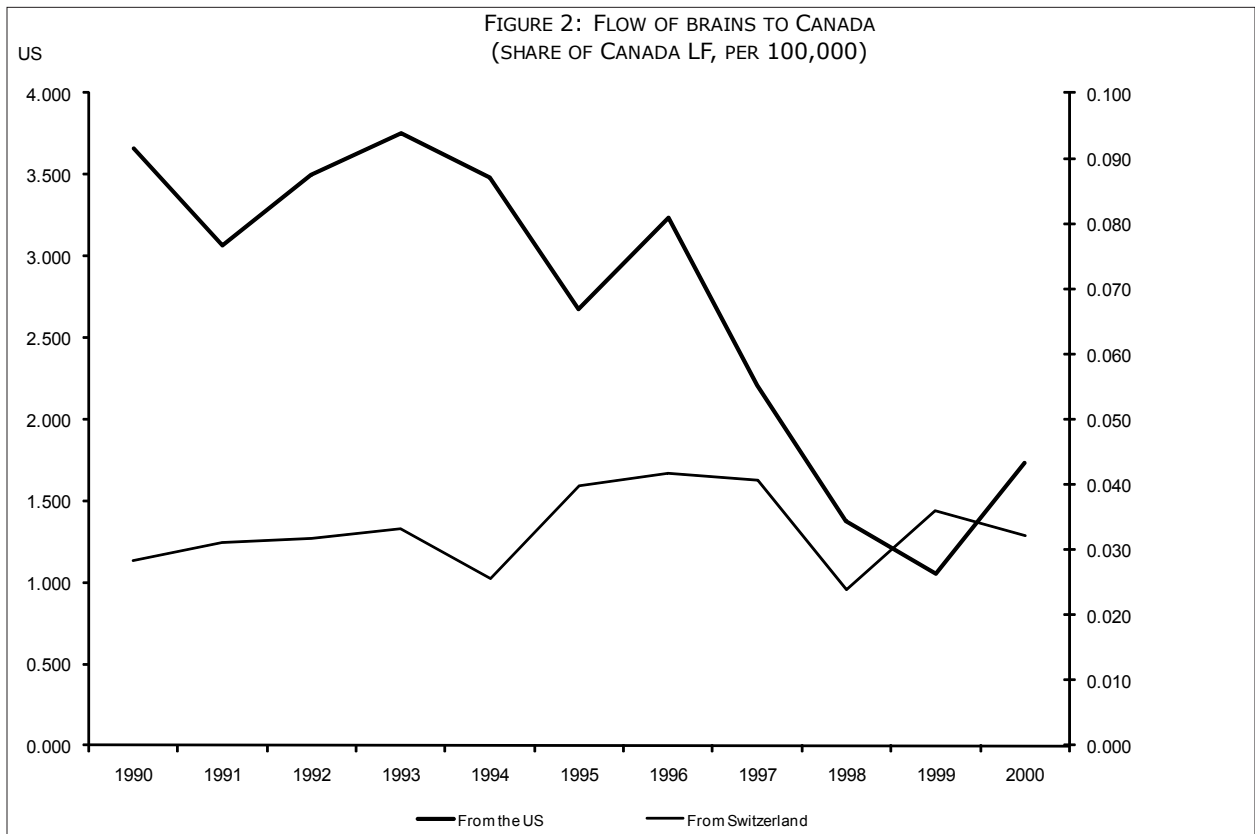
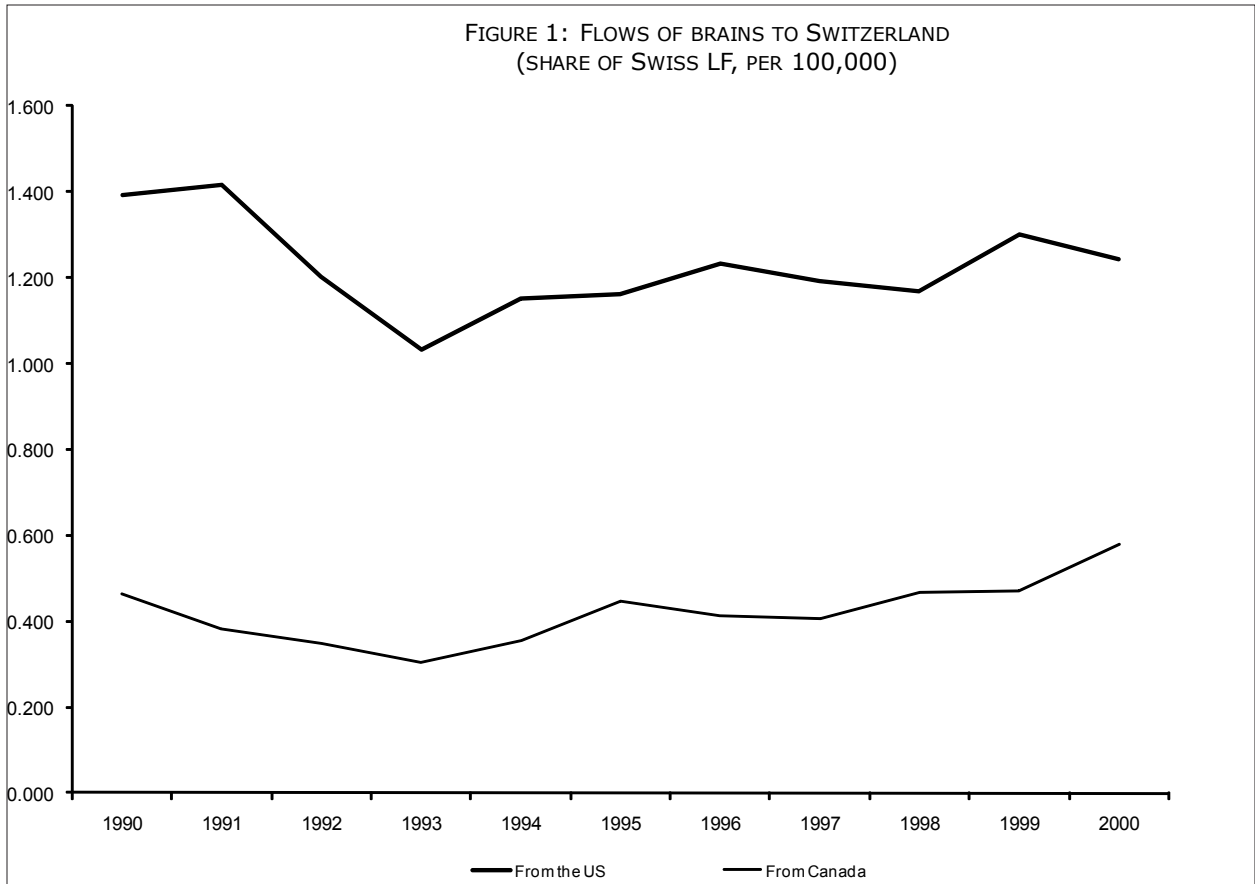
TABLE 1: SKILL CONTENT OF EXPATRIATE POPULATION (% WITH TERTIARY EDUCATION)

		DESTINATION COUNTRY ^{a/}					
		1990			2000		
		CANADA	SWITZERLAND	US	CANADA	SWITZERLAND	US
Source country	Canada	-	26.5%	47.9%	-	49.7%	61.9%
	Switzerland	77.6%	-	63.5%	81.2%	-	74.1%
	US	64.5%	37.5%	-	72.9%	57.6%	-

a/ Share of each country's foreign-born population with tertiary education in the country's foreign-born population.

Source: Computed from dataset by Docquier and Marfouk (2005).

Figures 1 to 3 show the evolution over time of the flows scaled by the skilled labour force at destination. Brain flow rates from Canada and the United States to Switzerland were quite steady (Figure 1); both stopped declining in 1993, and exhibit a small upward trend for the rest of the period. For Canada (Figure 2), the skilled inflow from the United States experienced a sharp decline beginning in the mid 1990s, while the inflow from Switzerland shows some variation but no major trend. The increase in 1995 is probably due to the new immigration policy which required the economic class to make up at least 50 percent of the annual intake. Finally, the flows into the United States exhibit a similar time profile to the ones into Canada (Figure 3). Brains from Switzerland have been going to the United States rather steadily, and the somewhat higher flows between 1992 and 1997 are most likely due to a large increase in the number of executives; brain immigration from Canada did decline steadily beginning in 1993 and started rising again in 1997. Overall, these observations suggest that the brain flows from Switzerland to North America have been very steady while the flows between the two North American countries have declined over time. This might be due to the introduction of freer





mobility for some of the highly skilled under NAFTA in 1994. The occupational composition of these flows may shed some light on the reasons for these diverging evolutions.

Table 2 shows the flows of skilled immigrants for the twelve comparable occupation categories between 1990 and 2000 to each country. Looking at the first row, it is clear that the magnitude of the movements is somewhat proportionate to the source country's population size. However, when related to the size of the tertiary-educated labour force in the source country, the image is quite different. While the United States sends only a slightly larger share of its skilled labour force to Switzerland than to Canada (35 vs. 29 per 100,000), Canada receives a much smaller share of Swiss brains than the United States (75 vs. 445 per 100,000). Switzerland is also able to attract a sizeable flow

of Canadian brains even though it is much lower than the one heading for the United States (227 vs. 2,867 per 100,000). So, clearly the United States is a much stronger magnet for the two smaller countries than they are for Americans or for each other.

TABLE 2: TWO-WAY FLOWS PER OCCUPATION CATEGORIES (1990-2000)

			SWISS		AMERICANS		CANADIANS		AMERICANS		CANADIANS		SWISS	
			INTO CANADA				INTO SWITZERLAND				INTO THE US			
			Total	%	Total	%	Total	%	Total	%	Total	%	Total	%
Class	ISCO 1-digit													
Total	(Rate per 100,000)	616 (75)	100	8,936 (29)	100	3,820 (227)	100	11,017 (35)	100	48,298 (2867)	100	3,644 (445)	100	
Exec-utive	F 1	231 ^{d/}	37.5	1,233	13.8	415	10.9	2,199	20.0	16,157	33.5	1,165	32.0	
Professional and technical occupations	A 2	9	1.5	66	0.7	11	0.3	54	0.5	198	0.4	75	2.1	
	B 3,4	40	6.5	957	10.7	435	11.4	1539	14.0	8,154	16.9	694	19.0 ^{a/}	
	C 2	13	2.1	494	5.5	715	18.7	2033	18.5	2,008	4.2	174	4.8	
	D 2	4	0.6	222	2.5	49	1.3	102	0.9	2,370	4.9	110	3.0	
	E 2	52	8.4	387	4.3	93	2.4	354	3.2	2,383	4.9	322	8.8	
	G 3	55	8.9	576	6.4	1472	38.5 ^{b/}	1,316	11.9	3,485	7.2	254	7.0	
	H 2,3	87	14.1 ^{c/}	3,065	34.3	384	10.1	2,528	22.9 ^{c/}	5,122	10.6	444	12.2	
	I 2	40	6.5	465	5.2	128	3.4	473	4.3	820	1.7	62	1.7	
	J 2	42	6.8	377	4.2	52	1.4	191	1.7	695	1.4	131	3.6	
	K 2	2	0.3	175	2.0	0	0.0	0	0.0	5,570	11.5	83	2.3	
L 2	41	6.7	919	10.3	66	1.7	228	2.1	1,336	2.8	130	3.6		

^{a/}Administrative officers, financial analysts, investment dealers, and others. ^{b/} Health technicians primary, secondary teachers, physical and engineering technicians, and others. ^{c/} Social scientists, humanities, law professionals, and others. ^{d/} Regardless of degree obtained.

