

Impact of immigration on public finances in Switzerland

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Summary

The Economic Analysis and Policy Advice Unit of the Federal Finance Administration carries out studies on the long-term challenges of fiscal policy. A long-term outlook for public finances in Switzerland is drawn up every four years.¹ It takes into account demographic scenarios, as well as more detailed studies carried out in the area of health.² Immigration is an important topic that has not been analysed much up to now in this framework. After addressing the demographic impact of immigration, we will look at its economic impact and then focus on the core of this paper: its budgetary impact, be it direct or indirect.

Demographic impact in Switzerland

Since the 1980s, population growth has been due more to net migration than to an excess of births over deaths. The share of the permanent resident population of foreign nationality reached 25% in 2016. Almost 30% of the Swiss population was born abroad and the trend is increasing. Wanner (2013) found that, between 1980 and 2010, the

population would have increased by only 180,000 people in the absence of migratory flows, instead of the 1.5 million observed. According to the UN, the Swiss population would remain approximately stable in the absence of migration, at least for the studied time horizon of 2045. According to Wanner, the number of elderly people per worker would have been about 40% higher in 2010 without immigration. However, immigration was not sufficient to maintain this ratio at its 1980 level. Typically, immigration initially makes the population younger, but it eventually reinforces its ageing (see box S.1). It nevertheless seems that immigration improves dependency ratios (number of elderly people per worker, non-workers per worker) even in the long term.

Gainful activity not subject to quotas is the main reason for immigration, followed by family reunification. It is difficult to quantify the migratory impact of the Agreement on the Free Movement of Persons between Switzerland and the European Union. Eritrea has long been the most common country of origin for asylum

1 See FDF (2016) for the last edition.

2 For a recent projection concerning healthcare expenditure, see Brändle and Colombier (2017). Other studies are available at the following link: https://www.efv.admin.ch/efv/de/home/themen/publikationen/oeko_grundlagenarb.html

seekers. For third countries excluding the asylum procedure, family reunification prevails over arrivals within the framework of quotas. By international standards, Switzerland is among the countries which have experienced considerable immigration for a long time, and it thus has a large proportion of residents born abroad and foreign nationals. Consequently, migratory phenomena are particularly significant in Switzerland.

General principles concerning the economic impact

Immigration undoubtedly increases GDP. However, it is GDP per capita that reflects a country's prosperity. This depends on the proportion of workers in the population and the productivity of those workers. If the impact on unemployment is not negative (or is sufficiently small), immigration can increase the proportion of workers by raising the population's proportion of working-age people. Moreover, immigration has an impact on workers' productivity by modifying (at least in the short term) the relative proportions of the various production factors and by modifying total factor productivity (innovation).

There is a vast amount of international literature on the economic

impact of immigration. The results differ from one study to the next. The impact of immigration on GDP per capita in the host country is generally considered to be low. Nevertheless, there may be redistributive effects between labour and capital, or between different types of workers.

Budgetary impact in Switzerland: direct effects

The direct budgetary impact is the difference between what immigrants pay in taxes and social contributions on the one hand and what they benefit from in terms of public expenditure and social benefits on the other. For Switzerland, the most recent and in-depth study on this topic is Ramel and Sheldon (2012). Specifically, this study has the merit of examining not only the present (2003–2009), but also the long term (see Box S.1). It thus differs from short-term studies which take into account the old-age and survivors' insurance contributions paid by immigrants, for example, without considering the old-age and survivors' insurance pensions to which these contributions will entitle them. Ramel and Sheldon (2012) found that the budgetary balance is highly dependent on the origin of immigrants. For immigrants as a whole, the

average budgetary balance is initially significantly positive (i.e. immigrants pay more than they receive), while the equilibrium population resulting from this immigration in the long term shows a significantly negative average budgetary balance.

The fact that immigration has a positive budgetary impact initially but a permanent negative impact in the long term raises the following question: Should the initial surpluses be saved to at least partially offset future negative balances? The old-age and survivors' insurance fund could thus be increased during

the transitional period when the balance is positive in anticipation of the negative impact to which these contributions will give a right (it is not a question of transforming a pay as you go system into a funded system, but rather of smoothing out fluctuations). That said, consideration must also be given to the fact that, with no policy change, the budgetary balance of natives will evolve negatively too because of the ageing of the population. A change of fiscal policy will thus be necessary in any case (while Ramel and Sheldon's calculations are with no policy change).

Box S.1: Equilibrium population

A simple example makes it possible to understand the concept of "Equilibrium population". Suppose a migration policy reform leads to an additional 10,000 immigrants per year. To simplify matters, let us assume that these immigrants all arrive in Switzerland at the age of 25 and remain there until they die at 85. In the first year after the reform, there will be 10,000 more 25-year-olds in Switzerland (relative to the scenario without the migration policy reform). In the second year, there will be 10,000 25-year-olds who have just arrived, as well as the 10,000 immigrants from the preceding year who are now 26 years old. The following year, there will be 10,000 immigrants aged 25, 10,000 aged 26 and 10,000 aged 27, and so on. 60 years later, there will be 10,000 immigrants in each age group (in addition to what there would have been without the reform). This is the equilibrium population, as

within the framework of our assumptions, the last age group (85 years) dies and the group aged 25 is constantly renewed with new immigrants. The average age of this population is 55. If the host country has an average age lower than that, this permanent flow of young adults will eventually increase the average age of the population. It should be noted, however, that this average age is higher only because these immigrants were not in Switzerland during their childhood. Consequently, it does not necessarily have a negative impact on Swiss public finances, as children cost money in terms of public funds. In the equilibrium population in our example, there are two people of working age for every person over the age of 65. If this ratio is more favourable than that of the host country (which is typically the case if the host country's population is declining), the reform will improve this ratio.

This highly simplified example illustrates the concept of equilibrium population and provides an intuitive understanding of why immigration can eventually accentuate the ageing of the population while improving the old-age dependency ratio. A more realistic calculation should take account of the fact that immigrants do not necessarily arrive in Switzerland at the age of 25 and do not necessarily die at 85. They can also leave Switzerland. The age of arrival in Switzerland, as well as the mortality rate or the probability of leaving Switzerland can depend in particular on the country of origin. Moreover, it is not age per se that matters for public finances, but rather the budgetary balance. Budgetary balances by age group (and other immigrant characteristics) must therefore be taken into consideration. Ramel and Sheldon (2012) calculated the equilibrium population as well as the budgetary balances by age group to find the average budgetary balance of the equilibrium population.

Ramel and Sheldon (2012) and subsequent calculations by Sheldon yield the following results.

Table S.1 Budgetary balance for an average immigrant household by origin

Origin	Monthly budgetary balance [CHF]		Sum of discounted budgetary balances [CHF]		
	Short term (immigrants 2003–2009)	Long term (equilibrium population)	Discount rate		
			0%	2%	3%
EU17 North/EFTA	1754	544	108 850	117 532	118 562
EU17 South	424	-515	-104 594	-11 538	7 101
Rest of Europe	-937	-1448	-770 683	-414 807	-328 039
Rest of world	611	398	76 683	69 854	66 200
Total	729	-405	-106 050	-18 536	1 091

Source: Monthly budgetary balances: Ramel and Sheldon (2012)³
Sum of discounted budgetary balances: Sheldon communication

On arrival, the overall budgetary balance of immigrants is definitely positive (CHF 729 per month), but clearly becomes negative in the long term (minus CHF 405 per month), as this continuous immigration leads to an equilibrium population of older and less qualified immigrants (skilled immigrants tend to stay in Switzerland for shorter periods). Since budgetary balances are initially more favourable than in the long run, it is

interesting to know the present value of budgetary balances. This value depends on the discount rate. If the sign is positive, investing the surplus at a return equal to the discount rate would more than compensate for the negative balances of the equilibrium population. However, surpluses do not make it possible to fully offset negative balances if the discounted sum is negative.

3 Since it is a question of studying the impact of immigration, all immigrants are taken into account, irrespective of whether they acquired Swiss citizenship.

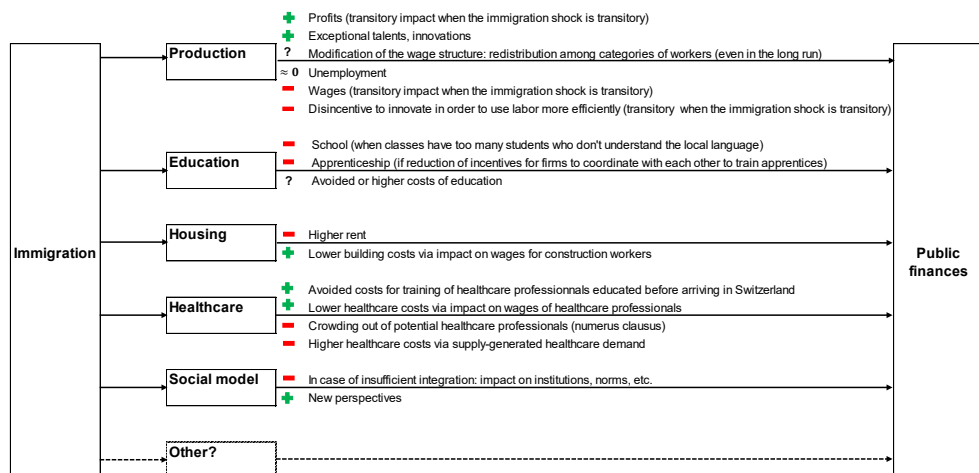
These calculations are of course subject to uncertainties. Our analysis of Ramel and Sheldon's (2012) hypotheses suggests that treating immigrants' children born in Switzerland as immigrants tends to result in overly negative budgetary balances. At the time Ramel and Sheldon wrote the paper, during the reference period (2000–2005) for calibrating budgetary balances by foreigner category, public finances were seen as representative. However, after subsequent revisions and with hindsight, this period was weaker than normal, which also tends to lead to final budgetary balances that are overly negative. Conversely, various public expenditure amounts have been assumed to be independent of immigration, whereas they probably increase at least proportionally with the population. This tends to result in budgetary balances that are too favourable. Moreover, the authors indicated that they were unable to factor in old-age and survivors' insurance/disability pensions paid abroad, which also tends to result in overly favourable budgetary

balances. Furthermore, we would have thought it preferable not to take account of the 2nd pillar (neither contributions nor pensions). Ramel (2013) calculated the budgetary balance of Swiss households during the period 2003–2009, but not their long-term balance. With constant policies, the budgetary balance of natives will evolve negatively too. Consequently, the study does not make it possible to know whether the budgetary balance of immigrants will be more favourable or more unfavourable than that of the Swiss in the long term.

Budgetary impact in Switzerland: indirect effects

An indirect impact through the effect of immigration on the budgetary balances of other residents has to be added to this direct impact. Ramel and Sheldon (2012) do not calculate this indirect effect, which is very difficult to quantify. We will just give some qualitative indications here. The indirect budgetary impact can pass through various channels.

Figure S.1: Channels for indirect budgetary impact



Production

Let us consider a transitory migration shock. It is generally accepted that immigration does not have a long-term impact on the overall level of wages in that case, but it penalises workers competing with immigrants in favour of workers who are complementary to them. Even if it is only a transfer from one category to another, it can have a budgetary impact. Consequently, if the winning group does not have the same average income as the losing group initially, this transfer may alter tax receipts (because of progressive

taxation) and social expenditure. A difference in the propensity to save can also modify indirect tax receipts.

In the short term, i.e. before the stock of capital has adjusted, the impact on the overall level of wages is negative: a fall relative to a scenario with less immigration (not necessarily relative to the past). This decline in wages is offset by an increase in profits of about the same magnitude. This transfer can have a budgetary impact for different reasons: i) the proportion of capital holders living abroad is not necessarily equal to the proportion of wor-

kers living abroad (cross-border commuters); ii) the tax rate on capital income is not necessarily the same as that on labour income (capital gains are not taxed in Switzerland, for example); iii) the holders of capital are typically better off than workers and have a higher income tax rate (progressive taxation); iv) a difference in the propensity to save changes VAT receipts; v) the fall in wages implies an increase in social expenditure which is not likely to be offset by a corresponding fall in social expenditure for the holders of capital.

We discussed the impact of a transitory migration shock above. A permanent increase in immigration as a result of higher (still binding) quotas corresponds to an accumulation of transitory shocks: the impact of each shock on the general level of wages and profits always disappears in the end, but it is continually replaced by the impact of new shocks. The free movement of people implies a total opening up of the labour market towards the European Union: wages converge towards a balance where they are permanently lower than they would have been with less immigration, but they remain higher than wages in the European Union. The balance de-

pends on the relative mobility of labour and capital.

Whatever the nature of the migration shock, there can be an impact on the productivity of other workers that is difficult to evaluate. An effect on productivity also has an indirect budgetary impact insofar as this effect is not already included in the remuneration of immigrants (e.g. transfer of knowledge from immigrants to indigenous workers).

The impact of immigration on unemployment is generally low in Switzerland, although there may be exceptions in specific cases.

Education

The education of indigenous students may be adversely affected in classes where the proportion of students who do not understand the local language exceeds a certain threshold. Young people may also have difficulty finding apprenticeships if the possibility of hiring immigrants ultimately reduces the incentive for businesses to coordinate themselves to train apprentices. If immigrants are better trained than natives, this implies that more natives would have had to be trained to replace them in the absence of these immigrants. In that case, immigra-

tion enables the state to avoid training costs. The effect is reversed if immigrants are less well trained than natives. It must be taken into account in both cases that a change in the level of education of natives also has an impact on their income and the taxes they pay.

Housing

Immigration increases the demand for housing and therefore prices. Without immigrants, construction wages would be higher, which would increase costs. Rising housing prices increase tax receipts on profits in the property sector. If the rental value is adjusted, it also increases the imputed rental value tax paid by those who live in their own home. However, the money spent on the increase in rent would have been saved or spent on the consumption of goods and services subject to VAT (as opposed to rent). The taxes that would have been paid by these producers of goods and services depend on whether they are produced in Switzerland or abroad. On the public expenditure side, higher rents tend to increase social expenditure.

Healthcare

The number of foreigners in the healthcare workforce is disproportionately high. Without them, the wages of medical workers would have to be increased in order to attract natives to these professions, which would lead to higher healthcare costs for the state and households. The shortage of Swiss doctors is partly due to the *numerus clausus*. This can have an indirect budgetary impact via natives who could have become doctors and have been replaced by immigrants (crowding out), but account must also be taken of the significant training costs thereby avoided. As the medical services on offer create their own demand to some extent, the influx of foreign specialists tends to increase healthcare costs.

Social model

Economic prosperity, and thus the health of public finances, is largely due to what Collier (2013) calls the "social model": a combination of institutions, rules, norms and organisations. Acemoglu and Robinson (2012) demonstrate the central role

Summary

of institutions. The long-term impact of immigration on our social model should be studied more carefully. It will depend on the gap between our

social model and that of the countries from which immigrants come, on the integration policy pursued and, probably non-linearly, on the scale of immigration.

1 Introduction

The Economic Analysis and Policy Advice Unit of the Federal Finance Administration carries out studies on the long-term challenges of fiscal policy. A long-term outlook for public finances in Switzerland is drawn up every four years.⁴ It takes into account demographic scenarios, as well as more detailed studies carried out in the area of health.⁵ Immigration is an important topic that has not been analysed much up to now in this framework. In this paper, we discuss the economic impact of immigration and especially the budgetary impact.

It is not surprising that immigration is a sensitive and divisive subject: some win while others lose. Those who are competing with immigrants in the labour market or for housing naturally do not have the same interests as those who are in a complementary situation to them: their employers, the employees to whom immigrants are complementary, the business partners who sell what immigrants buy or buy what they sell. If we were less eager to join a camp, many of us would find ourselves both winners

and losers, albeit not all in the same proportions. But the issue goes far beyond economic issues. There are those who deplore the increase in population as villages and towns expand to join together and eventually form huge urban areas. And there are those who create a family with an immigrant partner. There are those who value cultural diversity and those who see it as a threat to their own culture. The success of restaurants of all origins proves our taste for diversity, while the result of certain votes provides evidence of our fears. Almost 30% of the Swiss population was born abroad and the trend is increasing. With the current fertility rate, the Swiss population would have admittedly remained constant temporarily without immigration, but it would be destined to disappear. For better or for worse, immigration has an impact on our society and will have an even greater one in the future.

Understandably, people defend their personal interest according to their preferences and situation. But beyond this, there is the question of

4 See FDF (2016) for the last edition.

5 For a recent projection concerning healthcare expenditure, see Brändle and Colombier (2017). Other studies are available at the following link: https://www.efv.admin.ch/efv/fr/home/themen/publikationen/oeko_grundlagenarb.html

the importance to be attached to the interests of the first beneficiaries of immigration: the immigrants themselves. Refugees are welcomed to protect them from persecution or to relieve their first host country. Switzerland has also made refugee commitments under the Geneva Convention. As provided for in Article 14 of the Universal Declaration of Human Rights, everyone has the right to seek and to enjoy in other countries asylum from persecution. In contrast, the gain for ordinary immigrants is mostly economic. And what about their countries of origin? Does immigration help them or steal their talents? More fundamentally, is it legitimate to limit the possibility of settling in a country? Some believe that living in the country of one's choice is a human right and that any restriction on migration is part of a xenophobic policy that should be abolished. Others, on the contrary, consider that a country has tangible capital (infrastructure, etc.) and intangible capital (institutions, etc.) created by its inhabitants and their ancestors and it has the right to limit access to these. Their sense of solidarity

concerns first and foremost their national community.

The ultimate utopia, or dystopia, would be the free worldwide movement of people. Given the productivity differences between countries, abolishing borders and allowing workers to immigrate to where they are more productive would increase global GDP by USD 40 billion, or 60%.⁶ According to these same calculations, this would imply the immigration of nearly 6 billion people: roughly speaking, developing countries would lose their populations, which would immigrate to rich countries. Some are calling for such a development. Others believe that the productivity of rich countries would be penalised by such massive immigration and dispute the idea that such a future is the best conceivable for developing countries.

Despite our differences in terms of values and preferences, we should at least agree on the facts. Does immigration have a positive or negative impact? The question is unclear. How much immigration, what types of immigrants, positive or negative for whom? It is even difficult to answer

6 Borjas (2016a), chapter 2.

more specific questions. The impact of immigration on wages, for example, is highly controversial, even for an episode as specific as the Mariel boatlift.⁷ Assessing the impact of an increase in immigration involves comparing a scenario with and without this increase. However, only one of these scenarios occurs and can actually be observed for a given country and date. It is thus a case of comparing an observed value with a value calculated on the basis of the idea we have of what would have happened in the alternative scenario. The result will not be purely empirical: it will also depend on theoretical assumptions. It is thus unsurprising that different studies lead to different conclusions. This is a standard difficulty in economics that prevents the achievement of results that are as clear as in an experimental science such as physics, where both alternatives can be observed while neutralising the other factors.

There are certainly questions to which a clear and indisputable

answer can be obtained. Take, for example, a migration policy change that would add a constant flow of immigrants in terms of size and structure to annual immigration. Assuming that these additional immigrants are essentially young adults, what population would this additional immigration eventually generate? The answer will not fully satisfy either of the opposing camps on the issue of immigration. With the additional immigrants being young, they will rejuvenate the population, or at least reduce its ageing. That will please immigration advocates. But these immigrants will eventually age too, and the rejuvenation will thus be less pronounced than initially. Worse still, this immigration will typically accentuate the ageing of the population. This is an argument against immigration. However, this additional ageing of the population is due solely to the fact that an immigrant arriving in Switzerland is older than an individual born in Switzerland. Consequently, this ageing does not imply an increase in the number of elderly

7 Mass immigration of 125,000 Cubans to Florida between April and October 1980 when the Cuban government authorised those who so wished to leave the country from Mariel Harbour. Although this episode's magnitude and limitation in space and time should facilitate studies, it has been the subject of numerous publications with differing conclusions.

people per worker. Despite the ageing it generates, immigration typically improves this ratio even over the long term. In addition, as foreigners contribute for a shorter period to old-age and survivors' insurance (OASI) in Switzerland, they will also receive a lower old-age pension. And Switzerland avoids schooling costs when an immigrant arrives here as an adult. These are all arguments for advocates of immigration. But what about the impact of this ageing on supplementary old-age, survivors' and disability insurance benefits, as well as on health expenditure?

Even when the question is simple, the answer is rarely clear-cut. Our aim here is to do justice to this complexity. With this paper, we wish to provide an overview of the channels through which immigration has an impact on public finances (we do not address the related subject of the impact of cross-border commuters). We also hope to prove that such a sensitive issue can be addressed objectively. We know that each group will be able to select the elements that suit it in this paper to give a false image that supports its theses. This is a risk that we are obliged to take if we want to account for the complexity of reality.

By focusing on public finances in Switzerland (communes, cantons, federal government, social insurance), we simplify the task considerably, but we obviously leave out a significant proportion of the consequences of immigration. We use existing quantitative studies as a basis, particularly those by Ramel and Sheldon that study the direct effects of immigration on public finances by comparing what immigrants pay in terms of contributions to public funds (including social insurance) and what they cost. However, we want to avoid considering only quantifiable effects, as that would mean neglecting effects that are potentially equally important. Consequently, we will also discuss the indirect effects that pass through the budgetary balances of other residents via the impact of immigration on the labour market, for example. This obliges us to address the economic impact of immigration more broadly. And to begin with, we need to understand its demographic impact.

After recalling the demographic impact of immigration in Switzerland (§2), we will present the approaches used in economic literature to study the economic impact of immigration

and propose a list of channels through which this influence is exerted (§3). We will describe the approaches for studying the budgetary impact and discuss the thought

experiment considered in this paper (§4). We will then examine the direct (§5) and indirect (§6) effects, and conclude by discussing the implications for fiscal policy (§7).

2 Demographic impact of immigration in Switzerland

Before studying the impact of immigration on the economy and public finances, we must first understand its demographic impact.

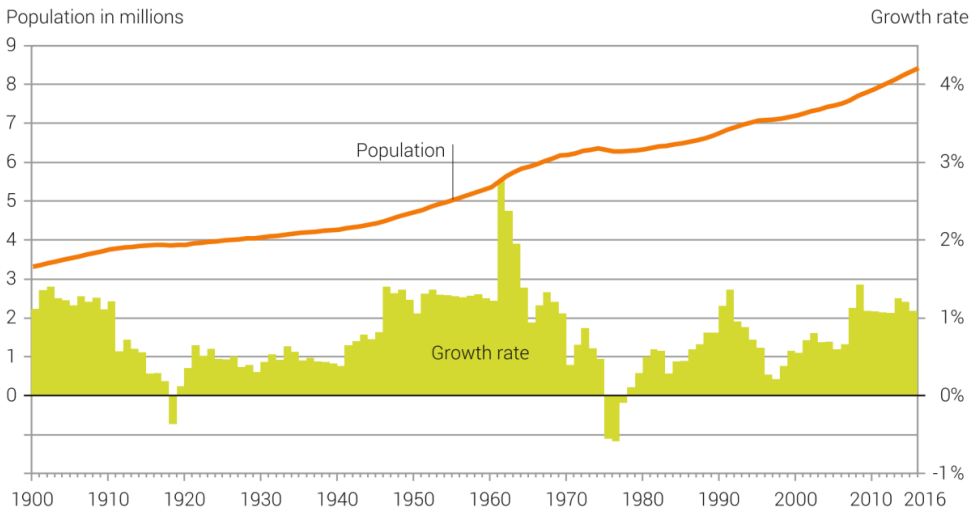
2.1 Past demographic trends in Switzerland

2.1.1 General trend

As Figure 2.1 shows, the Swiss population has doubled in less than a century. Since the 1980s, population growth has been due more to net migration than to an excess of births over deaths in most years.

Figure 2.1 : Demographic trends

Population growth and size



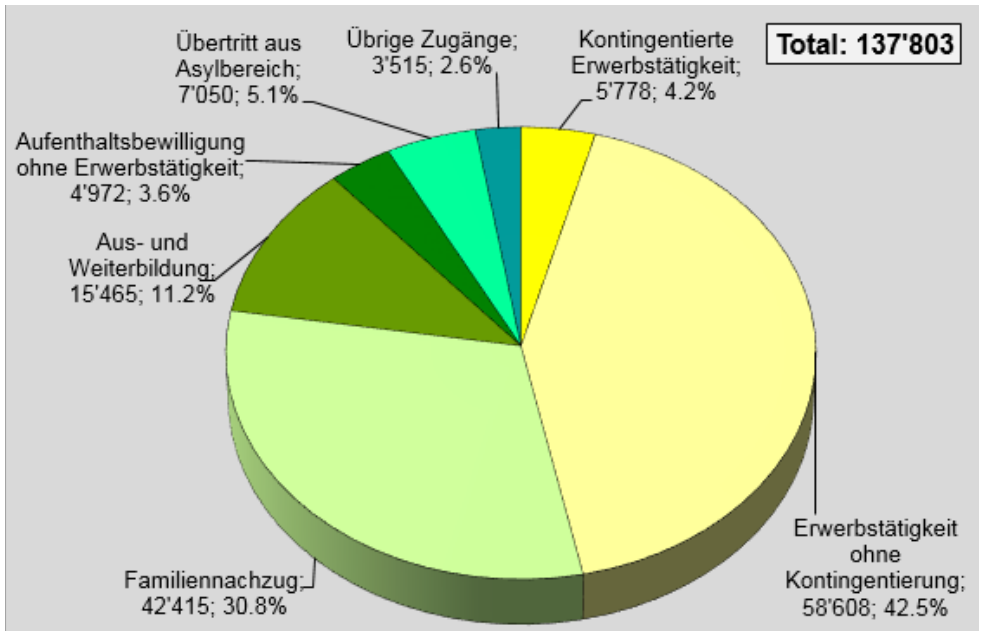
Source: FSO (2017b)

Simulating a closure of borders to migratory flows, Wanner (2013) found that the population would have increased by only 180,000 people between 1980 and 2010, instead of the 1.53 million actually observed. According to the latest FSO report on integration, 2.5 million people aged 15 and over are currently of migrant origin, representing more than a third of the permanent resident population aged 15 and over. This immigrant population may be foreign nationals or have become naturalised as Swiss citizens. However, the FSO typology is only a proxy for quantifying the number of people who would not be in Switzerland if there had been no immigration. For example, a person born in Switzerland to parents where one immigrated to Switzerland and the other was born in Switzerland to immigrant parents is not considered by the FSO as being of immigrant origin if his parents acquired Swiss nationality before the birth of the person in question. The share of the permanent resident population of foreign nationality reached 25% in 2016.

