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The Impact of Official Development Assistance on the Donor's Economy: The Case of Switzerland

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by

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on the Donor's Economy: The Case of Switzerland

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Le doyen

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Abstract

This thesis investigates the impact of Official Development Assistance (ODA) on the donor's economy in the case of Switzerland. As a first step, chapter 1 discusses a flow-of-funds approach to quantify the impact of bilateral and multilateral ODA on the donor country's economy. The simple yet rigorous methodology employed allows to compute both, the primary (immediate) and the final impacts of ODA on the domestic GDP. We find for the year 2014 a primary effect of around 70 to 90 centimes for each Swiss franc of ODA provided. Regarding the final effect, computed by means of a Keynesian multiplier, it is found to lie between 1.19-1.56 franc.

In addition to these effects, ODA, particularly bilateral ODA, may induce exports from the donor to the recipient countries. This hypothesis is tested in the following chapters using time-series and structural econometric modeling based on panel data.

Chapter 2, as a preliminary step towards chapter 3, discusses and further develops a statistical method, namely the Dumitrescu-Hurlin (DH) Granger non-causality test that enables the verification of causal links between any pair of time series based on panel data. In particular, the chapter presents the user-written command `xtgcause`, implemented in the Stata software that allows for the computation of DH Granger non-causality tests.

Chapter 3 employs the method discussed in chapter 2 to investigate the existence and direction of Granger causality between Swiss bilateral ODA and Swiss exports. The results reveal foremost bidirectional Granger causality. In other words, exports from Switzerland to the recipient countries are Granger-caused by ODA flows and vice-versa.

Finally, chapter 4 measures the magnitude of the induced effect of bilateral ODA on Swiss exports. To this end, an augmented-gravity trade model is employed. The results point towards a return through exports of 0.59 USD for each 1 USD of ODA allocated in the short run (static model) and of up to 1.73 USD in the long run (dynamic model).

These results are important in terms of policy implications on several accounts, not the least of which is providing decision makers with a more comprehensive view of the (real) costs of ODA.

Keywords: donor country, official development assistance, exports, flow-of-funds approach, Granger causality, gravity model, panel datasets.

Résumé

Cette thèse analyse l'impact économique de l'Aide Publique au Développement (APD) sur le pays donateur pour le cas de la Suisse. Comme première étape, le chapitre 1 discute d'une approche "flux de fonds" pour quantifier l'impact de l'APD bilatérale et multilatérale sur l'économie du pays donateur. Cette méthodologie simple mais rigoureuse, permet de calculer l'impact primaire (immédiat) ainsi que l'impact final de l'APD sur l'économie domestique. Nous trouvons, pour l'année 2014, un effet primaire se situant entre 70 et 90 centimes pour chaque franc suisse fourni. Concernant l'effet final, calculé à l'aide d'un multiplicateur keynésien, il se situe entre 1,19 et 1,56 franc.

En plus de ces effets, l'APD, en particulier l'APD bilatérale, peut induire des exportations du pays donateurs vers les pays receveurs. Cette hypothèse est testée dans les chapitres suivants à l'aide d'analyse de séries temporelles et de modélisation économétrique structurelle basées sur des données de panel.

Le chapitre 2, comme étape préliminaire en vue du chapitre 3, discute et développe une méthode statistique, à savoir le test de non-causalité de Granger élaboré par Dumitrescu et Hurlin (DH), qui permet la détection de liens de causalité entre n'importe quelle paire de séries temporelles basée sur des données de panel. En particulier, le chapitre présente la commande `xtgcause`, implémentée dans le logiciel Stata et qui permet d'effectuer des "DH Granger non-causality tests".

Le chapitre 3, utilise la méthode décrite dans le chapitre 2 pour examiner l'existence et le sens de causalité entre l'aide publique bilatérale suisse et les exportations suisses. Les résultats révèlent une causalité bidirectionnelle au sens de Granger. En d'autres termes, les exportations suisses vers les pays receveurs d'APD sont Granger-causées par les flux d'APD et vice-versa.

Finalement, le chapitre 4 mesure l'ampleur de l'effet induit de l'APD bilatérale sur les exportations suisses. Pour ce faire, un modèle gravitationnel de commerce international est utilisé. Les résultats montrent un retour de l'APD à travers les exportations de 0,59 USD pour chaque USD d'APD alloué à court terme (modèle statique) et de jusqu'à 1,73 USD à long terme (modèle dynamique).

Les résultats obtenus sont importants en termes d'implications politiques et ce pour plusieurs raisons, notamment en fournissant aux preneurs de décisions une vision plus complète du coût (réel) de l'APD.

Mots-clés: pays donateur, aide publique au développement, exportations, approche flux de fonds, causalité au sens de Granger, modèle gravitationnel, données de panel.

Contents

General Introduction

This thesis is about investigating the impact of Official Development Assistance (ODA) on the donor country's economy, in the case of Switzerland. In its own way, each of the four chapters comprising the thesis provides an answer, or at least part of the answer, to this non-trivial research question. Before discussing the motivation of this thesis and briefly presenting the content of each article, it is worth giving a broad-spectrum overview of ODA in general and Swiss ODA in particular.

1 General overview

The first international financial flows measured date back to the 15th century when rich and powerful European families lent money throughout Europe. However, these international capital flows from private sources were profit oriented, differentiating them from international assistance flows, the ODA ancestor. Even if international assistance originated in the 19th century, mainly in the United States, Great Britain and France, the origin of modern ODA can be situated in the mid-20th century, after World War 2, spurred by the United Nations. Among the first ODA flows stand the ones arising from the Marshall Plan. The present section looks at the definition of ODA, answers the questions of who manages the concept of ODA, who provides ODA (donors), how much and why, who receives ODA (recipients), in what form and finally what are the main criticisms addressed to ODA?

1.1 Definition of ODA

Official development assistance is a concept used and defined by the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) as a measure of international aid flows.[1]

Each word composing the acronym ODA contributes to building its definition. Indeed, "official" means that the assistance must come from an official source, which in this case means a public institution (usually the government, central and/or local level). Therefore, ODA does not include assistance directly provided by households, Non-Governmental Organizations (NGOs) or private firms. Nonetheless, these private actors could still channel ODA on

[1]It should be noted that assistance/aid directed to countries/territories that are on Part II (more advanced developing countries/territories) of the DAC list of aid recipients is called Official Aid (OA).

behalf of the public institutions. In other words, they act as the government's executing agencies. Considering only public assistance is obviously restrictive but since the concept of ODA refers to the responsibility of governments, which are accountable internationally of their assistance policy, the measurement of ODA is drastically facilitated.

The word "development" refers to the primary objective ODA should achieve, namely promote economic development and welfare of the recipients. More recently the DAC referred to the Sustainable Development Goals (SDGs) introduced by the United Nations. Thus, to be considered as ODA, assistance is meant to be directed to developing countries/territories.

Finally, the word "assistance" has been purposely chosen as a broad term. Indeed, to help recipients to develop, government and public agencies have a wide range of instruments at their disposal: e.g. loans (with specific conditions attached), grants, knowledge transfers, donations in kind, funding projects and programmes, etc. Although the DAC has defined eligible activities, the list remains almost infinite. This is why the word "assistance" has been preferred to other terms, such as "donations", "loans" or "money". The term "aid" is frequently used instead of "assistance".[2]

1.2 ODA governing bodies

Not every activity of a developed nation directed to a less-developed country/territory is considered as ODA. As we just mentioned, one of the tasks of the Development Assistance Committee is to provide clear definitions of eligible activities and financial assistance that can be considered as ODA. The DAC also plays the role of coordinator between all the member countries. The committee was set up in 1960, a little more than a decade after the origin of modern ODA, under the auspices of the OECD's forerunner, the Organisation for European Economic Co-operation (OEEC) and in September 1961 by a Ministerial Resolution of the new OECD. Data collection on ODA started in 1960.

At the national level, each contributor has its own governing body or bodies responsible of defining and implementing ODA policies. Sometimes the body is an entity in itself and sometimes a mix of different public agencies that collaborate to take the ODA-related decisions. The national ODA governing body usually decides how to allocate ODA to which recipient, and more importantly, what effort will be made in providing ODA. Key decisions

[2]This is true no matter the recipient country, that is Part I or Part II of the DAC recipients' list.

on ODA are however, in many donor countries, subject to the approval of the state authorities, as is the case for other government expenses.

1.3 Who provides ODA, how much and why?

The term ODA refers not only to a statistical concept but also to an international system of resource transfer between donors and recipients. The donors are organized by the DAC, which is composed of 29 member countries and the European Union. Currently, the 30 DAC members are 24 European countries[3] (including EU), and Australia, Canada, Japan, New Zealand, South Korea, and the United States. Most of the time total ODA figures used in reports refer to these 30 DAC members (or 29 given that the European Union is often not considered). However, ODA figures sometimes also include assistance reported to the DAC by non-DAC members. The countries (around 20) included in this latter group do not fulfill all the DAC requirements to be members, but still provide ODA flows on a regular basis. Sometimes those countries are referred to as the "emerging" donors, which include developed and relatively rich nations from all over the world, such as Israel, Kuwait, Malta, Russia, Thailand, Turkey and the United Arab Emirates among others.

The OECD reported that in 2017, ODA (from DAC and non-DAC members) amounted to around 178,000 million USD (current price). As we will show later, this number represents only around 0.3% of the donors' GNI (on average), but still, about 33% of the Swiss GNI. With respect to the Least Developed Countries (LDCs), on average, ODA flows represented in 2016 around 4.6% of their GNI (World Bank database). This ratio even goes up to 10% for some LDCs recipients. The fact that total ODA represents such a large amount of money and implies so much in terms of the recipients' budget, gives credence to the present thesis. Indeed, results found regarding the impact of ODA on the donor country's economy, particularly Switzerland that is a major donor as we will discover later, may impact substantially ODA provided and therefore many developing countries/territories.

The DAC members have contributed to around 92% of the 2017 total ODA amount. The top five donors are, in order, United States, Germany, United Kingdom, Japan and France. Interestingly and although in a different order, the top five donors were the same in 1960. Total ODA (from DAC and non-DAC members) in constant prices has remained roughly constant

[3]Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

since the early 1970s (at around 80,000 million USD). However, since the beginning of this century, total ODA has strongly grown as table 1 shows:

Table 1: Total ODA in US dollars, millions, constant prices (2016)

2000	**2005**	**2010**	**2015**	**2017**
80,961	128,976	137,738	162,057	175,324

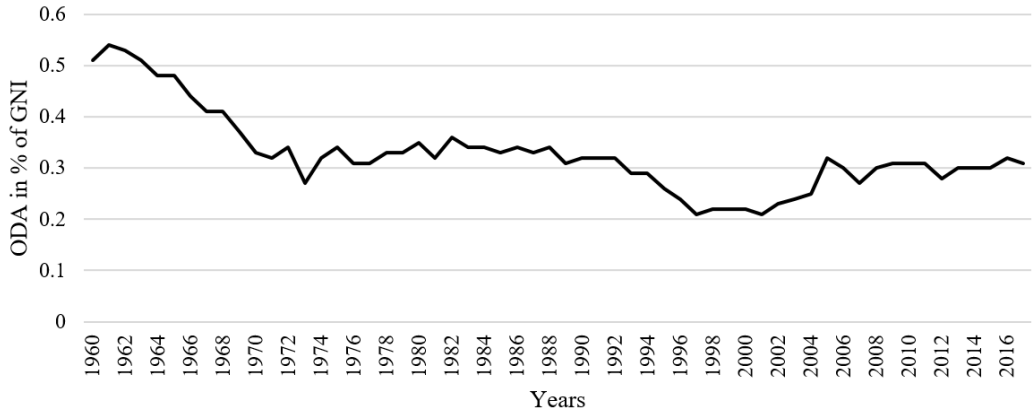
It should be noted that the significant growth between 2000 and 2005 is mainly driven by the important (and highest ever measured, i.e. 28%) annual ODA growth between 2004 and 2005. The main factors explaining this growth rate are the debt relief for Iraq and Nigeria agreed by the Paris Club (USD 19.4 billion) and ODA provided following the devastating December 2004 Indian Ocean tsunami (USD 2.2 billion).