In terms of destination by occupation, a number of conclusions can be drawn from Table 2. First, managers dominate the flows in terms of share as they rank first or second in all cases. They represent about one-third of the flows from the two small countries into the United States and from Switzerland into Canada. Interestingly, they do not represent the largest share of flows from the United States into Switzerland, despite the fact that American com-

panies have long found Switzerland attractive for establishing regional or world headquarters (Arthur D. Little, 2009). Second, Canada attracts similar types of skilled immigrants from the United States and from Switzerland as more than 50 percent are either managers (F) or social scientists and humanities-related professionals (H). A similar comment applies to the United States but for managers (F) and commercial and financial technicians (B). Third, Switzerland attracts different types of skilled immigrants from Canada (Health and science technicians, G, and, teachers, C) and the United States (social scientists and humanities-related professionals, H, and, managers, F). Finally, American brains to Switzerland are more diversified as three occupation categories lead with shares between 18.5 and 22.9 percent. For the other two countries, the top occupation category represents more than 33 percent of the total flow. These basic observations suggest that the North American market attracts a homogenous set of skills regardless of the source country, while Switzerland draws source-country specific skills.

To draw more specific conclusions about brain exchange versus brain gain/loss, I use the Grubel-Lloyd trade index (Grubel and Loyd 1975) applied to occupation categories such that:

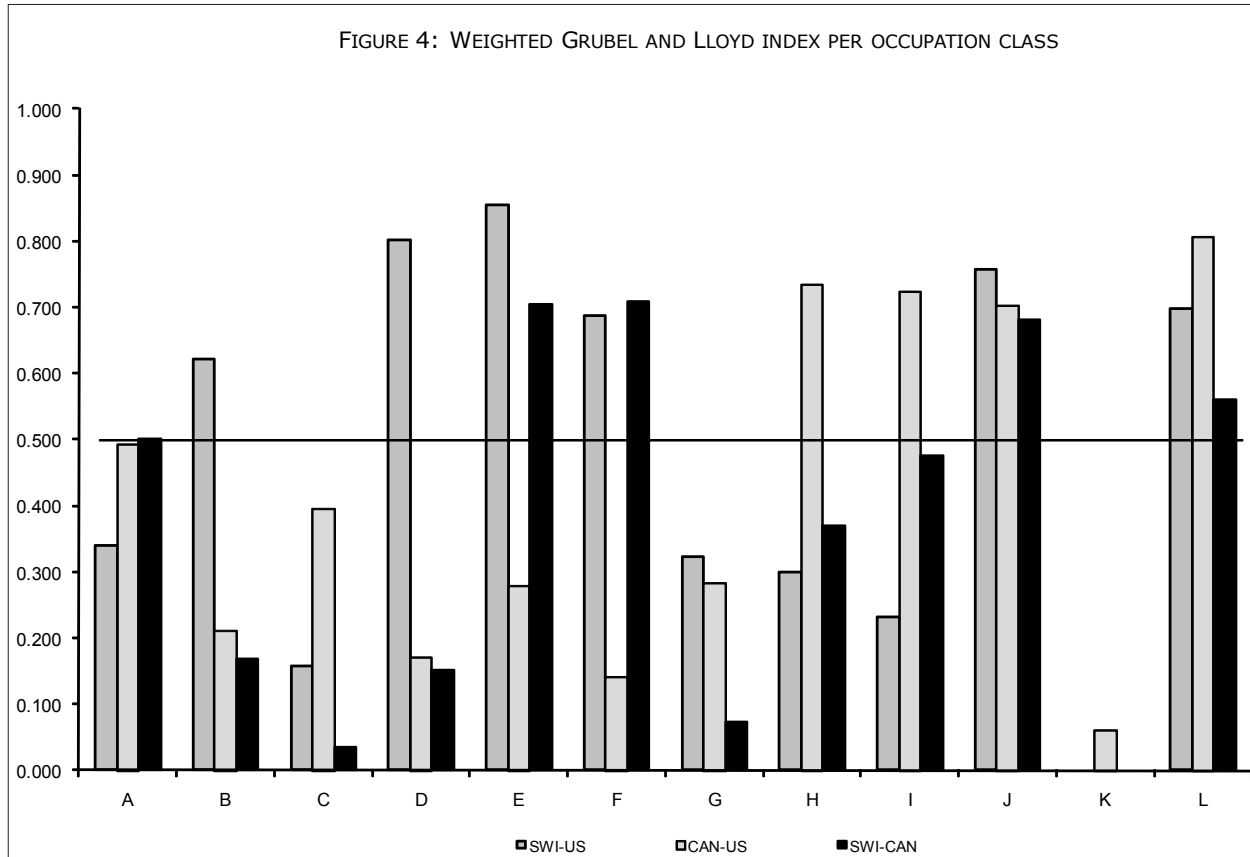
$$IOBE_{j,i,t}^k = 1 - \frac{|O_{j,i,t}^k - I_{j,i,t}^k|}{(O_{j,i,t}^k + I_{j,i,t}^k)}$$

where $O_{j,i,t}^k$ ($I_{j,i,t}^k$) is the outflow (inflow) of brains from country j ($j \neq k$) to country k for occupation category i in year t . Then, an weighted aggregated index over time is computed for each occupation category such that,

$$IOBE_{j,i}^k = \sum_t w_{j,i,t}^k IOBE_{j,i,t}^k \quad \text{with} \quad w_{j,i,t}^k = \frac{(O_{j,i,t}^k + I_{j,i,t}^k)}{\sum_t (O_{j,i,t}^k + I_{j,i,t}^k)}$$

There is perfect brain exchange (i.e., equal two-way flows) when $IOBE=1$ and full brain drain/gain (i.e., one-way flow only) when $IOBE=0$. The IOBE-value for each occupation between Canada, Switzerland, and the United States are given in Figure 4. It is immediately clear that there are geographical as well as occupational differences. Using 0.500 as the dividing value, six categories of occupations clearly support brain exchange between Switzerland and the United States, while only four do the same between Canada and the United States or Canada and Switzerland, so, in line with the results from Table 2, there is broader brain exchanges between Switzerland and the United States than between other countries' combinations.

Exchanges between all three countries occur with scientists (J) and professors (L), while gain/loss characterize architects (A), teachers (C), and health and science technicians (G). With the United States, Canada has exclusive



exchanges of social scientists and various humanities-related professionals (H=0.734) and IT specialists (I=0.724), while Switzerland has exclusive exchanges of physicians (D=0.802) and commercial and financial technicians (B=0.622). Finally, both countries in North America exchange engineers (E) and managers (F) with Switzerland but not among themselves. So, overall there are more exchanges between Switzerland and the United States than Canada and the United States or Canada and Switzerland; and whether there are exchanges or gains/losses, they are both country- and occupation-specific.

To summarise, the descriptive analysis confirms that the United States is a magnet for brains; however, there are bilateral exchanges of scientists and professors with both Canada and Switzerland, which is consistent with Hunter et al. (2009). For a majority of occupation categories, the outcome is specific to the country combination since brain gains/losses common to the three countries occur only for three occupations. This diversity of results across occupations and countries confirms the necessity to analyze skill movements at the occupational level and to evaluate whether policies outside immigration policy are successful in influencing international skill movements.

5. WHY BRAINS CHOOSE TO MOVE

A useful basic framework commonly used in studies of immigration is the gravity model (Helliwell 1997; Karemera, Oguledo, and Davis 2000). It is consistent with the utility maximizing present value decision theory and is flexible enough to accommodate skill-specific incentives and policies. The general gravity equation is,

$$Fl_{j,k} = G_{j,k} [w_j (M_j^\alpha) w_k (M_k^\beta)] / d_{j,k}^b, \quad (1)$$

with $Fl_{j,k}$ the flow between country j and k which is a function of weighted masses (wM) in each country and distance between the two countries (d). The weighted mass in the case of skilled migration is the highly educated population corrected by the standard of living (Isard 1998). Distance can be physical, cultural, or political, depending on the case under investigation. A log linear form of (1) is thus:

$$FlRate_{j,i,t}^k = c_{j,k} + \beta_2 Learn_{i,t}^k + \beta_1 Learn_{j,i,t} + \beta_4 UR_{i,t}^k + \beta_3 UR_{j,i,t} + \beta_6 LFBA_t^k + \beta_5 LLFBA_{j,t} + \sum_{l=6+1}^m \beta_l Z_{i,t}^k + \sum_{p=m+1}^q \beta_p Z_{j,i,t} + \varepsilon_{j,i,t}, \quad (2)$$

where the dependent variable ($FlRate_{j,i,t}^k$) is the flow of individuals with occupation i ($i=1$ to 12), from country j ($j \neq k$, $j=1,2$), in year t ($t=1$ to 11), to destination country k ($k=1$ to 3) as a share of the labour force with university education in the destination country. The flow is standardised with destination country labour force for comparability within the sample and because the focus is on destination countries' policies to attract skills. There are 264 observations for each destination country estimated separately. The fixed effect ($c_{j,i}$) accounts for time-invariant, country-specific, and occupation-specific factors, such as cost of moving or international transferability of skills.