Immigration changes not only the size of the population, but also its structure. Immigrants are thus younger than residents on average. Wanner (2013) found that in 2010 the ratio of elderly people to workers would have been 38 persons aged 65 or over per 100 persons of working age (20 to 64 years) in the absence of migratory flows. Thanks to immigration, the rate actually observed in 2010 was only 27 elderly persons per 100 persons of working age (however, immigration was not sufficient to maintain the 1980 value of 24).

The figure below shows the reasons for immigration. First comes immigration to work under the Agreement on the Free Movement of Persons ("Erwerbstätigkeit ohne Kontingenzierung"), followed by family reunification ("Familiennachzug") and, far behind, training and education ("Aus- und Weiterbildung"), asylum ("Übertritt aus Asylbereich"), gainful activities subject to quotas ("Kontingenzierete Erwerbstätigkeit"), residence permits without gainful employment ("Aufenthaltsbewilligung ohne Erwerbstätigkeit").

Figure 2.2 Immigration to Switzerland by reason for immigration, January to end of December 2016 (permanent resident foreign population)

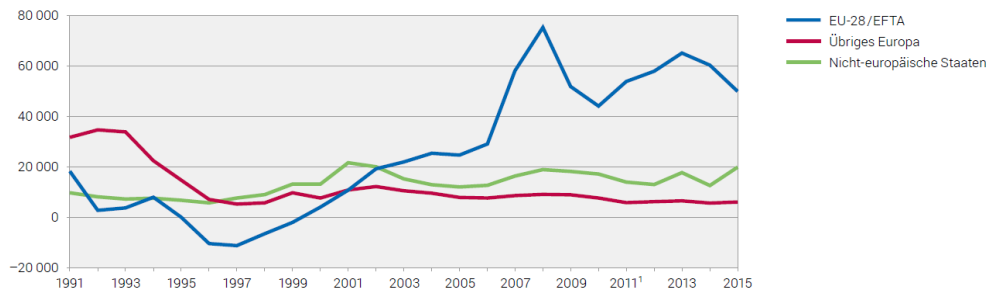


Source : SEM (2018b)

The figure below shows the trend for the net migration of the foreign population, broken down by origin: EU 28/EFTA, other European countries ("übriges Europa") and non-European countries ("nicht-europäische Staaten").

Figure 2.3 Net migration**Wanderungssaldo der ständigen Wohnbevölkerung nach Staatsangehörigkeit, 1991–2015**

Politische Gliederung



1 Ab 2001 Wechsel des Produktionsverfahrens und neue Definition der ständigen Wohnbevölkerung, die zusätzlich Personen im Asylprozess mit einer Gesamtaufenthaltsdauer von mindestens 12 Monaten umfasst.

Source: FSO (2017a).

In terms of migration policy, it would have been more interesting to have the trend for the net migration of the following three groups:

- i) EU 28/EFTA; ii) asylum procedure;
- iii) other. Unfortunately, output data is not available separately for asylum

seekers, which makes it impossible to know their net migration. We will nevertheless discuss the evolution of migration according to these three categories, which seem more relevant to us.

2.1.2 EU/EFTA: The difficulty of quantifying the migratory impact of the Agreement on the Free Movement of Persons

Net migration was low or even negative during the crisis of the 1990s. It then rose considerably during the upturn that followed, especially after 2007 when the economic crisis hit the European Union hard and left Switzerland rather unscathed. It was also from 2007 onward that free movement of persons became complete with the EU 15/EFTA, Cyprus and Malta.

It is difficult to say to what extent the increase in net migration was due to the free movement of persons agreement, rather than to the economic situation (it is thus difficult to quantify the economic impact of this

agreement).⁸ That would mean comparing the observed net migration with that which would have prevailed in the absence of an agreement. But what would have happened in the absence of an agreement is not observable. It is thus a case of comparing an observed value with a value calculated on the basis of the idea we have of what would have happened in the absence of an agreement. Consequently, the result will not be purely empirical, and will also depend on theoretical assumptions. This is a standard difficulty in economics. This difficulty is nevertheless reinforced here by the fact that we have to guess what political decisions would have been taken in the absence of an agreement. Would the quotas have been adapted to employers' demands as was often the case before the agreement?⁹ Or would possible public dissatisfaction have been taken into account?

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- 8 For example, in the conclusion of their article "Die Auswirkungen der Personenfreizügigkeit der Schweiz mit der EU auf die Löhne einheimischer Arbeitskräfte", Sheldon and Cueni (2011) state very clearly that the effects they quantified should not be understood as being caused by the free movement of persons agreement (Sheldon had not yet proposed a quantification of the migratory impact of this agreement).
- 9 Sheldon (2017a) noted that the quotas were generous, as they were exhausted only once between 1980 and 1999. He further noted that, for each authorisation within the framework of quotas, there were typically four additional immigrants with the conversion of short-term residence permits into long-term ones and with family reunification.

The free movement of persons agreement restricts Switzerland's possibilities for managing the flow of immigrants. Had it so wished, Switzerland could have obtained the same net migration without this agreement (all other things being equal). But would it have wanted to? Insofar as it would not have wanted to, this agreement had an impact on net migration. Several factors suggest that the economic situation also played an important, if not a predominant, role: i) the dependence of net migration on the Swiss economy; ii) the development of immigration to countries other than Switzerland; and iii) the trend of countries of origin according to the economic situation in the country of origin.¹⁰

Various studies attempt to quantify the impact of this agreement on net migration. For example, Aeppli et al. (2008) assume that the free movement of persons agreement leads to an annual increase of 4,000 migrant workers, but this is only an assumption they consider plausible. Can et al. (2013) found that only 28% of aggregate net migration can be explained by the agreement. This impact stems mainly from a decrease

in emigration (26%) and only to a very small extent from an increase in immigration (2%). Sheldon (2015) and Sheldon (2017a) intuitively explained this surprising result: with the agreement, the first residence permits went from one year to five years and after those five years immigrants were entitled to a permanent residence permit. The agreement would thus have had its real impact on the return of foreigners to their countries of origin and not on immigration. According to Bolli et al. (2015), on the contrary, the free movement of persons agreement increased annual immigration by about 24,000 people (between 16,300 and 26,300), while it did little to alter emigration. However, half of the increase in immigration from the EU 27/EFTA was offset by a decrease in immigration from third countries. The authors concluded that this agreement increased the overall annual net migration from 10,000 to 15,000 people. They nevertheless recognised that this figure may be overestimated given that the number of quotas is often tailored to the needs of the economy, suggesting that some of the immigration attributed to the agreement may have

10 For a discussion of immigration from Germany, see Hermann (2013). For a study on countries of origin, see SECO (2017), page 30.

occurred without the agreement. According to SECO (2017), the rise in net migration compared with the 1990s can be explained primarily by the generally favourable economic growth in Switzerland since the 2000s.

It is also difficult to assess the impact of the agreement on the composition of immigration from the EU/EFTA. While it is true that the education level of immigrants is higher, it is not clear to what extent this is due to the agreement. The quota system reserved some of the quotas for certain branches or regions with a low level of value creation to the detriment of more skilled immigrants. SECO (2017) concluded that the agreement has favoured more skilled immigration. The proportion of immigrants from EU 27/EFTA countries with tertiary education rose from 27% for those who arrived in Switzerland before 2002 to 57% for those who arrived after 2002, when the agreement came into force (although still with transitional restrictions). But the proportion of

tertiary education also increased for immigrants from third countries, going from 16% to 42%. While it is true that the regulations for third countries have become stricter, it is likely that the changing needs of the economy caused these regulations to be modified. Furthermore, the agreement also gives the right to family reunification, which does not necessarily mean higher qualifications. Indergand and Beerli (2015) found that the free movement of people contributed little to the rise in the education level of immigrants in Switzerland, which was rather due to the change in the training structure of immigrants in their countries of origin and to greater demand for highly skilled labour in Switzerland. We can imagine that this greater demand for highly skilled labour is due to technological progress and Switzerland's specialisation in high-end products. Siegenthaler and Sturm (2012), on the contrary, assumed that the agreement had an impact on the structure of immigration, while acknowledging that their view was not based on a scientific study.

Box 2.1: Length of stay in Switzerland

The length of stay in Switzerland differs according to the type of migrant. It can be assumed that recognised refugees tend to remain permanently in Switzerland. According to Ramel and Sheldon (2012), immigrants from northern EU countries remain in Switzerland for a shorter period on average than those from the south and the rest of the EU.

Duc-Quang Nguyen (2017) considers immigrants who arrived in Switzerland in 1998 (i.e. before the entry into force of the free movement of persons agreement) and presents graphs showing for 18 nationalities what proportion of these immigrants left Switzerland during the subsequent fifteen years. The table below draws two pieces of information from these graphs: i) the number of years after which half of the immigrants left Switzerland; ii) the proportion of immigrants who left Switzerland after a stay of fifteen years or less.¹¹ Among the countries presented, Japan had the highest proportion of immigrants leaving Switzerland after 15 years at the latest, while Sri Lanka had the lowest (the countries are listed in descending order).

Country	Number of years after which half of the immigrants left Switzerland [years]	Proportion of immigrants who left Switzerland after a stay of fifteen years or less [%]
Japan	2	84.0
United States	2	83.4
China	2	80.7
United Kingdom	2	75.8
India	2	71.5
Spain	4	67.6
Austria	3	65.4
Netherlands	3	62.0
Germany	4.5	61.4
France	11	61.1
Poland	11	51.5
Italy	12	53.0
Russia	–	46.3
Brazil	–	38.4
Portugal	–	32.6
Morocco	–	25.5
Turkey	–	21.4
Sri Lanka	–	7.2

Source: Duc-Quang Nguyen (2017)

¹¹ We did not interpolate the number of years after which half of the immigrants left Switzerland, but simply read on the graph the year for which the total number of departures was closest to 50%. If two years were at the same distance, we took the average (this is the case for Germany). Of course, we could not indicate any results in the absence of a 50% departure rate in the 15 years studied by Duc-Quang Nguyen (this is the case for the last six countries).

2.1.3 Asylum-related immigration: Eritreans at the forefront

According to the Geneva Convention, a refugee is a person who has a well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinion. The number of asylum seekers depends on events in the countries of origin and the opening of migration routes. It is therefore very volatile, rising from nearly 11,000 in 2005 to almost 40,000 in 2015 (SEM, 2018a). Some of these asylum seekers are returned to their country or to a country through which they have transited. The protection rate (granting of asylum and temporary admissions following first instance

asylum decisions) is around 50%, but it is volatile (57.5% in 2017, 48.7% in 2016). As indicated above, however, it is not possible to indicate net asylum seeker migration, as we do not have data on departures. Countries of origin also tend to fluctuate depending on events. Eritrea has nonetheless been the main country of origin almost every year since 2006. Exceptions are 2009 and 2010, when Eritrea was second behind Nigeria, and 2006, when Eritrea was second behind Serbia (including the future Kosovo). Eritrea accounted for a much smaller proportion of asylum applications in the past: ranked 19 in 2005, 24 in 2004, 25 in 2003.¹² In the European Union, in contrast, the proportion of Eritreans is much lower than that of Syrians, for example.¹³ The qualifica-

12 Source: SEM (2018c).

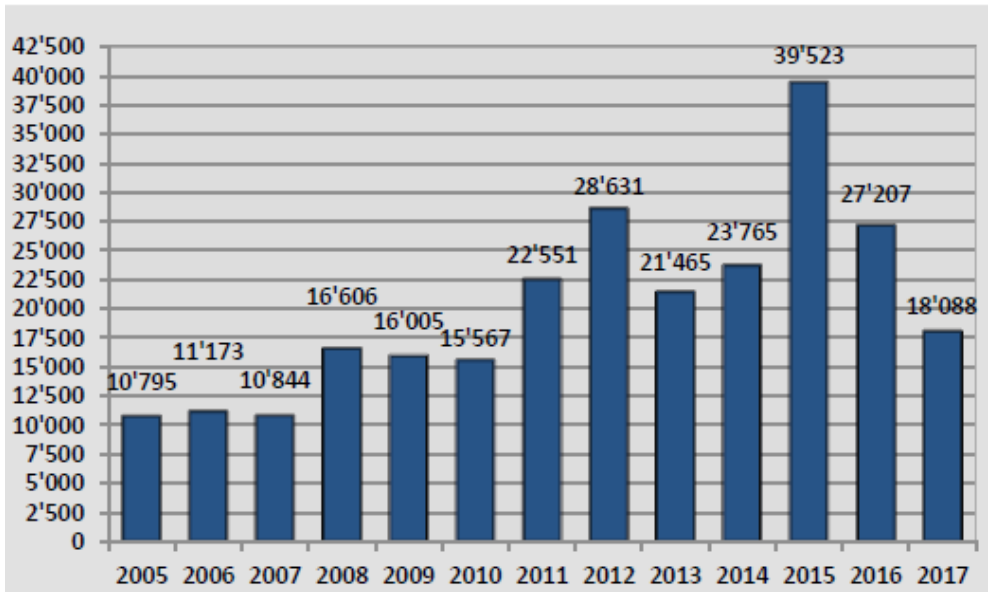
This development can be explained by the fact that the former Asylum Appeals Commission ruled in 2005 that deserters were exposed to sanctions under asylum law (JICRA 2006/3). Since the 2013 vote, the Asylum Act has explicitly stated that persons are not considered refugees if they are subject to serious disadvantages or have a well-founded fear of being exposed to such disadvantages because they have refused to perform military service or have deserted. However, this law has not reduced the influx of Eritrean asylum seekers, presumably because they are often granted refugee status or temporary admission because they are recognised as at risk of persecution as a result of having deserted or illegally left their country. The Federal Administrative Court nonetheless changed its legal precedent on 30 January 2017: illegal departure from the country cannot in itself justify recognition as a refugee.

13 Eurostat (2018a).

tion level of refugees is often low, which could explain why KEK-CDC and B.S.S. (2014) found that their

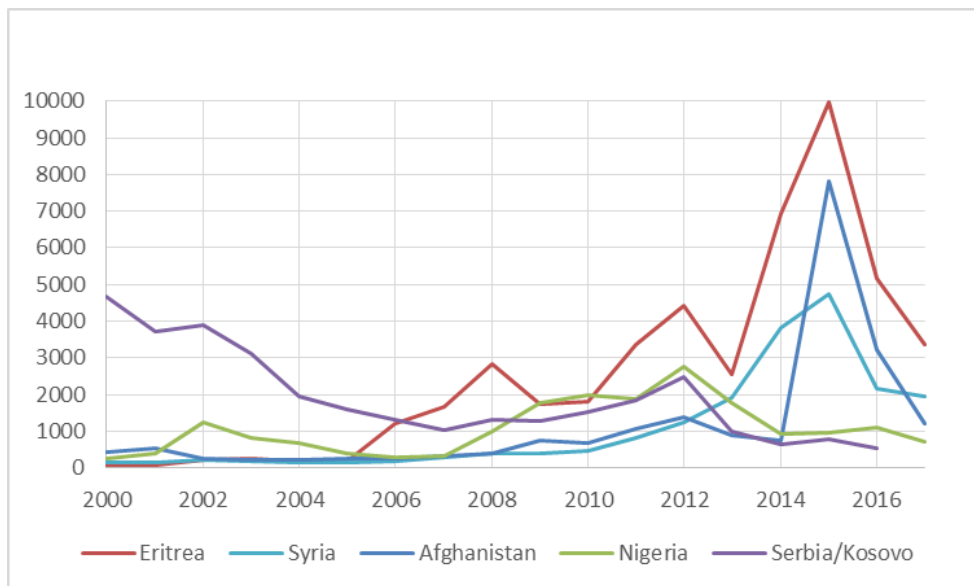
employment rate remains relatively low, even ten years after their arrival.¹⁴

Figure 2.4 Asylum applications per year



Source: SEM (2018a)

14 For the first three months after filing an application for asylum, asylum seekers may not engage in any gainful employment. Thereafter, the applicant may engage in gainful employment, albeit subject to certain conditions (customary wages, priority for Swiss nationals and those who already have a permanent or non-permanent residence permit, etc.). It is possible to provide for derogations from some of these conditions. If the application for asylum is rejected, the right to engage in gainful employment expires at the end of the period specified for the applicant's departure. If refugee status is granted, the refugee may freely change job and occupation. For more details, see FER (2015).

Figure 2.5 Asylum applications for some countries of origin

Source: Our chart is based on the figures from SEM (2018a) and SEM (2018c)

2.1.4 Third countries excluding asylum: family reunification prevails over quotas

Workers from third countries (outside the EU/EFTA and excluding the asylum procedure) are subject to an annual quota. Employers can recruit third-country nationals on the Swiss labour market only if they have been unable to find workers with the required profile on either the Swiss or

EU/EFTA labour markets. Short stay and residence permits for work purposes may now be granted only to managers, specialists and other qualified workers. The Federal Council sets the quotas each year, distinguishing between long-term residence permits (B permit) and short-term residence permits (L permit). At the start of the year, some of the quotas for third-country nationals are distributed among the

cantons. The federal government reserves the second half in order to react in a targeted manner according to the needs of the cantons. India and the United States are the two third states of origin for the majority of workers subject to quotas at present. The requests come mainly from companies in the IT, pharmaceutical and consulting sectors. Similarly, scientists in academic circles, specialised chefs and elite athletes are recruited in this way.

Quotas evolve over time. Going from 8,500 in 2014, they fell to 6,500 in 2015 and remained at that level in 2016, rose to 7,500 in 2017 and then to 8,000 in 2018 (3,500 residence permits and 4,500 short-term residence permits).¹⁵ However, the vast majority of immigration from third countries is due to family reunification. In 2017, 20,567 third-country nationals immigrated outside the quota framework for family reunification purposes (SEM, 2018b).

¹⁵ Rohner and Sormani (2011) give the amount of quotas, their utilisation rate and the countries of origin for a more distant past.

Box 2.2 Immigration for family reunification purposes

The nationality of the persons authorised to enter Switzerland for family reunification purposes is entered, as is the residence status of the person bringing his or her family. In response to parliamentary procedural request number 14.3185, the Federal Council recalled the following figures concerning family reunification within the permanent resident foreign population.¹⁶

**Immigration to Switzerland for family reunification purposes
(according to immigrant's nationality)**

	EU 27/EFTA	Third states	Asylum	Total
2009	21 937	21 680	1 335	44 952
2010	21 628	21 652	1 566	44 846
2011	23 261	21 787	1 707	46 755
2012	24 711	20 668	1 567	46 946
2013	28 794	21 256	1 007	51 057

**Immigration to Switzerland for family reunification purposes in 2013
(depending on the appellant's residence status)**

Appellant's residence status	Immigration	Total
Swiss or Swiss spouse	9 132	50 050
Foreign		
EU/EFTA	29 011	
Third states	11 907	
Asylum	1 007	1 007
		51 057

Entry into Switzerland within the framework of asylum granted to families is mentioned above, but is not counted as family reunification: it comes under asylum applications. Of the 50,050 persons who immigrated to Switzerland for family reunification purposes in 2013, only 109, or about 0.2%, were not part of the family nucleus (spouses and children).

The Federal Council emphasises that it is not possible to establish a detailed classification by category (e.g. according to qualification level), nor to say whether persons who have immigrated for family reunification purposes work. It is not possible to give family reunification figures for persons admitted on a temporary basis.

Every year, the immigration statistics of the SEM indicate the figures for family reunification (excluding the field of asylum). In 2016, 44,836 people immigrated to Switzerland for family reunification purposes, including 23,954 from the EU/EFTA and 20,882 from third states. Of these 44,836 people, 9,074 were sponsored by Swiss nationals (or Swiss spouses) and 35,762 by foreign nationals.

16 Interpellation number 14.3185, Darbellay Christophe, Genaue Zahlen zum Familiennachzug.

2.2 Demographic scenarios for the future

2.2.1 Demographic change parameters

Demographic forecasting is facilitated by demographic inertia, i.e. the fact that it takes time for the consequences of a change in demographic parameters to become fully apparent. For example, a population may continue to grow temporarily because a large proportion of women are of childbearing age even though it is destined to disappear due to its low fertility rate. The current population structure thus has a certain dynamic that will only become apparent in the long term. This dynamic can be clarified by calculating the development of the population assuming fertility, mortality and constant migration.¹⁷ However, a more realistic calculation should take account of the future development of these parameters. This is where the main difficulty lies, as we do not

know how fertility, mortality and migration will move in the future.

Fertility has been relatively stable in Switzerland at around 1.5 children per woman since the late 1970s. This rate is lower than the 2.1 required to ensure the long-term stability of the population: if the fertility rate remains low, Switzerland will depopulate in the absence of immigration. This is despite the fact that the population would not decline at present in the absence of immigration. If births exceed deaths despite a low fertility rate, it is only because women of childbearing age constitute a sufficiently high proportion of the population and elderly people a sufficiently low proportion. But this situation has to be transitory if fertility and mortality rates by age remain unchanged. These women will age and the population structure will change. This illustrates an important point: since demographic shocks take time to have an effect, the short-term impact can be very different from the long-term im-

¹⁷ Mathematical demography studies population dynamics, particularly those of populations whose age structure tends towards a stable distribution. Ergodic theorems play a key role. Arthur (1981) proposed a demonstration of these ergodic theorems which reveals fundamental intuition. Espenshade et al. (1982) extended the study of stable populations to include migration. While it is generally the impact of a constant flow of immigrants that is studied, Alho (2008) studied the case of immigration proportional to births.

pact.¹⁸ It is difficult to predict fertility rates. How can a baby boom or baby bust be anticipated? Some determinants of fertility have been studied, e.g. in the framework of the study on the "demographic transition" (shift from a population with high birth and death rates to a population with low birth and death rates). But other factors could play a role in the future, e.g. the development of medically assisted procreation against a backdrop of longer life expectancy.

Mortality rates by age are generally expected to decline and life expectancy to increase. But at what rate? Moreover, mortality rates depend not only on medicine, but also on behaviour and lifestyle, as well as on the environment (e.g. an epidemic due to the mutation of a virus). Consequently, a rise in mortality rates cannot be ruled out. It is also possible that surprising advances in science could lead to a considerable and rapid increase in life expectancy.

Immigration is perhaps the most difficult parameter to predict. It depends on the demographic and economic situation in Switzerland and abroad, as well as on migration policy. Will immigration bring Swiss wages closer to those of the European Union and cause living conditions in Switzerland to deteriorate? That would reduce the incentive to immigrate to Switzerland: immigration would then stabilise on its own. Or will Switzerland be similar to a big city that constantly attracts people while maintaining high wages and an enviable quality of life?¹⁹

The ageing of the population has three causes: i) low fertility, ii) longer life expectancy and iii) retirement of baby boomers. The last cause will have only a transitory effect. As pointed out by Grünenfelder and Müller-Jentsch (2017), immigration can delay the ageing of the population, as immigrants are generally younger than the population average. However, immigrants age too.

18 This is evident when it is a transitory shock like that of baby boomers beginning to become a burden for the old-age and survivors' insurance 65 years after their birth after having had a positive impact for decades. However, it also exists in the case of a permanent shock.

19 Schellenbauer (2017) discusses the possibility that Switzerland will not attract as many immigrants in the future as it does now because of the slow development of the productivity of the Swiss labour force, the cost of living in Switzerland and demographic ageing in neighbouring countries.

Eventually, immigration will probably increase the ageing of the population. This is due to the fact that the average age of immigrants over the length of their stay can easily exceed that of the rest of the population, as they arrive already at a certain age, while the rest of the population arrives at birth.²⁰

2.2.2 FSO demographic scenarios and UN projections

Every four years, the Federal Statistical Office (FSO) draws up scenarios concerning demographic change in Switzerland. The last scenarios were published in June 2015 and covered the period from 2015 to 2045. There are three baseline scenarios: a reference scenario together with a high

scenario and a low scenario. The population would reach about 10.2 million by 2045 according to the reference scenario.²¹ The reference scenario assumes net migration of 80,000 in 2015 and 2016, falling to 60,000 in 2017 and stabilising at that level until 2030, then gradually falling to 30,000 in 2040 and remaining at that level until 2045, the end of the projection period.