If the focus is on the "effort" of providing ODA (i.e. ODA/GNI) rather than on the absolute amount, the picture is very different. In 2017, the country putting the highest effort in providing ODA is a non-DAC member, namely the United Arab Emirates with a ratio of ODA/GNI equal to 1.31%. The four following countries are Sweden, Luxembourg, Norway and Turkey. The average effort of all the 2017 donors is 0.38% whereas the one of the DAC members for this same year is 0.31%. Thus, emerging donors are, on average, putting relatively more effort in providing ODA than the DAC members. Figure 1 shows the DAC members' effort (there is no sufficient data on non-DAC members to include them in the time series) in providing ODA. During the first decade, in the 1960s, the level of ODA was quite high, but declining, probably because of the phasing out post-WW2 reconstruction effort. Thereafter, ODA effort of the DAC members remained roughly constant, at around 0.3%.
Note that the quantitative objective set until 1969 by the United Nations Assembly was 1% of the donors' GNI. Todays, the objective is 0.7%, which obviously is not reached either. A working committee established by the World Bank in 1969 and led by Lester Pearson, a former Canadian prime minister, has proposed the current target.

1.4 Why ODA?

To the almost philosophical question, what are the motives of the donors to provide ODA, Charnoz and Severino (2015) propose five arguments based on the theory of international relations, namely the quest of power, the "capital-

Figure 1: ODA effort, DAC members



ist" exploitation, the quest of material welfare, the pursuit of private interests and the moral fulfillment.[4]

- **The quest of power**. As any international action, providing ODA gives the donor visibility and increases its relative power. Furthermore, based upon the amount of aid, a donor country can reward, or the opposite, sanction, a specific country or region, establishing a domination-based relationship towards the recipients.

- **The "capitalist" exploitation**. In a context where countries are either "capitalist" or "proletarian", exporting capital, no matter the purpose, strengthens the position of a capitalist country and contributes to the exploitation of the proletarian countries.

- **The quest of material welfare**. In this case, donors spend on aid not to gain power or to reinforce their dominance but simply because providing ODA allows recipients to be better-off which implies for the donor future potential commercial relationships with the assisted countries. In other words, ODA is not a zero-sum game, it is an investment.

- **The pursuit of private interests**. According to this line of argument, the donor has no interest in the recipient's development. ODA

[4] An alternative contribution on aid allocation is the one of McKinlay and Little (1977) that developed an analytic model of aid allocation (donor's perspective). They find that imperialistic behavior of the donor is the model best explaining the allocation of aid (based on U.S. data).

is provided by governments who may encourage foreign aid for private purposes like for instance to satisfy exporters' lobbies.

- **The moral fulfillment**. ODA is provided to fulfill the moral duty wealthy and developed countries have regarding their less-developed peers. This does not necessarily mean that donors admit a share of the responsibility regarding the recipients' current economic situation.

In fact, it is very difficult if not impossible to fully comprehend the donors' motivations for providing ODA. Whatever the reasons are, it is believed that providing ODA does economically impact the donor. Martínez-Zarzoso et al. (2009) discuss three reasons why ODA may affect positively the donor's economy, in particular its exports. First, the authors mention that ODA can be tied to the donor's goods and services implying automatically a positive impact on its aggregate demand (even though it could be argued that some of the exports arising from tied aid would have occurred anyway with or without ODA). It should be noted at this point that untied aid can also imply a positive impact on the donor's aggregate demand, and that together tied and untied aid may be the root of supplementary positive effects on the aggregate demand. The first chapter of the present thesis discusses this issue extensively. Second, and related to the possibility to provide ODA in the form of national goods and services, the recipient country may develop a dependence towards the donor's goods and services. This habit-formation effect, as discussed by Djajić et al. (2004), may imply future exports from the donor to the recipient, since assistance flows can cause a gradual shift in the consumption preferences in favor of the donor's goods and services. Finally, yet importantly, when a recipient receives assistance from a donor, this relationship may alter, in a positive way, the perception the recipient has towards the donor (goodwill effect). Thus, trade relations may emerge in either the short run or the long run because of ODA. Chapter 3 and 4 of this thesis precisely aim at, respectively, investigate the presence of a statistical causal relationship between ODA and exports and quantify the effect ODA induces on the donor's exports.

1.5 Who receives ODA?

As for the donors, DAC decides who should belong to the list of recipient countries/territories. Currently DAC revises the list of recipients every three years. The list for the period 2018-2021 comprises no less than 143 countries/territories. The criteria used to decide the status of recipient are twofold. First, are considered as recipients all the countries/territories

identified by the United Nations as Least Developed Countries, that is, 47 countries/territories for the years to come. The identification of the LDCs by the UN is based on the countries/territories' GNI as well as on two composite indexes, namely the Human Asset Index that considers the countries/territories' level of nutrition, health, education and adult literacy and the Economic Vulnerability Index that takes into account eight different criteria.[5] Second, are also listed as recipients low- and middle-income countries/territories as defined by the World Bank (respectively 2 and 94 countries/territories[6] for the period 2018-2021). For the World Bank, low- and middle-income countries/territories have a GNI per capita (in US dollars and calculated using the World Bank Atlas method) below USD 12,235 (in 2016).[7] It is commonly agreed that as far as possible, LDCs should be helped in priority given that, in addition to be very poor (very low GNI per capita), they also face some other severe problems. Some of the emerging donors can potentially also be considered as recipients, like in the cases of Thailand and Turkey.

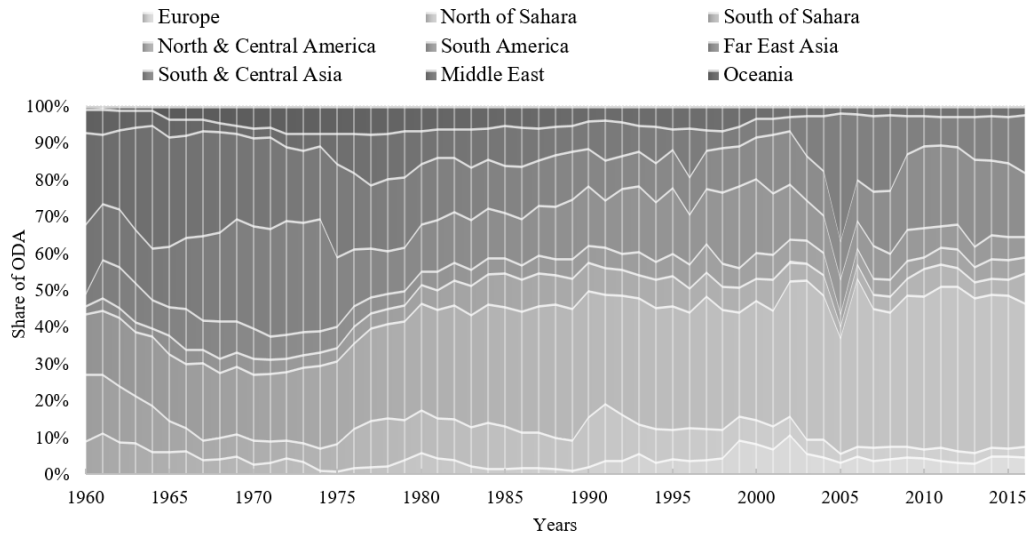
OECD data on ODA disbursements to countries/territories and regions highlight which geographical areas are receiving the highest share of ODA. Figure 2 shows that since the mid-1970s, the region receiving the highest share of ODA is the Sub-Saharan Africa.

[5]The eight criteria retained by the UN are: population size; remoteness; merchandise export concentration; share of agriculture, forestry and fisheries; share of population in low elevated coastal zones; instability of exports of goods and services; victims of natural disasters and instability of agricultural production.

[6]The middle-income group is often further divided in two, the lower and the upper middle-income groups.

[7]The WB thresholds are mainly based on operational thresholds. For instance, the low-income group of countries threshold has been set in 1989 relying on the operational threshold for "civil works preference".

Figure 2: ODA by region: DAC members



According to Charnoz and Severino (2015), the poorest countries receive the highest share of ODA. This observation is in line with figure 2 above since on average the poorest countries are the sub-Saharan African countries.

1.6 Destination and forms of ODA

Despite the absolute necessity to respect the DAC requirements regarding the eligibility criteria ODA needs to fulfill, each donor still has a considerable leeway regarding the sector to which its ODA is directed as well as the form it takes.[8] Indeed, regardless of the sector (with the exception of "debt relief"), ODA can either be in the form of goods and services (G&S) or in the form of pure financial flows (with the possibility to attach "strings", i.e. conditionalities on how to use the funds). Furthermore, ODA can be directly allocated to a country (bilateral ODA) or indirectly through international organizations (multilateral ODA) which channel the ODA collected towards recipient countries. In 2016, around 70% of ODA was bilateral. The fact that ODA can be in the form of G&S and that financial flows can be subject to conditionalities gives the possibility to donor countries to provide tied aid, that is aid provided in the form of the donor G&S (necessarily). In the early 2000s, DAC emitted recommendations to untie aid, which caused, according

[8]The OECD considers eight sectors, namely social infrastructure, economic infrastructure, production, multisector, program assistance, debt relief, humanitarian aid and unspecified.

to OECD, a large drop of the share of tied aid from around 80% in the 2000s to less than 20% nowadays.[9]

1.7 Main criticisms addressed to the measurement of ODA

As we have seen, DAC is the body deciding what can or cannot be considered as ODA. Thus, most of the criticisms are linked to the decisions of the DAC on including or excluding specific flows. The probably most discussed issue over the past years is the degree of concessionality a loan must show to be considered as ODA. Hynes and Scott (2013) discuss extensively this issue. The authors note that even after many years of debate, and the choice of a minimum 25% share of grant elements in a loan, it still remains a topic of discussion. The same applies to the fixed 10% discount rate which is used in calculating the grant element of a loan, determined in 1972 and never changed since. Nowadays, the 10% discount rate is obviously too high compared to market interest rates, and therefore artificially increases the grant element of a loan. This facilitates commercial loans to be considered as ODA.

A second debated example is the fact that ODA includes study and school fees for students originating from the recipient countries. However, if those students do not go back to their countries of origin, should those fees really be considered as ODA? Alternatively, even if the students go back to their country, do those expenditures really help the recipient countries to develop? In the same vein: should the expenditures on the hospitality and travel expenses of the refugees be considered as ODA? The return of refugees in their home country, after a period, will not necessarily help the recipient country to grow; on the other hand, the hosting of refugees may ease the international climate and therefore favor the development of the less developed (mainly the ones at the border of the country in conflict).