The specification includes standard variables such as real occupation-specific earnings in source and destination countries ($Learn_{j,i,t}$, $Learn_{i,t}^k$), occupation-specific unemployment rates in source and destination countries ($UR_{j,i,t}$, $UR_{i,t}^k$), and tertiary-educated labour force in source and destination countries ($LLFBA_{j,t}$, $LLFBA_{i,t}^k$). Earnings and labour market condition measures are expected to have the standard impact. An increase in the source labour force usually increases flows while an increase in the destination labour force has the opposite effect. However, in the case of brains, an increase in the source

country skilled labour force may induce people to stay at home as the professional environment becomes more favourable to networking. Similarly, a larger skilled labour force at the destination may be more attractive for foreign brains. So the sign is indeterminate.

The model is augmented for skill-oriented policies ($Z_{i,t}^k, Z_{j,i,t}$). A large number of instruments is available to high-income countries to stimulate innovation, and they result in three types of outcomes likely to influence skilled migrant decisions: foreign direct investment, research and development spending, and academic production. In each case, high-skill immigrants are expected not only to respond to these factors but also to potentially contribute to their expansion. However, since migration flows are measured for individual countries, the endogeneity problem is likely to be minimal. The skill-oriented policies are occupation-specific, and thus, occupation categories are grouped into four classes based on Auriol and Sexton (2002) and Mahroum (2000) with each one identified by a dummy: business occupations (B,F: *BUS*); technical occupations (E,G,I: *TECH*); professional occupations (A,C,D,H,K: *PROF*); and academic occupations (J,L: *ACAD*). Business occupations are assumed to follow past foreign direct investment (FDI) from each source country into the destination country ($LFDI_{j,t-1}^k * BUS$). The stock of FDI is used because intra-firm migration occurs throughout the life of the investment and not just at inception. Technical occupations are assumed to be attracted by investment in Research and Development (R&D) measured in destination and source countries ($R\&D_t^k * TECH$ and, $R\&D_{j,t} * TECH$). R&D environment is alternatively measured by the number of applications for patenting ($LPat_t^k * TECH$ and, $LPat_{j,t} * TECH$) and the number of triatic patents ($LTriPat_t^k * TECH$ and, $LTriPat_{j,t} * TECH$) in both destination and source countries. Academics are assumed to be driven by scientific network and academic excellence captured by publications in

scientific journals in destination and source countries ($LSciArt_t^k * ACAD$ and $LSciArt_{j,t} * ACAD$).¹³ Finally, professional occupations, which include academic as well as technical occupations, are tested for response to either R&D or scientific network as R&D spending includes higher education and private non-profit spending as well as business and direct government spending (OECD 2010). The model is estimated for each destination country (k) in turn with a number of robustness tests and policy scenarios.

5.1. Canada as destination

Starting with the basic gravity model with earnings, unemployment, and labour force for Canada, the fixed effect estimation in Column 1 exhibits serial correlation,¹⁴ and thus, White corrected robust standard errors are used; there are, however, only small changes in significance (Column 2). A concern with panel estimation is endogeneity arising from the fixed effect and error term being correlated if panel-specific time-varying effects are not adequately controlled (Woolridge 2002). In Column 3, a time trend is not significant, suggesting time variations are adequately accounted for by earnings and unemployment which are both panel-specific and time-varying. In Column 4, each of the explanatory variables is occupation category-specific with technical and professional occupations as references and overall occupation categories show similar sensitivities to the push and pull factors. Interestingly, in that simple model, Canadian characteristics play a passive role as mostly source-country factors matter. So, the next step is to test whether Canadian skill-oriented policies have impacts.

13 The number of scientific citations (Thompson Corporation 2008) has also been considered; however, it is available only as a time-invariant variable and thus is fully correlated with the fixed effect.

14 The result for an AR(2) process in the estimated errors: $e_{j,t} = 0.0003 + 0.667e_{j,t-1} - 0.096e_{j,t-2}$ with p-value = 0.00 and 0.15 respectively.

TABLE 3: CANADA AS A DESTINATION: BASIC MODEL

	FLRATE _{KJ,I,,T}			
	1.	2.	3.	4.
K=CANADA	BASIC FE	WHITE PE- RIOD SE	TIME TREND	OCCUP. SPECIFIC ELAST.
$IEarn_{i,t}^k$	.022(2.7)***	.022(1.2)	.024(1.1)	.051(1.8)*
$IEarn_{j,i,t}$	-.031(2.0)**	-.031(2.4)**	-.035(2.4)**	-.003(0.3)
$UR_{i,t}^k$	-.0004(1.2)	-.0004(0.9)	-.0004(1.0)	-.0002(0.5)
$UR_{j,i,t}$	.003(3.4)***	.003(2.5)**	.003(2.6)***	.003(2.2)**
$ILFBA_t^k$	.048(2.4)**	.048(2.9)***	.057(1.7)*	.048(1.9)**
$ILFBA_{j,t}$	-.112(3.9)***	-.112(3.4)***	-.104(2.7)***	-.111(2.2)**
Time	-	-	-.0007(0.3)	-
$IEarn_{i,t}^k * BUS$	-	-	-	-.034(1.1)
$IEarn_{j,i,t} * BUS$	-	-	-	.009(0.1)
$UR_{i,t}^k * BUS$	-	-	-	-.0008(0.3)
$UR_{j,i,t} * BUS$	-	-	-	.0006(0.2)
$ILFBA_t^k * BUS$	-	-	-	.056(0.9)
$ILFBA_{j,t} * BUS$	-	-	-	-.134(1.1)
$IEarn_{i,t}^k * ACAD$	-	-	-	.042(0.8)
$IEarn_{j,i,t} * ACAD$	-	-	-	-.016(0.4)
$UR_{i,t}^k * ACAD$	-	-	-	.0000(0.1)
$UR_{j,i,t} * ACAD$	-	-	-	.004(1.0)
$ILFBA_t^k * ACAD$	-	-	-	.016(0.3)
$ILFBA_{j,t} * ACAD$	-	-	-	-.041(0.5)
Adj R^2	.934	.934	.934	.945
SC	-6.681	-6.681	-6.661	-6.653
t	11	11	11	11
n	24	24	24	24
d.f.	234	234	233	222

In Table 4, Column 1, it is assumed that managerial and business occupations follow FDI; technical and professional occupations are driven by R&D spending; and academic professions by scientific publications. Only R&D spending has a significant impact. In Column 2, professional occupations are assumed to be driven by academic publications because the category includes scientists as well as technicians; however, there is no impact. In Columns 3 and 4, the two alternative measures to R&D spending are tested, i.e., national patent applications and triatic patents. National patent applications lead to

very similar results to R&D spending while the results are weaker for triatic patents. Hence, the initial specification in Column 1 is considered the most appropriate; however, because there is potential for multicollinearity between source- and destination-country policies,¹⁵ only the most significant variable in each pair is kept in Column 5; the results are very stable and the restricted specification is used for further testing.

Evidence of the impact of immigrants on local labour market and wage in particular is mixed (see, for example, Longhi, Nijkamp, and Poot 2005), but one cannot exclude the possibility of endogeneity of earnings. So, in Column 6, the two earnings variables are lagged and the results hardly change. Furthermore, earnings may represent only partially the benefits of migrating. As Ewers (2007) and IMIA (2005) among others argue, amenities and lifestyle matter for brains' movements beyond pure financial returns. Two alternative specifications are thus estimated: The first includes the Human Development Index (HDI) as a substitute for earnings, which in addition to PPP income, includes life expectancy, adult literacy, and enrolment in education as proxies for quality of life (UNDP, 2009). In Column 7, neither destination (IHDI_{ikt}) nor source HDI (IHDI_{jt}) is significant. The second specification includes happiness measures (IHappy_{ikt}; IHappy_{jt}) in addition to earnings (Column 8).¹⁶ Amenities proxied by happiness are not significant. It must be noted that the HDI as well as the happiness measures are not occupation-specific and are available only at multiple year intervals; hence, they are clearly only rough proxies. Also, because amenities do not change quickly, it is likely that much of their impact is taken into account by the fixed effect. In Column 9, income

15 The simple correlations between the three countries' measures for skill-oriented policy are relatively high in some cases as all three countries try to attract brains and have the means to do so (see Appendix II, Table A.II.1).

16 The measure is the mean value of the answers on a scale 1 to 10 to Question 122D: "All things considered, how satisfied are you with your life as-a-whole now?" from the World Database of Happiness (Veenhoven 2010).

TABLE 4: CANADA AS A DESTINATION: EXPANDED MODEL

	1.	2.	3.	4.	5.	6.
	FULL FE (R&D: TECH, PROF; SCIART)	FULL FE (R&D: TECH; SCIART: PROF, ACA- DEM)	FULL FE (PAT: TECH, PROF; SCIART)	FULL FE (TRIPAT: TECH, PROF; SCIART)	RESTRICTED SPECIFICA- TION	LAGGED EARNINGS
K=CANADA						
$IEarn_{i,t}^k$	.035(1.9)*	.031(1.8)*	.039(2.2)**	.034(2.3)**	.036(2.1)**	-
$IEarn_{j,i,t}$	-.022(1.6)	-.016(1.1)	-.048(2.2)**	.009(0.4)	-.022(1.8)*	-
$UR_{i,t}^k$	-.0004(1.0)	-.0003(0.6)	-.0004(0.9)	-.0002(0.4)	-.0004(1.0)	-.0006(1.4)
$UR_{j,i,t}$	.004(2.4)**	.003(2.8)***	.003(2.6)***	.003(2.6)**	.004(3.0)***	.003(2.8)***
$ILFBA_t^k$	.009(0.5)	.021(1.4)	.056(3.0)***	.043(2.5)**	.010(0.6)	.022(1.3)
$ILFBA_{j,t}$	-.184(3.3)***	-.088(3.6)***	-.140(3.7)***	-.136(3.5)***	-.087(3.2)***	-.103(3.2)***
$IFD_t^k * BUS$	-.012(1.2)	-.015(1.3)	-.013(1.3)	-.011(1.1)	-.012(1.1)	-.016(1.7)*
$R\&D_t^k * TECH$	.076(3.0)***	.058(2.7)***	-	-	.077(2.8)***	.073(2.8)***
$R\&D_{j,t}^k * TECH$	.018(0.8)	.017(0.8)	-	-	-	-
$LPat_t^k * TECH$	-	-	.012(2.7)***	-	-	-
$LPat_{j,t}^k * TECH$	-	-	.017(2.4)**	-	-	-
$ITriPat_t^k * TECH$	-	-	-	-.0006(0.2)	-	-
$ITriPat_{j,t}^k * TECH$	-	-	-	.022(2.1)**	-	-
$R\&D_t^k * PROF$	.056(2.7)***	-	-	-	.059(2.4)**	.043(1.8)*
$R\&D_{j,t}^k * PROF$	-.012(0.3)	-	-	-	-	-
$LPat_t^k * PROF$	-	-	.009(2.6)***	-	-	-
$LPat_{j,t}^k * PROF$	-	-	.006(0.9)	-	-	-
$ITriPat_t^k * PROF$	-	-	-	-.010(1.3)	-	-
$ITriPat_{j,t}^k * PROF$	-	-	-	.032(2.8)***	-	-
$ISciArt_t^k * PROF$	-	.0000(0.1)	-	-	-	-
$ISciArt_{j,t}^k * PROF$	-	.022(1.7)*	-	-	-	-
$ISciArt_t^k * ACAD$	.018(0.4)	.037(0.7)	.019(0.4)	.002(0.1)	-	-
$ISciArt_{j,t}^k * ACAD$	.035(1.5)	.033(1.5)	.013(0.8)	.035(1.2)	.034(1.7)*	.034(1.7)*
$IEarn_{i,t-1}^k$	-	-	-	-	-	.045(2.4)**
$IEarn_{j,i,t-1}$	-	-	-	-	-	-.0003(0.3)
Adj R ²	.940	.937	.940	.938	.941	.941
SC	-6.641	-6.597	-6.639	-6.610	-6.705	-6.708
t	10	10	10	10	10	10
n	24	24	24	24	24	24
d.f.	227	227	227	227	230	230