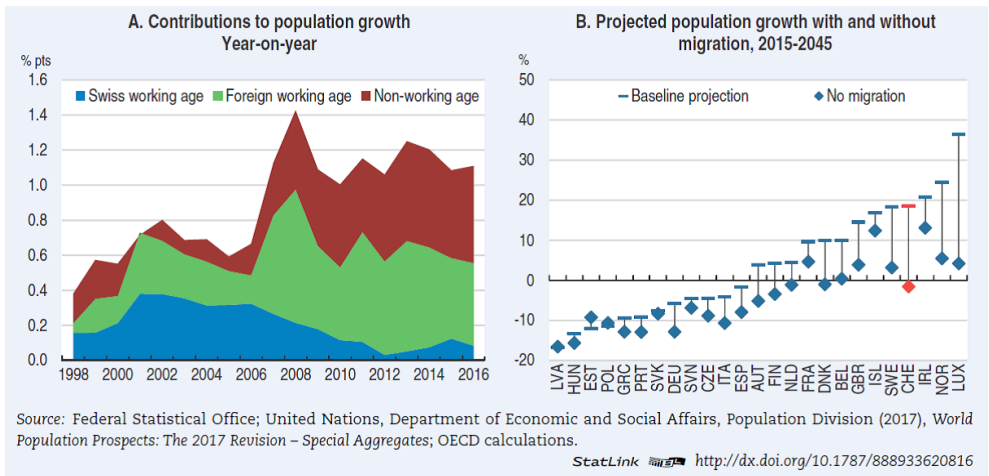
In part B of the following figure, the OECD (2017a) presents the UN growth projections between 2015 and 2045 for Switzerland and other countries. The Swiss population would be more or less constant in the absence of net migration. With immigration, it would grow by nearly 20% to reach a population of almost 10 million.²²

20 According to Goldstein (2009): "a steady stream of migrants almost always makes a population younger in the short term but older in the long term, as compared to the age structure in the absence of migrants".

21 For more detail, see FSO (2015). The migration assumptions are shown in Table T3.

22 The UN (2017) projects a Swiss population of 9.88 million in 2050.

Figure 2.6 The role of net immigration in the past and projected population growth



Source: OECD (2017a), Figure 19 page 28

The stability of the population in the absence of immigration may surprise people, especially when compared with other countries. However, it extends into the future the stability achieved by Wanner (2013) for the period 1980 to 2010. But as explained above, this is not sustainable: a fertility rate of 1.5 children per woman inevitably leads to long-term depopulation in the absence of immigration (if the mortality rate cannot tend towards zero).

In view of demographic change in the past, it is plausible that the Swiss population will reach 10 million in 2045 and then continue to grow thanks to immigration. In a finite space, a population cannot grow indefinitely and necessarily has to stabilise at some point, with all the difficulties that a transition from a growth regime to a stationary regime implies. If Switzerland did not wish to reach 10 million inhabitants, migra-

tion policy could undergo a change that would modify these projections.

Part A of the figure above shows that the working age population has grown mainly as a result of immigration. According to the FSO reference scenario, the old-age dependency ratio will rise from 29.1 persons aged 65 and over per 100 persons aged 20 to 64 in 2015 to 39.6 in 2030 and 48.1 in 2045.²³ This is a clear deterioration. However, the current low ratio of about 29 is the result of historical circumstances that are not sustainable, as a population cannot grow indefinitely. By way of comparison, let us consider a balanced stationary population without immigration, where there is no population growth, but no decline either (the fertility rate is 2.1), and where the issue of baby boomers is ignored. Let us suppose that the inhabitants work from the age of 20 to 65, then retire and live until they die at 85. In these

circumstances, the dependency ratio is $100 \cdot 20 / 45$, i.e. 44.4 elderly persons per 100 persons of working age, i.e. a much higher ratio than 29.²⁴ In the absence of immigration, the population would nevertheless decline eventually and this ratio would become even higher than the 44.4 mentioned. This figure is nonetheless a more relevant reference than the current ratio of 29, which is not sustainable. Immigration can certainly increase the proportion of workers in the population, but to an extent that has to be put into perspective. According to the UN (2001), maintaining potential support ratios at their current levels (defined in this report as the number of people aged 15 to 64 per person over 65, which roughly corresponds to the opposite of the old-age dependency ratio) would require volumes of immigration that have nothing to do with past experience and what can reasonably be expected.

23 The term "old-age dependency ratio" is unfortunate, as it is only a population ratio which is merely an approximate indicator of a dependency ratio, especially since not all people of working age necessarily work and because they also have to finance elderly people who no longer live in Switzerland and thus do not appear in our population statistics. This last point is underlined by Consandey (2015).

24 This stationary population corresponds to the case of a population without immigration with a fertility rate equal to the replacement rate and where the mortality rate is zero before 85 and 100% at the end of 85 years of age.

2.2.3 Development of dependency ratios

Starting with the idea that the population cannot grow indefinitely, the question arises as to the extent to which immigration can eventually reduce dependency ratios (of the elderly, or of the young and the elderly). Consider the case of an indigenous population whose fertility rate is insufficient to ensure its renewal. If immigration is constant as a proportion of the population (rather than numbers of individuals), there is only one immigration rate value for which the population becomes stationary: for all other values, either the population increases indefinitely or it tends towards zero. If instead the number of immigrants (rather than the immigration rate) is constant, the population converges towards a steady state (which depends on the number of immigrants, but exists irrespective of the number of immigrants).²⁵ This is why studies on the

long-term demographic impact of immigration generally assume a constant flow of immigrants. A constant immigration rate would seem more realistic at first glance, but it leads to unlimited population growth that is not realistic in the long term.

As indicated above, the initially generally favourable impact of immigration on dependency ratios cannot be extrapolated in the long term. Knowing that immigration tends to reinforce the ageing of the population in the long term, we could be tempted to conclude that immigration penalises the old-age dependency ratio in the long run. This impression is corroborated if one thinks of an immigrant who arrives during his working life (e.g. at 30 years of age) and remains in Switzerland: on average, he will live as long as an indigenous person (assuming the same mortality rates), but will have lived a shorter working life in Switzerland than an indigenous

²⁵ Espenshade et al. (1982) showed that if the indigenous population has a fertility rate below the replacement rate, and if immigrants end up having a fertility rate below the replacement rate (possibly after several generations), a constant flow of immigrants does not cause an unlimited increase in the population level: it converges towards a stationary population. Schmertmann (2012) demonstrated a formula for calculating the age structure of this stationary population according to the age structure of immigration, as well as fertility and mortality rates.

person. However, it would be wrong to conclude that immigration necessarily penalises the old-age dependency ratio in the long term. It is also necessary to take into account the fact that a constant flow of immigrants makes it possible to turn a declining population into a stationary one in the long term. The decline of a population penalises its old-age dependency ratio. By stabilising the population, immigration can compensate, or even overcompensate, for its other seemingly harmful effects on the old-age dependency ratio.

Regarding the youth dependency ratio, an important point is that immigrants arriving in Switzerland as adults will never have directly been a burden on the youth dependency ratio as young people. Moreover, immigration increases both the number of workers and the number of young people (children born in Switzerland or abroad to immigrants), which has an ambiguous impact. However, these young people will age and become workers. In the long term, their more distant descendants also have to be taken

into account. The shift from a declining to a stationary population nevertheless has a negative impact on the youth dependency ratio: the inverted age pyramid typical of a declining population at least has the advantage of a low youth dependency ratio.

Since the overall impact on dependency ratios results from the sum of opposing effects, it is difficult to say without calculating how these effects vary according to the age structure of immigrants and the fertility rate, and which dominates. Wu and Li (2003) calculated that the proportion of the working-age population increases relative to a stationary population without immigration if the immigrants are mostly young workers. As shown by Schmertmann (2012), however, this condition is too restrictive: immigration also improves the total dependency ratio in cases where this condition is not met. Schmertmann calculated how old immigrants should be to maximise the proportion of workers in the population made (asymptotically) stationary by immigration. For Austria, he found

an age of 34 years, which is much higher than the start of working life.²⁶

In Appendix 1, we explore the conditions under which immigration improves dependency ratios. We find that, for realistic immigration age structures, constant immigration in terms of size and structure reduces the old-age dependency ratio and also the total dependency ratio (elderly and young people) even in the long term relative to a scenario without immigration for a declining indigenous population. The effect is greatest if immigration is made up solely of young workers (in the model, the young workers age group ranges from 20 to 40 years), despite the fact that the youth dependency ratio deteriorates in this case (be-

cause of their children). However, these calculations were carried out in a highly simplified framework.

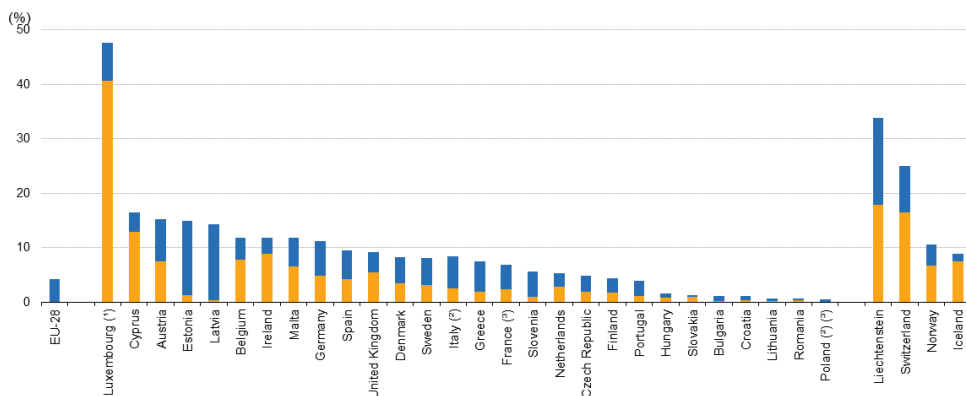
2.3 International comparisons

By international standards, Switzerland is among the countries which have experienced considerable immigration for a long time, and it thus has a large proportion of residents born abroad and foreign nationals. Consequently, migratory phenomena are particularly significant in Switzerland.

The figure below shows that the proportion of foreigners in Switzerland is particularly high when compared with Europe. Only Luxembourg and Liechtenstein have higher proportions.

26 Simon et al. (2012) calculated the migratory profile that maximises the proportion of the working-age population. Blanchet (1988) shows that a migration policy aimed at stabilising the old-age dependency ratio would lead to migratory cycles that could be explosive. "An influx of migrants into working-age groups at a given time may temporarily solve a problem of imbalance between the working and retired population, but when these migrants reach retirement age, the problem arises again and runs the risk of resurfacing in a more serious form. [...] An alternative is to adopt a fixed rate migration policy from the outset, with the rate being calculated with a view to long-term stabilisation, without taking account of the temporary fluctuations that its adoption could entail in the ratio of workers to retired". Nevertheless, the issue of optimal migration policy is different from the question of the conditions under which immigration increases the proportion of the working-age population relative to a scenario without immigration (although this is a related issue).

Figure 2.7 Foreigners as a percentage of the population
(Share of non-nationals in the resident population, 1 January 2017)



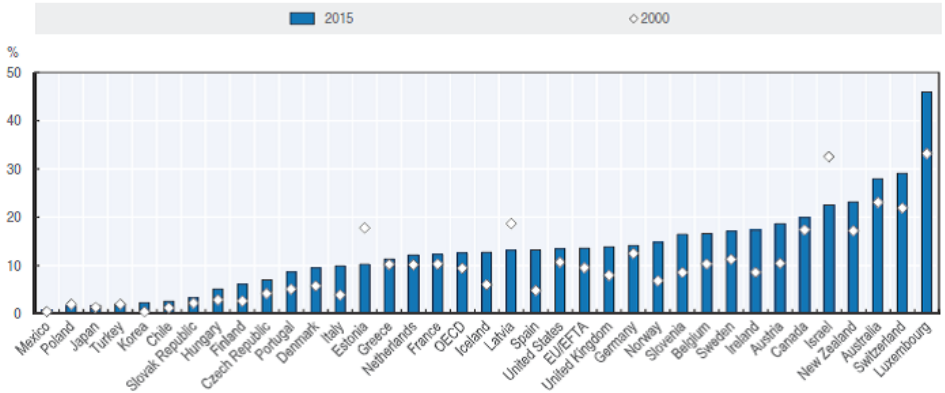
- (1) Break in series.
- (2) Estimate.
- (3) Provisional.

Source: Eurostat (2018b)

Since the proportion of foreigners can differ from one country to another because of differences in naturalisation policy, it is interesting to compare the proportions of

foreign-born inhabitants. Here again, Switzerland ranks third behind Liechtenstein and Luxembourg when compared with Europe (Eurostat, 2018b). The figure below provides a global comparison.

Figure 2.8 Foreign-born inhabitants as a percentage of the population



Note: Data refer to 2000 or the closest available year, and to 2015 or the most recent available year. The OECD and EU/EFTA averages are simple averages based on rates presented. For Japan and Korea, the data refer to the foreign population rather than the foreign-born population.

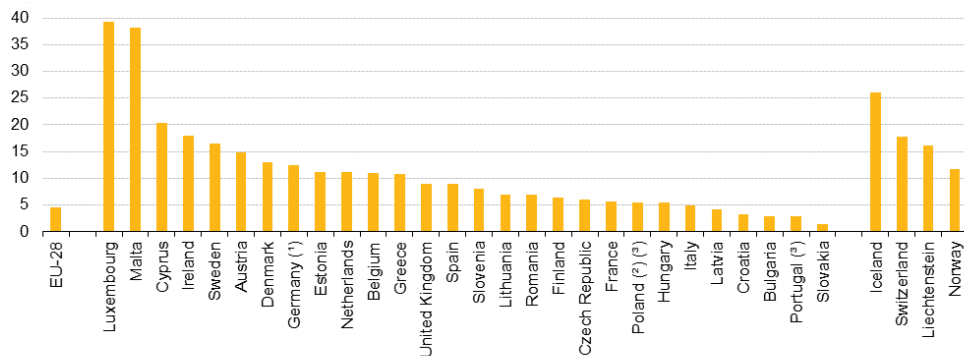
Source: OCDE (2017b)

Among the countries mentioned (Liechtenstein is not one of them), Switzerland ranks second behind

Luxembourg, but above countries like Canada. These population stocks are the result of past flows.

The chart below shows that Switzerland is currently (in 2015) among the European countries receiving the most migrants in relation to its population.

Figure 2.9 Immigrants as a share of the population (Immigrants in 2016 per 1000 inhabitants)



- (1) Break in series.
- (2) Provisional.
- (3) Estimate.

Source: Eurostat (2018b)

These flows vary considerably from one year to the next. Luxembourg has had the highest immigration rate for years, while the immigration rate in Austria and especially Germany

was much lower in the past (it almost doubled in Germany between 2014 and 2015). Asylum seekers play a major role in these fluctuations.

The chart below shows the number of asylum seekers as a share of the population in 2015–2016 (i.e. during

a period when Germany was particularly generous).

Figure 2.10 Asylum seekers as a share of the population

Country	New asylum seekers, people, 2015-2016 total	New asylum seekers as a share of population, %, 2015-2016 total
Sweden	178870	1.83
Austria	125570	1.47
Germany	1164260	1.44
Switzerland	63990	0.77
Luxembourg	4240	0.75
Finland	37590	0.68
Norway	33720	0.65
Greece	61220	0.56
Denmark	27470	0.48
Belgium	53370	0.47
Iceland	1490	0.45
Netherlands	61510	0.36
Italy	205360	0.34
Turkey	211440	0.27
France	152190	0.24
Australia	39990	0.17
Israel	13160	0.16
United States	434710	0.14
United Kingdom	78350	0.12
Ireland	5520	0.12
Canada	39900	0.11
Slovenia	14500	0.07

Source: OECD (2018)

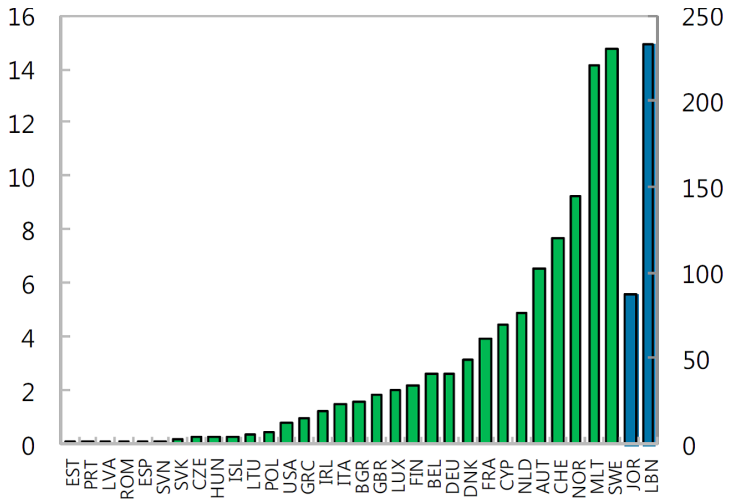
Switzerland is one of the OECD countries with the highest number of refugees per capita. Following its new policy, Germany received more refugees than Switzerland in 2015 and especially 2016, even in proportion to its population. The difference

in the number of asylum seekers per capita in Germany and Switzerland nevertheless declined significantly in 2017, as the number of asylum seekers fell to a greater extent in Germany than in Switzerland.

The chart below shows the number of asylum seekers per 1,000 inhabitants in 2014 (i.e. before 2015, the

year in which Chancellor Merkel eased Germany's asylum policy).

Figure 2.11 : Refugee share of the population, Refugees to 1,000 Inhabitants, 2014 (Number of people)



The blue histograms should be read on the right-hand axis.

Source: IMF (2016)

Switzerland is one of the countries with the highest number of refugees per capita, although it is overtaken

by the Nordic countries and some countries in the Middle East or close to the Middle East.

3 The economic impact of immigration

As we will also consider the indirect impact of migration on the budget, we need to have a broader understanding of its impact on the economy.²⁷ §3.1 gives a panoramic view of the problem, while the channels we propose in §3.2 focus on a small open economy as host country.

3.1 Impact of immigration on the economy: why studies diverge

We cannot do justice here to the abundant literature on the economic impact of immigration, let alone evaluate it.²⁸ Moreover, the economic impact of immigration differs from one country to another because of differences in the characteristics of their economy or the type of migrant. We simply give a panoramic

view of the problem here. We indicate the main elements for understanding why different studies can produce different results: group of individuals whose interests are taken into account (global, national, etc.), short term versus long term, hypothesis concerning the impact of immigration on the social model, GDP versus GDP per capita, hypothesis on the complementarity between immigrants and residents, hypothesis concerning the impact of immigrants on productivity and the repercussions for indigenous people. However, we will not discuss many econometric points that may seem to be details but have a considerable impact on the results (see for example the literature on the Mariel boatlift).

²⁷ We do not discuss the overall well-being impact, which depends in particular on non-economic factors unlikely to have a budgetary impact. Nonetheless, there are studies on this subject. For example, Akay et al. (2012) found that immigration to Germany increases the subjective well-being of natives. In the UK, Longhi (2014) found that living in a culturally diverse area reduces the subjective well-being of white Britons, but not of non-white Britons. Some votes, such as Brexit or the Swiss vote against mass immigration, express a desire to limit immigration.

²⁸ For two opposing views, see Borjas (2014) and Peri (2016).

Box 3.1 The Mariel boatlift

Between April and October 1980, the Cuban government authorised those who so wished to leave the country from Mariel Harbour. 125,000 Cubans immigrated to Florida (the "Marielitos"). This largely unskilled immigration increased Miami's labour supply by 7% overall and even more in the low-skilled category (Card, 1990). At least 60% of the Marielitos were high school dropouts (Borjas, 2015b). Although this episode's magnitude and limitation in space and time should facilitate studies, it has been the subject of numerous publications with differing conclusions.

Card (1990) found that this immigration had virtually no impact on wages or on the unemployment rate for low-skilled workers in Miami.

Borjas (2015b) found that this immigration led to a wage decline of between 10% and 30% for high school dropouts in Miami.

A series of studies and counter-studies followed. See Merler (2017) for a presentation of this controversy.

It is always difficult to assess the extent to which the results of a quasi-experimental situation, which involves extraordinary events with their specific features, can be generalised to ordinary migration. For example, some of the Marielitos had been released from prisons and mental asylums by the Cuban government.

3.1.1 Global impact

It is generally accepted that reducing barriers to migration would increase global GDP (in principle, it would thus be possible to compensate the losers), as work could move to where it is most useful. This would increase net migration to more productive countries overall. Immigrants would be the main beneficiaries. Provided

that immigration does not penalise the efficiency of host countries, removing all restrictions would increase global GDP by USD 40 billion, or 60% (Borjas, 2015a). However, this would imply the immigration of 2.6 billion workers (i.e. 95% of workers in southern countries), or even 5.6 billion people if workers immigrated with their families.

In this context, the key question is knowing what level of immigration maximises global GDP. To answer this question, we first have to understand why some countries are more productive than others. It is difficult to sustainably attribute this cause to what can move, such as technology or capital. Having natural resources does not seem necessary for a country to be prosperous and can even be harmful (the paradox of plenty). Acemoglu and Robinson (2012) demonstrated the central role of institutions for economic prosperity. In addition to institutions, Collier (2013) stresses the importance of rules, norms and organisations.²⁹ He refers to the combination of institutions, rules, norms and organisations that plays a crucial role in prosperity as the "social model". The more national productivities are assumed to be independent of migration, the higher the optimal level of immigration from a global perspective. Collier (2013) argues that a massive increase in immigration would

threaten the productivity of developed countries. Borjas (2015a) calculated how the impact on GDP depends on the influence of immigration on national productivity. Clemens and Pritchett (2016) point out that the optimal level of immigration remains higher than current restrictions allow.

It remains to be seen whether the free worldwide movement of people automatically makes it possible to achieve the optimum. Since the immigrant chooses to leave his country, it can be assumed that he will actually improve his situation.³⁰ Just like the immigrant, the employer benefits in principle, as both freely choose their deal. The situation is more ambiguous with regard to third parties who may suffer or benefit from externalities. In the country of origin, immigration can reduce the forces likely to reform institutions. Immigration can lead to a brain drain. Conversely, the prospect of being able to immigrate can prompt

29 Preferences could be added. For example, Wang et al. (2011) found that cultural factors have a significant impact on differences in time preferences between countries.

30 This assumption is probably correct most of the time, even if it has to be put into perspective firstly because the immigrant is imperfectly informed and secondly because he may be concerned not only about his own well-being, but also about that of his descendants and the help he will be able to provide to his extended family back home.

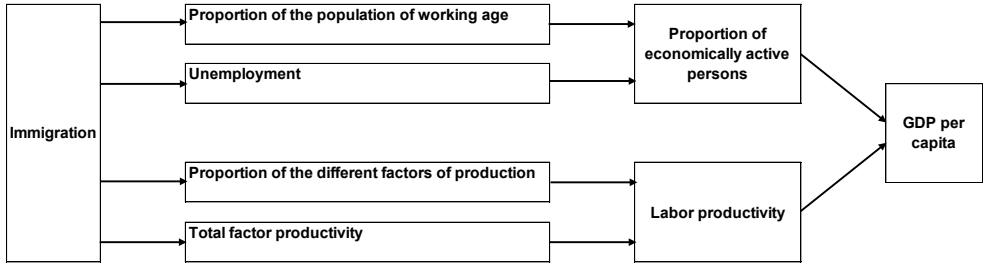
people to commit to training. The diaspora can financially help the country of origin and influence its standards. In the host country, people other than the employer may be positively or adversely affected as workers, consumers, producers or taxpayers. Above all, worldwide free movement can lead to a level of immigration that exceeds the optimal level, as its impact on productivity via the social model is an externality. However, it is likely that the level of migration that maximises global GDP is significantly higher than the current level, at least in the absence of a more sustained effort to improve the social model of poor countries.

3.1.2 Impact on the host country

Immigration contributes to economic growth by increasing labour supply and demand (for goods and services, as well as investment), which partly involves domestic products. But higher GDP does not necessarily mean a richer country. It is GDP per capita that is an indicator of economic prosperity, albeit a less than perfect one. This indicator is imperfect because it only measures per capita wealth generation and does not take account of utility flows from stocks such as infrastructure, capital, housing or nature. The wealth generation needed to restore these per capita stocks to the level excluding a migration shock does not constitute a net increase in prosperity. This indicator does not take inequalities into account either.

Immigration can influence GDP per capita via the proportion of workers in the population or the productivity of workers.

Figure 3.1 Impact on GDP per capita



The long-term economic impact of immigration on the host country is generally considered low for current international immigration rates (it would be higher in the absence of immigration restrictions).

Proportion of working-age people, unemployment

We saw in §2.2 that immigration generally tends to increase the proportion of working-age individuals in the population. The impact on

unemployment depends on the flexibility of the labour market.

Proportion of various production factors

With regard to productivity, a distinction has to be made between the impact on the proportions of the various production factors and that which is independent of these proportions (total factor productivity discussed below).