To summarize, if there are some expenditures that are globally accepted as being ODA (e.g. expenses in water supply and sanitation or disaster prevention among others), others cause much ink to flow. Hynes and Scott (2013) discuss the contemporary ODA concept and show its main drawbacks. In a second step, the authors propose an alternative aggregate measure, namely the Official Development Effort (ODE), which excludes some controversial expenditures such as student's fee and spending on refugees, and include only the donation part of loans. Their contribution precedes the one by Roodman (2014) that as a first step also analyzed which current expendi-

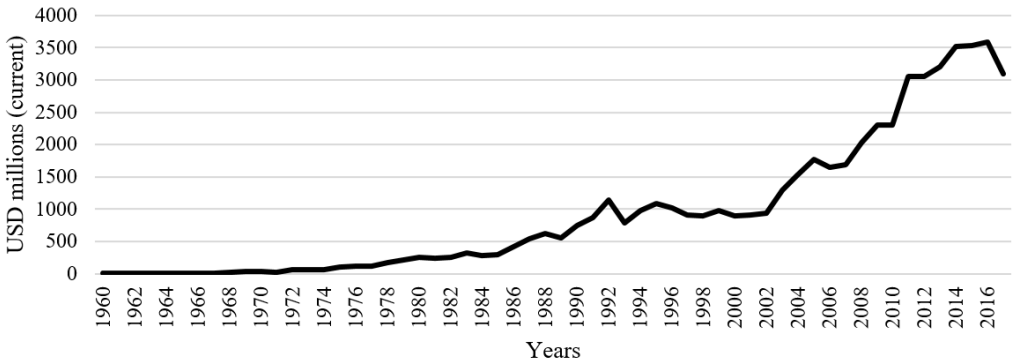
[9]The fundamental reason why DAC encourages donor countries to untie their aid is that tying aid may increase the costs of a development project.

tures should not be part of ODA anymore and which ones should be included. Then, the author proposed a new method to more accurately compute the grant elements of a loan, which will in turn be accounted as ODA instead of the loan itself (as also proposed by Hynes and Scott (2013)).

2 Swiss context

With roughly eight million inhabitants, Switzerland is one of the less populated DAC members but on the other hand one of the wealthiest. This latter fact allows Switzerland to be above the median DAC members' donors in terms of ODA in US dollars (ranked 13th in 2017 and 12th in 1960). Figure 3 shows the Swiss ODA contributions since 1960. As it can be seen, it is only towards the end of the 1970s that Swiss contributions have really started to increase.[10] The significant drop of Swiss ODA contributions last year (2017) is predominantly due to an important decrease of Swiss expenditures on asylum and to a lesser degree to the adjustments to DAC's guidelines on computing asylum-related costs. For the purposes of saving money, the Swiss government has not allocated the funds saved in another form of assistance.

Figure 3: Swiss ODA disbursement

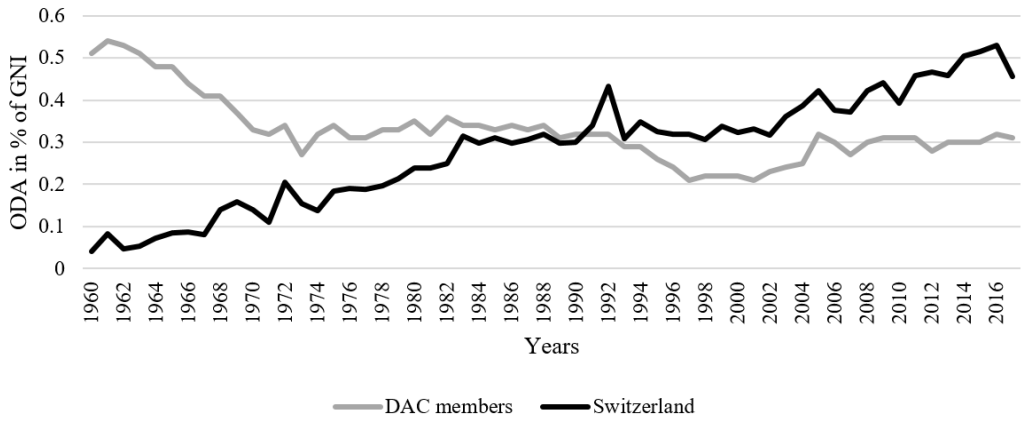


Note: The 1992 peak is due to extraordinary debt relief measures for the 700th anniversary of the Swiss confederation and Switzerland's accession to the Bretton Woods institutions.

By plotting the share of ODA relative to GNI (figure 4), Switzerland shows a performance more in line with its prosperous nation status, especially since the early 1990s with a ratio above the average of all DAC members.

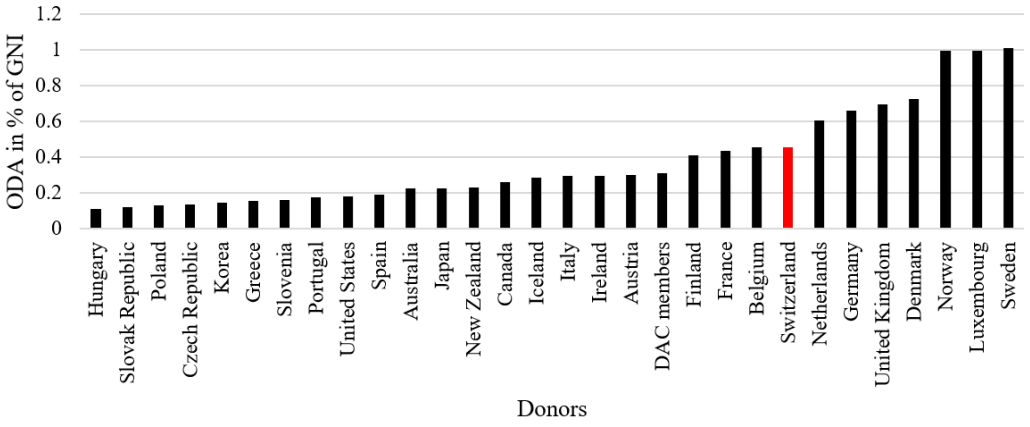
[10]Switzerland became a DAC member in 1968. The increase of ODA contributions in the late 1970s is mainly due to the incorporation of humanitarian aid as ODA in 1977.

Figure 4: Switzerland vs DAC members ODA effort



Since 2014, the Swiss effort in providing ODA oscillates around 0.5% of GNI, in accordance with the decision of the Parliament in 2011 to increase Switzerland's contribution to 0.5% of its GNI by 2015. As it can be seen in figure 5 below, the current Swiss effort in providing ODA is among the highest.

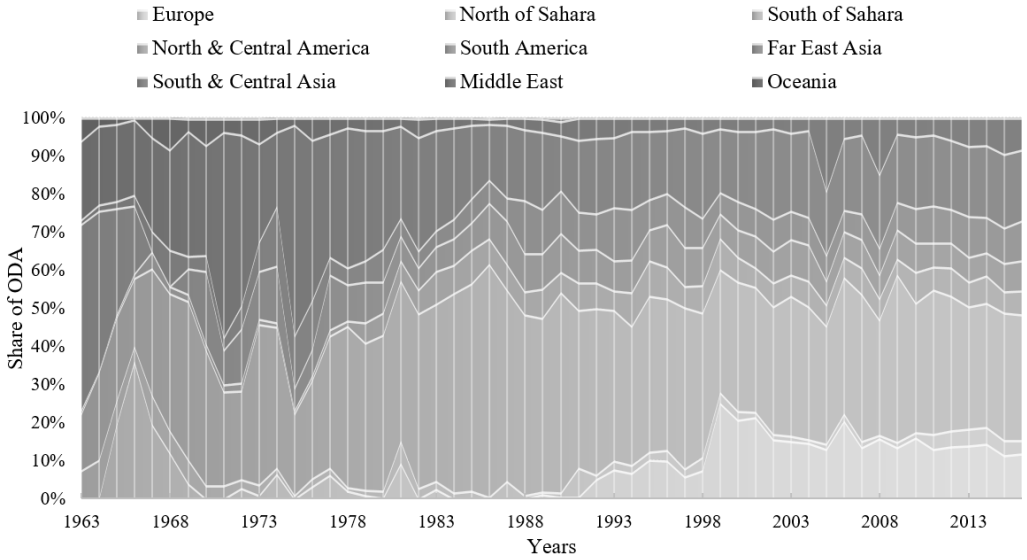
Figure 5: DAC members ODA effort, 2017



In 2016, Switzerland provided ODA to slightly more than 100 countries and territories. Figure 6, based on OECD data, shows the geographic distribution of Swiss ODA across different regions of the world. As a whole, Swiss

ODA spread is similar to the global one (figure 2), the sub-Saharan Africa region being the area receiving the highest share of Swiss ODA.[11]

Figure 6: Swiss ODA by region



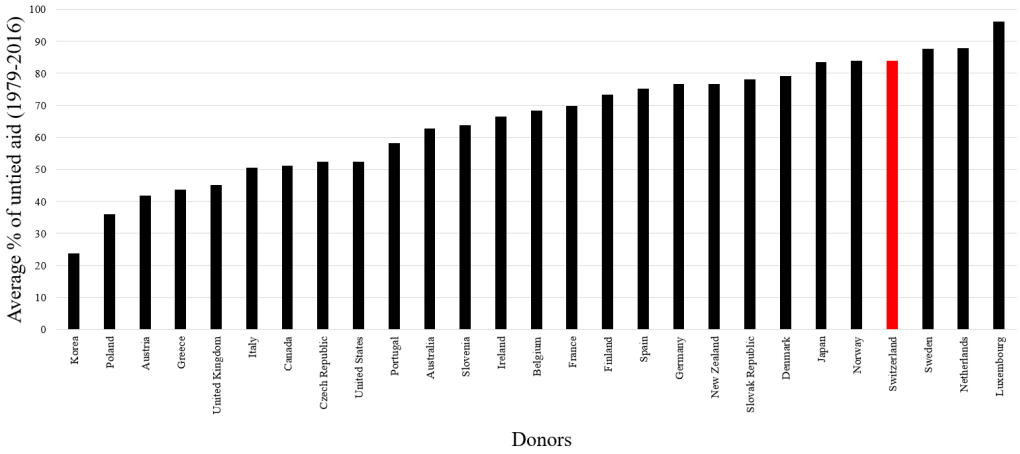
Note: On the graph, only eight regions can be distinguished because Swiss ODA contributions towards Oceania are very small.

Finally, one specific feature of Switzerland is the high share of untied aid it provides. The DAC/OECD started to collect data on the tying status in 1979. Figure 7 shows the average share of untied aid[12] for the 27 donor countries for which data are available.

[11]No evidence of ODA allocation bias, as for instance in Arvin and Drewes (1998) who analyze Canada, was found regarding Swiss ODA.

[12]The untied aid share is defined as the proportion of untied aid relative to total ODA excluding partially tied aid and negative commitments.

Figure 7: Untied aid share, DAC members



Switzerland stands among the top five countries, with an average share of 84%. Note that the ratio for Switzerland moved upwards to 96% for the period 2000-2016. However, as already mentioned, providing untied aid, i.e. behaving altruistically, does not mean that returns on ODA for the donor are proportionally lower. On one hand a high share could indeed lead to lower purchases of goods and services from the donor's economy, but on the other hand, untied aid may foster (possibly more that tied aid) the so-called goodwill effect. Moreover, Arvin et al. (1996) have shown in their contribution, based on Canadian data, that untied aid does have indeed a lingering/persistent impact on exports.[13] With a ratio of untied aid close to unity, Switzerland is a very interesting country to investigate.