TABLE 4: CANADA AS A DESTINATION: EXPANDED MODEL (CONTINUED)

	7.	8.	9.	10.	11.
K=CANADA	HDI	HAPPINESS	NET OF TAXES EARNING	CANADIAN IMMIG. POLICY	OCCUPATION-SPECIFIC POLICIES
$IEarn_{i,t}^k$	-	.034(1.5)	-	.030(1.5)	.038(2.4)**
$IEarn_{j,i,t}^k$	-	-.024(1.8)*	-	-.011(0.8)	-.016(1.4)
$UR_{i,t}^k$	-.0005(1.1)	-.0004(1.0)	-.0004(1.0)	-.0004(0.9)	-.0005(1.3)
$UR_{j,i,t}^k$	.004(2.6)***	.003(2.3)**	.004(2.9)***	.003(1.9)*	.004(3.2)***
$ILFBA_t^k$	.009(0.4)	.018(0.7)	.012(0.7)	-.008(0.3)	.008(0.6)
$ILFBA_{j,t}^k$	-.110(2.6)**	-.076(2.4)**	-.091(3.1)***	-.054(1.5)	-.087(3.5)***
$IFD_{i,t-1}^k * BUS$	-.008(0.9)	-.013(1.1)	-.012(1.1)	-.012(1.3)	-
$R\&D_t^k * TECH$	.079(2.6)**	.072(2.7)***	.078(2.9)***	.072(2.7)***	-
$R\&D_t^k * PROF$	.043(1.7)*	.052(2.0)**	.060(2.6)**	.051(2.1)**	-
$ISciArt_{j,t}^k * ACAD$	.026(1.3)	.031(1.4)	.036(1.8)*	.029(1.4)	-
$IHDI_t^k$	.844(1.4)	-	-	-	-
$IHDI_{j,t}^k$	.197(0.7)	-	-	-	-
$IHappy_t^k$	-	.887(0.6)	-	-	-
$IHappy_{j,t}^k$	-	-.107(1.4)	-	-	-
$INetEarn_{i,t}^k$	-	-	.037(2.1)**	-	-
$INetEarn_{j,i,t}^k$	-	-	-.015(1.4)	-	-
<i>CanPolicy</i>	-	-	-	-.004(1.4)	-
<i>CanPolicy*Switzerland</i>	-	-	-	.006(1.4)	-
$IFD_{j,t-1}^k * BUS(B+F)$	-	-	-	-	B,F(-)*
$R\&D_t^k * TECH(E+G+I)$	-	-	-	-	E(+)** , G(+)** , I(+)**
$R\&D_t^k * PROF(A+C+D+H+K)$	-	-	-	-	A(+)** , C(+)** , D(+)** , H,K(+)**
$ISciArt_{j,t}^k * ACAD(J+L)$	-	-	-	-	J,L(+)*
<i>Adj R²</i>	.937	.941	.940	.941	.942
<i>SC</i>	-6.642	-6.676	-6.700	-6.682	-6.583
<i>t</i>	10	10	10	10	10
<i>n</i>	24	24	24	24	24

is corrected for taxes and social contributions and the results hardly change, probably because total rates are similar even though the composition is quite different (see Appendix II, Table II.2.2). Finally, in Column 10, the change in Canadian immigration policy with increased emphasis on skilled immigrants in 1995 is represented by a dummy variable (*CanPolicy*), allowing for different responses from the two source countries. The policy change has no statistically significant effect on the skilled flow rate from the United States or

Switzerland. Hence, the results from the specification in column 5 are quite robust to modifications, and they are used for further comments.

Brains from Switzerland and the United States migrating to Canada are influenced by both general and policy-related factors. Relative income matters as well as the state of the labour market in the source countries, irrespective of the type of occupations. Hence, push factors dominate brains' decision to immigrate to Canada. The Canadian unemployment rate is not significant either, but a worsening of the job market in Switzerland and in the United States pushes skilled individuals to move to Canada. An expansion of the source-country labour force induces them to stay at home, probably because a larger pool of brains at home creates a more appealing, professional environment. These results are consistent with Canadian immigration policy, which is supply-driven.

There is a strong pull effect from Canadian R&D spending on immigrant technicians and professionals. Since those two groups are made of diverse occupation categories, a disaggregated model is also estimated (Column 11). All technical (TECH) and professional (PROF) categories are responsive to R&D individually except social scientists and various humanities-related professionals (H), which probably benefit the least from R&D spending. Finally, more publications in source countries generate more migration to Canada for academics (mostly professors, L). This apparently counter-intuitive result suggests that Canadian universities are more likely to be followers than leaders, as they attract foreign academics when their field abroad becomes comparatively more productive.

5.2. Switzerland as destination

The same steps are followed for Switzerland as a destination, and the results are given in Tables 5 and 6. In the basic model, robust standard errors are also used because of serial correlation,¹⁷ and the time trend is not significant (Table 5, Columns 1 to 3). The unrestricted and restricted models for occupation-specific elasticities are in Columns 4 and 5.¹⁸ Swiss unemployment is a determinant for all categories of brains except academics, and a larger domestic skilled labour force has a bigger adverse effect on foreign academics than on other skilled immigrants. In Table 6, none of the policies specific to groups of occupation appear to influence immigration of brains to Switzerland, regardless of how they are measured (Columns 1 to 4). Nevertheless, because groups are broadly defined, further tests are conducted using the restricted specification from Column 5. Results are also robust to lagged earnings (Column 6). The Human Development Indexes (Column 7) are significant for source and destination while earnings alone are not. However, the labour force results also change significantly, and this is due to the high degree of correlation between HDI and the labour force for Switzerland (simple correlation is 0.982) as neither is occupation-specific. The happiness index in Column 8 is not significant despite the good performance of Switzerland in various quality-of-life rankings,¹⁹ and taxes do not affect the results significantly. Interestingly, the 1995 change in immigration policy (SwiPolicy) which gave priority to immigrants from the EU did not affect the flow rates from North America nor

17 The result for the AR(2) estimation are: $e_{j,t} = 0.0008 + 0.534e_{j,t-1} - 0.177e_{j,t-2}$ with p-value=0.00 and 0.011 respectively.

18 The close significance of unemployment at destination for managers in the full model is probably the result of multi collinearity as the t-value totally collapses in the restricted model; therefore, the variable is not maintained in the remaining estimations.

19 For example, in 2005, Switzerland ranked second for quality of life and seventh for GDP per capita while Canada ranked fourteenth and fifth respectively and the United States, thirteenth and second (EIU 2005) but the error in measurement attached to the Happiness variable may be too large to capture that type of effect.

TABLE 5: SWITZERLAND AS A DESTINATION: BASIC MODEL

	FLRATEKJ,I,T				
	1.	2.	3.	4.	5.
K=SWITZERLAND	BASIC FE	WHITE PE- RIOD SE	TIME TREND	OCCUP. SPECIFIC ELAST.	RESTRICTED SPECIFICATION
$IEarn_{i,t}^k$	.134(2.7)***	.134(1.0)	.134(1.0)	-.052(0.5)	.004(0.1)
$IEarn_{j,i,t}$	.001(0.1)	.001(0.1)	-.001(0.1)	-.014(0.2)	-.029(0.8)
$UR_{i,t}^k$	-.012(4.0)***	-.012(3.0)***	-.012(2.7)***	-.010(2.1)**	-.014(2.3)**
$UR_{j,i,t}$	-.001(0.4)	-.001(0.5)	-.001(0.5)	-.001(0.5)	-.0004(0.3)
$ILFBA_t^k$	-.134(1.7)*	-.134(0.8)	-.124(1.0)	-.302(2.3)**	-.223(1.7)*
$ILFBA_{j,t}$	.137(2.6)***	.137(1.7)*	.146(1.1)	.212(2.5)**	.190(2.9)***
Time	-	-	-.0001(0.2)	-	-
$IEarn_{i,t}^k *BUS$	-	-	-	.621(2.8)***	.590(2.9)***
$IEarn_{j,i,t} *BUS$	-	-	-	-0.099(0.8)	-
$UR_{i,t}^k *BUS$	-	-	-	-0.016(1.9)*	-.003(0.5)
$UR_{j,i,t} *BUS$	-	-	-	.005(0.9)	-
$ILFBA_t^k *BUS$	-	-	-	.057(0.1)	-
$ILFBA_{j,t} *BUS$	-	-	-	.119(0.6)	-
$IEarn_{i,t}^k *ACAD$	-	-	-	.039(0.3)	-
$IEarn_{j,i,t} *ACAD$	-	-	-	-.007(0.1)	-
$UR_{i,t}^k *ACAD$	-	-	-	.008(1.6)	.012(2.4)**
$UR_{j,i,t} *ACAD$	-	-	-	.001(0.8)	-
$ILFBA_t^k *ACAD$	-	-	-	.184(1.3)	-
$ILFBA_{j,t} *ACAD$	-	-	-	-.138(1.6)	-.044(1.9)*
Adj R ²	.949	.949	.949	.953	.953
SC	-4.509	-4.509	-4.488	-4.392	-4.519
t	11	11	11	11	11
n	24	24	24	24	24

did it change the relative elasticities of the domestic and foreign labour force (Columns 10 and 11). It thus appears there has been little substitution of EU migrants for their North American counterparts in Switzerland following the introduction of the two-circle policy. Finally, when policies are occupation category-specific (Column 12), some individual categories respond to them: foreign direct investments impact managers (F), R&D spending affects engineers (E), health and science technicians (G), and physicians (D).