Capital versus labour

Let us discuss two extreme cases:

1. *Temporary increase in immigration*

Immigration initially reduces the capital stock per worker. The relative scarcity of capital just after the shock leads to a decline in labour productivity and hence in wages (relative to the scenario with no shock). If the shock is large enough to cause wages to fall not only relative to what they would have been in the absence of the shock, but also relative to the past, different factors (downward nominal wage rigidity, minimum wage, flanking measures for the Agreement on the Free Movement of Persons) can slow this process down: the fall relative to the scenario with no shock will occur only gradually by reducing wage increases. It is generally accepted that the capital stock per worker, and thus labour productivity and the general level

of wages, adjusts over the long term to return to its no-shock value.³¹ The so defined long-term adjustment occurs sooner, or even immediately, insofar as the migration shock is anticipated.

2. *Introduction of the free movement of persons*

In the absence of barriers to the movement of people and in the simplest models, workers migrate from low-wage countries to high-wage countries until wages (or more accurately the purchasing power of wages) equalise apart from a wedge reflecting the cost for the immigrant to leave his country. However, we show in Appendix 2 that the free movement of people does not imply an equalisation of wages (even when the wedge discussed above is equal to zero), and instead leads to a balance that depends on the relative mobility of labour and capital (more precisely, on the relative

31 If capital is immobile internationally, the capital stock per worker will not return to its no-shock value even in the long run. This is evident if the savings rate is exogenous (Solow-Swan model). This is also true if individuals choose their savings rate by maximising their own utility and that of their descendants (Ramsey model): not taking into account the utility of future migrants leads to savings that are not sufficient even in the long run to restore the amount of capital per worker (see Barro and Sala-i-Martin, 1995, chapter 9).

capacity to generate net flows of workers and capital).³² Nevertheless, the capital stock per worker generally does not return to its no-shock value even in the long run.

If capital is infinitely mobile, immigration does not change the capital stock per worker in either case. In the first case, the long-term adjustment occurs immediately. In the second case, the interest rate is determined by its international level (with the exception of a spread representing exchange rate expectations). The capital stock per worker results from this and is not modified by immigration. In reality, however, capital is not perfectly mobile. It

takes time to build new buildings and create new companies. Moreover, there is a correlation between a country's savings and its investments: this is the Feldstein-Horioka puzzle. It is a puzzle because the international mobility of capital should make national investment largely independent of national savings. Horioka and Ford (2016 and 2017) propose an explanation for this puzzle based on friction in the international trade in goods and services. They argue that the market for goods and services must also be involved in order to achieve net capital flows. However, the market for goods and services suffers from friction. Krugman (2017) also believes that the mobility of capital depends on

32 Under the assumptions generally used in economic models, setting the return on capital determines the capital stock per worker, as does setting the remuneration of labour. What happens if a small, efficient economy like Switzerland is simultaneously open on the capital and labour markets? The capital stock per worker determined by the free movement of capital will generally be incompatible with that determined by the free movement of people. The wage drop triggered by immigration (relative to the scenario with less immigration) will be limited by the fact that this immigration will also lead to an increase in the profitability of capital, which will in turn attract capital. Immigration thus attracts capital, which attracts immigration and so on. Capital and the number of workers thus increase indefinitely. However, the factor returns converge towards a steady state. Wages in Switzerland should therefore converge towards a value that is lower than it would have been in the absence of immigration (or with lower immigration), but that is still higher than wages in the European Union. More details are presented in Appendix 2.

the market for goods and services.³³ It is thus likely that it is less easy to generate net capital flows than could be thought in theory. If capital is not infinitely mobile, the long-term impact on wages and profits differs depending on whether a temporary increase in immigration or the introduction of the free movement of people is considered.

A permanent increase in immigration as a result of higher quotas that are still binding is an intermediate case between these two extremes. We can understand this case as the accumulation of transitory shocks; the impact of each shock on the capital stock per worker always ends up disappearing, but it is continually replaced by the impact of new shocks. Insofar as the quotas remain binding, the impact will be different

from that of the free movement of people.

Different types of work

Immigration can also have an impact on the breakdown between different types of worker. If the initial breakdown was not optimal, e.g. in the case of a shortage of certain types of worker, it leads to an increase in output per worker. The initial breakdown may be sub-optimal for various reasons:

- *Unanticipated development of the demand for certain types of worker*
It is then a question of using immigration to correct an unforeseen development of the demand for certain types of worker.

³³ In another context (in the United States and following a reduction in corporate taxation), Krugman (2017) argues that even in the absence of friction over the international movement of capital, and regardless of the time needed to create new companies, the adjustment of capital stock is slow. Krugman calculated that it takes about 12 years for capital to make half of its adjustment towards its long-term equilibrium. His argument is based on the idea that foreign investment corresponds to a loan that translates into a trade deficit (or a reduction in the surplus) by changing the exchange rate. The adjustment of capital is slowed down (despite the free movement of capital) by the limits of the sensitivity of the trade balance to the exchange rate. It remains to be seen whether this argument remains relevant if the increase in the profitability of capital is due to immigration rather than to a tax cut for a small open economy such as Switzerland, where capital flows do not necessarily trigger variations in the trade balance (as items in the financial accounts or other elements of the current account balance can also adjust).

- *Qualifications that are difficult or impossible to teach*
Some individuals have gifts that cannot be acquired through training or experience. These extraordinarily talented individuals are rare, including among immigrants, but tend to be highly mobile. It is probable that a large proportion of exceptional individuals are willing to immigrate to the country that will give them the best reward. More modestly, other immigrants have knowledge that is difficult to learn in the host country, such as a perfect command of a foreign language.
- *Training policy gaps*
The host country training system may not be able to teach certain skills (or too few indigenous people may be able to acquire these skills). The host country may also decide not to provide certain types of training because of the

possibility of hiring foreign-trained immigrants. The possibility of thereby benefiting from such training without financing it may result in immigration replacing training to a certain extent.

- *Impact of earlier immigration*
If immigration lowers wages for a job (relative to other jobs), it discourages indigenous people from training for that job. Immigration may thus encourage additional immigration to replace indigenous people in this job area. Indigenous people may have preferences that cause them to turn away from an occupation. But in the absence of immigration, wages would adjust so that domestic supply equals demand.

Total factor productivity

Immigration can alter total factor productivity.

Table 3.1 Channels through which immigration can alter total factor productivity

Positive impact	Negative impact
<p>The disproportionately high numbers of immigrants among scientific Nobel laureates in the US, as well as the talent attracted to Silicon Valley, illustrate the importance of extraordinarily talented immigrants.</p> <p>The immigration of well-trained workers can foster the capacity for innovation, entrepreneurial activity and international economic contacts. Ideas can remain in the host country even when the immigrants who brought them leave.</p>	<p>The abundance of labour discourages the search for innovations aimed at using labour more efficiently (such as robotisation or digitalisation).</p>
<p>Agglomeration externalities or economies of scale</p>	<p>Congestion (land, etc.)</p>
<p>Impact on the social model. Immigration can have a positive impact on the host country's social model by opening up new perspectives. It can be assumed, however, that the impact of immigrants via this social model is generally negative for economic growth to the extent that they come from less prosperous countries, if they are representative of their country and if the host country is not able to sort the good innovations they bring to the social model from the bad. This impact increases more than proportionally with immigration, as a high rate of immigration makes integration more difficult. In the long term, if immigration accelerates, its greatest impact could pass through this social model.</p>	

The contribution of highly skilled immigrants can be counted as additional only insofar as it does not crowd out local talent. Borjas (2016), for example, found that the arrival of Soviet mathematicians in the US crowded out US mathematicians working in their preferred field. Hunt and Gauthier-Loiselle (2010) found that increasing the proportion of university immigrants in the population by one percentage point leads to a 6% increase in patents per capita, or even 9% to 18% if indirect effects are taken into account (which implies positive externalities rather than crowding out). Also in the US, Doran et al. (2016) found that companies with H-1B visas (for skilled workers, especially in new technologies) do not increase employment to the same extent. The authors deducted a substantial crowding out effect. For France, Mitaritonna et al. (2017) found that immigration increases total productivity. Highly qualified residents competing with highly qualified immigrants find employment in companies that hire fewer immigrants. Jaumotte et al. (2016) found that increasing the share of immigrants in the adult population by one percentage point increases GDP per capita by 2% in the long term (considering a wider range of countries, Ortega and Peri, 2014, found a factor five times higher:

increasing the share of migrants by 10 percentage points doubles long-term income). This effect comes from the increase in productivity rather than the increase in the proportion of workers. Both highly qualified and low skilled immigrants contribute to this increase in productivity. The gains from immigration are widely shared among the population. For Norway, Furlanetto and Robstad (2016) found that immigration leads to lower productivity and lower unemployment.

3.1.3 Impact on individuals living in the host country before the migration shock

In the previous section, we discussed the economic impact on the host country. However, a positive impact on the host country does not necessarily imply a positive impact on the individuals living in the host country before the migration shock. It can happen that only the immigrants benefit. Similarly, a negative impact on the host country does not necessarily imply a negative impact on the individuals living in the host country before the migration shock. As taxpayers, it is clear that residents have an interest in the immigrants being well trained and therefore having high incomes that cause them to pay high taxes and receive fewer

social benefits. In contrast, it is more complex to know what their interest is as employees, for example. Countries generally limit immigration. This suggests that they feel that immigration above a certain threshold would not be in their interest.

One question being debated is whether residents have a direct economic interest in immigrants being highly skilled or rather low skilled. The argument in favour of highly skilled immigrants depends very much on whether immigrants are fully paid for their contribution (paid according to their marginal productivity) or whether some of their contribution benefits residents (positive externalities).³⁴ If these immigrants are fully paid for their talents, there is not necessarily a gain for the resident population, except through the taxes paid by the immigrants. If, however, their remuneration is incomplete, there is a gain for residents even before tax is considered. The argument in favour of less skilled immigrants is that they tend to complement host country resi-

dents, who are generally quite highly skilled on average.

Immigration has a positive impact on those who are complementary to immigrants and a negative impact on those for whom they are substitutes. The following are complementary to immigrants: i) capital holders; ii) employees who perform different tasks from immigrants; iii) consumers of goods and services produced by immigrants (e.g. cleaning services that become cheaper, ethnic restaurants that offer diversity or childminders who enable resident parents to work); iv) producers of goods and services consumed by immigrants. The following are substitutable for immigrants: i) employees who perform the same tasks as immigrants; ii) consumers of the same goods and services as immigrants.

Some of these effects can disappear in the long term as the economy adjusts. The overall impact on wages can be zero in the long term, despite there being a negative impact on the residents who are the most similar to the immigrants even in the long term

34 Studies exist on quasi-experimental situations (example: arrival of German Jewish scientists in the US after 1933) or on programmes like H-1B. For two opposing views on the impact of H-1B immigrants on residents, see Peri et al. (2015) and Borjas (2016b).

and a positive impact on those who are the most complementary to them. In particular, there is a redistribution from labour to capital. This redistribution is temporary in the case of a transitory migration shock (see Appendix 3), but it may be permanent in other cases (see Appendix 2). There is also a redistribution from some workers to others. Whatever the overall result, the fact that there are winners and losers is a challenge.

The degree of substitutability of different groups of workers, which is a crucial element for estimating the impact of immigration on wages, is controversial.³⁵ Substitutability estimates are sensitive to how different groups of workers are divided.³⁶ Therefore, it may not be noticed that a certain group is substitutable for immigrants if it is

part of a larger group that also includes many workers who are complementary to immigrants. It seems obvious that people with different qualifications are not very substitutable. The debate concerns the substitutability of residents and immigrants with comparable qualifications.

3.1.4 Impact on natives

In the previous section, we discussed the impact of immigration on individuals living in the host country before the migration shock. These inhabitants include former immigrants, people of immigrant origin and natives. To the extent that new immigrants are more substitutable for former immigrants than for natives, it is possible for new immigration to have zero impact at the national level, with a positive impact

35 See Ottaviano and Peri (2007), Borjas et al. (2008), Ottaviano and Peri (2008), Borjas et al. (2011), Card and Peri (2016).

36 The level of disaggregation of groups of workers is limited in particular by the fact that the number of parameters describing substitutability between groups increases with the square of the number of groups, which causes estimation problems or requires a reduction in the number of parameters to be estimated based on assumptions that will not be empirically verified (e.g. the assumption that some of these parameters are identical). Borjas (2014) discusses this on page 107.

for natives and a negative impact for those who immigrated earlier.

3.2 The channels through which immigration has an impact

Here, we summarise the channels through which immigration has an economic impact on a small open economy like Switzerland as host country. We consider a transitory migration shock that permanently increases the population relative to the absence of a shock (in case of a permanent shock, some impacts are modified as indicated in the previous section). Unless otherwise specified, all comparison terms (e.g. "increase" or "decrease") are to be understood in relation to the scenario with no shock (rather than the past). To find these channels, we first examined a very theoretical benchmark, and then gradually added more realistic elements to it. The benchmark serves as a reference despite its lack of realism, as it represents a case where immigration has almost no impact. Consequently, primarily the deviations from this reference explain the impact of immigration. After describing this approach (§3.2.1), we

present the channels we found (§3.2.2).

3.2.1 Approach

In order not to be blinded by the multitude of channels through which migration affects the economy, we consider different situations that increasingly approach a realistic migration shock.³⁷ This gradual approach also enables us to better understand which dimensions of immigration contribute to which effects. To get a good view, we consider major shocks (e.g. doubling of the population), but the conclusions generally remain qualitatively similar for a smaller shock. The effects in italics are presented in the table in §3.2.2.

- **Doubling of Switzerland (population, surface area, etc.)** Switzerland doubles (population, surface area, budget deficits or surpluses, etc.), while the rest of the world is unchanged. Impact: as a first approximation, nothing would change, as no relationship changes when everything doubles. Population change can

³⁷ This gradual approach is common in economics. See for example Rowe (2017). We followed it in a particularly systematic way here with the aim of identifying the channels as comprehensively as possible.

nevertheless be important.
Second approximation: terms of trade and economies of scale.

- **Doubling of only the population (not the surface area, etc.)**
The population in Switzerland doubles without its structure changing, but unlike with the previous scenario, this shock does not change anything else in the immediate future. Therefore, the companies are the same as before and Switzerland's surface area is still the same. Impacts: pre-shock public debt and assets, population density, land prices, housing prices, return on private capital, international movement of capital, wages, unemployment, employment structure, international movement of labour.

- **Immigrants with a different age structure**
The age structure of immigrants is different from that of the population resident in Switzerland (although it is still assumed that, for a given age, immigrants are identical to residents in Switzerland): the proportion of young adults is higher among immigrants (despite the fact that family reunification can be an important reason for immigration). Impact:

impact on social security via the age structure of the population, training costs.

- **Immigrants with different qualifications**
Qualification differences between immigrants and residents (same age). Impact: impact on social security via qualifications, training policy, qualifications that are difficult or impossible to teach, complement versus substitute.
- **Immigrants who differ from the resident population also in other ways**
Immigrants may differ from residents not only in terms of age and qualifications, but also in other ways, such as preferences and values. Impact: social model, other.

3.2.2 Channels

At this stage, we only describe the channels qualitatively. In the following chapters, we will seek to provide quantitative information for Switzerland. These channels are not presented in order of importance, but rather in a logical order related to the approach described above. The first channels are linked mostly to size effects that would exist also in the event of population growth

caused by an increase in fertility rather than by immigration. In

contrast, the last channels are more specific to immigration.

Table Channels for the impact of immigration on the economy

Channel	Description and examples
Population	The per capita rather than the absolute quantities matter. However, the absolute number of people is also important if the demographic shock (or a succession of shocks) prevents the population from eventually disappearing.
Terms of trade	To the extent that external demand for Swiss goods and services (our exports) is partly driven by the Swiss label, an increase in the working population and thus Swiss supply will tend to lower the prices of Swiss goods and services relative to other goods and services, as external demand for Swiss production remains constant and domestic demand is partly devoted to imports.
Economies of scale	Because of fixed costs, for example, a service of the same quality can sometimes be provided at lower unit costs when the population increases (e.g. national defence). We also include efficiency improvements resulting from positive externalities (e.g. network externalities or agglomeration economies) here.
Pre-shock public debt and assets	The burden of pre-shock public debt will be shared among more inhabitants. Physical public capital (roads, etc.) existing before the shock will also be shared among more inhabitants. Therefore, transport networks may initially be congested. However, they can eventually be adjusted, albeit at a higher cost than before because of the increase in land prices (see below) and because road widening, for example, may require the destruction of homes.
Population density	As Switzerland's surface area cannot be extended, an increase in population results in an increase in population density.
Land prices	An increase in population density leads to higher land prices and landowner remuneration.

Housing prices	The initial increase in housing prices will gradually be mitigated by an adjustment in the housing stock, without them necessarily returning to the level they would have been at without the shock (the increase in land prices has a long-term impact on housing prices). This effect depends on the magnitude of the shock, particularly whether the population increases not only relative to the scenario with no shock, but also relative to the past.
Return on private capital	The increase in the number of workers will lead to an increase in the number of workers per unit of capital and thus in the return on capital. This will attract capital (with the free movement of capital). The capital stock should eventually rise to the point where capital returns to the same profitability level as in the absence of a shock. This implies that, after an initial fall, the capital stock per worker gradually increases in order to return to its no-shock value in the long term. The transitional period is shortened or even cancelled if the shock is anticipated.
International movement of capital	Higher investments can be financed with foreign savings (or by placing domestic savings less abroad). But even if global savings are available to finance investments without friction, the adjustment of capital will not be immediate, if only because it takes time to build new buildings and create new companies.
Wages	The impact on wages was discussed in §3.1: temporary decline in the overall level of wages relative to the scenario with no shock.
Unemployment	If the labour market is perfectly flexible, the demographic shock should not trigger an increase in unemployment. In reality, the labour market is not perfectly flexible. The impact on unemployment depends non-linearly on the magnitude of the shock.
Employment structure	If the demographic shock is significant enough to generate an increase in population not only relative to the scenario with no shock, but also relative to the past, this will lead to an increase in the construction sector's share of employment.
International movement of labour	The transitory drop in wages and higher rents reduce the incentive to immigrate to Switzerland and may even cause some people to leave Switzerland.
Impact on social security via the age structure of the population	The arrival of young adults initially makes the population younger. But these immigrants age too. In the long term, immigration generally tends to increase the average age of the population. However, the ratio between working people and pensioners is generally improved even in the long term, but to a lesser extent than suggested by short-term values. This improvement in the ratio between working people and pensioners provides relief for old-age and survivors' insurance (OASI). The OASI benefits even more if immigrants pay the OASI more than they receive. This happens especially if the OASI is a losing strategy for the new generations.

Impact on social security via qualifications	Since social security is levied from the better-off in order to be redistributed to the less well-off, immigrants will tend to have a positive or negative impact on social security depending on whether their income is higher or lower than average.
Training costs	Switzerland benefits from the qualifications of immigrants whose pre-immigration training was financed by the countries of origin.
Training policy	<ul style="list-style-type: none"> – Training of immigrants For example, to learn the local language. – Residents' choice of training If immigration changes the relative wages of different occupations, this can influence the training direction of residents. – Public training policy The possibility of hiring foreign-trained immigrants can lead to changes in training policy: replacing training to some extent with immigration or, on the contrary, strengthening training so that natives are competitive in the face of competition from foreign labour. If skilled immigration is complementary to natives, the question arises as to why natives are not better qualified. – In-company training Every company has an interest in letting other companies train apprentices. But all companies have a collective interest in coordination for training apprentices. At least as long as they cannot acquire all the workers they want abroad. The incentive to train apprentices decreases if all companies can find all the workers they need without training them, or can even hire already trained migrant workers as apprentices.
Qualifications that are difficult or impossible to teach	Some individuals have gifts that cannot be acquired through training or experience. More modestly, other immigrants have knowledge that is difficult to learn in Switzerland, such as a perfect command of a foreign language.
Complement/substitute	Immigration has a positive impact on those who are complementary to immigrants and a negative impact on those for whom they are substitutes. Some of these effects can disappear in the long term as the economy adjusts.
Social model	Immigration can have a positive impact on the host country's social model by opening up new perspectives. It can be assumed, however, that the impact of immigrants (from typically less prosperous countries) on this social model is generally negative for economic growth. The question of the social model takes on a special dimension in Switzerland, as its institutions, especially direct democracy, differ from those prevailing in most countries of origin of immigrants.
Other	It is not surprising that immigrants can differ from residents in terms of their values and preferences, given that there are already differences within Switzerland, for example between French-speaking and

German-speaking Switzerland, regarding the social role of the state. These differences between immigrants and residents can manifest themselves in various ways such as in the structure of consumption or fertility. There can also be effects related to the fact that the value system of immigrants has not co-evolved with the Swiss social model where they arrive. The greater the initial differences in values, and the longer these differences persist during the immigrant's life, or even that of his descendants, the greater their impact. This point is thus very closely linked to the question of the integration of immigrants.

4 Approaches for studying the budgetary impact

We will first discuss the approaches used in the literature to assess the budgetary impact of immigration (§4.1), and then specify the thought experiment considered in this paper (§4.2).

4.1 The approaches used in the literature

Different approaches are used in the literature to study the budgetary impact of immigration.³⁸ They differ according to their time horizon and the type of channel taken into account. Static approaches only study the impact during a past period. As they only take short-term effects into account, they do not provide information on the budgetary impact of a change in immigration. An example of a typical shortcoming of these approaches is to integrate the old-age and survivors' insurance contributions paid by immigrants without taking account of the pensions to which these contributions will entitle them. Dynamic approaches take account of the future and the long-term impact. A first dynamic approach, the "net

transfer models", quantifies budgetary balances like with the static approach, but it extends it into the future, which implies formulating certain assumptions. These approaches generally assume a "no policy change" that may be unrealistic if fiscal policy is unsustainable.³⁹ The generational accounting approach, in contrast, assumes that fiscal policy must be sustainable. If the correction of an unsustainable fiscal policy puts a burden only on future generations (including future immigrants), the fiscal balance of immigrants will be more positive than with other approaches, but debt may become unrealistically high before being corrected. These approaches are generally limited to the direct impact via the budgetary balance of immigrants and sometimes also of their descendants. A more comprehensive approach should also take account of the indirect impact via the budgetary balance of other inhabitants. A more sophisticated model is needed for this, e.g. a general equilibrium model with overlapping generations. To study the budgetary impact, all

38 For a literature review, see Rowthorn (2008).

39 A correction is sometimes made in „net transfer“ or even static models: if the budget is not balanced, taxes are assumed to be increased (to the same extent for all residents) so that the budget is balanced. See for example Rowthorn (2008).

effects must be taken into account, including long-term and indirect effects. However, calculating the long-term effects involves making assumptions about the future, and the indirect effects are difficult to quantify.

The studies also differ according to their choice of modelling details. In particular, will account be taken of the budgetary impact of the descendants of immigrants? This seems logical, as the descendants would not be in the host country without the immigration of their parents. Recognising the costs of educating immigrant children while omitting their contributions to public budgets when they work would distort the conclusions. However, account has to be taken of the growing integration of these generations into the Swiss population (in terms of budgetary balances, fertility, etc.) and the fact that a child may have one immigrant parent and one native. For a comparison of a scenario with and without immigration, the most correct approach would probably be to count the children of immigrants in the scenario without immigration as a proportion of their non-immi-

grant ancestors, as it is to this extent that they would have been in Switzerland in the absence of immigration. Do immigrants who have acquired Swiss nationality still have to be taken into account? This seems logical, as these Swiss nationals would not be in Switzerland without immigration.

Few studies explicitly analyse the impact of immigration on public finances in Switzerland. In its publication "International Migration Outlook 2013", the OECD devoted a chapter to the impact of immigration on public finances in OECD countries (Liebig and Mo, 2013). The authors compare the taxes paid by immigrants and their social insurance contributions with the use of public services and the receipt of social benefits from 2007 to 2009 (with and without the pension system). For Switzerland, they concluded that public finances clearly benefited from immigration in this period, particularly because the immigrant population of working age was over-represented, came mostly from high-income countries and had a high employment rate.⁴⁰ Limited to the

40 Figure 3.2 of Liebig and Mo (2013) shows that the net fiscal contribution (taxes + social contributions – social benefits) is EUR 15,000 on average for households with both Swiss-born and immigrant heads. According to their table 3.7, the extent of the gain for Swiss public finances depends very little on inclusion in or exclusion from the pension system (contributions and pensions).

period 2007 to 2009, this study does not measure the long-term impact.

However, the argument that immigration from the EU benefits public finances has been called into question by Ramel and Sheldon (2012), who assessed the long-term impact. This study factors in the ageing of immigrants. It also takes into account the fact that immigrants who have a positive overall impact on public finances (especially from countries in the north of the EU/EFTA) are more likely to return to their country of origin, while those who tend to weigh on public finances are more likely to remain in Switzerland. This approach examines the scenario where certain historical data items remain constant in the future (size and structure of immigration, probability of a category change for each category of migrants, budgetary balance according to the category of migrant), but it does not assume that the structure of the foreign population remains constant. It examines the long-term equilibrium. Can et al. (2013) propose an estimate of the budgetary impact of immigration during the transitional period

through to 2060. We will discuss Ramel and Sheldon (2012) and the resulting studies in detail in Chapter 5.