3 Motivation and contributions

There is a large number of academic studies on ODA. Economically, there are at least two broad research topics, namely 1) does ODA really help the recipient country to develop? and 2) does ODA imply any economic benefit for the donor? The literature on the first topic is vast and the methods and models used to answer that simple but non-trivial question are manifold. A striking observation is that no clear answer is provided by the existing literature. Some authors argue that ODA helps a recipient only if the latter satisfies specific demographic and economic features; others claim that no

[13]In reality, the frontier between tied and untied aid can sometimes be thin. For instance, ODA in the form of technical cooperation, usually accounted as untied ODA, implies mostly purchases of goods and services from the donor country.

matter the characteristics of the recipient, ODA does help them to develop; finally, some assert that ODA has no significant impact on the recipient countries' capability to grow. Concerning the second topic, the existing literature is much more limited. Although this is understandable given the main objective of ODA, at least four reasons can be given/cited for the importance of analyzing the economic impact of ODA on the donors.

First, by definition, ODA is financed by public resources and the government in democratic countries is accountable to the taxpayers who will foot the bill in the last resort. Taxpayers want to know what are the risks and gains from providing ODA and what is the true opportunity cost of ODA in terms of forgone, present and future consumption. An inspection of the economic benefits of ODA for the donor country responds to those legitimate needs.

Second, it may be crucial for a given donor country to know if ODA produces a significant impact on its economy, in particular through exports. Indeed, in open economies, exports are a major driver of income and growth. Thus, failing to measure the effect of ODA on exports would for instance underestimate the consequences of a cut in ODA.

Third, as we have seen in the previous two sections, ODA is not a marginal amount or concept. On the contrary, for some recipients ODA represents one-tenth of their budget. Even though total ODA in constant prices has more than doubled since the beginning of the century, the donors' effort in providing ODA stagnates since more than a decade. The plan is however to increase this effort in the coming years. ODA provided is increasing in scale, and thus deserves more attention from the scientific community at large.

Last but not least, except for some donor countries, namely Luxembourg and the Scandinavian countries among a few others, the target of 0.7% of GNI has not (yet) been reached. Thus, if ODA is found to positively influence the donor's economy, it may be a strong argument for the governments to increase their effort and reach the 0.7% share of GNI initially put forward by the Dutch economist and Nobel Prize winner Jan Tinbergen and reaffirmed by the UN within its millennium development goal target.

This thesis is composed of four chapters, each of them corresponding to an empirical contribution. The order of the chapters is basically governed by the structure (constraints) imposed on data. Chapter 2, co-authored, has already been published (Lopez and Weber (2017)). The remainder will be hopefully submitted for publication in peer-reviewed journals in due time.

Chapter 1 presents and discusses extensively a flow-of-funds approach to quantify the impact of official development assistance on the donor country's economy. In particular, it looks at the economic impact of the different ways public resources allocated to ODA are spent in the donor's country by

the donor itself, the recipient countries and the various partners of ODA-financed aid projects and programmes. Based on Swiss data for the year 2014, and following a simple yet rigorous methodology, the primary (immediate) and final impacts of Swiss ODA on the domestic aggregate-demand (GDP) are computed. In a nutshell, results show that, for each franc spent, Swiss ODA has a return lying somewhere between 0.70-0.90 Swiss franc in terms of the immediate impact and 1.19-1.56 franc by integrating the multiplier effect. ODA's effect on employment for that same year is roughly estimated at around 25,000 full-time equivalents. This chapter also provides some useful guidelines and recommendations for future implementations of the methodology in Switzerland and other donor countries.

The second and third chapters are related to each other given that the former implements and further develops the econometric techniques employed in the latter.

Chapter 2 presents the Stata user-written command `xtgcause`, which implements and further develops a procedure proposed by Dumitrescu and Hurlin (2012) for detecting Granger causality in heterogeneous panel datasets. The main advantages of this procedure are twofold. First, it enables the user to conduct Granger causality tests, initially developed in a purely time series framework (Granger (1969, 1980)), within a panel involving the observation of multiple individuals (countries) over time. Second, it allows for heterogeneity of the causal relationships. In other words, Granger causality can be found for the panel even though such causality is not present for some individuals. This chapter also discusses a further salient feature of the `xtgcause` command that gives practitioners the possibility to select the optimal number of lags to include in the models by minimizing the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), or Hannan-Quinn Information Criterion (HQIC). The optimal lag selection is a major issue in time-series modelling since an inappropriate selection of the number of lags can lead to wrong conclusions as we show in the chapter.

Chapter 3 uses the technique discussed in chapter 2 to investigate the direction of Granger causality (i.e. temporal precedence), if such causality there is, between Swiss bilateral official development assistance and Swiss exports for a panel of 50 recipients over the period 1974-2016. To account for possible geographical effects, three specific groups of recipient countries are considered, namely "Africa", "Latin America" and "Asia". To shed light on potential level effects, four other groups of countries are considered according to the relative amount of ODA, respectively exports, flows Switzerland has maintained with a given recipient country throughout the whole period. As a necessary first step, four different panel unit root tests are run on each series of all eight panels and results systematically indicate stationary series

in levels. Then, to test for Granger causality, Dumitrescu-Hurlin Granger non-causality tests are conducted. Results indicate bidirectional Granger causality in all panels. This finding augurs well for the fourth and last chapter of the thesis.

Chapter 4 estimates a structural econometric model to investigate the relationship between Swiss bilateral ODA and exports in the recipient countries based on a panel of 95 recipient countries over 51 years. More precisely, we use an augmented gravity model of trade in order to quantify the impact of Swiss bilateral ODA on Swiss exports while controlling for standard variables such as exchange rate, GDP or free trade agreements. The results point towards a statistically significant relationship between the two variables. The average return on ODA (through exports) is estimated at 0.59 USD for each 1 USD donated in the short run (static model) and up to 1.73 USD in the long run (dynamic model). These effects (magnitude and significance) vary substantially when groups of recipient countries are formed based on their geographical location or the magnitude of bilateral ODA or export flows they receive from Switzerland (same criteria as in chapter 3). In particular, return on ODA turns out to be statistically significant if ODA is directed toward countries to which Switzerland exports the least but donates the most or toward African or Asian countries (rather than to Latin American or European countries).

To summarize, Swiss ODA does produce positive economic returns for the home country. Specifically, bilateral ODA and exports are found to be statistically linked, both in the short run and in the long run. This observation leads to some policy implications that are discussed in the general conclusion. The general conclusion also presents some general limitations of the present thesis and more importantly provides some further research ideas.

Chapter 1: Measuring the Impact of Official Development Assistance on the Swiss Economy: A Flow-of-Funds Approach*

1 Introduction

Official Development Assistance (ODA) has a single and outright priority, namely helping developing countries to economically progress and enhance their welfare. To be considered as ODA, assistance contributions must originate from the government (central or local) and meet the eligibility criteria prescribed by the Development Assistance Committee (DAC).

ODA flows have been subject to numerous studies mostly dealing with ODA's impact on the beneficiary countries (aid efficiency issue). A smaller number of studies have focused on the donor countries themselves. The latter topic is of primary interest in the present contribution. Although ODA is often seen as an altruistic act, i.e. a pure donation without any expected impact on the donor's economy, the reality is different. First, ODA is not necessarily a donation. For instance, a loan to a recipient that is concessional in character with a grant element of at least 25% is considered as an ODA contribution according to DAC standards. Furthermore, assistance to recipient countries can come in the form of goods and services purchased in the donor country, thereby conveying some economic benefits to the donor. In fact, the donor government or its executing agencies have the possibility to purchase domestic goods and services to be sent to the recipient countries. In the same vein, resident experts can be mandated to contribute to ODA-related programmes and projects. Even though the experts' findings and activities are targeted to benefit the recipients, their salaries are likely to be

*This paper is co-authored with Alain Schönenberger. The results discussed in this chapter emanate from a study - based on 2014 data - commissioned by the Swiss Agency for Development and Cooperation (SDC) and the State Secretariat for Economic Affairs (SECO). The research project was directed by Prof. Gilles Carbonnier (Graduate Institute of International and Development Studies, Geneva) and Prof. Milad Zarin-Nejadan (University of Neuchâtel). The project report submitted to SDC/SECO in 2015 was written by the authors of the present chapter together with Dr. Moez Ouni and Mr. Lorenzo La Spada.

at least partially spent in their home country. Thus, the question of how and where ODA is spent determines the magnitude of the economic benefits for the donor.

In addition to these direct impacts on the donor's aggregate demand, bilateral ODA contributions from the donor government can also be the triggering element of supplementary aid flows activated by NGOs and other institutions (i.e. the executing agencies of the government), implying a "leverage" effect on the donor's aggregate demand for goods and services. Finally, yet importantly, multilateral ODA contributions to international organizations may give rise to an indirect effect on the donor's economy by entailing expenditures from international bodies in the donor country that would otherwise not have occurred.

Considering the above-mentioned facts, a thorough examination of the spending behavior of all the actors involved, i.e. the government as the direct provider of ODA, the NGOs involved in aid and cooperation activities, as well as all other institutions, private firms and international organizations that are providing aid flows, is needed. All these ODA-related spending on goods and services of the donor (primary effect) increase the domestic GDP by more than the total value of goods and services sold. Moreover, by means of a multiplier, estimated on the basis of macroeconomic parameters, it is possible to derive an estimation of the final effect of ODA on the donor's GDP. The number obtained can then be used to roughly evaluate the effect on employment. In the case of Switzerland and for the year 2014, we estimate the primary effect on aggregate demand for goods and services purchased in the country to be in the range of 70 to 90 centimes for each Swiss franc of ODA. The final effect on GDP ranges between 1.19 and 1.56 Swiss franc.[14] As for the resulting impact on Swiss employment, it is roughly estimated at around 25,000 full-time equivalents, which represent about 0.6% of Swiss employment (full-time equivalent).

This flow-of-funds approach described above, focusing on the economic impact of procurements derived from ODA programmes and projects, has the virtue of relying on a large set of available data and transparent calculations. If information is missing but needed, imputations are made based on reasonable, evidence-based hypotheses. Furthermore, the methodology used generates an estimate of the economic benefits of ODA-related spending on the donor economy without the restrictions imposed by any economic model and resorting to econometric techniques. It also has the advantage of providing useful insights on the impact of ODA on the donor's economy, which can be easily communicated to decision makers and the general pub-

[14] Schönenberger et al. (2015).

lic. On the other hand, not all effects of ODA on the donor economy can be accounted for. This is true for instance for the growth-induced imports of the recipient countries (exports for the donor) or goodwill effects on trade and direct investment. The flow-of-funds approach can at best give a lower bound estimate of the total domestic effects of ODA.

The rest of the paper is organized as follows. Section 2 provides a brief literature review. Section 3 goes through the methodology employed. Section 4 presents and discusses the results for Switzerland in 2014. Section 5 points out the limitations of the methodology and provides directions for future improvements. Section 6 concludes and mentions some policy implications.

2 Literature review

This section reviews the limited number of studies which have used the flow-of-funds methodology to compute the economic impact of ODA on the donor country. To the best of our knowledge, the first contribution on the economic "fallout" of ODA for the donor country is the study by Hyson and Strout (1968). In their contribution the authors estimate the impact of foreign aid on U.S. exports over the years 1960 to 1965 in three-steps. First, they assess the effectiveness of foreign aid on the economic growth of the recipient countries. Then, based on the estimation of the growth effect of the aid flows, they calculate the increase of the demand for imports of the recipient countries. Finally, using U.S. trade shares in those recipient countries, the authors quantify the impact of foreign aid on U.S. exports. The estimated impact is unsurprisingly large given the fact that "the federal government has adopted the policy of maximizing the procurement of goods in the United States for all projects financed with Official Development Assistance". Around 60% of the total increase of U.S. commodity exports towards the analyzed set of recipient countries was attributed to U.S. foreign aid, of which about two thirds were the outcome of U.S. foreign assistance tying policy and one third the result of increases in income in the recipient countries generated by U.S. foreign aid. Note however that the authors did not consider the direct spending by U.S. aid on the domestic markets of goods and services (administration, U.S. experts). Hyson and Strout are, to a certain extent, the pioneers of the empirical analysis on the existing links between foreign development aid and export performance of the donor country.