Consistent with the labour market-driven immigration policy in Switzerland, the flow rate of brains is sensitive to unemployment and responds to the size

TABLE 6: SWITZERLAND AS A DESTINATION: EXPANDED MODEL

	1.	2.	3.	4.	5.	6.
$K=$ SWITZER- LAND	FULL FE (R&D: TECH, PROF; SCIART: ACAD)	FULL FE (R&D: TECH; SCIART: PROF, ACAD)	FULL FE (PAT: TECH, PROF; SCIART: ACAD)	FULL FE (TRIPAT: TECH, PROF; SCIART: ACAD)	RESTRIC- TED	LAGGED EARNINGS
$IEarn_{i,t}^k$	.019(0.3)	-.011(0.2)	-.044(0.5)	-.077(0.8)	-.077(1.3)	-
$IEam_{j,i,t}^k$	-.005(0.1)	-.018(0.5)	-.028(0.8)	-.039(1.3)	-.028(0.8)	-
$UR_{i,t}^k$	-.013(2.9)***	-.012(2.5)**	-.013(3.1)***	-.016(4.0)***	-.013(3.1)***	-.013(3.8)***
$UR_{j,i,t}^k$	-.0000(0.1)	-.0002(0.2)	.0000(0.1)	-.0000(0.1)	-.0003(0.3)	.0001(0.1)
$ILFBA_t^k$	-.140(1.3)	-.238(2.4)**	-.213(1.8)*	-.163(1.6)	-.223(2.0)*	-.177(1.7)*
$ILFBA_{j,t}^k$	.133(1.5)	.211(3.1)***	.220(3.4)***	.202(2.7)***	.230(3.7)***	.176(3.3)***
$IEARN_{i,t}^k * BUS$	.436(2.8)***	.451(3.0)***	.461(2.8)***	.503(3.2)***	.489(3.2)***	.379(3.1)***
$UR_{i,t}^k * ACAD$	.010(2.6)**	.008(1.6)	.010(2.1)**	.014(3.0)***	.011(2.6)***	.007(1.8)*
$ILFBA_{j,t}^k * ACAD$	-.085(1.0)	-.149(2.2)**	-.158(2.6)**	-.145(2.1)*	-.164(2.6)**	-.135(2.3)**
$IFD_{j,t-1}^k * BUS$	.023(0.9)	.024(0.9)	.023(0.9)	.021(0.8)	.023(0.9)	.025(1.0)
$R\&D_t^k * TECH$	.158(0.9)	.046(0.2)	-	-	-	-
$R\&D_{j,t}^k * TECH$	.105(1.0)	.059(0.5)	-	-	-	-
$LPat_t^k * TECH$	-	-	-.021(0.4)	-	-	-
$LPat_{j,t}^k * TECH$	-	-	-.032(1.6)	-	-.022(1.0)	-.008(0.4)
$ITriPat_t^k * TECH$	-	-	-	-.043(1.1)	-	-
$ITriPat_{j,t}^k * TECH$	-	-	-	.019(0.7)	-	-
$R\&D_t^k * PROF$	.390(1.0)	-	-	-	-	-
$R\&D_{j,t}^k * PROF$	.071(0.6)	-	-	-	-	-
$LPat_{k,t}^{Dest} * PROF$	-	-	.028(0.8)	-	.043(1.6)	.018(0.7)
$LPat_{k,t} * PROF$	-	-	-.008(0.3)	-	-	-
$ITriPat_t^k * PROF$	-	-	-	-.069(1.6)	-	-
$ITriPat_{j,t}^k * PROF$	-	-	-	.023(1.3)	-	-
$ISciArt_t^k * PROF$	-	-.031(0.5)	-	-	-	-
$ISciArt_{j,t}^k * PROF$	-	.023(0.3)	-	-	-	-
$ISciArt_t^k * ACAD$	.038(0.5)	.092(1.4)	.074(0.9)	.042(0.6)	.070(1.0)	.092(1.2)
$ISciArt_{j,t}^k * ACAD$	-.038(0.8)	-.040(1.1)	-.018(0.3)	-.010(0.1)	-	-
$IEarn_{i,t-1}^k$	-	-	-	-	-	.091(1.3)
$IEam_{j,i,t-1}^k$	-	-	-	-	-	.032(0.8)
Adj R^2	.956	.956	.957	.957	.957	.957
SC	-4.456	-4.447	-4.460	-4.472	-4.525	-4.533
t	10	10	10	10	10	10
n	24	24	24	24	24	24

TABLE 6: SWITZERLAND AS A DESTINATION: EXPANDED MODEL (CONTINUED)

	7.	8.	9.	10.	11.	12.
	HDI	HAPPI- NESS	NET OF TAXES EARNING	SWISS IMMIG. POLICY	POLICY CHANGE ON LF	DISAGGREG. DEST. POL.
K=SWITZERLAND						
$IEarn_{i,t}^k$	-	-0.079(1.3)	-	-0.077(1.3)	-0.071(1.2)	-0.086(1.4)
$IEarn_{j,i,t}$	-	-0.038(1.1)	-	-0.028(0.8)	-0.040(1.2)	-0.012(0.5)
$UR_{j,i,t}^k$	-0.004(1.0)	-0.016(4.4)***	-0.0145(3.4)***	-0.014(3.1)***	-0.013(3.1)***	-0.012(2.7)***
$UR_{j,i,t}$	.0004(0.3)	-0.0004(0.4)	-0.0003(0.3)	-0.0003(0.3)	-0.0003(0.3)	.0006(0.6)
$ILFBA_t^k$	-0.239(2.2)**	-0.148(1.5)	-0.204(1.8)*	-0.224(2.0)**	-0.178(1.6)	-0.244(2.3)**
$ILFBA_{j,t}$	.077(1.7)*	.275(2.9)***	.214(3.7)***	.231(3.3)***	.197(2.8)***	.229(3.6)***
$IEarn_{i,t}^k * BUS$	-	.499(3.5)***	.462(3.1)***	.489(3.2)***	.491(3.1)***	.565(5.8)***
$UR_{j,i,t}^k * ACAD$	.005(0.9)	.009(1.7)*	.010(2.5)**	.011(2.6)**	.009(2.2)**	.011(2.5)**
$ILFBA_{j,t}^k * ACAD$	-.144(2.3)**	-.228(2.6)***	-.158(2.5)**	-.164(2.6)**	-.198(2.8)***	-.158(2.7)***
$IFD_{j,t}^k * BUS$	.024(0.9)	.027(1.0)	.023(0.9)	.023(0.9)	.026(1.0)	-
$LPat_{j,t}^k * TECH$	-0.007(0.4)	-0.023(1.1)	-0.019(0.9)	-0.022(1.0)	-0.020(0.9)	-
$LPat_t^k * PROF$	.020(0.7)	.047(1.6)*	.038(1.4)	.043(1.6)	.042(1.5)	-
$ISciArt_t^k * ACAD$	.099(1.2)	.140(1.3)	.073(1.0)	.069(1.0)	.111(1.4)	-
IHD_t^k	3.02(2.2)**	-	-	-	-	-
$IHD_{j,t}$	-2.19(3.0)***	-	-	-	-	-
$IHD_t^k * BUS$	.934(0.7)	-	-	-	-	-
$IHappy_t^k$	-	.558(0.8)	-	-	-	-
$IHappy_{j,t}$	-	.294(1.3)	-	-	-	-
$INetEarn_{i,t}^k$	-	-	-0.045(0.8)	-	-	-
$INetEarn_{j,i,t}^k$	-	-	-0.028(0.8)	-	-	-
$SwiPolicy$	-	-	-	-0.0001(0.1)	-	-
$SwiPolicy * ILFBA_t^k$	-	-	-	-	.005(1.4)	-
$SwiPolicy * ILFBA_{j,t}$	-	-	-	-	-0.004(1.6)	-
$IFD_{j,t-1}^k * BUS(B+F)$	-	-	-	-	-	B,F(+)**
$R\&D_t^k * TECH(E+G+I)$	-	-	-	-	-	E(-)**,G,I
$R\&D_t^k * PROF(A+C+D+H+K)$	-	-	-	-	-	A(+)**,C,D(+)**,H,K(+)**
$ISciArt_t^k * ACAD(J+L)$	-	-	-	-	-	J,L
Adj R ²	.956	.958	.957	.957	.957	.961
SC	-4.510	-4.501	-4.521	-4.502	-4.495	-4.477
t	10	10	10	10	10	10
n	24	24	24	24	24	24

of the source-country skilled labour force. Academic flows for which the state of the Swiss labour market is irrelevant²⁰ are the exception. Also, an increase in the domestic supply of brains is likely to induce employers to hire domestically as flow rates are affected adversely. In 2001, the World Economic

20 The Wald test for equality of coefficients on unemployment at destination in absolute value is $F(1,231)=1.245$ thereby not rejecting H_0 .

Forum (WEF) estimated through its executive opinion survey that Switzerland ranked sixteenth for availability of scientists and engineers while Canada ranked thirteenth and the United States eighth.²¹ Furthermore, the proportion of people with tertiary education in Switzerland is much lower than in Canada and the United States, confirming a possible shortage of highly skilled workers in Switzerland. In 2002, only one-quarter of the Swiss population aged 24 to 34 had tertiary education while the proportions were one-half and one-third for Canada and the United States, respectively (OECD 2004, Table A.3.3). Finally, larger foreign direct investments into Switzerland increase the inflow rate of executives. Hence, despite the fact that executives do not represent the largest share of American skilled immigrants, the attractiveness of Switzerland for North American firms to establish their European or World headquarters (Arthur D. Little 2009) is confirmed.

5.3. *The United States as destination*

The determinants of Canadian and Swiss brain flows to the United States are identified following the same step-by-step process and the results are in Tables 7 and 8.²² In the basic specification, Table 7, Column 1, only earnings are significant but earning at destination has an unexpected sign. Despite the small number of significant variables, the explanatory power of the model is very high (Adjusted R2=0.870). It is worth noting that the Adjusted R2 increases substantially with the FE methodology compared to OLS (adjusted R2=0.271 in Column 2). Hence, much of the explanatory power can be attributed to occupation category time-invariant effects. Thus, there is a fixed flow of brains from Canada and Switzerland to the United States independent

21 Executives are asked to rank the following statement: "Scientists and Engineers in your country are 1=non existent; 7=widely available" (WEF 2002).