Aside from the studies of the OECD and Ramel and Sheldon, some older studies exist, including Weber (1993), Weber and Straubhaar (1996), Raffelhüschen and Borgmann (2004), and Künzi and Schärer (2004).

We are not aware of any studies on the indirect budgetary impact of immigration in Switzerland. However, there are studies on the impact of immigration on other inhabitants through specific channels, such as the labour market. These studies do not explicitly address the budgetary impact, but they can help to assess it.

There are studies that analyse the impact of immigration on public finances in countries other than Switzerland.⁴¹ The results of these studies cannot be extrapolated to Switzerland, as they depend on the number and characteristics of immigrants (e.g. education, age, length of stay) as well as the host country (especially its social safety net).

41 See for example Nowrasteh (2014) or Rowthorn (2008) for a discussion on this literature.

Nevertheless, international comparisons highlight the main factors that influence the budgetary impact of immigration. Some general observations are reliable. For example, highly skilled migrants pay more than they cost the state. It appears that the costs and benefits are generally unevenly distributed among the different levels of government, with typically higher costs at the local level.⁴²

4.2 A thought experiment

We wish to examine the short- and long-term impact of immigration on public finances in Switzerland. We will thus consider a migration shock as a starting point. It cannot be a migration shock triggered by a boom in the Swiss economy, as it would then be difficult to distinguish between the impact of the migration shock and that of the economic boom that caused the shock. We will thus consider a change in migration policy instead. Our question becomes operational as follows: what would be the budgetary impact of a change in immigration following a migration policy modification? The simplest example is a change in

quotas (when these quotas were initially exhausted, otherwise they did not limit immigration) that would lead to a given increase in net migration.

Several questions arise. First, is it sufficient to calculate the impact of a given increase in immigration to know the impact of any change? This would be the case if the impact were a linear function of the shock: the impact would be doubled for a shock twice as big and the opposite for a drop instead of an increase. This may be the case for small changes, but not more generally. If we consider a shock that sufficiently increases immigration, the opposite of this shock may imply negative net migration, which would change the nature of the phenomenon by transforming an immigration country into an emigration country. Moreover, all other things being equal, the difficulty of integrating increases with the immigration rate. In particular, integration can become difficult when the majority of pupils in a class are immigrants. The impact is thus a linear function of immigration for small changes, but not for large changes. It remains to be seen

42 For the impact at the local level, see the "Local fiscal impact of migration" section in Chapter 3 of the OECD's publication (2016).

whether this non-linearity is already perceptible for realistic magnitudes of immigration.

Second, we have seen that different long-term impacts on wages can be expected depending on whether the shock is an increase in quotas (still binding) or the introduction of the free movement of people (from a situation of binding quotas). That is why we will consider the following two shocks: i) increase in quotas to another level that remains binding; and ii) switch to the free movement of people.

Third, the impact of a shock will be different depending on whether it is anticipated or not. The transitional period before reaching the new equilibrium will be shorter if the shock is anticipated, as the capital adjustment will have been anticipated. However, even if the shock has been perfectly anticipated for a long time, the long-term equilibrium will not be reached immediately: not only does capital have to adjust, but also the new demographic equilibrium has to be reached.

Fourth, the impact of the migration shock depends on its magnitude, as well as on its duration. It is not the same if it is a temporary increase in immigration for one year or a permanent increase. A temporary increase in immigration typically has a permanent impact on population levels (to the extent that immigrants stay and have children). It is also necessary to distinguish whether a permanent shock is constant in terms of the number of immigrants or the proportion of immigrants relative to the population.

Fifth, the impact of the migration shock depends on the type of immigrants. The direct impact depends in particular on the age and education level of migrants. The ideal immigrant for the public budget is a young worker who has acquired advanced training abroad at no cost to Swiss public finances and who is still a long way from retirement age. The indirect impact depends in particular on the degree of complementarity or substitutability with resident workers. The impact on wages also differs depending on whether immigration is legal or illegal. Illegal immigrants tend to

have lower wages than if they were legal, which especially penalises the residents competing with them. Since illegal immigrants do not

receive social benefits, they are less of a burden for social security than legal immigrants with the same low income.

5 Budgetary impact of immigration in Switzerland: direct effects

The direct budgetary impact consists of the budgetary balances of immigrants and their descendants (the indirect impacts via other taxpayers will be discussed in Chapter 5). This budgetary balance depends on the type of immigrant. The most recent and comprehensive study on the direct impact of immigration on public finances is Ramel and Sheldon (2012), which we will call "RS". We will also refer to the following papers: Ramel (2013), Ramel (2014), and Can, Ramel and Sheldon (2013). RS have the merit of assessing the long-term impact of immigration. This is important, as the short-term impact is too optimistic since immigrants are typically younger than the population average, while in the long term they lead to an average population age that is higher than that of immigrants or even higher than that of the indigenous population.

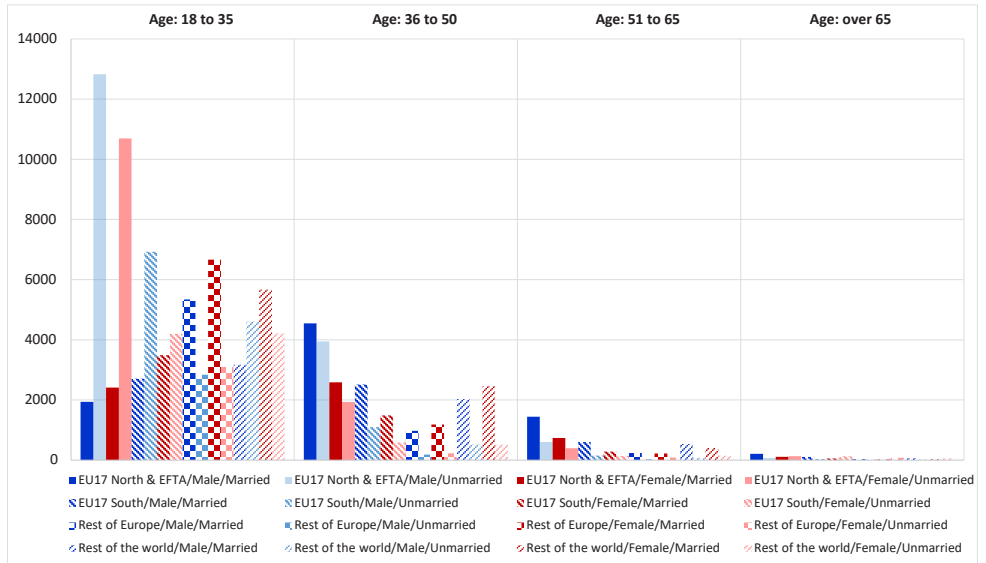
5.1 Methodology and available data

RS limit their study to the budgetary impact of the permanent population for data availability reasons. People

whose stay lasts less than one year are not taken into account. RS calculate the average budgetary balance by crossing the budgetary balances for different categories of foreigners and the long-term equilibrium populations for these categories.

The size and structure of immigration, as well as the probability of transitioning from one category of foreigners to another, are assumed to be constant at their average value for the period 2003 to 2009. In contrast, the size and structure of the foreign population are not assumed to be constant, and instead result from the annual flow of immigration and the probability of transitioning from one category of foreigners to another. The immigration is new, in the sense that, during the period 2003 to 2009, it was already more qualified than in the past. The chart below shows data on immigrants by age (4 age groups: 18 to 35, 36 to 50, 51 to 65, over 65), origin (4 origins: EU17 North/EFTA, EU17 South, rest of Europe, rest of the world), gender and marital status, i.e. 64 categories.

Figure 5.1 Size and structure of annual immigration



Source: Our chart based on the data in Table D.3 of Ramel (2014).

The immigrants are generally young: they are between 18 and 35 years of age in 70.4% of cases, between 36 and 50 years of age in 23.3% of cases, between 51 and 65 years of age in 5.3% of cases, over 65 years of age in only 1.0% of cases.

The evolution of the structure of the foreign population is calculated based on the probability of transitioning from one state to another, where the state is defined by age

(four age classes) and marital status (married/not married). These probabilities differ according to gender and origin. They include not only the fact that immigrants age, but also that those from southern Europe are more likely to stay in Switzerland than those from the north (who also tend to be better trained). The sources used are statistics on the resident population of foreign nationality (PETRA) and the Swiss Labour Force Survey (SLFS). Natural-

ised persons are considered Swiss in the statistics. Nevertheless, since they are in Switzerland via immigration, it is relevant to take them into account as immigrants despite their new nationality when studying the impact of immigration. This is why the calculations are carried out counting naturalised immigrants on the one hand and without counting them on the other hand. Here, we will summarise only the results that take immigrants into account even if they are naturalised, as that is the calculation that is relevant. The budgetary balances are worse than if naturalised people were omitted.

Having a forecast of the evolution of the structure of the foreign population, all that remains is to estimate what each category of foreigner pays the state and receives from it in order to assess the direct impact of immigration on public finances. The budgetary balances by category of foreigners are assumed to remain constant at their average value for

the period 2000 to 2005 (cash flows are expressed in francs, 2005). This implies that fiscal policy is assumed to be constantly the same as in 2000 to 2005. Ramel (2014) indicates that fiscal policy can be considered balanced overall during this period (page 76 and table H.4 on page 192). Due to revisions, and with hindsight, the current perception is that the period 2000 to 2005 was in deficit instead.⁴³ In contrast, the public finances have tended to post a surplus since 2005. Insofar as the deficits in the period 2000 to 2005 were cyclical, and that the future economic situation will be better on average than in that period, the budgetary balances will be better than those calculated by RS. These balances will also be better because fiscal policy is now more averse to debt. The debt brake was implemented at federal level in 2003. These balances can also be improved by promoting labour market integration. In the case of the European Union, Kanks and Lecca (2016)

43 The deficits and surpluses as a percentage of GDP shown in Table H.4 are taken from the 2012 FSO "Public finance indicators, GFS Model" (i.e. before the 2014 revision of the national system of accounts). In the last version of this document (FSO, 2017e), the overall balance for this same period is more negative than indicated in Table H.4. Moreover, according to the FSO (2017d), the total debt of the three levels of government and social security funds increased during this period (see Figure 8). See also Figures 2 and 4 of the FFA's "Assessment of public finances for 1990–2007 based on the new finance statistics models".

found that, although the costs of refugee training (language, vocational training) weigh on the budget in the short and medium term, they can be recouped in 9 to 19 years.

RS use in particular the data from the statistics on income and consumption (EVE) for the years 2000 to 2005 to calculate the budgetary balances by category of foreigners, and they supplement this where necessary with other sources. The EVE is a survey that provides information on the income and expenditure of households – not individuals – for the permanent population. RS regress this data according to different variables (age, gender, marital status, region, four origin categories, qualification, household size, children, employment, labour income, earnings on assets) in order to determine how they depend on the category of foreigners. The characteristics defining the household's foreigner category are those of the reference person: the household member with the highest income (almost never under 18 years of age). Using households rather than individuals has its merits insofar as taxes often relate to households rather than individuals (e.g. married couples) and public benefits are also often linked to household characteristics. In any case, transfer data is not available at

the individual level. It is thus necessary to consider the household as the unit of analysis.

Monetary data is known for households, while population changes are calculated using information on individuals. However, as it is the relative weights of the different categories of foreigners that matter, population data on individuals can be applied to households on the assumption that the ratios for groups of individuals are equal to the corresponding ratios for groups of households. As Ramel (2014) indicates, the evaluation of the average household budgetary balance can be biased if this assumption is not fulfilled (page 42).

The level of disaggregation is less fine for population changes (64 categories) than for monetary data (the previous 64 categories are disaggregated by additional variables such as the level of education, which is not available in the statistics on the resident population of foreign nationality). RS assume that these additional variables remain constant over time within each of the 64 categories of foreigners. As indicated by Ramel (2014), the assumption that the level of education remains constant over time within each category can lead to an overestima-

tion of the level of education, as those with a higher level actually tend to stay less time in Switzerland (page 44). More generally, data availability limits the level of disaggregation for which the budgetary impact can be calculated. The participation of refugee households in surveys is too low to enable this category of foreigners to be considered separately.

By way of comparison, Ramel (2013) calculated the budgetary balance of Swiss households during the period 2003–2009. It is slightly negative, but statistically significantly so. The budgetary balance of all foreigners during this period is positive, but not statistically significantly different from zero. However, the budgetary balance of Swiss households (except naturalised households) has not been calculated for the long term and therefore cannot be compared directly with the budgetary balance of foreigners. With constant policies, the budgetary balance of natives will evolve negatively too. Consequently, the study does not make it possible to know whether the budgetary balance of immigrants will be more favourable or more unfavourable than that of the Swiss in the long term and with constant policies.

The Swiss-born descendants of immigrants are taken into account indirectly: children born in Switzerland are integrated into a new cohort of immigrants (see Ramel and Sheldon, 2012, page 10). This is unsatisfactory, as the children of immigrants born in Switzerland (and their grandchildren, etc.) are different from immigrants. We can imagine that they are better integrated and that on average their budgetary balance is close to that of the indigenous population. Moreover, the number of descendants of immigrants counted as immigrants by RS increases over time, thus reducing the number of true immigrants. However, there is no reason to believe that immigration will decrease to compensate for the increase in immigrants' descendants. In principle, it is not excluded that, for certain categories of foreigners, genuine immigration eventually has to become negative in order for immigration in the RS sense to remain constant despite growing numbers of descendants. Ideally, only true immigrants should be considered as immigrants. It is the flow of true immigrants that should be assumed to be constant in terms of size and structure. Their offspring should be explicitly modelled as such, assuming increasing integration over generations. This would probably

improve budgetary balances. When a Swiss-born child of immigrant origin (whose schooling costs have been taken into account in the calculation of the budgetary balance) becomes an adult, this does not lead to an additional young worker (at the age when the budgetary balance is particularly favourable) in the RS calculations, since this is offset by a reduction in immigration of the same magnitude in the same category of foreigners (particularly the same age group).

In the next two paragraphs, we discuss in more detail the assumptions about the two components of the budgetary balance: government receipts and expenditure.

5.2 Receipts

Taxes are not necessarily borne by those who legally pay them: this is the phenomenon of tax incidence. RS take account of the main examples of this phenomenon by assuming that employers' social contributions are passed on to employees (60%) and consumers (40%), and corporate taxation is passed on to consumers. Ramel (2014) cites a study leading to this 60%/40% short-term impact for social contributions (page 22). It is nonetheless likely that these employer contribu-

tions are passed on to employees more extensively in the long term. Regarding corporate taxation, it is likely that it is also partly assumed by shareholders and employees.

RS include all taxes and duties: i) income and tax on investment income (including withholding tax) at federal, cantonal and communal level; ii) indirect and consumption taxes (VAT, alcohol and tobacco duty, mineral oil tax, other taxes passed on to consumers, etc.); iii) other taxes and charges (such as property taxes).

RS also factor in the social contributions (old-age and survivors' insurance, disability insurance, income compensation, unemployment insurance, accident insurance) of employees and their employers (through their incidence on wages), as well as health insurance premiums (basic insurance) and occupational benefits contributions.

Receipts are thus taken into account in a comprehensive manner for the three levels of government and social security funds. In contrast, it is not clear that is appropriate for occupational contributions and benefits to be taken into account. This inclusion assumes that when young people become old they will receive the same second pillar pensions as older

people currently receive. However, it seems more realistic to assume that they will receive a sum corresponding to what they have paid in to the second pillar. There is certainly also a redistribution within the second pillar. Unlike the old-age and survivors' insurance (OASI), however, it does not necessarily go from high income to low income, but results mainly from an inertia in the evolution of the parameters determining pensions. In part, it can be seen as insurance against interest rate volatility when determining the pension. It does not seem *à priori* to have a direct link with the variables used by RS to define the categories of foreigners. That is why, unlike the OASI, it could be defensible to omit occupational pension provision on both the contribution and benefit sides.

5.3 Expenditure

RS take into account the benefits provided by the state (health, education, transport, etc.), as well as social insurance (OASI and disability insurance pensions, supplementary benefits, unemployment benefits, health insurance premium reduc-

tions, etc.) and other allowances (family, housing, etc.) and occupational benefits (which is consistent, as contributions are taken into account; as indicated above, however, it would seem preferable to omit both contributions and benefits).

RS indicated that they were unable to factor in pensions paid abroad. However, about a third of pensioners receive their OASI pensions abroad, particularly in Italy (mainly former Italian workers, with the Swiss share being very low).⁴⁴ This represents around 13% of the total amount paid by the OASI.

RS consider that some public expenditure does not increase with immigration because it finances public goods at fixed costs. This can be justified for national defence, but it is questionable in other cases. Public administration should thus grow to some extent with the population. Ramel (2014) also cites a study which concludes that the administration at communal and cantonal level grows in proportion to the population (page 24).

⁴⁴ RTS (2017b).

As Ramel (2014) acknowledges, her choice to consider that police and justice expenditure is independent of population size and therefore immigration is particularly controversial. One would imagine a priori that it would increase in proportion to the population. Or even more than proportionally. The number of foreigners involved in crime is disproportionately high.⁴⁵ This overrepresentation does not necessarily reflect a causal link between nationality and crime, as other factors (gender, age, income, etc.) have to be taken into account. Part of this overrepresentation is due to foreigners who are passing through. In an attempt to compare what is comparable, Schwarzenegger and Studer (2013) considered only judgments for criminal code offences that the Swiss can commit as well as foreigners (no offences under the Foreign Nationals Act), they also eliminated "tourists"

(as we cannot know how many came to Switzerland) and they retained only men between 18 and 29 years of age (as this is the category in which there are the most offences). They found a disproportionately high number of foreigners involved in crime, even with these other factors being constant.⁴⁶ According to Kuhn (2012), the variables that explain the criminal phenomenon are, in order: gender, age, socio-economic level, level of education, and sometimes nationality (in the case of migrants from countries at war). According to Killias et al. (2010), crime in Switzerland among young people from the Balkans is higher than among young Swiss, but also than among young people living in their country of origin. This suggests that migration rather than nationality is a factor for crime. As an explanation, the authors highlight the difficulty for parents to supervise their children in an unfavourable environment.

45 The crime rate varies significantly according to the nationality of foreigners. Police crime statistics provide information on crime by nationality. See FSO (2017c), pages 26–28. 73% of prisoners are foreigners (RTS, 2016).

46 Schwarzenegger and Studer (2013): "It appears that young asylum seekers are sentenced 14.7 times more frequently for drug offences than young Swiss men. The frequency rate for asylum seekers is 129.4 drug offences per 1,000 men between 18 and 29 years of age. In contrast, young foreigners in the permanent resident population differ only slightly from the young Swiss (frequency rate: 10.6, versus 8.8 for the Swiss) [...] With regard to violent crimes, we see that young foreigners in the permanent resident population are sentenced 2.4 times more frequently than young Swiss. The factor is 8.2 for young asylum seekers".

miliar environment. It is worth noting that in the short term it does not matter for public finances whether the overrepresentation of foreigners in crime is due to gender, age or nationality: the budgetary impact is the same. However, the immigrant population ages, which ultimately reduces the crime rate in that it is age-related.

Some expenditure that RS assume is proportional to the population is likely to depend more than proportionately on the population, at least for certain categories of immigrants. RS assume (for data availability reasons) that health expenditure is the same for Swiss and foreigners, even though it seems higher for foreigners (see our overview on health in §6.4). That is probably the case for schooling costs as well. Teaching children whose mother tongue is not the local language is likely to be more expensive. Furthermore, certain categories of immigrants cause particularly high costs, such as illiterate minor migrants and unaccompanied minor asylum seekers (RTS, 2017c).

RS say that their study does not take sufficient account of the fact that Switzerland reaps the benefits of immigrants' training without having financed it.⁴⁷ We understand this statement as an indication of indirect budgetary effects (such as a higher cost for training doctors in the event of less immigration of doctors) not taken into account in their study devoted to direct effects, but not as self-criticism of their calculation of the direct effect. Their study takes full account, as appropriate, of the budgetary impact of the benefits of the training of immigrants (and naturally does not in any way include the costs of such training abroad as Swiss public expenditure). Consequently, there is nothing to be added in terms of the direct impact.

The assumption that transportation costs rise in proportion to the population is not necessarily realistic. In the event of a deviation from proportionality, an in-depth study would be necessary to determine whether this expenditure increases less than proportionally with immigration (because of fixed costs) or more than

47 Ramel (2014): "Furthermore, it should be noted that the approach adopted – due to the static consideration of transfers between the state and foreigners – does not take full account of the fact that the training costs of immigrants are incurred abroad but the returns are incurred in Switzerland" (in the opening at the end of the conclusion, page 82).

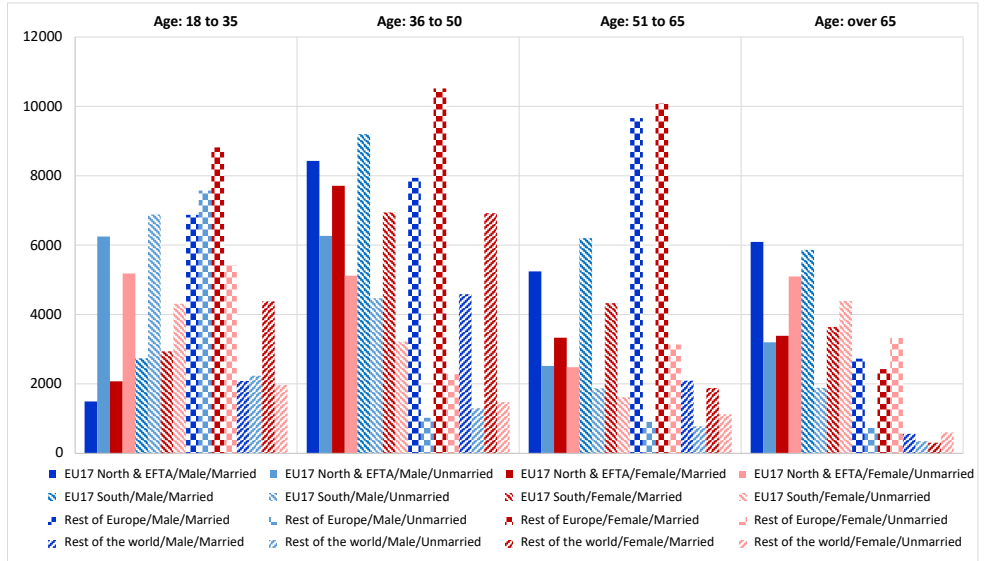
proportionally (e.g. because of the destruction of dwellings to widen roads that would have been sufficient in the absence of immigration). It is likely that these costs change non-linearly with cumulative immigration: they increase less than proportionally as long as this cumulative immigration is sufficiently low and increase more than proportionally if it exceeds a certain threshold. Given the accumulation of high levels of annual immigration, it is likely that we will end up in the area where transport costs change more than proportionally with immigration. However, the proportionality assumption seems acceptable as an initial approximation.

In summary, RS make assumptions about how each type of public expenditure on the production of goods and services depends on immigration (independent of the population or proportional). The assumptions we criticise lead to an underestimation of public expenditure directly attributable to foreigners.

5.4 Interim results: equilibrium population, budgetary balances by foreigner category

Given the probability of transitioning from one category of foreigners to another, constant immigration leads to a population of immigrants and descendants of immigrants that converges towards an equilibrium population. RS found the following equilibrium population.

Figure 5.2 Long-term equilibrium population

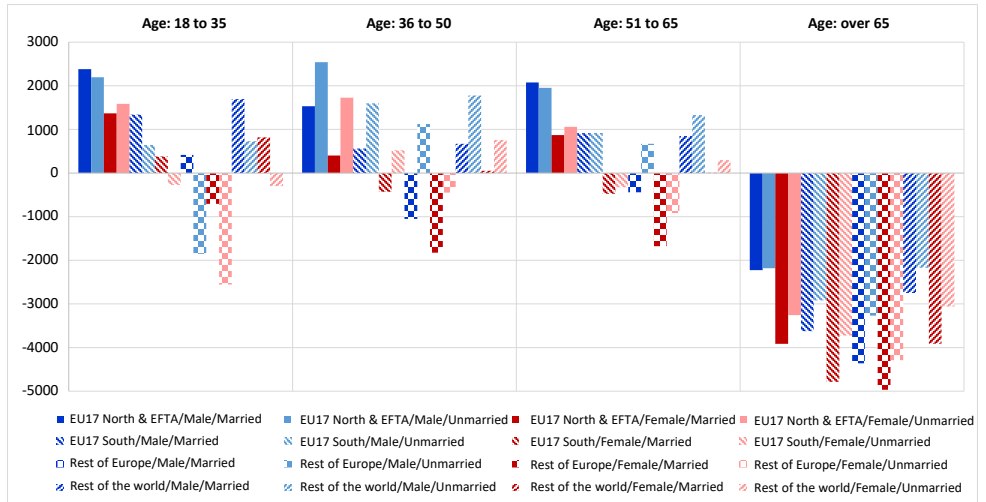


Source: Our chart based on the data in Table D.1 of Ramel (2014).