Nearly two decades later, Schumacher (1984) analyzed the impact on employment of bilateral ODA flows by studying the direct effect on German (former Federal Republic of Germany) exports of goods and services purchased in relation with tied and untied aid as well as financial transfers

which cofinance local initiatives and investment projects promoting economic development of the recipient countries. As an additional beneficial impact of ODA on German employment, the author also considered technical cooperation consisting of employing experts with their equipment in the recipient countries and training of local staff. Furthermore, he also included the exports of Germany resulting from ODA activities of multilateral institutions and the bilateral ODA by other donor countries (as well as private direct investment in developing countries). The author warns the reader about the fact that resulting economic growth of the recipient country can actually have a negative impact on employment in the donor country since more favorable economic conditions in the former encourage local production and consumption, possibly provoking import substitutions.

The author used input-output modeling, thus accounting for the direct effect on the industries benefitting from ODA-related exports and the indirect induced effect through purchases of intermediate goods and service provided by other sectors. For the year 1982, he found a return on bilateral ODA of around 32,000 full-time equivalent positions to which one could add 18,000 employments if private engagements on aid projects and programmes, not included in the official assistance figures, are taken into account. Then, he found that the contracts obtained in the international tendering procedure by German firms and institutions for the delivery of goods and services in relation to the aid programmes and projects financed by the multilateral institutions (World Bank, UNDP, European Development Fund EDF, and the regional development banks) accounted for approximatively 35,000 employments. Bilateral ODA of the other donors implied 16,000 additional employments. Last but not least, the author also considered the additional (German) exports induced by ODA flows directed to other recipient countries (not on the list of countries of cooperation) and estimated the corresponding impact on employment at around 24,000 jobs. In total, he estimated the return on ODA in terms of employment to reach 125,000 positions in 1982.

Note that using the same methodology, May et al. (1989) reported for the year 1985 an employment effect of ODA of 120,000 in Germany, which represented at that time around 0.4% of the total employment. The authors also reported that the British team of the joint research project found for Great Britain an ODA return of 75,000 jobs (around 0.3% of total employment).

Fitzpatrick and Storey (1988) carried out a flow-of-funds study to measure the economic benefits of ODA on Ireland as a donor country. The authors adopted a cost-benefit approach. They considered as costs total ODA contributions but also two additional elements that can be construed as opportunity costs of providing ODA. The first one is the fact that Irish workers employed as a result of bilateral or multilateral aid cannot be used

to produce goods and services to satisfy the domestic demand. Secondly, when goods and services are produced for ODA-financed purchases, physical capital is used which becomes unavailable to produce other goods and services. The authors mitigate however the importance of these opportunity costs which greatly depend on the pre-existing degree of utilization of these resources. At the time of the study, Irish unemployment was indeed high. Unemployed resources, of the quality required by the ODA-induced production, have therefore a lower opportunity cost compared to a situation of full capacity utilization. Regarding benefits, the authors consider the expenses, from bilateral aid programmes, in form of purchases of Irish goods and services as well as employment opportunities for the residents. They also consider the sales of goods and services and consultancy by national firms and organizations to multilateral agencies to which the Irish government contributed (multilateral ODA). The authors further mention, without being able to measure it, that the development of contacts and goodwill overseas should be considered as an additional benefit of ODA flows. They conclude however that, even if it is clear that ODA produces economic benefits for the donor, these effects do not outweigh the economic costs (i.e. cost-benefit ratio exceeds unity).

Recently, Schönenberger et al. (2012) estimated for the year 2010 the effect of Austrian ODA on GDP. To do so, the authors employed the same methodology as the one we discuss below (section 3), slightly modified to take into account some specific features of the Austrian ODA. The authors found a primary effect of around 53 cents for each euro of Austrian ODA and a final effect of about 66 cents. Regarding Austrian employment, the impact was roughly estimated between 8,300 and 10,600 full-time equivalent (0.2 to 0.3% of total employment).

Regarding Switzerland, the first study using the flow-of-funds approach, followed by subsequent quadrennial studies, was undertaken on behalf of the Swiss Agency for Development and Cooperation (SDC) by Forster et al. (1996). The methodology used, quite similar to the approach employed by Fitzpatrick and Storey (1988), is presented in detail in the next section based on the report for the year 2014. The authors estimated for the year 1994 the primary and final effects of ODA on the Swiss economy. They found a primary effect of ODA expenditure on aggregate demand of between 0.90 and 1.02 Swiss franc for each franc of ODA. Then, by including the impact of estimated Keynesian multipliers, the final effect - i.e. increase in GDP - was estimated between 1.55 and 1.79 Swiss franc. In terms of employment, a positive impact of roughly 16,000 to 23,000 full-time equivalent positions was reported (0.5 to 0.7% of total employment).

Even though the contributions reviewed above all use a flow-of-funds

approach, the results are not strictly comparable, not the least because of important institutional differences among the countries. Besides, differences in the composition and definition of ODA exist between the countries, partly related to the time frame. Furthermore, the methods used to estimate the economic impact (on GDP and employment) can be very different. In particular, when using an input-output approach for taking into account the existing links between sectors via intermediate goods and services, results would be undoubtedly different (most probably higher) compared to those obtained by a simple multiplier. Also, the "indirect effect" induced by ODA is not comparable across studies. For instance, Schumacher (1984) includes the effect on the donor economy of bilateral ODA from other donors. Last but not least, some studies focus on the effect of ODA on employment whereas others report results in terms of aggregate demand (GDP).

3 Methodology

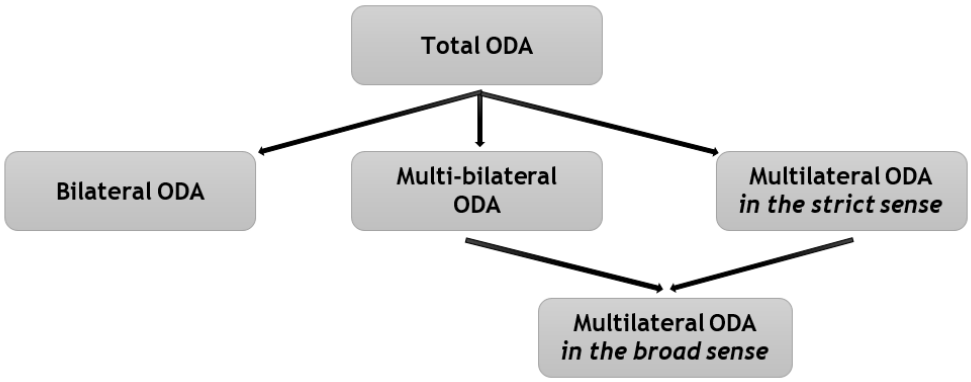
This section presents in detail the flow-of-funds approach used in this paper. It corresponds to the most recent quadrennial Swiss study conducted for the year 2014. In particular, we describe how total ODA flows are decomposed in two distinct categories (contrary to the three categories the DAC considers). Then, it will be explained how the two types of financial flows considered produce different effects on the donor's aggregate demand. Finally, the Keynesian multiplier is computed and applied to the primary effect of ODA. The multiplier serves to calculate the final effect on GDP and, by means of official figures on average labor productivity, the corresponding full-time employment generated.

Based on the nature of ODA provided by government, the flows as they appear in public accounts can be divided into three distinct categories, namely, *bilateral*, *multi-bilateral* and *multilateral*[15] . Bilateral ODA programmes and projects are negotiated and implemented by the recipient and the donor. Multi-bilateral ODA is spent on programmes and projects designed and executed by international organizations but financed by the donor country in specific recipient countries. The third category of ODA refers to financial resources allocated to international organizations either to contribute to their overhead or to finance specific development projects but without the donor being able to decide to which recipient the funds are directed. The DAC considers multi-bilateral ODA as bilateral ODA because the assistance is geared to a specific recipient country. For our purposes, however, multi-bilateral

[15]A glossary defining the terms and ODA-related effects to which we refer is available at the end of this paper, after the appendices.

and multilateral ODA are assumed to produce the same kind of effect on the donor country's aggregate demand. Thus, those two types of flows are therefore subsumed in one single category, namely multilateral ODA (in the broad sense). Figure 1 below exhibits the different types of ODA.

Figure 1: Total ODA decomposition



Bilateral ODA produces two distinct effects on the aggregate demand, namely a *direct* effect and a *leverage* effect.

Regardless of the donor country, the allocated resources for bilateral ODA are spent on goods and services except if they represent a pure financial flow (e.g. general contribution to the recipient's budget and debt relief). A donor can buy goods and services (e.g. agricultural equipment) from any country in the world, and then import them into the recipient country. It is also possible that the national or foreign executing agency in charge of an ODA project decides or co-decides what to buy and from which countries. Similarly, the donor or its executing agencies may mandate experts from any country to deliver services in the recipient country. Some of the funds will be spent on goods and services emanating from the donor country even if the ODA is not tied (i.e. conditional on purchasing goods and services from the ODA provider country). This might be the case because the national producers of the goods and services needed are competitive or for reasons related to domestic policy goals. Note that the costs of administering various programmes and projects are included in the definition of ODA, so that automatically part of the budget is necessarily spent in the donor country (e.g. public administration, overhead and resident employees of executing agencies).

The part of the bilateral ODA budgetary allocation which is spent in the donor country has a direct effect on the latter's aggregate demand for goods and services.[16] The direct effects are estimated by examining how (much) government bodies providing ODA and their executing agencies, usually a small number, spend in the donor country. Most of the executing agencies mandated for carrying out or supervising the programmes or projects have their headquarters in the donor countries. It is therefore necessary to look for data on how and where those organizations spend the funds which have been allocated to them. The information can be gathered by questionnaire and/or personal interviews. In general, to be time and cost efficient, not all individual parties are contacted and questioned. A representative set of stakeholders should however be consulted, if possible, and the results extrapolated to the total spending of the ODA category examined. The questionnaires/interviews typically ask for information on how the project funds are spent (mainly salaries and social security contributions, purchase of goods and services, and possibly other important spending items such as direct transfers or interest charges) and of course what proportion of each item is spent in the donor country. The survey also collects information on the existence of private sources of funds, which might complement the ODA funds, in order to account for a possible leverage effect.

The leverage effect of bilateral ODA occurs when existing ODA donations attract matching funds. Indeed, available ODA financing is often complemented by private (or even some foreign public) sources.[17] A share of these additional funds, like the bilateral ODA funds themselves, are spent on the donor's goods and services (including work remuneration). Thus, bilateral ODA, but not exclusively, is prone to entail, through additional contributions, a leverage effect on the donor's aggregate demand. For the ODA financed projects and programmes, the executing agencies, private or public, must keep an exact record of the spending and its allocation. However, additional private funding, not necessarily included in the official project request, is unfortunately not subject to the same scrutiny by the public or government. This complicates the approximation of the so-called leverage effect. In

[16]Providing ODA in the form of national goods and services does not mean that aid is tied. Indeed, tied aid is defined as an aid provided under the explicit condition that it will be used to purchase goods or services from the donor country. Switzerland, compared to other countries, has traditionally had a relatively low proportion of tied programmes and projects (see for instance Berthélemy (2006) who categorizes Switzerland as the most altruistic donor of the panel due to the low share of tied aid the country provides). Presently, in most OECD countries, only a small part of ODA is conditional in terms of the destination of the funds.