22 In the basic fixed effect estimation errors in Column 1, are not serially correlated The results for the AR(2) estimation are: $e_{j,t} = 0.00003 + 0.080e_{j,t-1} - 0.087e_{j,t-2}$ with p-value=0.236 and 0.218 respectively.

of any push or pull factor, which can be interpreted as a representation of the perceived magnet effect by the United States for the brains of the world.

When factors are made occupation-specific, there are significant shifts in the results Columns 3 and 4). In the restricted specification, lower source country earning and higher source country unemployment in fact concern only business occupation flows to the United States. In Table 8, the impacts of skill-oriented policies show high stability across experiments. However, high correlation between source and destination skill-oriented policies create multicollinearity, especially with triatic patents (see Appendix II, Table A.II.1); so the constrained model includes only source country policy variables which

TABLE 7: UNITED STATES AS A DESTINATION: BASIC MODEL

	FLRATE _{KJ,I,T}			
	1.	2.	3.	4.
K = UNITED STATES	BASIC FE	OLS	OCCUP. SPECIFIC ELAST.	RESTRICTED SPECIFICATION
$IEarn_{i,t}^k$	-.049(2.3)**	.009(1.3)	-.056(2.5)**	-.036(1.9)**
$IEarn_{j,i,t}$	-.037(6.4)***	-.008(2.1)**	-.009(1.3)	-.008(1.3)
$UR_{i,t}^k$	-.0001(0.2)	-.0001(0.1)	-.0001(0.2)	-.0002(0.3)
$UR_{j,i,t}$	.0002(0.6)	.0009(2.2)**	.0000(0.3)	.0001(0.4)
$ILFBA_t^k$	.006(0.5)	-.022(3.2)***	.012(0.9)	.005(0.5)
$ILFBA_{j,t}$	-.007(0.7)	.008(6.0)***	-.010(1.0)	-.008(0.9)
$IEarn_{i,t}^k * BUS$	-	-	.081(1.4)	-
$IEarn_{j,i,t} * BUS$	-	-	-.038(2.9)***	-.051(5.0)***
$UR_{i,t}^k * BUS$	-	-	-.001(0.3)	-
$UR_{j,i,t} * BUS$	-	-	.004(3.6)***	.003(4.0)***
$ILFBA_t^k * BUS$	-	-	-.035(1.0)	-
$ILFBA_{j,t} * BUS$	-	-	.005(0.2)	-
$IEarn_{i,t}^k * ACAD$	-	-	.040(0.8)	-
$IEarn_{j,i,t} * ACAD$	-	-	.008(0.5)	-
$UR_{i,t}^k * ACAD$	-	-	.0002(0.1)	-
$UR_{j,i,t} * ACAD$	-	-	-.0001(0.2)	-
$ILFBA_t^k * ACAD$	-	-	-.007(0.2)	-
$ILFBA_{j,t} * ACAD$	-	-	.005(0.2)	-
Adj R^2	.870	.271	.903	.903
SC	-7.588	-6.253	-7.674	-7.847
t	11	11	11	11
n	24	24	24	24

TABLE 8: UNITED STATES AS A DESTINATION: EXPANDED MODEL

	1.	2.	3.	4.	5.	6.
	FULL FE (R&D: TECH, PROF; SCIART)	FULL FE (R&D: TECH; SCIART: PROF)	FULL FE (PAT: TECH; SCIART)	FULL FE (TRIPAT: TECH; SCIART)	CON- STRAINED	LAGGED EARNINGS
$IEarn_{i,t}^k$	-.037(1.6)	-.049(2.4)**	-.049(2.5)**	-.040(2.0)**	-.022(1.2)	-
$IEarn_{j,i,t}$	-.011(1.7)*	-.007(1.1)	-.003(0.4)	-.006(0.9)	.003(0.4)	-
$UR_{i,t}^k$	.002(2.2)**	.001(1.1)	.002(1.9)**	.002(1.8)*	.0001(0.2)	.002(2.0)*
$UR_{j,i,t}$	-.0000(0.2)	-.0001(0.5)	-.0000(0.2)	-.0002(0.8)	.0000(0.3)	.0000(0.3)
$ILFBA_t^k$	.019(1.3)	.005(0.3)	-.003(0.2)	-.010(0.4)	-.016(1.2)	-.006(0.4)
$ILFBA_{j,t}$	-.003(0.2)	.004(0.4)	.014(1.3)	.020(1.5)	.009(0.9)	.012(1.2)
$IEarn_{j,i,t}^k * BUS$	-.035(3.1)***	-.039(3.5)***	-.047(3.9)***	-.044(3.8)***	-.062(5.8)***	-.045(5.4)***
$UR_{j,i,t}^k * BUS$	.005(5.2)***	.005(5.4)***	.005(5.3)***	.005(5.6)***	.004(4.4)***	.004(4.9)***
$IFDI_{j,t-1}^k * BUS$	-.003(1.3)	-.001(0.5)	-.0003(0.1)	-.0002(0.1)	-	-
$R\&D_t^k * TECH$	-.009(0.7)	-.001(0.1)	-	-	-	-
$R\&D_{j,t}^k * TECH$	-.010(0.7)	.011(0.9)	-	-	-	-
$LPat_t^k * TECH$	-	-	.001(0.1)	-	-	-
$LPat_{j,t}^k * TECH$	-	-	-.005(2.0)**	-	-.006(2.1)**	-.004(1.5)
$ITriPat_t^k * TECH$	-	-	-	.017(1.6)	-	-
$ITriPat_{j,t}^k * TECH$	-	-	-	-.011(2.1)**	-	-
$R\&D_t^k * PROF$	-.025(2.1)**	-	-	-	-	-
$R\&D_{j,t}^k * PROF$	-.014(1.3)	-	-	-	-	-
$LPat_t^{Dest} * PROF$	-	-	-.0002(0.1)	-	-	-
$LPat_{k,t} * PROF$	-	-	-.006(2.9)***	-	-.006(2.7)***	-.005(2.3)**
$ITriPat_t^k * PROF$	-	-	-	.020(2.0)**	-	-
$ITriPat_{j,t}^k * PROF$	-	-	-	-.014(3.0)***	-	-
$ISciArt_t^k * PROF$	-	.037(1.7)*	-	-	-	-
$ISciArt_{j,t}^k * PROF$	-	.016(2.6)**	-	-	-	-
$ISciArt_t^k * ACAD$	.002(0.1)	-.012(0.4)	-.019(0.5)	-.017(0.4)	-	-
$ISciArt_{j,t}^k * ACAD$	.002(0.2)	.006(0.8)	.009(1.0)	.010(1.0)	.010(1.4)	.006(0.8)
$IEarn_{j,i,t-1}^k$	-	-	-	-	-	-.029(1.8)*
$IEarn_{j,i,t-1}$	-	-	-	-	-	-.014(2.3)**
Adj R ²	.919	.920	.920	.921	.906	.922
SC	-7.900	-7.918	-7.914	-7.927	-7.821	-8.013
t	10	10	10	10	10	10
n	24	24	24	24	24	24

TABLE 8: UNITED STATES AS A DESTINATION: EXPANDED MODEL (CONTINUED)

	7.	8.	9.	10.
	HDI	HAPPINESS	NET OF TAXES EARNING	DISAGGREG. DEST. POL.
$IEarn_{i,t}^k$	-	-.034(1.8)*	-	-.022(1.3)
$IEarn_{j,i,t}$	-	.014(1.9)*	-	-.001(0.2)
$UR_{i,t}^k$	-.0005(0.9)	-.001(1.8)*	-.0001(0.2)	-.0001(0.4)
$UR_{j,i,t}$	-.0002(0.9)	-.0001(0.5)	.0000(0.4)	.0001(0.6)
$ILFBA_t^k$	-.218(4.9)***	-.103(4.3)***	-.016(1.2)	-.016(1.3)
$ILFBA_{j,t}$	.040(2.8)***	.055(3.7)***	.010(0.9)	.009(0.6)
$IEarn_{j,i,t}^k * BUS$	-	-.070(6.8)***	-.062(5.8)***	-.058(5.9)***
$UR_{j,i,t}^k * BUS$	.006(7.2)***	.003(3.9)***	.004(4.4)***	.004(3.5)**
$LPat_{j,t}^k * TECH$	.0005(0.2)	-.004(1.4)	-.006(2.1)**	-
$LPat_{j,t}^k * PROF$	-.0003(0.1)	-.004(1.9)*	-.006(2.7)***	-
$ISciArt_{j,t}^k * ACAD$	-.005(0.6)	.003(0.4)	.010(1.4)	-
$IHDI_t^k$	1.09(3.5)***	-	-	-
$IHDI_{j,t}$	1.07(4.9)***	-	-	-
$IHDI_{j,t}^k * BUS$	-.361(4.3)***	-	-	-
$IHappy_t^k$	-	-.394(4.1)***	-	-
$IHappy_{j,t}$	-	-.052(2.5)**	-	-
$INetEarn_{j,t}^k$	-	-	.003(0.4)	-
$INetEarn_{j,i,t}$	-	-	-.022(1.1)	-
$LPat_{j,t}^k * TECH(E+G+I)$	-	-	-	E(-)***,G(-)***,I
$LPat_{j,t}^k * PROF(A+C+D+H+K)$	-	-	-	A,C(-)***,D,H(-)***,K(-)***
$ISciArt_{j,t}^k * ACAD(J+L)$	-	-	-	J(+)**,L(+)**
Adj R ²	.900	.915	.906	.907
SC	-7.758	-7.893	-7.820	-7.713
t	11	11	11	11
n	24	24	24	24

have a higher level of significance than destination variables (Column 5). The use of alternative measures for earnings leads to significant results but with unexpected signs (columns 6 to 8), and taxes hardly affect the results. Finally, when the occupation groups are disaggregated, only three categories of occupations are not affected: IT professionals (I), architects (A), and physicians (D). Therefore, overall I consider the results in column 10 to be the most reliable for the United States. Interestingly, most factors affecting skilled immigration to the United States are source-specific except for what appears to be a basic attractiveness for all classes of occupations through the fixed effect.

6. POLICIES AND BRAIN MOVEMENTS

For easier comparison, the results of the preferred specification for each of the three destination countries are summarised in Table 9. There are striking differences between the two small countries as well as between the two small countries and the United States. The traditional push and pull factors mostly matter for the two small countries, with a stronger relevance of push factors for Canada and pull factors for Switzerland. Generally speaking, while competitive earnings attract brains to Canada, the domestic demand and supply determine the inflow of brains to Switzerland, with the exception of academics, reflecting the vastly different immigration policies the two countries have in place.