Compared with immigrants (Figure 5.1), the foreign equilibrium population is much less young (27% between 18 and 35 years old, whereas this age group represented 70% of immigrants). People originating from the EU17 North / EFTA (this is the best-qualified immigrant group) account for only 28% of the equilibrium population, whereas they represented 39% of immigrants.

Using the data on what each type of foreigner pays and receives, RS calculated their budgetary balance. The figure below shows the age profile of the budgetary balance for the different categories of foreigners.

Figure 5.3 Age profile of the monthly budgetary balance

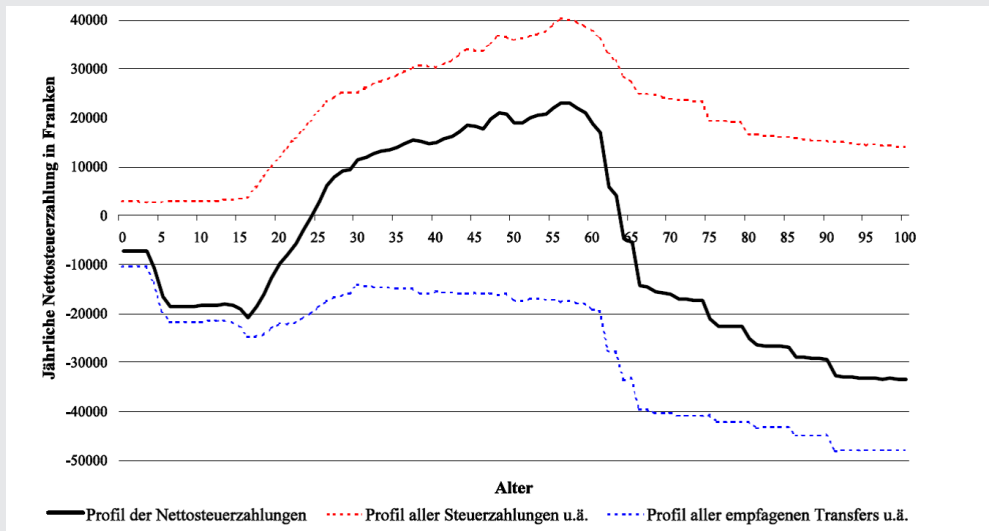


Source: Our chart based on the data in chart 5.1 of Ramel (2013). Ramel's chart also gives confidence intervals.

The budgetary balance depends on age and (to a lesser extent) origin.

By way of comparison, the following box presents the age profile according to Raffelhüschen and Borgmann (2004):

Box 5.1 Age profile of the budgetary balance for an average person (Raffelhüschen and Borgmann, 2004)



Source: Raffelhüschen et Borgmann (2004)⁴⁸

We can see that the balance (the black line) is negative on average up to 25 years. The amount of cumulative negative balances over these 25 years is relatively high. Visually, it

seems that it is necessary to reach just over 45 years of age for the surpluses generated after 25 years to offset previous deficits (at a zero discount rate). This means that,

⁴⁸ A chart distinguishing different sub-categories of receipts and expenditure and established during more recent generational accounting is presented (Figure 9) in Moog et al. (2014).

assuming that immigrants have the same net payment profile as residents, an average immigrant arriving in Switzerland between the ages of 25 and 45 will have a better budgetary balance overall than a resident, and that balance is maximised on average if the immigrant arrives in Switzerland at the age of 25. The assumption that an average immigrant has the same characteristics as a resident is admittedly incorrect (and it must also be taken into account that there are different categories of immigrants, and that the benefit of constant immigration leads to a stationary population rather than a declining one), but this reasoning already gives an interesting indication.

5.5 Final results: average budgetary balances

Crossing these budgetary balance profiles with this workforce, RS found that the average budgetary balance of a foreign household (including people who have become naturalised) is negative in the long run with an average value of -405 francs per month per household. This means that an average household will receive 405 francs more than it

pays each month. With the confidence interval (at 95%) being [-550;-295], this value is significantly different from zero. The improvement in the qualification level of foreigners is thus too weak to offset the impact of their ageing, even if the age structure of immigrants remains constant (with a high proportion of young workers).

This average covers differences according to origin.

Table 5.1 Long-term monthly budgetary balance by origin

Origin	Monthly budgetary balance	
	Average	Confidence interval
EU17 North/EFTA	544	[389;666]
EU17 South	-515	[-659;-397]
Rest of Europe	-1448	[-1709;-1238]
Rest of the world	398	[64;706]
Total	-405	[-550;-295]

Source: Ramel and Sheldon (2012)

EFTA and the rest of the world, while it is significantly negative for the EU17 South and the rest of Europe. Since immigrants from southern Europe are more likely to stay in Switzerland than those from the north, the negative balances dominate in the final balance. By way of comparison, the authors found that the average balance for foreigners in 2003 to 2009 was not significantly different from zero, and it was significantly positive for immigrants during the same period. The clear long-term deterioration in relation to the immigrant budgetary balance is due to the ageing of immigrants (despite the continuous arrival of young immigrants) and the fact that the composition by origin changes unfavourably as a result of average lengths of stay that vary according to origin.

As indicated above, Ramel (2013) calculated the budgetary balance of Swiss households during the period 2003–2009. It is slightly negative, but statistically significantly so (while the budgetary balance of foreigners during this period is positive, but not

statistically significantly different from zero). However, the budgetary balance of Swiss households (except naturalised households) has not been calculated for the long term and therefore cannot be compared with the budgetary balance of foreigners. What their long-term simulation implies for public finances is not indicated either. Assuming that public finances are more or less balanced initially, it can be assumed that, unless there is a policy change,⁴⁹ immigration will eventually cause public finances to have more deficits in nominal terms (in francs). However, these calculations do not allow us to say whether immigration will increase government debt as a percentage of GDP relative to a scenario with less immigration. The indigenous population ages too, which likewise leads to a deterioration in public finances with constant policies.

The negative long-term impact of immigration on public finances coexists with an initially positive impact. The long-term value is relevant for future generations, but

49 The calculation is based on a constant fiscal policy, whereas a deterioration in public finances will lead to a change in this policy. It is nonetheless appropriate to calculate with a constant fiscal policy to assess the need for consolidation.

the initially positive impact must also be taken into account for a global assessment, especially since the surpluses initially generated by immigration could be saved in principle to offset, at least in part, the negative impact that immigration will have in the longer term. Can, Ramel and Sheldon (2013) calculated the present value (with a discount rate of 2%) of the sum of these future flows through to 2060. They found that the positive impact during the transitional period dominates the negative long-term impact: the present value is CHF 83,000 on average per household, and even between CHF 270,000 and CHF 300,000 considering only people from the EU17/EFTA. They concluded that immigration is undoubtedly

lucrative for Switzerland from a budgetary point of view.

What would these values be with another discount rate? It is interesting to note that the values in Table 5.1 (including the budgetary balance of -405 francs per household) are equal to the corresponding sums of the undiscounted budgetary balances (zero discount rate). That is not obvious, because this value of -405 francs corresponds to the average budgetary balance for the long-term equilibrium population, whereas we are now trying to calculate the cumulative impact of an average immigrant over time. Intuitively, the equilibrium population also corresponds to an average migrant and

his future.⁵⁰ This means that the sum of all future budgetary balances of an average immigrant is significantly negative. Is a discount rate of 2% really sufficient to turn this negative value into a positive figure?

We contacted Sheldon, who told us that these values had been calculated using a simplified method. He made more accurate calculations by simulating the transitional period, calculating the budgetary balances for each period and then the sum of the present values. He obtained the following values:⁵¹

50 Formally: S is the vector indicating the budgetary balances by type of foreigner. Z is a vector indicating the annual flow of migrants by type of foreigner, and P is the transition matrix from one type of foreigner to another. The total budgetary balance for the year of arrival of these immigrants will be $Z'S$. The following year, immigrants will have become $Z'P$ and their total budgetary balance will be $Z'PS$. The next year, their total budgetary balance will be $Z'P^2S$, and so on. The sum of the budgetary balances for all these years will be: $Z'S + Z'PS + Z'P^2S + Z'P^3S + Z'P^4S + \dots = Z'(I + P + P^2 + P^3 + P^4 + \dots)S = Z'(I - P)^{-1}S$ where I is the identity matrix. But $Z'(I + P + P^2 + P^3 + P^4 + \dots)$ is also the transposition of the equilibrium population B_{eq} : immigrants who have just arrived (Z'), and what happened to those who arrived the previous period ($Z'P$) and the period before that ($Z'P^2$), etc. $B'_{eq}S$ is therefore the sum of the population's budgetary balances and $-405 = B'_{eq}S / (12 * \text{no. of households in the equilibrium population})$. With a discount rate of zero, the discounted sum of the budgetary balances of an average immigrant is thus equal to $-405 * 12 * \text{no. of households in the equilibrium population} / \text{no. of households immigrating annually}$. With a discount rate other than zero, the sum of the discounted budgetary balances is given by $Z'(I - dP)^{-1}S$ where $d = 1/(1+r)$ where r is the discount rate and the result can no longer simply be deducted from the -405 francs. The sum of the discounted budgetary balances for an average household is $Z'(I - dP)^{-1}S / Z'1$ where 1 is a vector where each element is worth 1.

51 As we are interested in knowing the impact of immigration, the budgetary balances of all immigrants are taken into account irrespective of whether or not they acquire Swiss nationality. Sheldon (2017b), in contrast, gives the figures for the case where only immigrants who do not acquire Swiss nationality are taken into account.

Tableau 5.2 Sum of discounted budgetary balances for an average migrant of a given origin

Origin	Sum of discounted budgetary balances for an average immigrant household		
	Discount rate: 0%	Discount rate: 2%	Discount rate: 3%
EU17 North/AELE	108 850	117 532	118 562
EU17South	-104 594	-11 538	7 101
Rest of Europe	-770 683	-414 807	-328 039
Rest of the world	76 683	69 854	66 200
Total	-106 050	-18 536	1 091

Source: Communication from Sheldon

These figures only concern immigrants without their descendants (as indicated in §5.1, children born in Switzerland to immigrants will themselves be considered as immigrants, but in a later cohort). That is why the sums are finite even with a zero discount rate.

With a discount rate of 2%, the sum of the discounted budgetary balances for an average household is negative overall and is nearly -20,000 francs per immigrant household. It is positive for EU17 North / EFTA and the rest of the world, and negative for EU17 South and the rest of Europe.

If all of the budgetary balances were positive, their discounted sum would

decrease when the discount rate increases, as future contributions are reduced by discounting. In each category, though, the budgetary balances are negative for people over 65 years of age (mainly because of old-age and survivors' insurance). However, the higher the discount rate, the lower these negative values are, not only in absolute terms, but also in relation to balances that are less far away in the future and generally more favourable. One effect therefore tends to make the sum of the present values a decreasing function of the discount rate, while the other effect tends to make this an increasing function. Which of these two effects dominates depends on the case. In the table above, the discounted sum is

an increasing function of the discount rate, except for immigrants from the rest of the world.

A discount rate of 2% seems appropriate.⁵² An argument nonetheless

exists for taking a much lower discount rate to study long-term policies involving future generations, as was done in the Stern review on climate change.

52 This is the real interest rate used by the Federal Finance Administration in its baseline scenario for its report on the long-term sustainability of public finances published in 2008 and 2012. A value of 1.5% was used for the 2016 edition.

6 Budgetary impact of immigration in Switzerland: indirect effects

The aim here is to discuss the impact of a migration shock via the budgetary balances of those who were resident in Switzerland already before the shock. This means studying the impact on the entire economy. Therefore, if immigration has an impact on wages or unemployment, there will be an indirect impact on public finances through the taxes paid by the other inhabitants and the public expenditure from which they benefit. This indirect impact can also pass through other channels such as employer profits. The channels were discussed qualitatively in §3.2 and are difficult to quantify. We will simply clarify some points based on elements available in the literature. We cannot discuss these studies as thoroughly here as those of RS. We will simply mention the results of the literature without attempting to evaluate them. However, we will use Gerfin and Kaiser (2010) as a basis for further calculations regarding the impact of immigration on profits.

The first section (§6.1) is devoted to output (labour market and profits). We will then discuss other points on which the economic literature is

much less abundant. Nevertheless, we will not seek to be exhaustive. For example, we will not talk about the impact via climate policy (meeting Switzerland's greenhouse gas emission commitments will be more difficult and thus more expensive if the population is bigger).

6.1 Output

What is the impact of immigration on the labour market (wages and unemployment), as well as on profits? There is an abundance of empirical literature on the impact of immigration on the labour market in Switzerland.⁵³

An impact on wages or unemployment obviously has consequences for tax receipts and government expenditure. This impact depends on the structure of immigration. For example, low-skilled immigration penalises workers competing with them and implies an increase in social expenditure. In contrast, highly skilled immigration reduces the income disparity between employees. But in both cases, the disparity between employees on the one hand and capital holders on the other is temporarily accentuated.

⁵³ For a recent review, see SECO (2017).

Impact on wages

The empirical studies generally assume that the quantity of capital per worker gradually returns to its no-shock value. This assumption is reasonable if the shock is temporary (often, the impact of immigrants who arrived during a given period is studied, without taking into account that immigration continues). As a result, the overall impact on wages is zero in the long term. If we distinguish two types of workers who differ in their degree of complementarity or substitutability with immigrants, the long-term impact of immigration on the wages of these two types of workers will be different. As the overall impact on wages is assumed to be zero, it must be positive for some workers (those who are more complementary to immigrants) and negative for the others (those who are less complementary).⁵⁴ Gerfin and Kaiser (2010) studied immigration from 2002 to 2008 which led to a 3.9% increase in labour supply. It had a negative long-term impact (relative to the scenario with no shock) on the wages of foreigners already working in Switzerland (drop of 1.6%) who were more substitutable for new

immigrants, while it had a positive impact of 0.4% on Swiss workers who were less substitutable for immigrants (Table 7). The short-term impact (i.e. in the absence of any capital stock adjustment) is generally negative: compared to the long-term impacts, a deduction of 1.5% must be made regardless of the worker category (which, taking rounding into account, gives -1.0% for the Swiss, -3.0% for foreigners and -1.5% overall). A 1.5% decrease in wages for a 3.9% increase in labour supply corresponds to a 0.38% decrease in wages for a 1% increase in labour supply. This is more than the value of 0.3% used by Borjas (2016a). Assuming a capital adjustment rate of 10% per year, the authors found that the amount to be deducted from the long-term impact is 1% for 2008 and 0.5% for 2012.

The degree of substitutability of different groups of workers, which is a crucial element for estimating the impact of immigration on wages, is controversial. For Switzerland, Gentili and Mazzonna (2017) found that substitutability is almost perfect with comparable qualifications if the native language is identical to the local language.

54 This argument is presented in Borjas (2016a), page 143.

An issue related to substitutability is whether immigration is targeted to areas where there is a shortage of workers. According to Mühlemann and Wolter (2013), it has reduced the shortage of skilled labour in Switzerland. According to Ruffner and Siegenthaler (2016), the introduction of free movement has increased sales particularly for companies that were suffering a lot from a shortage of qualified workers. However, AWAZH (2016) found that only one in five working immigrants holds a position that was difficult to fill due to the shortage of skilled labour.

It is difficult to assess the long-term impact of immigration on productivity. Moreover, it needs to be determined whether this impact is fully reflected in the remuneration of immigrants (and thus already taken into account in the calculation of the direct impact of immigration carried out by RS) or whether it constitutes an externality for other workers. Transfers of knowledge between immigrants and local labour, for example, can constitute such externalities. Switzerland attracts talent. According to SECO (2017), not only are immigrants better trained than in the past, but a higher proportion of them now have tertiary education than the Swiss (but immigrants are

also more likely than the Swiss to have no post-compulsory education). Surveying the main authors of articles in four scientific fields, Franzoni et al. (2012) found that Switzerland is the country (out of 16 countries) that employs the highest proportion of foreign-born scientists: 57% of these scientists studying or working in Switzerland lived abroad when they were 18 years old (conversely, Switzerland is the second country in terms of emigration: a third of Swiss scientists in these fields live abroad). Highly educated immigrants should promote productivity. Yet productivity growth remains low in Switzerland. It is possible that it would be even lower without immigration, but it is difficult to establish this. According to Sheldon (2008), the increase in labour productivity in Switzerland between 1995 and 2000 was entirely due to immigration. According to SECO (2015): "Labour productivity and GDP per capita have increased only moderately in Switzerland since 2007, like in many other countries. However, we cannot conclude from this that immigration in recent years has not had a positive effect on productivity. It is impossible to know how the Swiss economy would have evolved without the strong immigration of recent years."

Downward nominal wage rigidity hinders a decline in wages over time. It does not prevent a slowdown in wage growth. The flanking measures complementing the Agreement on Free Movement of Persons do help to sustainably limit a drop in wages relative to a scenario with less immigration (and not only in relation to the past) only insofar as they prevent workers' bargaining power for an improvement in their wage conditions from being weakened by the presence of potential immigrants who are willing to work under present conditions.

Overall, the studies indicate a relatively low impact of immigration on wages. But weak relative to what? We show in Appendix 3 that the short-term loss for resident employees calculated by Gerfin and Kaiser (2010) corresponds to 36% of immigrants' wages. Moreover, as these studies generally analyse immigration only over a certain period (often the beginning of free movement), successive flows of immigrants can have a greater cumulative impact, even if the impact of each wave of immigration disappears in the long run. Finally, Appendix 2 shows that even when wages remain constant despite a constant immigration rate, a reduc-

tion in the immigration rate can lead to a sustainable increase in wages.

Impact on unemployment

The impact of immigration on unemployment is relatively easy to assess. Overall, it cannot be major, as unemployment is low in Switzerland and it could not have been negative with less immigration (whereas it is more difficult to know what the wage level would have been with less immigration).

Can immigration nevertheless cause unemployment for some indigenous people (unemployment of immigrants themselves is already taken into account in RS)? This can happen if companies prefer to hire immigrants rather than indigenous people. As the accompanying measures prevent wage dumping in principle, this happens only if employers think they can get a better worker for the same wage. An employer may fear that unemployment is correlated with inferior skills and may prefer to attract a person employed abroad rather than hire an unemployed resident. He may also wish to hire a younger person for physical work, especially in construction. Moreover, he may wish to take on an already trained person as an

apprentice. However, studies generally do not find any impact of immigration on unemployment.

Immigration can reduce unemployment (or lead to higher wages) if it creates more jobs than it increases labour supply. These jobs can be created via an increase in demand for goods and services or directly through business creation. Major Swiss companies were founded by immigrants, e.g. Nestlé and Brown Boveri, not to mention Nicolas Hayek's role in emerging from the watchmaking crisis. According to IFJ Startup Support, immigrants created four out of ten businesses in 2013 (SRF, 2013). According to Crif, three out of ten companies were created by foreigners in the last 10 years (Tages Anzeiger, 2016). However, Piguet (2010) found that the self-employed rate is lower among foreigners than among Swiss people. Piguet (2010) and Guerra (2012) explored explanatory factors. It should be noted that disproportionately high numbers of immigrants in business creation is not incompatible with underrepresentation among the self-employed. This paradox could be explained by a higher failure rate for companies founded by foreigners, for example.

Impact on profits

The (transitory) drop in wages (relative to a scenario with less immigration) leads to an increase in the return on capital. Consider, for example, the model of Gerfin and Kaiser (2010). Although these authors limit their analysis to wages, we can use their figures to calculate the impact of immigration on the return on capital.

As a first approximation, we find that the short-term 1.5% drop in wages causes an increase of about 2.5% in the return on capital (see Appendix 3). The wage reduction that immigration generates in the short term for workers resident in Switzerland prior to the wave of migration is offset by an increase in profits. The increase in profits slightly overcompensates for the loss of workers. A 2.5% increase in the return on capital corresponds to 0.95% of GDP when the share of capital is 38% of GDP. The 1.5% drop in wages corresponds to 0.93% of GDP, as wages represent 62% of GDP. The difference of 0.02% of GDP between the increase in profits and the decrease in the wage bill constitutes the immigration surplus. Immigration representing 3.9% of the labour supply therefore leads to a transfer of 0.93% of GDP from workers to

the holders of the capital, i.e. almost a quarter of a percent of GDP per percent of immigration. However, it should be remembered that this is only a short-term effect when the capital stock has not yet adjusted at all, and it gradually fades as capital adjusts.

As a first approximation, we can ignore the 0.02% surplus and consider that immigration makes capital holders earn the same amount as it makes workers lose. Nonetheless, the indirect budgetary impact is not necessarily zero, as these amounts are not necessarily taxed identically when they change hands: i) the proportion of capital holders living abroad is not necessarily equal to the proportion of workers living abroad (cross-border commuters); ii) the tax rate on capital income is not necessarily the same as that on labour income (capital gains are not taxed in Switzerland, for example); iii) differences in income may lead to differences in tax rates (progressive direct taxation) and differences in the propensity to consume may be reflected in VAT receipts. Moreover, the decline in wages leads to an increase in social expenditure that is not offset by any decrease caused by the corresponding increase in profits, as capital holders are typically richer than workers.

6.2 Training and education

Training costs for immigrants have already been discussed in Chapter 4, dedicated to the direct impact of immigration. It remains to be seen whether the presence of immigrants has an impact on the training and education of the rest of the population, and thus on their future income. There can potentially be an impact through different channels. First, the presence of students who do not speak the local language may penalise the schooling of their classmates. Second, young people may have difficulty finding apprenticeships if the possibility of hiring immigrants ultimately reduces the incentive for businesses to coordinate themselves to train apprentices. Third, if immigrants are better trained than natives, this implies that more natives would have had to be trained to replace them in the absence of these immigrants. In that case, immigration enables the state to avoid training costs. The effect is reversed if immigrants are less well trained than natives. It must be taken into account in both cases that a change in the level of education of natives also has an impact on their income and the taxes they pay.

According to the OECD (2017a), schools with a higher proportion of

immigrant students than the median perform less well (PISA score for science) than schools with a lower proportion (Figure 31). However, this information does not enable us to know whether the presence of migrant students has a negative impact on the academic performance of non-migrants.

Cattaneo and Wolter (2012) argue that immigration and migration policy must be taken into account when interpreting PISA scores. They found that the scores of immigrant students have improved significantly. They attribute this improvement to a better socio-economic status and a reduction in the proportion of students not speaking the local language (used for testing). They found that the results of Swiss-born students have remained stable despite this improvement. Different explanations are possible. This may indicate that immigrant students have no impact on the results of students born in Switzerland. Alternatively, the change in this impact may have been offset by other developments.

The impact of immigrants on the education of natives also depends on what happens to the children of immigrants born in Switzerland (second generation). Kunz (2014)

found that the results of the second generation of immigrants are better in Switzerland than in Germany.

6.3 Housing

In the short term (until the supply has adapted), immigration increases the real estate prices. Looking at the period 2001 to 2006, Degen and Fischer (2017) found that almost two thirds of the rise in the price of single-family homes was due to immigration. Immigration of 1% increases the price of single-family homes by 2.7% and the prices of multi-family homes by 3.5%.

Various factors must be taken into account in order to assess the impact of higher housing prices on tax revenues. Rising housing prices increase tax receipts on profits in the property sector. If the rental value is adjusted, it also increases the imputed rental value tax paid by those who live in their own home. In addition, the money spent on the increase in rent would have been saved or spent on the consumption of Swiss or imported goods and services. As rent is not subject to VAT, the rent increase reduces VAT revenue insofar as the corresponding amounts would have been spent on consumption (subject to VAT).⁵⁵ If

this amount would have been spent on imports, however, it would not have affected the Swiss receipts on producer's income tax, whereas the property owner's income is taxed in Switzerland if he is domiciled in Switzerland. On the public expenditure side, higher rents tend to increase social expenditure.

Since rent also depends on construction costs, a full analysis should take into account that immigration reduces construction costs (relative to a scenario with less immigration) by reducing wages in this sector (again relative to a scenario with less immigration).

6.4. Overview in the field of healthcare

Above, we separately discussed the direct and indirect components of the budgetary impact of immigra-

tion. In contrast, we will now give an overview for healthcare by simultaneously discussing the direct and indirect impact.

According to the FSO (2016), the number of people working in the healthcare sector in 2015 was about 285,000 full-time equivalents.⁵⁶ A significant proportion of these people were foreigners. Thus, according to H+ (2015), one in three hospital and clinic employees in 2015 was foreign (45% in the case of doctors). According to FMH Swiss Medical Association, a third of the doctors practising in our country are of foreign origin (more precisely: have a foreign medical degree): this proportion is 28% in the outpatient sector and 38% in the hospital sector. These figures have to be compared with the proportion of foreigners in the population, which is currently around a quarter.⁵⁷ As a

55 See <https://www.estv.admin.ch/estv/fr/home/mehrwertsteuer/fachinformationen/was-ist-die-mehrwertsteuer.html>

56 About 157,000 full-time equivalents in hospitals, 90,000 in social and medical institutions, 20,000 for home help and care and 18,000 doctors in the outpatient sector.