[17]It is assumed that government contributions attract additional donations and not the other way around.

the earlier Swiss studies, no limit on the possible leverage effect of bilateral ODA was set. Because the data collected and subsequently used regarding the leverage effect were not always representative (enough) and reliable (e.g. not necessarily closely connected to the ODA-financed programmes and projects), for the 2010 study, a 50% ceiling was set for the leverage effect (unless detailed recent reliable information were available). We kept the same leverage effect ceiling for the 2014 report. In other words, it is assumed that bilateral ODA of 1,000 CHF enabled the mobilization of private funds of up to 500 CHF. Alternatively, one can also include all purely private funded projects in the estimations (in the same vein as Schumacher (1984)), but with the risk of overestimating the leverage effect.

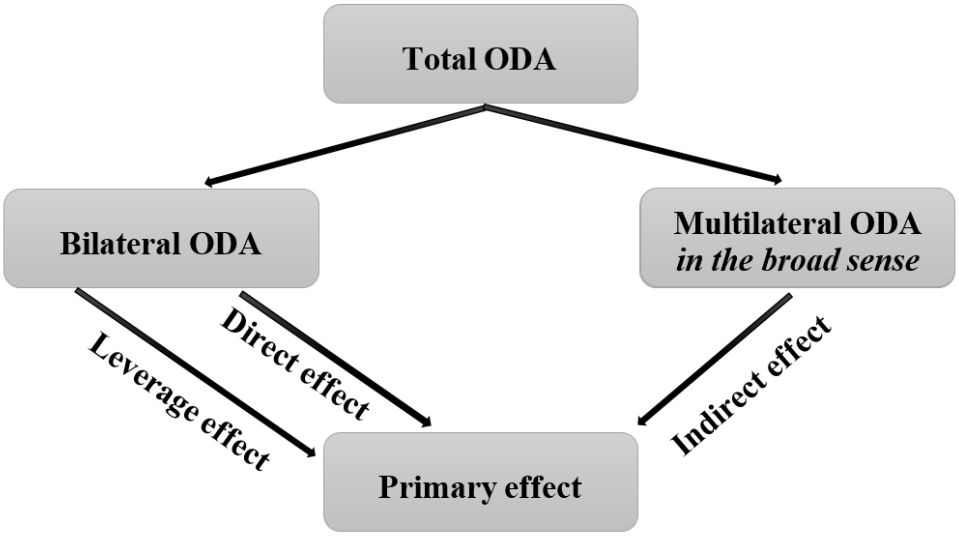
Multilateral ODA comprises contributions by national governments to the financing of aid projects and programmes promoted by international organizations. Typically, a programme might be financed by several donors. In general, goods and services of some importance (i.e. beyond a certain threshold) are spent following a tendering procedure at the international level. If firms and organizations in the donor country win the tender, then the funds spent have a greater likelihood to benefit the donor's economy. This effect is called indirect since the purchases in the donor country are in principle, by regulation and contracts, not linked to the individual contributions to international organizations. However, it is true that only contributing countries can participate in the tendering process. Likewise, it is also possible that donor countries may preferably fund programmes within international organizations from which they are most likely to benefit.

In practice, most of the important international organizations receiving multilateral ODA, e.g. the UN, or the regional Development Banks, keep a database on their contracts and can provide a list of organizations and firms which provided goods and services co-financed by ODA funds. It should be noted that if the beneficiaries are internationally active Swiss NGOs or Swiss multinational firms (as opposed to national), the impact of their contracts on the aggregate demand (primary effect) is expected to be smaller. In the extreme case, a contract given to a very large international corporation whose headquarters are located in the donor country might be executed entirely abroad with no significant impact on the donor's economy. Acknowledging this fact, and based on data collected on ODA co-financed contracts, two variants for the indirect effect have been considered and computed. The lower bound (LB) comprises expenditures made to Swiss-based companies producing in Switzerland (territorial criterion) whereas the upper bound (UB) also includes expenditures directed overseas to the subsidiaries of the Swiss companies (national criterion). Also note that many contracts run over several years, and only the disbursements during the year of interest should of course

be retained.

The primary effect of ODA mentioned above on the aggregate demand is the sum of the three types of aid spending effects, namely the direct, leverage and indirect effects (figure 2).

Figure 2: ODA types of aid spending effects



Put differently, the primary effect is the measure of the immediate impact of ODA on the donor's aggregate demand for goods and services. According to the well-known Keynesian multiplier process, the primary effect gives rise to a second round of expenditures on the donor country goods and services, then a third round, and so forth thereby increasing aggregate demand and GDP. The size of the multiplier effect depends, for a given primary effect, on the behavior of households and firms, represented by macroeconomic parameters determining consumption (i.e. marginal propensity to consume out of disposable income) and imports (i.e. marginal propensity to import).[18] The marginal propensities to consume and to import we used in the 2014 Swiss report are derived from the econometric equations for private consumption and

[18]Note that large purchases might increase investment demand thereby, everything being equal, enhancing the multiplier effect ("accelerator principle"). For a simple but thorough exposition of the multiplier, see Peacock and Shaw (1976). A discussion of the "crowding out" effect of an increase of aggregate demand, mentioned in the section below on the limitation of the Keynesian multiplier linked to an increase in public spending (e.g. in ODA expenditure), can be found in Shaw (1971).

imports estimated by Mattei (2007) in the framework of his macroeconomic model of the Swiss economy.

Since ODA impacts the economic circuit differently in terms of value added (primary effect) depending on the nature of the spending, a different multiplier is computed to obtain the direct, indirect and leverage final effects. For instance, the purchase of goods has a smaller multiplier effect compared to the payment of consultancy fees. Indeed, for an equal initial sum, the former has a lower percentage of value added (salaries). Typically, the estimated value of the short-run multiplier could be smaller than one in the case of purchases of consumption goods, but higher than one for salaries which represent a larger direct contribution to value-added. Large differences in the percentage of value added in turnover exist even within the manufacturing industry.

Consequently, three multipliers depending on the nature of the primary impact of spending on the economic circuit are used to calculate the GDP impact of ODA (see diagrams in appendix A). The algebraic expressions of these multipliers (k_1, k_2, k_3) are reported in appendix B.[19]

The sum of the primary effect of ODA and the multiplier effect constitutes the final effect of ODA on the donor's GDP (figure 3). The time necessary for the whole multiplier process to be completed depends mainly on the economic agents' behavior and reaction.

Figure 3: ODA final effect

Algebraically, the final effect (FE) of ODA is given by:

$$FE = k_1 BODA + k_2 LF + k_3 IO$$

where $BODA$, LF and IO stand for, respectively, bilateral ODA, levied funds (thanks to bilateral ODA contributions) and multilateral ODA-related aid expenditures from international organizations towards Switzerland (two bounds are considered as discussed above). The terms $k_1 BODA$, $k_2 LF$ and $k_3 IO$ therefore represent, respectively, the direct, leverage and indirect final effects.

Given the estimated increase of GDP, the impact on employment (corresponding to full-time equivalent employment) can be roughly computed

[19]See Forster et al. (1996) for more detailed information on the multipliers.

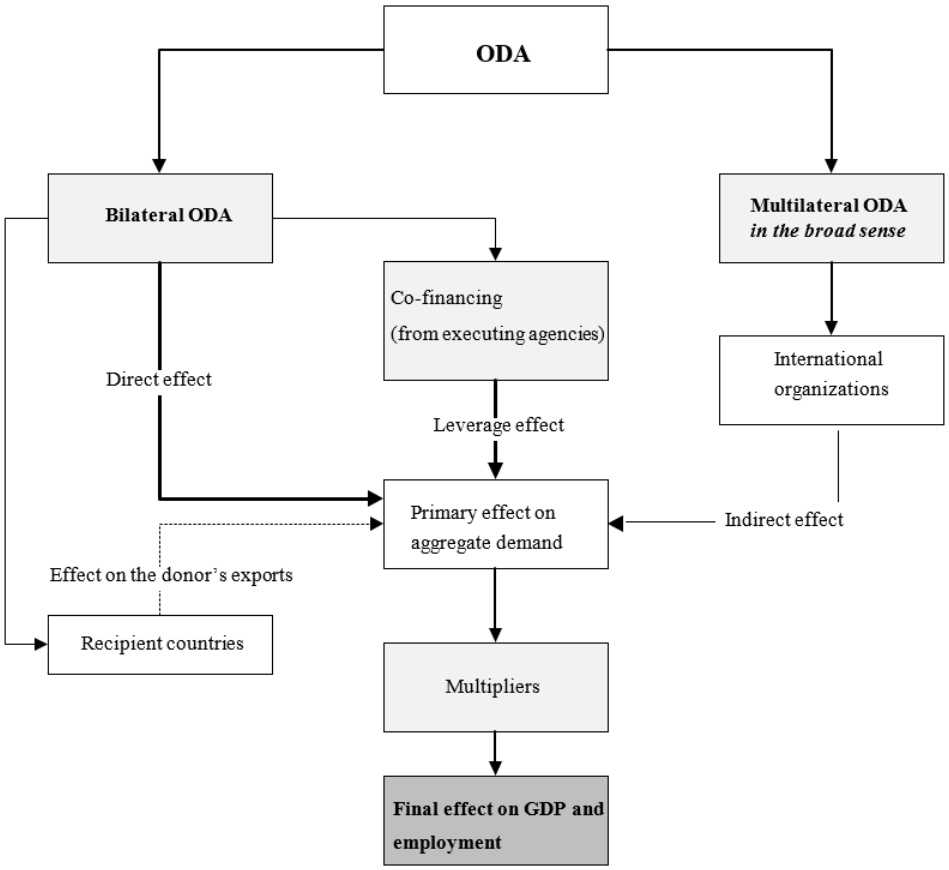
by using average[20] labor productivity. As discussed, the impact of ODA on the donor country's GDP occurs through the purchase of goods and services (including experts' remunerations). Thus, depending on the share of the sectors benefiting from ODA spending, the appropriate average productivity of labor should be used to compute the impact on employment. For instance, if the primary effect relates to the purchase of goods, the average productivity of labor in the manufacturing industry may be used. On the contrary, if the primary effect is due to the purchase of services, the service sector average productivity of labor would be more appropriate. An average or weighted productivity of labor can also be employed.

Average productivity of labor of industrial and service sectors differ considerably in Switzerland. As the data collected do not differentiate between the purchases (primary increase of aggregate demand) among sectors and industries within the direct, leverage and indirect effects, it is necessary to choose, for the computation of the employment effect, a single value for the average labor productivity (value added divided by full-time equivalent positions) derived from the production account of the Swiss national accounts (data available on the Swiss Federal Statistical Office website. Two employment levels are computed: the lower bound of the employment effect is calculated by using the average productivity of labor in the manufacturing industry while the upper bound refers to the productivity of administrative, technical and consulting activities. A unique estimation of the employment effect could be obtained for instance by using the labor productivity of market-based activities (i.e. excluding the public sector). It is the latter estimation that we use to provide a single figure for employment (see section 4).

Figure 4 below summarizes the different ways ODA can impact aggregate demand and thereby GDP (and employment). Note that the figure includes the potential effect ODA may have on the donor's exports (induced exports from the donor to the recipients and the so-called "goodwill" effect) which are not taken into account in the pure "flow-of-funds" approach (see section 5 for a discussion on this issue).