One type of skilled-oriented policies is found to be a clear determinant in attracting skilled foreigners to the small countries: Research and development spending by both Canada and Switzerland drives technician and professionals. Furthermore, larger R&D spending by the small countries slows down departures to the United States. These results show that while the United States is intrinsically attractive, flows of brains to and from small countries depend on skill-oriented home policies. In fact, R&D spending is a win-win tool for small countries, as it retains domestic brains in addition to attracting foreign ones. Academics, however, tend to be strongly attracted by the prolific environment of the United States, especially when they benefit from an increasingly stimulating environment at home. This latter result is in line with the high degree of brain exchanges observed in these occupations among the three countries as well as with the findings by Hunter et al. (2009) for about 150 highly cited scientists. Finally, foreign direct investments are only relevant for Switzerland, confirming its high rank in hosting American headquarters in Europe.

A legitimate question in light of these results is: Did the two small countries run relevant skill-oriented policies in the first few years of the twenty-first century? During the five years following the end of the sample, i.e., 2001 to 2005, Switzerland and Canada ran opposite policies on R&D spending: in Switzerland, its share of GDP increased by 14.6 percent and in Canada, it fell by 5.3 percent. So, while in Switzerland, the environment became more attractive for North American professionals and the incentive for Swiss technicians and professionals to leave was lowered, the opposite happened in Canada, even though the decrease in attractiveness due to lower R&D spending was dampened by a lower flight of Canadian technicians and professionals to the United States where R&D spending also decreased (-5.1%). Investigating the reasons why R&D spending dropped in Canada is not the purpose of this paper; nevertheless, it is worth noting that while Canada has been ranking high in the tax treatment generosity of research and development spending,²³ the ratio of private to public funding was much lower than in Switzerland and the United States in the 1990s (1.21 versus 2.62 and 1.84, respectively), and despite rising, remained lower in the early twenty-first century (1.63 versus 3.07 and 2.21, on average, between 2001 and 2005) (OECD 2010).

Academics are relatively immune to labour market conditions but are sensitive to the productivity of their colleagues, especially in the United States but also at home. Between 2001 and 2005, the number of scientific articles per one million people increased in all three countries but much more substantially in Canada (i.e., +13.2 percent versus +7 percent in Switzerland and +3.6 percent in the United States), thereby increasing the flow of academics to both Canada and the United States but not to Switzerland. In fact, based

23 Extensive work has been done on developing a measure for R&D tax treatment which is now regularly updated by the OECD. In 1999, Canada placed among the *generous incentive providers*, the United States, the *moderate incentive providers* and Switzerland, the *no-incentive providers*; by 2008, the ranking had not changed (see Statistics Canada 1999; Warda 2001; OECD 2009).

TABLE 9: SUMMARY

	SWISS AND AMERICANS TO CANADA	CANADIANS AND AMERICANS TO SWITZERLAND	SWISS AND CANADIANS TO US
BASIC GRAVITY PUSH AND PULL FACTORS			
<i>Destination:</i>			
<i>Earnings</i>	(+)		
<i>Unemployment</i>		(-)	
<i>Skilled labour force</i>		(-)	
<i>Source:</i>			
<i>Earnings</i>	(-)		
<i>Unemployment</i>	(+)		
<i>Skilled labour force</i>	(-)	(+)	
<i>Manager</i>		Earnings destination (+)	Earnings source (-) Unemployment source (+)
<i>Technicians professionals</i>			
<i>Academics</i>		Unemployment destination (+) Labour force source (-)	
SKILLED-ORIENTED POLICIES			
	<i>FDI</i>	(+) [F]	
<i>Destination:</i>			
<i>R&D, Patent</i>	(+) TECH (+) PROF[A,C,D,K]	(+) PROF[A,D,K]	
<i>Publications</i>			(+)
<i>Source:</i>			
<i>R&D, Patent</i>			(-) TECH (-) PROF[C,H,K]
<i>Publications</i>	(+) [L]		

on the results, an increase in publications in Switzerland rather than contributing to the retention of scientists in the country actually increased their rate of departure to Canada as they were concurrently attracted to the United States. So, while academic flows are generated mostly through third country effects, professionals and technicians go where R&D money is and at the beginning of the twenty-first century, Canada did not use that opportunity, unlike Switzerland.

7. CONCLUSION

This paper studies the factors that influence the movements of permanent skilled migrants between Canada, Switzerland, and the United States, with the goal of identifying whether, in addition to using immigration policy, small high-income economies can attract brains through skill-oriented policies in the face of the perceived magnetic role played by the United States. I do find that the United States has non-measurable advantages in attracting skilled immigrants, yet domestic policies can play a determining role in the flows of brains to and from the small countries. Research and development spending offers a win-win opportunity to decrease emigration of their own technicians and professionals to the United States and to increase immigration from other countries. In an environment where immigration is supply-determined as in Canada (versus demand-determined as in Switzerland), R&D policy may also improve the ability of skilled immigrants to find jobs in the occupations they trained for. But clearly the choice of instruments to stimulate R&D spending is important. While Canada has very generous tax incentives, it does not appear to be able to generate substantial R&D spending like Switzerland or the United States. The international movements of academics is less controllable as they are irremediably attracted by the United States' prolific environment, and when there is more production in their home country, they tend to become more competitive abroad and expatriation increases.

Movements of brains between high-income countries are the results of complex combinations of factors, and these results may not apply to all high-income countries. However, in small countries with a high-skill labour force, domestic policies fostering inventions can influence the attraction and retention of brains, despite the United States' inherent advantage.

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APPENDIX I

Both the United States and Canada have national occupational classifications that are different from the International Labour Organization International Standard of Occupation Classification (ISCO) used by Switzerland. Therefore, both occupational classifications had to first be translated to ISCO and then ISCO codes were allocated to occupational categories lettered A to L, which cover one-digit ISCO between 1 and 3, considered to be the highly skilled (Managers, professionals and technicians). Canada provides information for both education and occupation, and only migrants with completed university degrees are taken into account except for managers;²⁴ for the other two countries, information is only by occupations. This distinction is unlikely to affect data for professionals and technicians. The specific process of occupation classification for each country is now detailed.

Into Canada

The final file includes 616 Swiss-born and 8,936 US-born immigrants with university education who declared their intention to work in a skilled occupation for the period 1990–2000. Permanent immigrants who declared being students and people who did not report an occupation are not taken into account. The 4-digit occupation codes from the 1992 and the 2001 National Occupational Classification (NOC, CIC) and the National Occupational Classification Statistics (NOC-S, Statistics Canada) were matched to a single corresponding ISCO code.

²⁴ The executive class can include people with any level of education and restricting the sample to university education may have biased the actual number downward. For example, out of 486 Swiss-born immigrants classified as executives that came to Canada between 1980 and 2005 only 92 had a university degree.

CANADA OCCUPATION CATEGORIES

NOC-S	NOC	
A	0	Management occupations
B	1	Business, finance and administrative occupations
C	2	Natural and applied sciences and related occupations
D	3	Health occupations
E	4	Occupations in social sciences, education, government service and religion
F	5	Occupations in art, culture, recreation and sport
G	6	Sales and service occupations
H	7	Trades, transport and equipment operators and related occupations
I	8	Occupations unique to primary industry
J	9	Occupations unique to processing, manufacturing and utilities.

Into the United States

The final file includes 3,644 Swiss-born and 48,298 Canadian-born immigrants for the period 1990–2000. The US classification is a mix of occupation and labor force status. People who declared being homemakers, students, children, retirees, in the military, unemployed or did not declare an occupation are not part of the sample. The occupation classification is identified by 3-letter occupation codes (prior to 1999) and 3-digit codes (starting in 1999) with a matching key (USDJINS 2002).

US OCCUPATION CATEGORIES

BEFORE 1999	AFTER 1999	
SKILLED ^{a/}		
EXC	10	Executive, administrative, managerial occupations
ARC	20	Architects
ENG	31-49	Engineers
MCS	50	Mathematical, computer scientists
NSC	60,70	Natural scientists
SWK	75	Social, recreation, religious workers
SSC	80	Social scientists, urban planners
LAW	87	Lawyers and judges
TCU	90	Teachers, post-secondary
TCO	93	Teachers, except post-secondary
COU	95	Counselors, educational, vocational
LIB	97	Librarians, archivists, curators
DOC	100	Physicians
HLD	101,105	Other health diagnosing occupations
HLT	111,115	Other health assessment and treating occupations
NUR	110	Nurses
ART	120-140	Writers, artists, entertainers, athletes
TNH +TNO	150	Health technologists, technicians and non-health

^{a/} Skilled=Executive, administrative, managerial, professional specialty, and technical occupations.

Source: US DJINS (1984-2002).

Into Switzerland

The data has 3,820 Canadian nationals and 11,017 US nationals that immigrated to Switzerland between 1990 and 2000 classified with ISCO codes.

Built occupation categories

Finally, ISCO codes were used to determine broad occupation categories valid for all three countries (Table A.I.1).

TABLE A.I.1: FINAL OCCUPATION CATEGORY AND DESCRIPTION

CAT.	OCCUPATION TITLE	ISCO CODE	SHORT NAME
A	Architects, cartographers, surveyors, and urban or land use planners.	2141&2148	Architects and related specialists
B	Administrative officers, bookkeepers, clerks, financial and investment analysts, insurance underwriters, marketing and sales personnel, secretaries (except legal & medical), securities agents, investment dealers, and brokers.	340-343 & 400-422	Commercial and financial technicians
C	Kindergarten, elementary school and secondary school teachers, vocational and educational counselors.	232-235	Teachers
D	General practitioners and family physicians, other professional occupations in health diagnosing and treating, specialist physicians (including opticians, dentists, podiatrists), and veterinarians	222 & 3224	Physicians
E	Engineers	2142-2147	Engineers
F	Corporate managers, managers of small enterprises, and senior officials of organizations.	100-131	Managers
G	Air pilots; flight engineers; flying instructors; air traffic control and related occupations; ambulance attendants and other paramedical occupations; audiologist and speech language pathologists; elementary and secondary school teachers' assistants; engineering inspectors and regulatory officers; dieticians and related occupations; life science and health (except nursing) technicians and associate professionals; pharmacists, physiotherapists and related associate professionals; physical and engineering science operators, technicians, and technologists	300-334 & 344-345 (minus 3224)	Health and science technicians
H	Archivists; librarians; artistic, entertainment and sport associate professionals; business professionals (including accountants, specialists in HR); counselors (except educational); journalists, editors, reporters, public relations, announcers; law professionals (including paralegals); religious professionals; social scientists; social workers; translators, terminologists, interpreters, writers; creative or performing arts.	240-247 & 346-348	Social scientists and humanities related professionals
I	Computer programmers and developers, information system analysts and consultants, mathematicians, statisticians, actuaries, and web designers.	212-213	IT professionals
J	Natural scientists and physical scientists.	211 & 221	Scientists
K	Head Nurses, supervisors and Registered nurses.	223	Nurses
L	College and vocational instructors, post-secondary teachers, and research assistants and university professors.	231	Professors

APPENDIX II: DEFINITIONS OF VARIABLES

The matching of skill definitions across skill-specific variables is given in Table A.II.3. Destination country is identified by k .