57 Jaccard Ruedin and Widmer (2010) provide more global figures, but their study is older: the number of foreign healthcare professionals (foreign nationals resident in Switzerland and trained in Switzerland and foreign nationals trained abroad who then immigrated to Switzerland for employment) rose from 33% in 2002 to 36% in 2008, while foreigners accounted for just under 22% of the population in 2008 (page 50).

result, the number of foreigners among healthcare staff is clearly disproportionately high. Without this overrepresentation, medical staff wages would be higher in order to attract natives to these occupations. Healthcare costs for public authorities would thus be higher too (indirect budgetary effect).

The shortage of Swiss doctors is partly due to the fact that access to studies has been hindered by the *numerus clausus*.⁵⁸ To that extent, this shortage is a matter of education policy. There may then be an indirect budgetary impact insofar as natives who could have become doctors were prevented from doing so by the *numerus clausus* and were replaced by foreign doctors. However, this indirect impact exists only to the extent that these people opted for a lower-paying occupation. Furthermore, the cost of training these native doctors must be taken into account: at least half a million francs per doctor.⁵⁹

The medical services on offer create their own demand to some extent.

Higher numbers of doctors thus increase healthcare costs. That is why the cantons can limit the opening of medical practices. The moratorium introduced in 2002 was lifted in 2010 for first response medicine and in 2012 for specialised medicine, reactivated in 2013 and extended until 2019. Roth and Sturny (2017) found that the number of specialists increased sharply while the moratorium was lifted, and in a way that was not justified from a healthcare policy perspective, while the costs of health insurance for specialised medicine followed the same trend as the number of doctors. The influx of foreign doctors thus tends to increase both demand and the healthcare costs borne by public authorities in particular (indirect budgetary impact).

The demand for care also has a cultural component (direct budgetary impact). Just as there are differences between French-speaking and German-speaking Switzerland, it cannot be ruled out that there may be demand differences between the Swiss and foreigners in the health-

58 This *numerus clausus* still exists. RTS (2017a) headline "Record number of medical students in Switzerland, *numerus clausus* activated".

59 Der Bund (2017). The figure is nonetheless disputed: Aargauerzeitung (2015).

care sector.⁶⁰ Jaccard Ruedin et al. (2007) found that the number of GP consultations is higher in communes where the proportion of foreigners is higher (page 138). However, this does not prove that foreigners' healthcare expenditure is higher. They also show that care varies according to nationality when a person consults a doctor: the Swiss will be followed more intensively by their specialist, while foreigners will be treated more intensively by their GP (page 157). Brändle and Colombier (2015) found that the proportion of foreigners in the population is positively correlated with healthcare expenditure growth. To the extent that this correlation is due to the fact that the number of foreigners is disproportionately high in physically demanding sectors such as construction, and to the extent that natives would have had to do some of this work if immigration had been lower,

this additional cost relative to a scenario with less immigration must be put into perspective.

On average, healthcare expenditure rises roughly in line with age, while basic health insurance premiums are largely independent of age (according to Art. 61 of the Health Insurance Act, they are lower for children and may be lower for young adults, but are independent of age from 26 years).^{61,62} This has two implications for immigration (direct budgetary impact). First, immigrants benefit from the fact that they pay the same premiums as those who have been contributing since birth and who thus contribute longer to the redistribution from young people to the elderly within the framework of health insurance. However, immigration reduces the number of elderly people per worker, which also has a positive effect on this redistri-

60 Santésuisse (2013) found that people in French-speaking Switzerland spend more on healthcare than those in German-speaking Switzerland (page 4). It attributes these differences to cultural characteristics, lifestyles and patient expectations.

Camenzind and Wiedenmayer (2016) found indications that German-speaking people are more concerned about their health than French-speaking people (smoking, physical activity).

61 Brändle and Colombier (2017) provide examples of healthcare expenditure profiles by age.

62 See the page *Krankenversicherung: Risikoausgleich* on the website of the Federal Office of Public Health regarding the issue of risk balancing between insurers, e.g. with different insured age structures.

bution. Second, immigrants who return to their country of origin after a stay in Switzerland, e.g. for retirement, will have contributed to the redistribution from young people to the elderly within the framework of health insurance without benefiting themselves from this redistribution (unlike the old-age and survivors' insurance). Their country will pay the healthcare costs in their old age.

6.5 Social model

Various studies highlight the role of institutions in Switzerland for economic prosperity.⁶³ Immigration can have a positive impact on our social model by opening up new perspectives. Up to now, the Swiss social model has proved to be robust despite high immigration. However, the risk of a negative impact should not be overlooked. There are several indications that the future could be different from the past. The future increase in the foreign population may pose a problem for the bedrock of our political system: democracy.

According to the OECD (2017b), almost 30% of the Swiss population was born abroad and the trend is increasing. Either these foreigners cannot vote, and beyond a certain threshold the democratic nature of our institutions will be called into question, or else they are granted the right to vote, with the risk of direct democracy being called into question, insofar as some of these people from countries that do not have direct democracy (or only to a much lesser extent than Switzerland) can continue to adhere to the concept of democracy applicable in their country. The origin of immigrants also plays a role: the more they come from a country with a different social model, the harder it will be for them to adopt ours. The impact on our social model also differs according to the extent of immigration, in a way that is probably non-linear and becomes significantly negative only beyond a certain immigration threshold. Finally, the impact differs according to the integration strategy pursued.

63 See for example Baur et al. (2013) for an overview.

7 Conclusion: complex budgetary impacts

Immigration has an impact on public finances through many channels, on both the revenue and expenditure side, directly or indirectly. Some impacts are positive, others negative. The assessment of these impacts is sensitive to assumptions about the evolution of immigration and the functioning of the economy.

For Switzerland, the Ramel and Sheldon (2012) study is the most recent and comprehensive one on the direct impact of immigration on public finances. Ramel and Sheldon (2012) compared what immigrants pay in taxes (and social contributions) with what they cost the state (and social insurance). They made this calculation not only for the present (2003–2009 period), but also for the long term.

They assume a constant budgetary balance by type of immigrant (defined by origin, age group, etc.). It is thus a simulation with no policy change, be it fiscal policy or other policies, such as those aimed at

integrating refugees into the labour market. They calculated the equilibrium population resulting from constant immigration in terms of size and structure. A change in immigration could therefore modify the results. The equilibrium population has a different structure from that of immigrants when they arrive in Switzerland. These immigrants age. Moreover, the most highly skilled immigrants stay in Switzerland for a shorter period of time on average. As a result, this long-term equilibrium population is older and less skilled than immigrants upon arrival. Their budgetary balance will thus be worse. This budgetary balance depends on the immigrants' origin. For immigrants as a whole, Ramel and Sheldon found that they initially have a budgetary balance that is significantly positive on average (i.e. they pay more than they receive), while the resulting equilibrium population in the long term shows a significantly negative average budgetary balance.

Intuitively, this result is similar to the budgetary balances of baby boomers: positive when they were working and becoming negative when they retire. The difference is that the peak birth rate after World War II was a transitory phenomenon, while Ramel and Sheldon studied the impact of a permanent migration shock. They found that the shift from an initially positive budgetary balance to a negative one also occurs for this permanent shock. Moreover, for a permanent migratory shock, the negative long-term impact will also be permanent, while the baby boom generation is destined to disappear. The negative phase of the budgetary impact of immigration is therefore more persistent than that of baby boomers.

The fact that immigration has a positive budgetary impact initially but a permanent negative impact in the long term raises the following question: Should the initial surpluses be saved to offset future negative balances? For example, the old-age and survivors' insurance fund could be increased during the transitional period when the balance is positive in anticipation of the negative impact to which these contributions will give a right. It is not a question of transforming a pay as you go system to a funded system, but rather of

smoothing out fluctuations (similar to what could have been done for baby boomers). The calculations show that the compensation would probably be only partial. The overall budgetary balance actually remains negative (with a discount rate of 2%). From the viewpoint of future generations, however, even partial compensation may be preferable to no compensation at all. The question of whether or not to use the initial immigration surpluses to offset predictable negative balances is a highly political one. If such a policy were to be implemented, it would first be necessary to determine the amount that should be saved. The calculations of Ramel and Sheldon could be used as a basis for an estimate. That said, consideration must also be given to the fact that, with no change in policy, the budgetary balance of natives will evolve negatively too. A change of fiscal policy will thus be necessary in any case (while the calculations of Ramel and Sheldon are with the no policy change assumption).

Ramel and Sheldon have the merit of assessing the long-term impact of immigration. They show that, given the ageing of immigrants and the greater mobility of skilled people, the sharp increase in immigrants' qualifications is not sufficient to avoid a

globally negative long-term impact. Their study is of excellent quality, but, like any study, it also has its limitations. Some are due to limitations regarding the data available. For example, the authors distinguished different types of immigrants according to their origin, but they were unable to distinguish them according to their status (e.g. refugees). Other limitations could form the basis for an extension of their work. The two main limitations are as follows. First, there is the fact that the Swiss-born descendants of immigrants are themselves treated as immigrants in the calculations. This probably tends to give an overly negative image of budgetary balances. Second, some public expenditure is not taken into account. For example, old-age and survivors' pensions paid abroad are not included in the calculations, even though we now know that 13% of the amounts paid by the old-age and survivors' pension fund are paid abroad. In addition, some public expenditure, such as that for justice and police, is assumed to be independent of the population, whereas it increases with a growing population. These limitations on the expenditure side tend to give an overly positive picture of budgetary balances.

By comparing what immigrants pay and receive, Ramel and Sheldon examine only the direct budgetary impact of immigration. However, a difficult to quantify indirect impact through the effect of immigration on the budgetary balances of other residents has to be added to it.

The impact of immigration on the overall level of wages and unemployment is generally considered to be zero in the long term. However, this zero impact covers a positive impact on workers who are complementary to immigrants and a negative impact on those they can replace. Even if it is only a transfer from one worker category to another, it can have a budgetary impact. Consequently, if the winning group does not have the same average income as the losing group, this transfer may alter tax receipts because of progressive taxation and modify social expenditure. A difference in the propensity to save can also modify indirect tax receipts in principle.

In the short term, i.e. before the stock of capital has adjusted, the impact on the overall level of wages is negative. This is not in the sense that immigration would lead to a decrease in wages relative to the past, but rather a decrease compared with a scenario with less immigra-

tion. This decline in the total wage bill is initially equal to a significant proportion of the wage bill of immigrants, but it disappears as the capital stock adjusts. This decline in wages is offset by an increase in profits of the same amount (as a first approximation). However, this transfer may have a budgetary impact for different reasons. First, the proportion of capital holders living abroad is not necessarily equal to the proportion of workers living abroad (cross-border commuters). Second, the tax rate on capital income is not necessarily the same as that on labour income (capital gains are not taxed, for example). Third, the fact that holders of capital are typically better off than workers can also affect receipts in view of progressive taxation. A difference in the propensity to save can likewise play a role. These points mean that the same amount will not necessarily generate the same tax receipts depending on whether it goes into the pockets of workers or capital holders. Furthermore, the decline in wages implies an increase in social expenditure which is not likely to be offset by a corresponding fall in social expenditure for capital holders.

We discussed the impact of a transitory migration shock above. A permanent increase in immigration

as a result of higher, still binding, quotas corresponds to an accumulation of transitory shocks whose impact on the capital stock per worker (and thus wages and profits) always disappears in the end, but it is continually replaced by the impact of recent immigrants. The free movement of persons implies a total opening up of the labour market: wages converge towards a balance where they are permanently lower than they would have been with less immigration, but they remain higher than wages in the European Union.

The indirect budgetary impact of immigration can pass through other channels. For example, the education of indigenous students may be adversely affected if the proportion of students who do not understand the local language exceeds a certain threshold. Young people may also have difficulty finding apprenticeships if the possibility of hiring immigrants ultimately reduces the incentive for businesses to coordinate themselves to train apprentices. If immigrants are better trained than natives, this implies that more natives would have had to be trained to replace them in the absence of these immigrants. In that case, immigration enables the state to avoid training costs. The effect is reversed if immigrants are less well trained than

natives. It must be taken into account in both cases that a change in the level of education of natives also has an impact on their income and the taxes they pay.

Immigration increases the demand for housing and therefore prices. Without immigrants, construction wages would be higher, which would increase costs. Rising housing prices increase tax receipts on profits in the property sector. If the rental value is adjusted, it also increases the imputed rental value tax paid by those who live in their own home. However, the money spent on the increase in rent would have been saved or spent on the consumption of goods and services subject to VAT (as opposed to rent). The taxes that would have been paid by these producers of goods and services depend on whether they are produced in Switzerland or abroad. On the public expenditure side, higher rents tend to increase social expenditure.

The number of foreigners in the healthcare workforce is disproportionately high. Without them, the wages of medical workers would have to be increased in order to attract natives to these professions, which would lead to higher health-

care costs for the state. The shortage of Swiss doctors is partly due to the *numerus clausus*. This can have an indirect budgetary impact via natives who could have become doctors and have been replaced by immigrants. However, account must also be taken of the significant training costs thereby avoided. As the medical services on offer create their own demand to some extent, the influx of foreign specialists tends to increase healthcare costs.

Particular attention should be paid to one point: the impact of immigration on our social model. The health of public finances depends on the country's economic prosperity. But where does this prosperity come from? Certainly from the work of the population, including immigrants. Education, training, hard work, innovation and investment are what make us prosper. But all this occurs within a framework that determines the rules of the game. Economic studies have shown that a country's prosperity depends largely on its institutions. More broadly, it also depends on various rules, norms and organisations. It is this framework that Paul Collier calls "social model". It seems important to study the positive and negative impacts that immigration could eventually have on our social model.

This paper has outlined an overview of the budgetary impact of immigration in Switzerland. We have been careful not to limit ourselves to directly quantifiable effects, as elements that we can currently address only qualitatively can prove to be just as important. Our knowl-

edge suffers from gaps that are leads for research to better understand the future impact of immigration. Nonetheless, the area of immigration will probably always maintain a considerable degree of uncertainty. That is why it is important to have instruments to react flexibly to the unexpected.

Appendix 1 Long-term impact of constant immigration on dependency ratios

We saw intuitively in section 2.2 that it is not clear that immigration ultimately reduces the old-age dependency ratio or the total dependency ratio (elderly and young people). Different channels actually have opposite impacts. We examine here how the long-term impact of immigration on dependency ratios varies with the age structure of immigrants and the fertility rate.

In section 2.2, we used a simple model to discuss the dependency ratio for a population whose stationarity is ensured without immigration thanks to a fertility rate equal to the replacement rate. We assumed the mortality rate to be zero before 85 and 100% at the end of 85 years of age, with the working period ranging from 20 to 65 years of age. In this case, the old-age dependency ratio R_a is $20/45=0.44$ elderly people for a person of working age, while the dependency ratio of the young and elderly, which we will simply call the total dependency ratio R_d , is $(20+20)/45=0.89$ young or elderly people for a person of working age.

We will introduce immigration into this model by assuming a declining (rather than stable) indigenous population supplemented by a flow of immigrants that is constant in terms of number and age structure. To simplify the calculations, we sacrifice a little realism by adopting Blanchet's (1988) model with four equal age groups. We will assume in this appendix that the working period extends from 20 to 60 years of age (instead of 65) and that life expectancy is 80 years of age (instead of 85); mortality is zero up to 80 years of age. This allows us to consider four periods of equal duration in a person's life: i) youth 0 to 20 years (generation 1); ii) the first phase of working life from 20 to 40 years, which is also the fertility period (generation 2); iii) the second phase of working life from 40 to 60 years (generation 3); iv) retirement from 60 to 80 years (generation 4). If, as above, stationarity is ensured without immigration thanks to a fertility rate equal to the replacement rate, then $R_a=20/40=0.5$ and $R_d=(20+20)/40=1$.

Without immigration

- Let us first consider the case without immigration where the indigenous population is declining. We will refer to $P_{i,t}$ as the number of individuals in the life period i at time t . We will take 20 years as a unit of time, so that $P_{i,t} = P_{i-1,t-1}$ for $i > 1$ (those who were in their period $i-1$ at time $t-1$ will be in their period i at time t). $P_{1,t} = \phi P_{2,t}$ (we assume that the children of the population $P_{2,t}$ are born at time t so that they are counted in generation 1 at time t). We will assume that the population is half female and half male, so that ϕ is simply half the fertility rate. We assume a declining indigenous population: $\phi < 1$. It is easy to see that each generation is simply equal to the previous generation multiplied by ϕ . The dependency ratios are therefore:

$$R_a = \frac{P_{4,t}}{P_{2,t} + P_{3,t}} = \frac{P_{4,t}}{\phi^2 P_{4,t} + \phi P_{4,t}} = \frac{1}{\phi^2 + \phi}$$

$$R_d = \frac{P_{1,t} + P_{4,t}}{P_{2,t} + P_{3,t}} = \frac{\phi^3 P_{4,t} + P_{4,t}}{\phi^2 P_{4,t} + \phi P_{4,t}} = \frac{\phi^3 + 1}{\phi^2 + \phi} = 1 + \frac{(1 - \phi)^2}{\phi}$$

These ratios are independent of time despite the decrease in population over time, as all generations decrease in the same proportions.

With immigration

Let us now consider the case where constant migration in terms of number and age structure is added to the resident population in each time t . Let us refer to M_i as the number of immigrants in generation i (M_i is assumed to be independent of time). Since we are only interested here in the long-term balance and not in the transitional period, we can neglect the indigenous population that disappears in the long term. We assume that half of the migrants are women and half are men (e.g. because family reunification allows the spouse to be brought along). To simplify, we assume that immigrants immediately adopt the native fertility rate (otherwise, it would be necessary to distinguish between $\phi_{\text{immigrants}}$ and $\phi_{\text{indigenous}}$). The population dynamics are given by the following formulas:

$$P_{1,t} = \varphi P_{2,t} + M_1$$

$$P_{2,t} = P_{1,t-1} + M_2$$

$$P_{3,t} = P_{2,t-1} + M_3$$

$$P_{4,t} = P_{3,t-1} + M_4$$

By replacing the formula $P_{1,t}$ in $P_{2,t}$ we get:

$$P_{2,t} = \varphi P_{2,t-1} + M_1 + M_2$$

Through iteration, this gives:

$$P_{2,t} = (M_1 + M_2) * (1 + \varphi + \varphi^2 + \varphi^3 + \dots)$$

We assume that $\varphi < 1$. When t tends towards infinity, $P_{2,t}$ tends towards:

$$P_{2,\infty} \equiv P_2 = \frac{M_1 + M_2}{1 - \varphi}$$

From there, it is easy to calculate what the populations of the other age groups are converging towards. We get:

$$P_1 = \varphi \frac{M_1 + M_2}{1 - \varphi} + M_1$$

$$P_2 = \frac{M_1 + M_2}{1 - \varphi} = \varphi \frac{M_1 + M_2}{1 - \varphi} + M_1 + M_2$$

$$P_3 = \frac{M_1 + M_2}{1 - \varphi} + M_3 = \varphi \frac{M_1 + M_2}{1 - \varphi} + M_1 + M_2 + M_3$$

$$P_4 = \frac{M_1 + M_2}{1 - \varphi} + M_3 + M_4 = \varphi \frac{M_1 + M_2}{1 - \varphi} + M_1 + M_2 + M_3 + M_4$$

In this particular case, we find the known result that a constant flow of immigrants leads to a stationary population if the fertility rate is lower than the replacement rate. We have done some algebra to render visible the direct impact of immigration that would exist even if $\phi=0$, to which the effect of the immigrants' descendants who will be born in the host country is added. The direct effect leads to an inverted age pyramid. The closer ϕ gets to 1, the more dominant the indirect effect becomes. However, this effect is identical for all generations and thus tends to reduce the inversion of the age pyramid.

It is easy to calculate the dependency ratios (a little algebraic calculation makes it possible to ensure that ϕ appears only once for each ratio):

$$R_a = \frac{P_{4,t}}{P_{2,t} + P_{3,t}} = \frac{\frac{M_1 + M_2}{1 - \phi} + M_3 + M_4}{\frac{M_1 + M_2}{1 - \phi} + \frac{M_1 + M_2}{1 - \phi} + M_3} = \frac{1}{2} \left(1 + \frac{\frac{M_4 + M_3/2}{M_1 + M_2}}{\frac{1}{1 - \phi} + \frac{M_3/2}{M_1 + M_2}} \right)$$

$$R_d = \frac{P_{1,t} + P_{4,t}}{P_{2,t} + P_{3,t}} = \frac{\phi \frac{M_1 + M_2}{1 - \phi} + M_1 + \frac{M_1 + M_2}{1 - \phi} + M_3 + M_4}{\frac{M_1 + M_2}{1 - \phi} + \frac{M_1 + M_2}{1 - \phi} + M_3} = 1 - \frac{1}{2} \frac{\frac{M_2 - M_4}{M_1 + M_2}}{\frac{1}{1 - \phi} + \frac{M_3/2}{M_1 + M_2}}$$

It is also possible to calculate the youth dependency ratio:

$$R_{youth} = \frac{P_{1,t}}{P_{2,t} + P_{3,t}} = \frac{1}{2} \left(1 - \frac{\frac{M_2 + \frac{M_3}{2}}{M_1 + M_2}}{\frac{1}{1 - \phi} + \frac{M_3/2}{M_1 + M_2}} \right)$$

This ratio is never negative, as $\frac{M_2}{M_1 + M_2} < 1 < \frac{1}{1 - \varphi}$.

Therefore, $R_d = R_a + R_{\text{youth}}$ is never negative either.

Before analysing how dependency ratios vary according to fertility and immigration, it should be noted that each of the above formulas would remain valid if M_i were replaced with m_i , defined as $m_i = M_i/M$, where $M = M_1 + M_2 + M_3 + M_4$ is total immigration (therefore $m_1 + m_2 + m_3 + m_4 = 1$ and of course $m_i \geq 0$). It is thus the immigration age structure that is important for dependency ratios and not immigration in absolute terms.

R_a is a decreasing function of φ : the higher the fertility rate, the more favourable R_a becomes. Like expected, R_a deteriorates as m_4 increases. R_a does not depend on m_1 and m_2 separately, only on the sum of m_1 and m_2 . Intuitively, this is because m_1 immigrants do not enter the ratio until the following period when they are in their second period of life and are added to m_2 immigrants. R_a is a decreasing function of $m_1 + m_2$: the old-age dependency ratio improves with the proportion of immigrants of working age or who will soon be of working age. In the realistic case where $m_4 < \frac{m_1 + m_2}{1 - \varphi}$,

R_a is an increasing function of m_3 . This is understandable, as older workers are the retirees of tomorrow. R_a reaches its lowest value when m_3 and m_4 are zero, i.e. $m_1 + m_2 = 1$.

As expected, R_d is an increasing function of m_4 and a decreasing function of m_2 . In the realistic case where $m_2 > m_4$, R_d is an increasing function of φ if there are enough immigrants of child-bearing age, increasing fertility increases the number of young people to the point of penalising the total dependency ratio. When $m_2 > m_4$, R_d deteriorates when m_1 or m_3 increases. R_d reaches its lowest value when $m_2 = 1$.

R_{youth} does not depend on m_4 . It is a decreasing function of m_3 and an increasing function of m_1 . The impact of m_2 is not unambiguous, as immigrants in the second age group are in the denominator for R_{youth} and at the same time generate young people who are in the numerator. If m_3 or fertility is sufficiently low ($\varphi * m_3 / 2 < m_1$), the impact of m_2 as workers outweighs its impact as parents, and R_{youth} is a decreasing function of m_2 . $R_{\text{youth}} = 0$ when

$m_3=1$: there are no longer any young people in the long term if the indigenous population disappears and all immigrants are over child-bearing age. If $m_2=1$, $R_{youth}=\varphi/2$, which is higher than its value $\varphi^2/(1+\varphi)$ in the absence of immigration, whatever $\varphi < 1$.

For $\varphi = 1$, the ratios return to their values for a stationary population without immigration: $R_a=0.5$ and $R_d=1$.

If immigration is concentrated on the second generation (only m_2 is different from zero), $R_a=0.5$ (this value is always obtained when m_3 and m_4 are zero) and $R_d=(1+\varphi)/2$. It is remarkable that $m_2=1$ makes it possible to reduce R_a as R_a , although it does not minimise R_{youth} ($m_3=1$ would reduce R_{youth}) and instead leads to a deterioration of R_{youth} relative to a case without immigration.

For realistic parameter values, immigration improves both dependency ratios

What are the necessary and sufficient conditions for m_i and φ in order for immigration to improve (even in the long term) the old-age dependency ratio and the total dependency ratio relative to the situation without migration (with a declining indigenous population)?