[20]By using average productivity, the increase of employment is somewhat overestimated. Ideally, one should use the lower marginal productivity of labor. However, this latter being not observable, we use the average labor productivity.

Figure 4: Summary of ODA's effects on the donor's economy



To sum up, a prime concern of the flow-of-funds approach, whatever the type of effects (direct, leverage or indirect) considered, is to identify the nature of the purchases and the destination of the funds, namely whether these are directed to the donor country of interest or abroad (e.g. the recipient countries). Regarding the nature of the purchases, a given sum devoted to acquisitions of industrial goods has a relatively low multiplier effect on GDP (value added) because a large part of the turnover covers the cost of intermediate goods, as compared to expenditures on consultancy services which largely consist of salaries and honorariums (value added). Thus, it is advisable to collect some information on the spending behavior of the domestic cooperation partners in order to obtain accurate estimates of the primary effect, including the location of experts commissioned. For instance, the cost of expatriates consists mainly of their remuneration (including social security

contributions), which is spent to some extent in the recipient countries but certainly also in the country of residence, namely the donor country in most cases of bilateral ODA. Thus, if the expert is physically located in the donor country, then all his remuneration is deemed to have a positive impact on domestic aggregate demand. However, if the expert is expatriated, only part of his remuneration should be considered as impacting aggregate demand in his home country, given that a share of his income will probably be spent in the recipient country. In our study, it has been assumed that 65% of experts' salaries is spent in the home country (i.e. Switzerland). This proportion was determined as a result of informal discussions held with field experts and SDC officials.[21]

Old-age and most of the other social security contributions, as part of the labor costs, paid by the employer (donor country) and the expatriate are considered as increasing aggregate demand, as the social insurances are predominantly financed according to the pay-as-you-go principle. In this case, social security contributions finance directly pensions which are spent by the beneficiaries on good and services purchased in the donor country. Technically, and to be coherent, social contributions to pension funds - the so-called "second pillar" of the Swiss old-age pension system which capitalizes the contributions until the pension age is reached - should be considered as savings (therefore not impacting current aggregate demand).

Data requirement and treatment issues are briefly touched upon above when describing the various steps in estimating the direct, leverage and indirect effects. However, the published data are not sufficient to calculate the direct effect, let alone the leverage and indirect effects. Aggregate figures on ODA are provided and published in some details by the agencies in charge of development aid. Nowadays, the official agencies, members of the DAC/OECD, report their ODA spending items in the form of a harmonized Creditor Reporting System, which allows to aggregate the data while preserving the detailed information for analysis[22]. Nevertheless, this concerns only the different payments made by government and not the use of the funds by the beneficiaries (usually the executing agencies). Therefore, it is necessary to look for this information with the partners and executing organizations

[21] In the absence of any precise indication, previous Swiss studies mostly assumed that the entire remuneration of Swiss-based experts was spent in Switzerland. Of course, this assumption carried the risk of leading to a slight overestimation of the impact.

[22] The objective of the CRS Aid Activity database is to provide a set of readily available basic data that enables analysis on where aid goes, what purposes it serves and what policies it aims to implement, on a comparable basis for all DAC members. Data are collected on individual projects and programmes. Focus is on financial data but some descriptive information is also made available.

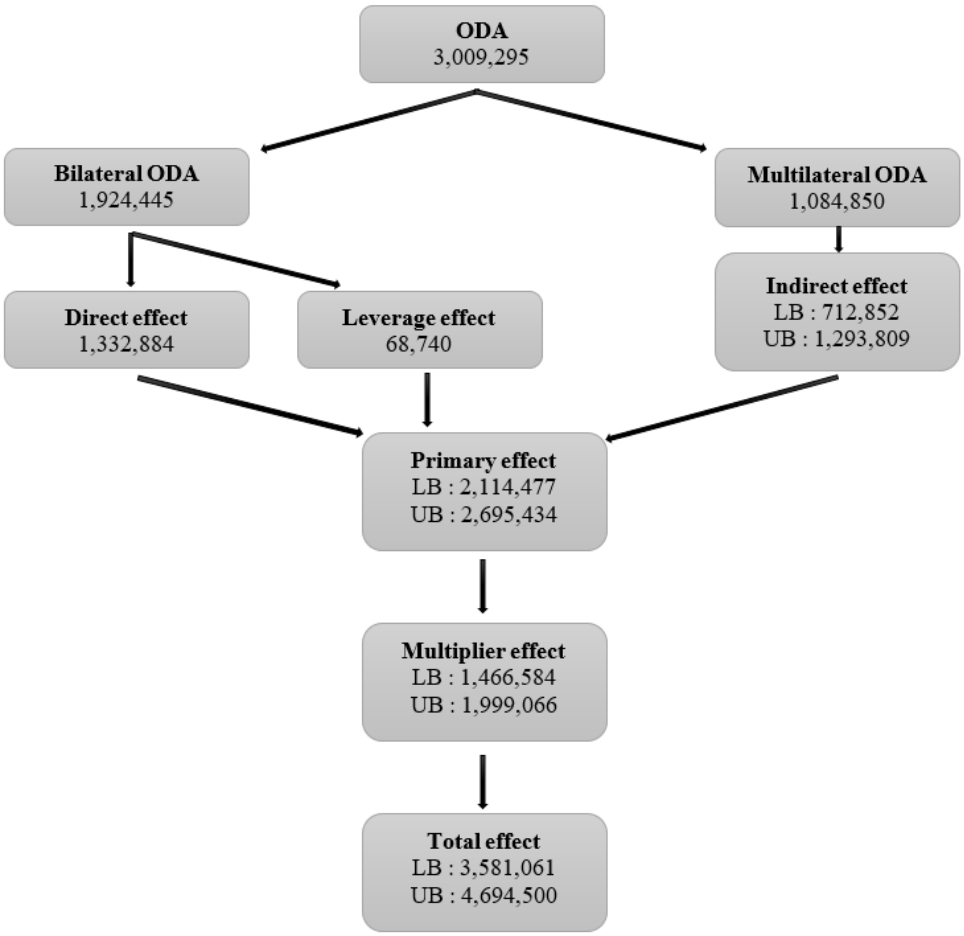
by means of questionnaires and/or interviews, and to exploit available data as well as qualitative information on spending patterns.

4 Results

In 2014 the total amount of Swiss ODA reached 3,009.295 million CHF according to the officially published figures, including contributions by all federal offices as well as local and cantonal governments. The statistics also break down total ODA into different categories (e.g. humanitarian aid, peacebuilding and human security, economic and trade cooperation, etc.) of aid and cooperation. The total sum spent is divided into bilateral and multilateral ODA. In practice, detailed information on the composition of ODA is provided by the two largest ODA spending federal agencies, namely SDC and the State Secretariat for Economic Affairs (SECO). As explained in the previous section, the missing information on how ODA funds are spent by the executing agencies is obtained either through surveys, reports of activity and interviews of experts and representatives of these institutions.

The results for the year 2014 are presented below in a graphical form (numbers in thousands of CHF). In accordance with the methodology, two bounds are computed regarding the indirect effect. Whereas the lower bound does not include goods and services purchased from subsidiaries of Swiss companies located abroad, the upper bound includes contracts awarded to Swiss companies but whose deliveries might originate from a subsidiary abroad.

Figure 5: ODA's effects for Switzerland, 2014

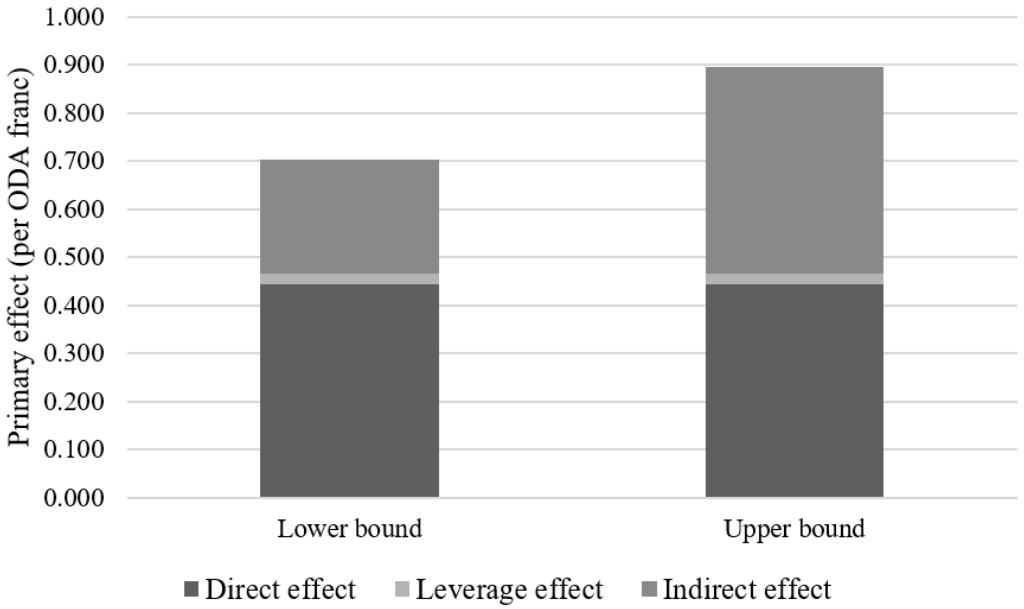


The estimated effects can be related to the ODA categories in order to show the comparative effect by franc of ODA and to allow meaningful comparisons over time. For instance, each Swiss franc of ODA allocated implies a total primary effect (lower bound) of 0.70 Swiss franc (2,114,477/3,009,295). Regarding the final effect, on average, each franc spent on ODA increases GDP by 1.19 franc (lower bound) or 1.56 franc (upper bound).[23]

One might also consider the impact of ODA on the total demand for goods and services by types of effects. Figure 6 shows the composition of the primary effect according to the direct, indirect and leverage effects.

[23]The total effect of 1 Swiss franc of ODA on Swiss GDP (in francs) is given by $\frac{k_1 BODA + k_2 LF + k_3 IO}{ODA}$.

Figure 6: Primary effect decomposition



The leverage effect is negligible (2 centimes). The direct effect accounts for around 0.45 franc and the indirect effect for 0.25 franc in the case of the lower bound. The latter effect is increased, to some 0.45 franc if one considers the upper bound, i.e. the purchases of goods and services from Swiss based multinational by multilateral ODA institutions. The fact that the indirect effect plays an important role in the computed return on ODA is in line with the results of Carbonnier (2013) that highlights the potential link between multilateral ODA and spending of international organizations in the contributor country. Furthermore, according to the magnitude of the direct effect, about half of ODA expenditures directly impact the Swiss economy. The size of this effect appears all the more impressive in the light of the largely untied nature of Swiss ODA.

Despite the mostly minor changes in the definition and composition of ODA from 1994 onward, the results can be compared through time and throughout the studies, with possibly the exception of 2010 (and 2014). Indeed, in 2010 some significant revisions have been made in the methodology to better reflect recent developments with regard to ODA expenses. For comparison, the figures of 2006 have also been computed with the changes. Table 1 below exhibits how the primary and total effects have evolved from 1994 to 2014.

Table 1: Swiss ODA returns through time

Effect \ Year	1994	1998	2002	2006	2010	2014
Primary effect	LB: 0.90 UB: 1.02	LB: 0.73 UB: 0.81	LB: 0.82 UB: 0.92	LB: 0.74 UB: 0.83	LB: 0.73 UB: 0.87	LB: 0.70 UB: 0.90
Total effect	LB: 1.55 UB: 1.79	LB: 1.43 UB: 1.60	LB: 1.42 UB: 1.63	LB: 1.03 UB: 1.21	LB: 1.29 UB: 1.51	LB: 1.19 UB: 1.56

By analyzing the figures of table 1, it turns out that the primary effects are quite stable over years despite the revisions. On average, the primary effect amounts to about 80 centimes for each Swiss franc of ODA. The estimated total effects on GDP seem to be much more volatile and decreased in 2006 with the changes in the calculations. On average, between the upper and lower bounds, one franc spent on ODA has an estimated return of 1.4 francs.