$ACAD:$	Dummy equal to 1 for academic occupations (categories J and L in Table A.I.1) and 0 otherwise.
$BUS:$	Dummy equal to 1 for managerial and business occupations (categories B and F in Table A.I.1) and 0 otherwise.
$FLRate_{j,i,t}^k:$	Flow of brains to destination country from source country j as a share of the tertiary educated labour force in the destination country ($LFBA^k$) in occupation category i ($j=1$ to 12) at time t ($t=1990$ to 2000); in Canada, entries of Swiss-born permanent immigrants with university education who declared an occupation (CIC 2007); in Switzerland, entries of Canadians and American citizens by ILO occupations (ODM 2007); in the United States, entries of Swiss-born permanent immigrants for skilled occupations during the fiscal year, October to September (US DJINS 1984-2000).
$LEarn_{i,t}^k, LEarn_{j,i,t}:$	Log of earnings in destination and source country j , occupation category i , at time t . In Canada, log of annual earnings of individuals by NOC-S in 2005-constant dollars (SLID, Statistics Canada 2008a); sub categories are computed from ratio of that category to overall from 1995-Census (Statistics Canada 2008b) converted in 2005 US\$ at the annual 2005 exchange rate (Bank of Canada 2008). In the United States, total private average weekly earnings (US BLS 2008b) weighted with ratio of occupational hourly compensation to average in 1997 (US BLS 1999) in 2005 dollars (US BLS 2008c). In Switzerland, 1991–2000, gross nominal annual revenue by ISCO 2-digit level (ESPA, Table 3.4.3.1., OFS 2008), corrected with CPI (Table 5.2.1., OFS 2008) in 2005 US\$ at the average of monthly 2005 exchange rate (Swiss National Bank 2008); the missing observations for 1990 were built using average growth rates over the available period.
$IFDI_{j,t}^k:$	Log of foreign direct investment capital stock in destination country by source country j . Values are in constant real 2000-US dollars. Foreign direct investment data for Switzerland with Canada and the United States is from SNB (2009) Tables 1.2, 2.2; data for Canada with the United States is from Statistics Canada (2008a), Table 376-0053. GDP deflator and exchange rates are from WB (2009).
$ILFBA_{i,t}^k, ILFBA_{j,t}:$	Log of labour force aged between 15 and 65 years old with a university degree in Canada (Statistics Canada 2008a). In the United States, 1992–2000 labour force with a bachelor's degree and higher, 25 years and over; the missing labour force numbers, 1990–91 are extrapolated using the average growth rate for the period 1992–2000, (CPS, US BLS 2008a). In Switzerland, 1991–2000 labour force with tertiary education (university and advanced professional education; ESPA, OFS 2008); the missing observations for 1990 are built using average growth rates over the available period.
$IHappy_{i,t}^k, IHappy_{j,t}:$	Log of happiness index for destination and source country j . Available

years are: for Canada, 1990 and 2000; for Switzerland, 1990, 1996, and 2000; for the United States, 1990, 1995, 1999, and 2000. Annual values for missing years are computed through linear extrapolation (Veenhoven 2010).

$IHDI_{i,t}^k, IHDI_{j,t}$:	Log of the human development index for destination and source country j (UNDP, 2009).
$INetEarn_{i,t}^k, INetEarn_{j,i,t}$:	Log of earnings ($LEarn_{i,t}^k, LEarn_{j,i,t}$) corrected for the average income tax plus employee contributions less cash benefits, for a single person without children in % of gross income (OECD 2010b).
$IPat_{i,t}^k, IPat_{j,t}$:	Log of the number of applications with a national office for exclusive rights for an invention in destination and source country j , at time t (WB 2009).
$ISciArt_{i,t}^k, ISciArt_{j,t}$:	Log of number of scientific and engineering journal articles published in physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences in destination and source country j , at time t (WB 2009).
<i>PROF</i> :	Dummy equal to 1 for professional occupations (A, C, D, H, and K in Table A.I.1) and 0 otherwise.
$R\&D_{i,t}^k, R\&D_{j,t}$:	Annual gross domestic expenditure on R&D as percentage of GDP in destination country and source country j , at time t (OECD 2010a).
<i>TECH</i> :	Dummy equal to 1 for technical occupations (categories E, G and I in Table A.I.1) and 0 otherwise.
$UR_{i,t}^k, UR_{j,i,t}$:	Unemployment rate in destination and source country j , occupation category i , at time t . In Canada, unemployment rates by NOC-S (Statistics Canada 2008a). In the United States, unemployment rate for one-digit ISCO categories based on the correspondences in Table A.II.1 (ILO 2010 Table 3E). In Switzerland, unemployment rate for one-digit ISCO categories calculated by multiplying total unemployment rate by the 2002-ratio of each digit to total unemployment for each year and applied to categories as in Table A.II.1 (ILO 2010, Table 3E; ESPA, OFS 2008).
<i>CanPolicy</i> :	Dummy with value 1 from 1995 on and 0 otherwise for Canada as destination. In 1995, the government indicated that 50% of the yearly intake of permanent immigrants had to come through the point system and pre-arranged employment was no longer necessary.
<i>SwiPolicy</i> :	Dummy with value 1 from 1995 on and 0 otherwise for Switzerland as destination. In 1995, all EU/EFTA countries are given priority in the allocation of work permits and other countries have access to permits only under exceptional circumstances.
<i>USPolicy</i> :	Dummy with value 1 from 1995 on and 0 otherwise for the United States as destination. The so-called diversity class was instituted with Switzerland as a participating country.
$ITriPat_{i,t}^k, ITriPat_{j,t}$:	Log of number of triatic patent applications to the EPO in destination country and source country j , at time t (OECD 2010).

TABLE A.II.1: CORRELATIONS BETWEEN SKILL-ORIENTED POLICY MEASURES

CORRELATION	R&D	PAT	TRIPAT	SCIART
(Canada, Switzerland)	-.814	-.779	.967	-.322
(Canada, US)	.099	.772	.996	.890
(Switzerland, US)	-.415	-.853	.965	-.401

TABLE A.II.2: STATISTICAL CHARACTERISTICS OF THE INDEPENDENT VARIABLES.

	UR	LFBA (,000)	EARN (2005- US\$)	PAT	SCIART	R&D	TRIPAT	FDI (Mios 2000- US\$)	From US	From Switzer- land	TAX + SOCIAL CON- TRIB.
CANADA											
Mean	3.24	2,458	65,899	3,096	23,241	1.69	957	87,952	2,728	26.38	
Min	0.00	1,940	41,095	2,182	22,125	1.51	505	67,096	2,015	23.80	
Max	9.40	2,994	151,741	4,187	24,565	1.92	1,622	130,395	3,937	27.70	
SD	2.19	322	24,344	695	785	0.11	419	21,771	598	1.12	
SWITZERLAND											
Mean	2.29	818	78,191	2,624	7,293	2.61	2,629	12,965	328	21.53	
Min	0.92	707	57,364	1,916	5,901	2.53	2,031	6,970	119	19.90	
Max	4.50	926	87,401	3,068	8,504	2.67	3,933	29,551	1,341	22.50	
SD	0.69	67	8,755	431	808	0.04	629	7,256	342	0.72	
UNITED STATES											
Mean	3.20	31,257	46,274	115,401	193,544	2.60	23,945	71,337	27,252	25.86	
Min	1.79	26,375	28,954	87,955	188,004	2.42	18,169	49,549	11,769	25.60	
Max	5.84	36,630	72,063	161,786	199,769	2.74	32,429	119,818	53,700	26.00	
SD	0.93	3,279	10,433	23,020	3,605	0.09	5,284	23,411	12,484	0.12	

TABLE A.II.3: CORRESPONDENCE BETWEEN OCCUPATION CLASSES ACROSS COUNTRIES FOR EXPLANATORY VARIABLES

OCCU- PATION CAT.	ISCO CODE	CANADA NOC-S UNEMP. RATES (STATS CAN)	SWITZER- LAND ISCO EARNINGS (OFS, ESPA; ILO)	US ISCO UNEMP. RATES (ILO)	CANADA NOC-S EARNINGS (STATS CAN CANSIM)	SWITZER- LAND ISCO EARNINGS (OFS, ESPA)	US COMPENSATION SURVEY 1997 EARNINGS (BLS)
A	2141,2148	C05	ISCO2	ISCO2	C05	ISCO2	Architect
B	340-343, 400-422	B	ISCO3,4 ^b	ISCO3,4 ^b	B	ISCO3,4 ^b	EAM: management- related
C	232-235	E13	ISCO2	ISCO2	E13	ISCO2	Teachers, except college and univ.
D	222, 3224	D01	ISCO2	ISCO2	D01	ISCO2	Physicians
E	2142-2147	C03	ISCO2	ISCO2	C03	ISCO2	Engineers
F	100-131	A	ISCO1	ISCO1	A (all)	ISCO1	EAM
G	300-334, 344-345 (minus 3224)	C1	ISCO3	ISCO3	C1	ISCO3	Technical

H	240-247, 346-348	F0	ISCO2,3 ^b	ISCO2,3 ^b	E0,E2 ^a	ISCO2,3 ^b	Librarians, social scientists, social recreation workers, lawyers, and writers ^a
I	212-213	C07	ISCO2	ISCO2	C06	ISCO2	Mathematic, Computer scientists
J	211, 221	C01	ISCO2	ISCO2	C01	ISCO2	Natural scientists
K	223	D1	ISCO2	ISCO2	D1	ISCO2	Registered nurses
L	231	E11,E12	ISCO2	ISCO2	E11,E12	ISCO2	Teachers, college and univ.

a Simple average of the classes. b Employment weighted average of the two classes.