Let us rewrite R_a in terms of m_i , substitute $m_4=1-m_1-m_2-m_3$, and make sure that m_3 appears only once:

$$R_a = \frac{P_{4,t}}{P_{2,t} + P_{3,t}} = \frac{\varphi \frac{m_1 + m_2}{1 - \varphi} + 1}{2 \frac{m_1 + m_2}{1 - \varphi} + m_3}$$

Knowing R_a and m_1+m_2 , it is possible to calculate m_3 .

$$m_3 = \frac{\varphi \frac{m_1 + m_2}{1 - \varphi} + 1}{R_a} - 2 \frac{m_1 + m_2}{1 - \varphi} = \frac{1}{R_a} - \left(2 - \frac{\varphi}{R_a} \right) \frac{m_1 + m_2}{1 - \varphi}$$

If m_3 is greater than this value, R_a will be lower and therefore more favourable than in the absence of migration. Intuitively, for a given m_1+m_2 , the larger m_3 is, the lower m_4 is, which is favourable. Knowing m_3 , we can find m_4 :

$$m_4 = 1 - (m_1 + m_2) - m_3 = 1 - \frac{1}{R_a} + \left(1 + \varphi - \frac{\varphi}{R_a}\right) \frac{m_1 + m_2}{1 - \varphi}$$

In the case without immigration with a declining population, we had

$$R_a = \frac{1}{\varphi^2 + \varphi}$$

Substituting this R_a in the above equation for m_3 , we find that immigration improves R_a if and only if:

$$m_3 > \varphi^2 + \varphi - (1 + (1 + \varphi)^2)(m_1 + m_2) = [1 - (m_1 + m_2)]\varphi^2 + [1 - 2(m_1 + m_2)]\varphi - 2(m_1 + m_2)$$

The right-hand side is a second degree polynomial in φ . As $m_1+m_2 < 1$, it is a concave function (if $m_1+m_2=1$, the right-hand side is always negative if φ is positive). It is $-2(m_1+m_2)$ when $\varphi=0$. If $m_1+m_2 > 0.4$, the function is still less than zero even if $\varphi=1$. This means that if the age breakdown of immigrants is such that the first two age groups (here from 0 to 40 years of age) account for more than 40% of immigrants, then R_a will be improved even in the long term, regardless of m_3 and m_4 (this is a sufficient condition, but not a necessary one). For $\varphi=0.75$ (corresponding to Switzerland's current fertility rate of 1.5), it is sufficient for m_1+m_2 to be greater than about 32% in order for immigration to improve R_a regardless of m_3 and m_4 . These calculations suggest that while immigration may in principle penalise the old-age dependency ratio, it should not happen in realistic cases.

Let us now examine the necessary and sufficient condition for immigration to improve R_d . We replace M_i with m_i in the R_d formula with immigration, replace m_4 with $1-m_1-m_2-m_3$, and compare with the value of R_d without immigration.

$$\frac{\phi^3 + 1}{\phi^2 + \phi} = R_{d, \text{ without immigration}} > R_{d, \text{ with immigration}} = 1 - \frac{m_2 - m_4}{2 \frac{m_1 + m_2}{1 - \phi} + m_3} = 1 - \frac{m_1 + 2m_2 + m_3 - 1}{2 \frac{m_1 + m_2}{1 - \phi} + m_3}$$

$$\Rightarrow m_3 > \frac{1 + \phi}{1 + \phi^3} [\phi(m_1 + 1) - 2(m_1 + m_2)]$$

If $m_2 > m_4$, R_d with immigration is less than 1 and thus less than R_d without immigration (which is always greater than or equal to 1). This condition, which is sufficient for immigration to improve R_d (but not necessary), is verified in realistic cases.

Case of immigration that is proportional to the population

We have studied the case of constant immigration in terms of number and structure. Let us consider the case of immigration where each age group is constantly proportional to the equivalent age group of the population.

Let us rewrite the equations giving the population dynamics by writing $M_{i,t}$ instead of M_i , as we will assume that immigration is likely to change over time.

$$P_{1,t} = \varphi P_{2,t} + M_{1,t}$$

$$P_{2,t} = P_{1,t-1} + M_{2,t}$$

$$P_{3,t} = P_{2,t-1} + M_{3,t}$$

$$P_{4,t} = P_{3,t-1} + M_{4,t}$$

Let us assume that $M_{i,t}$ is equal to $\Omega^* P_{i,t}$.

$$P_{1,t} = \varphi P_{2,t} + \Omega P_{1,t}$$

$$P_{2,t} = P_{1,t-1} + \Omega P_{2,t}$$

$$P_{3,t} = P_{2,t-1} + \Omega P_{3,t}$$

$$P_{4,t} = P_{3,t-1} + \Omega P_{4,t}$$

$$\Rightarrow P_{1,t} = \frac{\varphi}{1-\Omega} P_{2,t} \text{ and } P_{2,t} = \frac{1}{1-\Omega} P_{1,t-1} \text{ and } P_{3,t} = \frac{1}{1-\Omega} P_{2,t-1} \text{ and } P_{4,t} = \frac{1}{1-\Omega} P_{3,t-1}$$

$$\Rightarrow P_{i,t} = \frac{\varphi}{(1-\Omega)^2} P_{i,t-1} \quad \forall i$$

The population has a growth rate of $\frac{\varphi}{(1-\Omega)^2} - 1$ while keeping its age structure

constant. As we assumed that the immigration age structure is consistently identical to that of the population, it is normal that it does not change the population's age structure. In contrast, the population level experiences an unlimited increase if $\varphi > (1-\Omega)^2$, it is stable if immigration just offsets the lack of fertility, and converges towards zero if immigration is insufficient to offset the lack of fertility.

Conclusion

We found that, for realistic immigration age structures and fertility rates, constant immigration in terms of size and structure reduces the old-age dependency ratio and also the total dependency ratio (elderly and young people) even in the long term relative to a scenario without immigration (for a declining indigenous population). The effect is greatest if immigration is made up solely of young workers ($m_2=1$), despite the fact that the youth dependency ratio deteriorates in this case (because of their children). However, these calculations were carried out in a highly simplified framework. It would thus be useful to check the robustness of our results in a more general context, starting with the case where age groups are annual rather than extending over twenty years.

Appendix 2 Free movement of capital and workers in a small economy

Let us assume, as is commonly done, that the production function $Y=F(K,L)$ is such that if each production factor is increased in the same proportion, then production is increased in this same proportion (homogeneous production function of degree 1). It can be shown that the quantity K/L of capital per worker determines both the remuneration of capital and that of labour. Conversely, setting the remuneration of capital determines K/L . Similarly, setting the wage also determines K/L . In the case of the free movement of capital, the remuneration of capital in a small economy will be determined by its value at global level. Similarly, in the case of the free movement of workers, the wage of a small economy is determined by the wage prevailing in the free movement area. However, except in exceptional circumstances, the K/L ratio resulting from setting the remuneration of capital associated with the free movement of capital will generally not coincide with the K/L ratio resulting from setting the remuneration of labour associated with the free movement of workers. What happens if a small economy is simultaneously open on the capital and labour markets? To answer this question, we will use a simple model.

Let us assume that the production function is given by a Cobb-Douglas function:

$$Y = AK^\alpha L^{1-\alpha} \quad (\text{A2.1})$$

Let us assume that the production factors are remunerated according to their marginal productivity:

$$r = \alpha A(K/L)^{-(1-\alpha)} \quad (\text{A2.2})$$

$$w = (1-\alpha)A(K/L)^\alpha \quad (\text{A2.3})$$

where r is the interest rate and w is the wage.

From (A2.2) and (A2.3) we get:

$$r = \alpha * A^{\frac{1}{\alpha}} * \left(\frac{1-\alpha}{w}\right)^{\frac{1-\alpha}{\alpha}} \quad (\text{A2.4})$$

Let us assume that capital and labour markets are open and that the flow of a production factor is proportional to the difference in factor remuneration between the country studied and abroad. For simplicity, we assume that the market opening of the production factors we are studying is the only source of change in the quantity of these production factors.

$$\frac{dK}{K} = \Omega_k \frac{r - r_o}{r_o} \quad (\text{A2.5})$$

$$\frac{dL}{L} = \Omega_L \frac{w - w_o}{w_o} \quad (\text{A2.6})$$

Where r_o is the interest rate for which there would be no inflow of capital (r_o is equal to the interest rate abroad possibly minus a wedge related to the tendency of the local currency to appreciate). w_o is the wage for which there would be no inflow of labour (w_o is equal to wages abroad plus compensation for the cost of immigrating), Ω_k and Ω_L are constants.

A Ω_k smaller than infinity means that capital is not perfectly mobile. Such an assumption may seem strange given the high mobility of capital. However, it must be taken into account that we are talking about net capital flows here. Seeking to solve the Feldstein-Horioka puzzle (correlation between savings and investment despite the international mobility of capital), Horioka and Ford (2016 and 2017) argue that the capital market alone cannot achieve net capital flows: the market for goods and services must also be involved. However, there are frictions in the market for goods and services.

Implicitly, we assume that immigrants are perfectly substitutable for residents. Since in reality immigrants and residents are not perfectly substitutable (the degree of complementarity is the subject of debates), this assumption results in overestimating the impact of immigration on wages. Our only excuse for using such an assumption as a basis is to keep the model simple in order to qualitatively explore the dynamics of a small economy open to both capital and labour. While we will discuss the existence of an equilibrium and convergence towards this equilibrium, we will not draw any quantitative conclusions about the impact of immigration on wages. Consequently, this simplifying assumption should not influence our conclusions.

To know the dynamics of the factors' remuneration, we must understand the dynamics of the quantity of capital per worker

$$\frac{d(K/L)}{K/L} = \frac{dK}{K} - \frac{dL}{L} = \Omega_K \frac{r - r_o}{r_o} - \Omega_L \frac{w - w_o}{w_o} \quad (\text{A2.7})$$

K/L is thus constant if:

$$0 = \Omega_K \frac{r - r_o}{r_o} - \Omega_L \frac{w - w_o}{w_o}$$

In other words, if:

$$\frac{r_{eq}}{r_o} = 1 + \Omega^* \left(\frac{w_{eq}}{w_o} - 1 \right) \quad (\text{A2.8})$$

$$\text{where } \Omega = \frac{\Omega_L}{\Omega_K}$$

r_{eq} and w_{eq} stand for the interest rate and wage values such that K/L, and therefore r and w , remain constant.

Equations (A2.4) and (A2.8) determine r_{eq} and w_{eq} . In particular, w_{eq} is the solution of the following implicit equation:

$$\frac{\alpha^* A^{\frac{1}{\alpha}} * \left(\frac{1 - \alpha}{w_{eq}} \right)^{\frac{1 - \alpha}{\alpha}}}{r_o} = 1 + \Omega^* \left(\frac{w_{eq}}{w_o} - 1 \right) \quad (\text{A2.9})$$

which represents the intersection between:

i) the convex decreasing curve $\frac{\alpha^* A^{\frac{1}{\alpha}} * \left(\frac{1 - \alpha}{w_{eq}} \right)^{\frac{1 - \alpha}{\alpha}}}{r_o}$ which tends towards

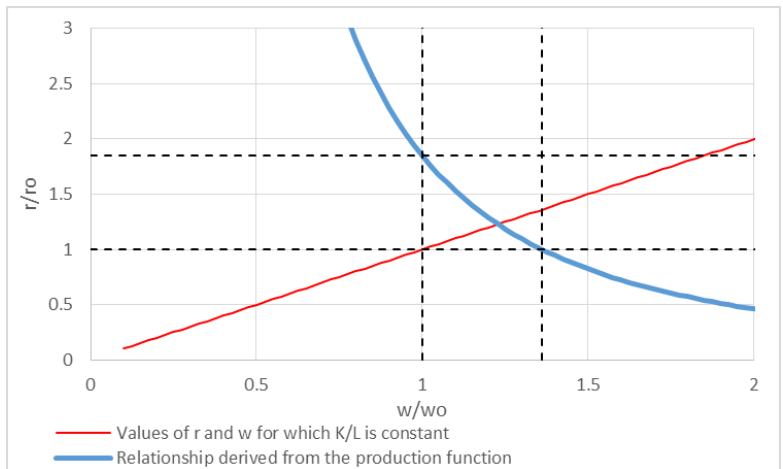
infinity when w_{eq} tends to zero, and tends towards zero when w_{eq} tends towards infinity

ii) the increasing straight line $1 + \Omega * \left(\frac{w_{eq}}{w_0} - 1 \right)$ with value 1 for $w_{eq}=w_0$ and slope $\frac{\Omega}{w_0}$.

It is clear that there is always an intersection between this curve and this line, and that an increase in Ω (for example if Ω_L increases with constant Ω_K) leads to a decrease in w_{eq} and an increase in r_{eq} .

The following figure shows an example of this curve and this line for illustrative purposes.

Figure A2.1 Computation of equilibrium



It remains to verify that this equilibrium is stable. The ratio K/L increases for the points above the red line, which increases w . w therefore increases if it is initially less than w_{eq} . Conversely, it decreases if it is initially greater than w_{eq} . The equilibrium is thus stable.

Let us consider two extreme cases (all other things being equal):

- $\Omega_L=0$

The labour market is closed. The red line in the figure above is horizontal at intercept equal to 1. The equilibrium wage for this case (which we will designate w_{eq}) is then determined by the ratio K/L set by the free movement of capital and thus such that $r=r_0$:

$$w_{eq}^* = (1 - \alpha) \left(\frac{\alpha * A^{\frac{1}{\alpha}}}{r_0} \right)^{\frac{\alpha}{1-\alpha}}$$

- $\Omega_L=infinite$

The labour market is infinitely open and responsive. The red line is vertical and $w_{eq}=w_0$: the wage is determined by the free movement of workers and converges in the long run to w_0 .

Intermediate values of Ω_L lead to a wage lower than that which would prevail without free movement of workers, but higher than that prevailing in the rest of the free movement area (or more precisely: higher than w_0 , which in the general case includes compensation for the cost of immigrating in addition to the wage abroad). This shows that wages can remain consistently higher than abroad even in the absence of economies of scale or aggregation effects. In such an environment, one could easily believe that immigration has no impact on wages: in equilibrium, new immigrants arrive each year without changing the level of wages. If A increases over time, the same reasoning applies to increasing wages rather than constant wages. A more restrictive migration policy (Ω_L smaller) would increase wages to the detriment of capital remuneration, however.

Except in special cases ($\Omega=1$ or $\Omega=1/2$), it is not feasible to find an explicit formula for the point $\langle w_{eq}, r_{eq} \rangle$ corresponding to the intersection between the blue curve and the red line. On the other hand, it is feasible to explicitly express the link at equilibrium between immigration and wages.

The equation of the line and that of the curve can be written as follows:

$$\begin{cases} \frac{r_{eq}}{r_o} = 1 + \frac{\Omega_L}{\Omega_K} \left(\frac{w_{eq}}{w_o} - 1 \right) \\ \frac{r_{eq}}{r_o} = \left(\frac{w_{eq}}{w_{eq}^*} \right)^{-\frac{1-\alpha}{\alpha}} \end{cases}$$

Or by replacing Ω_L in the first expression with its value from equation (A2.6):

$$\begin{cases} \frac{r_{eq}}{r_o} = 1 + \frac{1}{\Omega_K} \frac{dL/dt}{L} \Big|_{eq} \\ \frac{r_{eq}}{r_o} = \left(\frac{w_{eq}}{w_{eq}^*} \right)^{-\frac{1-\alpha}{\alpha}} \end{cases}$$

We can deduce:

$$\frac{w_{eq}}{w_{eq}^*} = \left(1 + \frac{1}{\Omega_K} \frac{dL/dt}{L} \Big|_{eq} \right)^{-\frac{\alpha}{1-\alpha}}$$

which can be written

$$\frac{w_{eq} - w_{eq}^*}{w_{eq}^*} = \left(1 + \frac{1}{\Omega_K} \frac{dL/dt}{L} \Big|_{eq} \right)^{-\frac{\alpha}{1-\alpha}} - 1 \quad (\text{A2.10})$$

where

$$\frac{dL/dt}{L} \Big|_{eq} = \text{equilibrium rate of immigration}$$

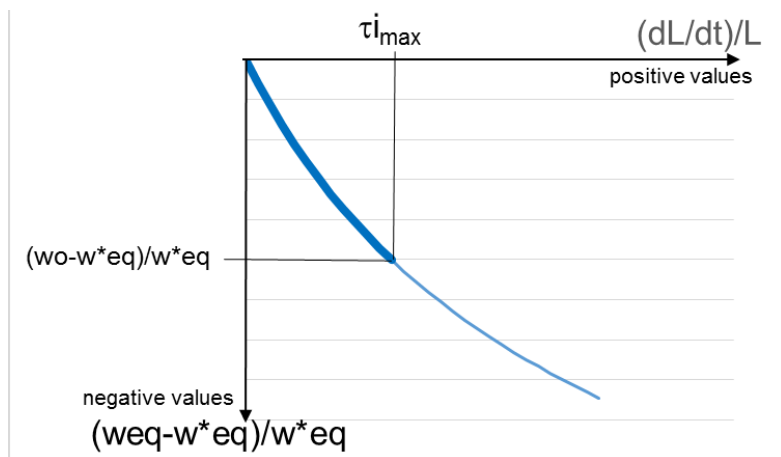
This formula therefore indicates the proportion to which the equilibrium wage changes (relative to the equilibrium wage in the absence of immigration) as a function of the equilibrium immigration rate.

If the immigration rate is low enough, the formula (A2.10) becomes approximately the following:

$$\frac{w_{eq} - w_{eq}^*}{w_{eq}^*} \approx - \frac{\alpha}{1 - \alpha \Omega_K} \frac{1}{L} \left. \frac{dL}{dt} \right|_{eq}$$

The formula (A2.10) can be represented by a curve with the following shape:

Figure A2.2 Immigration and wages



This curve depends only on α and Ω_K . The higher the equilibrium immigration rate, the lower the equilibrium wage. But the immigration rate is limited to the value $\tau_{i_{max}}$. It cannot reach a value that would lower the wage below w_o . In fact, when Ω tends towards infinity, the immigration rate tends towards $\tau_{i_{max}}$ and w_{eq} to w_o . The blue curve in bold shows the points that are reachable (with Ω between 0 and infinity).

Paradoxically, immigration is not zero when $w_{eq}=w_0$. On the contrary, this is where it is the highest. Indeed, this sustained immigration is necessary to maintain wages at w_0 . The formula (A2.6) that determines immigration is then of the type "immigration rate = infinite*0", and is therefore not incompatible with positive finite immigration.

Consider a change in migration policy, thus of Ω_L . The economy will move to a new equilibrium. To be specific, let us take the example of a facilitation of worker mobility, that is an increase of Ω_L , for a particularly attractive country (the blue curve in figure A2.1 goes to the right of the point $< 1, 1 >$). In the new equilibrium, wages will be lower and the interest rate higher. The convergence of wages and interest rates towards the new equilibrium will be gradual as the capital stock per worker converges towards its new value.

In contrast, the trajectory of immigration during the transitional period will not be gradual. The new equilibrium of the immigration rate will be higher than before, but immigration will overshoot by initially exceeding its new equilibrium value. Initially, Ω_L will pass to its new value, while wages will not have fallen yet. This will make this country particularly attractive and generate greater immigration than with the new equilibrium where the increase in Ω_L is partly offset by lower wages. The consequence is that the impact of the migration policy change on immigration will tend to be overestimated if one looks only at immigration just after the reform. This can provide rationale for implementing migration policy reforms in a gradual manner (as was the case for the Agreement on the Free Movement of Persons between Switzerland and the European Union).

Appendix 3 Impact of immigration on profits

The transitory drop in wages (relative to a scenario with less immigration) leads to a temporary increase in the return on capital. Consider, for example, the model of Gerfin and Kaiser (2010). Although these authors limit their analysis to wages, we can use their results to calculate the impact of immigration on the return on capital and profits, at least as an initial approximation.

Increase of 2.5% in the return on capital

Gerfin and Kaiser (2010) use a Cobb-Douglas aggregate production function (with composite work). The wage share is 62% (page 9). In the short term (before any capital adjustment), immigration reduces the general level of wages by 1.5% relative to the scenario without immigration (§7.2 in their article, table 2 in their summary in *La Vie économique*). But for a Cobb-Douglas production function, Δr can be calculated from Δw with the following formula (obtained using formula A2.4 in our Appendix 2):

$$\frac{\Delta r}{r} = \left(\frac{w}{w'} \right)^{\frac{1-\alpha}{\alpha}} - 1 \approx -\frac{1-\alpha}{\alpha} \frac{\Delta w}{w} + 0.5 \frac{1-\alpha}{\alpha^2} \left(\frac{\Delta w}{w} \right)^2$$

where α is the share of capital

The approximation is a second degree Taylor development (the first degree would have been sufficient to estimate the impact on the return on capital, but we will use the second degree to calculate the immigration surplus).

Replacing $\alpha = 1 - 0.62 = 0.38$ and $\Delta w/w = -1.5\%$ in this formula, we get $\Delta r/r = 2.5\%$. The (transitory) decrease of 1.5% in wages leads to a (transitory) increase of 2.5% in the return on capital.

Immigration surplus

In the short term, profits increase in the same proportion as r , as the capital stock is assumed to be constant:

$$\begin{aligned} K\Delta r &\approx Kr \left\{ \frac{1-\alpha}{\alpha} \left(-\frac{\Delta w}{w} \right) + 0.5 \frac{1-\alpha}{\alpha^2} \left(\frac{\Delta w}{w} \right)^2 \right\} = Y * \left\{ (1-\alpha) \left(-\frac{\Delta w}{w} \right) + 0.5 \frac{1-\alpha}{\alpha} \left(\frac{\Delta w}{w} \right)^2 \right\} \\ &= -wL \frac{\Delta w}{w} + 0.5 \frac{1-\alpha}{\alpha} \left(\frac{\Delta w}{w} \right)^2 Y = -L\Delta w + 0.5 \frac{1-\alpha}{\alpha} \left(\frac{\Delta w}{w} \right)^2 Y \end{aligned} \quad (\text{A3.1})$$

Where we used $Kr=\alpha Y$ and $wL=(1-\alpha)Y$ where Y is GDP.

The increase in profits ($K\Delta r$) therefore overcompensates the loss suffered by all workers already present in Switzerland before the wave of migration ($L\Delta w$) with a second-order term (proportional to Δw^2). More precisely, the increase in profits is constituted of a transfer from workers already present in Switzerland before the migration wave for an amount of $(1-\alpha)(-\Delta w/w)=0,62*1,5\%=0,93\%$ of GDP and a surplus of $0,5*(\Delta w/w)^2*(1-\alpha)/\alpha=0,5*(1,5\%)^2*0,62/0,38=0,018\%$ of GDP. The surplus is much smaller than the transfer.

Losses suffered by workers already present in Switzerland as a proportion of the wage bill of new immigrants

The transfer of 0.93% of GDP from workers to capital holders is not negligible. This represents almost a quarter of a percent of GDP per percent of immigration, which is significant relative to the wage bill of immigrants. If immigrants had to compensate other workers for their losses, it would cost them 36% of their wages (about 4% of employees would have to compensate a wage loss of 1.5% for 96% of workers, i.e. a group 24 times bigger: $1.25\%*24=36\%$). Nevertheless, it should be remembered that this is only a short-term phenomenon (before any adjustment of the capital stock) that gradually fades as capital adjusts.

Links with the Borjas formula for the immigration surplus

In his chapter 7, Borjas (2014) shows that, in the case of homogeneous work (he also shows more complex formulas for heterogeneous work), the surplus as a proportion of production is given by:⁶⁴

$$\frac{\text{immigration surplus}}{Y} \Big|_{\text{const. capital}} = -0.5s_L \varepsilon_{LL} p^2 \quad (\text{A3.2})$$

where $s_L = wL/Y$,

ε_{LL} is linked to the price elasticity of labour supply: $\varepsilon_{LL} = \frac{d \ln(w)}{d \ln(L)}$

p is the proportion of immigrants relative to workers.

This surplus is the share of the capital holders' gains not financed by the wage decline of workers present before the wave of migration. It is thus a gain linked to the infra-marginal productivity of immigrants.

Borjas points out that i) this surplus grows with the absolute value of ε_{LL} and thus with the negative impact on wages (if $\varepsilon_{LL} = 0$, there is no impact on wages, but no surplus either) and ii) this surplus is small relative to the redistribution from workers to capital holders (immigration certainly produces a small surplus, but essentially leads to a redistribution from workers to capital holders).

If the production function is a Cobb-Douglas, Borjas shows (page 66) that the elasticity is equal to $-s_K$ where s_K is the share of capital (so here $\varepsilon_{LL} = -\alpha$).

Borjas notes that, in the case of a Cobb-Douglas production function, this elasticity is completely determined by labour's share of income and does not depend in any way on other data. Borjas generally criticises the sensitivity of the results to the choice of production function, and particularly the fact that the calculation of the impact of immigration on the average wage level is typically significantly determined by the form chosen for the production function.

64 See also Borjas (1994)

In the case of a Cobb-Douglas, Borjas' formula for surplus immigration becomes:

$$\frac{\text{immigration surplus}}{Y} \Big|_{\text{const. capital}} = 0.5(1-\alpha)\alpha p^2 \quad (\text{A3.3})$$

In our case : $\varepsilon_{LL} = \frac{\frac{\Delta w}{w}}{\frac{\Delta L}{L}}$ and $p = \Delta L/L$. We thus have

$$p = \frac{1}{\varepsilon_{LL}} \frac{\Delta w}{w} = -\frac{1}{\alpha} \frac{\Delta w}{w} \quad (\text{A3.4})$$

Replacing p in (A3.3), we find the surplus contained in (A3.1) :

$$\text{Immigration surplus} = 0.5 \frac{1-\alpha}{\alpha} \left(\frac{\Delta w}{w}\right)^2 Y$$

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