Unfortunately, the results obtained for Switzerland cannot really be compared to those obtained for other donor countries, since the approaches followed differ quite substantially across countries and studies as we mentioned earlier. However, irrespective of the country studied and the precise method used in the flow-of-funds approach, the estimated benefits for the donor of providing ODA are found out to be relatively large.

5 Discussion and limitations

In the first place, we discuss possible extensions that could be made without changing the methodology employed. Then, and even though the flow-of-funds approach used is rather simple and straightforward, we explore some of the assumptions that had to be made (in particular for the indirect and leverage effects), often because of the lack of detailed and relevant information. Finally, we discuss some underlying limitations of the flow-of-funds method that can potentially lead to an overestimation or underestimation of the impact of ODA on the donor's economy.

A welcome extension and improvement of the present study would consist of differentiating ODA's effects across sectors by using an input-output analysis, as done by Schumacher (1984). A purchase from one sector leads to subsequent purchases of inputs from other sectors of the economy (or from abroad). Thus, a meticulous analysis of the primary effect at the sectoral level delivers more precise information on which economic sectors profit most from

ODA, which can be politically important from the industrial and regional policy viewpoints. Such an extension commands that the sectoral destination of each individual spending (contracts with an organization or a firm) be identified. Unfortunately, this is not possible without an extended revision of the data collection supported by the main national ODA governing bodies (to encourage the executing agencies to collaborate) and an increase of the associated work burden. The direction of the resulting changes in aggregate demand and income depends on the sectoral composition of the spending. For instance, some sectors might require large imported inputs (raw materials, semi-finished goods) whereas others have a much lower propensity to import. Compared to the simple one-sector variant, the multiplier effect might be larger or smaller.

The leverage effect takes into account the effect of ODA on levying private funds for financing projects and programmes. It is implicitly assumed that the availability of government funding increases the likelihood for NGOs to raise complementary private financing for their projects. However, this direction of causality can be put in question. Indeed, it may be that projects are first conceived and implemented owing to private funds and then the NGOs apply for complementary government funding (ODA). If this is the case, the legitimacy of defining a leverage effect should be reconsidered. A solution to this issue would be to conduct a survey on a certain number of agencies involved in such projects in order to better grasp the direction of causality, if causality there is. That being said, and regarding Switzerland, the leverage effect is a negligible part of the primary effect, consequently reducing this limitation. It should be noted at this point that one might also consider all purely privately-funded aid projects and programmes, applying the same eligibility criteria as for ODA (except of course for the origin of funds), as Schumacher (1984) did for Germany.

The indirect effect is included because it is believed that international organizations active in cooperation for development tend to spend their financial resources in priority in countries that have provided them with multilateral ODA. This hypothesis remains to be tested. However, Carbonnier (2013) found that multilateral ODA contributions might influence positively the purchases by international organizations of goods and services from contributing countries.

The present study does not consider the impact on aggregate demand of the financing pattern of ODA. Indeed, if for instance expenditures on ODA are financed by an increase in taxes, the ensuing impact on aggregate demand is smaller than if ODA expenses are financed by an increase in government debt. In the former case, the final effect is indeed reduced by an increase in taxes which has a contractionary effect on the aggregate demand. In

a purely Keynesian setting without a money market and price changes, the balanced-budget multiplier, i.e. when government spending is financed by an equivalent increase of taxes, is equal to one (Haavelmo's theorem). Similar effects arise when the government is subject to a budget constraint or a fiscal rule whereby an increase in spending must be (partially) compensated by a decrease in expenditure on other budgetary items.

The size of the multiplier effect also depends on other assumptions. There are numerous effects which may mitigate the multiplier effect. At worst, the multiplier will tend to zero, leaving only the primary effect of spending on goods and services produced by the donor country. Most of the current impact studies ignore potential crowding-out effects of spending. For instance, the impact of (deficit-financed) ODA on the interest rate is ignored. Rising interest rates can discourage (private) investment, thereby at least partially offsetting the effect of ODA spending. A rise of the price level, for instance when the economy is at full-employment level, reduces real money supply, thereby acting as a contractionary monetary policy. The impact on the interest rate would consequently be greater than under constant prices and the resulting crowding-out effect stronger, cancelling out at least part of the expansionary effect of an increase in ODA. The size of the crowding-out effect will also depend on the exchange-rate regime (flexible or fixed) via its impact on imports and exports of goods and services. Government spending, financed by deficit, could also give rise to a contractionary effect on private spending (via consumption), when households tend to save more in order to be able to pay later additional taxes required to reimburse the debt contracted (so-called Ricardian equivalence). However, as for the Swiss economy, very small and largely open, some of the above-mentioned crowding out mechanisms do not apply. For instance, the high mobility of capital and abundance of savings is likely to preclude any increase of the interest rate due to larger ODA spending.

Potential crowding-out effects are often ignored on the grounds that the spending under scrutiny is relatively small compared to aggregate demand, with negligible impact on other variables likely to influence the measured impact in one way or another. In short, the final effect of the primary increase of aggregate demand due to ODA spending would depend on the structure and characteristics of the donor's economy, especially the financing of the ODA, and the degree of sophistication of the underlying macro-economic model used in simulating an impact of ODA. However, one cannot rule out that taking into account these variables change significantly the final effect of ODA. That is why one should rely more on the primary effect than on the final demand effect.

Ideally, instead of using a simple framework (as reflected by the Keynesian

flow-of-funds diagram in Appendix A) like in the present study, one can use a more sophisticated model in order to compute more realistic multipliers (see for instance Batini et al. (2014) who discuss in detail the determinants of the size of the fiscal multiplier in the context of fiscal policy). However, it is not at all clear if expected gains in precision justify the costs of additional complexity in terms of economic modeling and econometric techniques.

More fundamentally, a flow-of-funds approach may completely miss positive economic effects induced by ODA contributions in a long-term perspective, not captured by simply identifying and tracing monetary flows linked to resulting spending. The methodology adopted takes into account indirect effects such as the "return" through an increase in exports linked to multilateral aid programs financed by the donor country, but not collateral or incidental effects of Swiss ODA on exports. Indeed, in the long run, bilateral ODA tends to foster economic and financial relationships with the recipient country that would not have occurred without ODA, thus facilitating trade and investment between the two countries.

6 Conclusion

This contribution used a flow-of-funds approach to determine the economic impact of ODA on the donor country. ODA has an impact on the donor's aggregate demand, at least due to the remuneration of the personnel in charge of managing ODA. However, the economic benefits could be much larger if the donor spends its ODA budget in a way that leads to purchases on national goods and services. The extreme case is a totally tied aid (against the international trend of untying aid and cooperation).

The leverage effect of bilateral ODA and the indirect effect of multilateral ODA generate additional incomes that have to be taken into account. Altogether, for 2014, we found a return of up to 1.56 Swiss franc for each franc of ODA. This return, above unity, means that Switzerland, at least in the short run, gains more income than the total amount spent of ODA. Depending on assumptions made in the course of the estimation procedure, it might be possible that the computed effect is somewhat overestimated. On the other hand, there are also reasons to believe that certain hypotheses made or methods used could lead to an underestimation of the true effect. Thus, if the magnitude of the effects is debatable, it can hardly be denied that providing ODA does impact the donor's economy positively. Even though the donor does not provide ODA for its own benefit, the fact remains that the economic return of ODA reduces its budgetary cost (or even exceeds it when multiplier effects are taken into account).

This observation has certain political consequences. Indeed, if decision makers of any donor country were aware of the existence and the magnitude of returns in terms of domestic aggregate demand, the amount of ODA might not be the same. Depending on the return, ODA could even be considered as an investment like direct foreign investments. More fundamentally, the resources of governments are scarce and taxpayers have the right to know how these resources are spent and what are the true opportunity costs of the various government spending items, including ODA. Note also that the knowledge of the true cost of ODA can well change the public perception of aid efficiency. There are only a handful of empirical studies on the economic fallouts of ODA estimated by using the data on the flow of funds while many more exist on the incidental impact on export via goodwill, information channels, induced growth and technical dependence (replacement investment, norms). In order to facilitate comparison and interpretation across regions and countries, it would certainly help if a unified methodology for such studies could be put in place by DAC.

Finally, it has been mentioned in this contribution and in most of the related literature that ODA flows may impact the donor country in ways that are not revealed by the flow-of-funds approach. In particular, it is believed that ODA contributions, especially bilateral flows, create a long-standing relationship between the donor and the recipient, which enhances trade and capital movements between the two countries to their mutual benefit. In particular, as a result of ODA flows, the recipient country may be more disposed to import goods and services from the donor country. Checking the accuracy of this hypothesis and the magnitude of the long term effect needs economic modeling and recourse to econometric techniques but would cast light on an important issue. Indeed, depending on the results, ODA could positively affect not only the recipients' but also the donor countries' long-term growth.

Appendix A

Figure A.1: Diagram of the multiplier effect of bilateral ODA (direct effect)

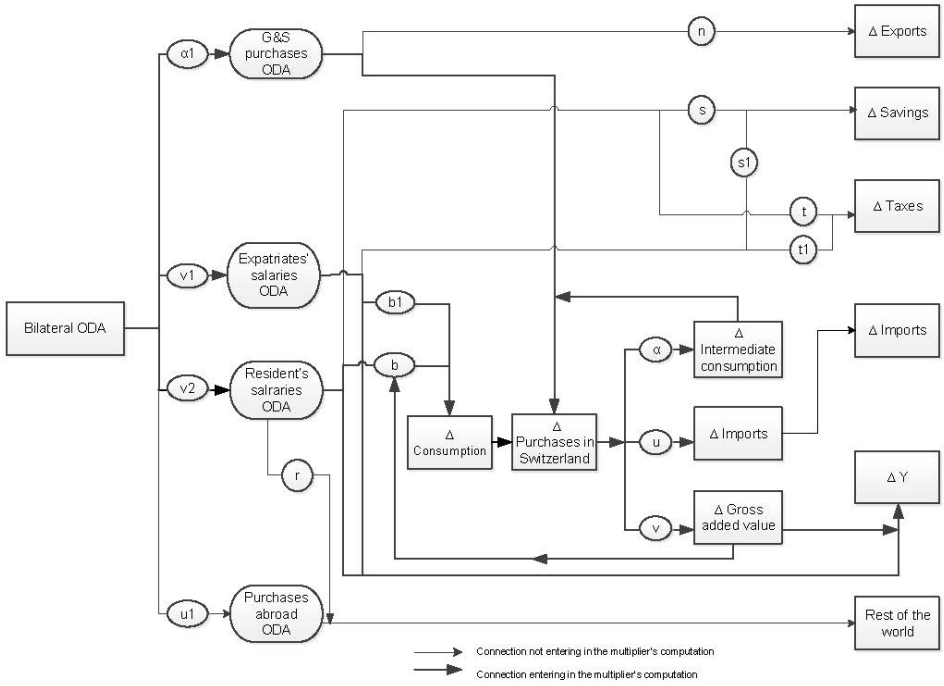


Figure A.2: Diagram of the multiplier effect of bilateral ODA (leverage effect)

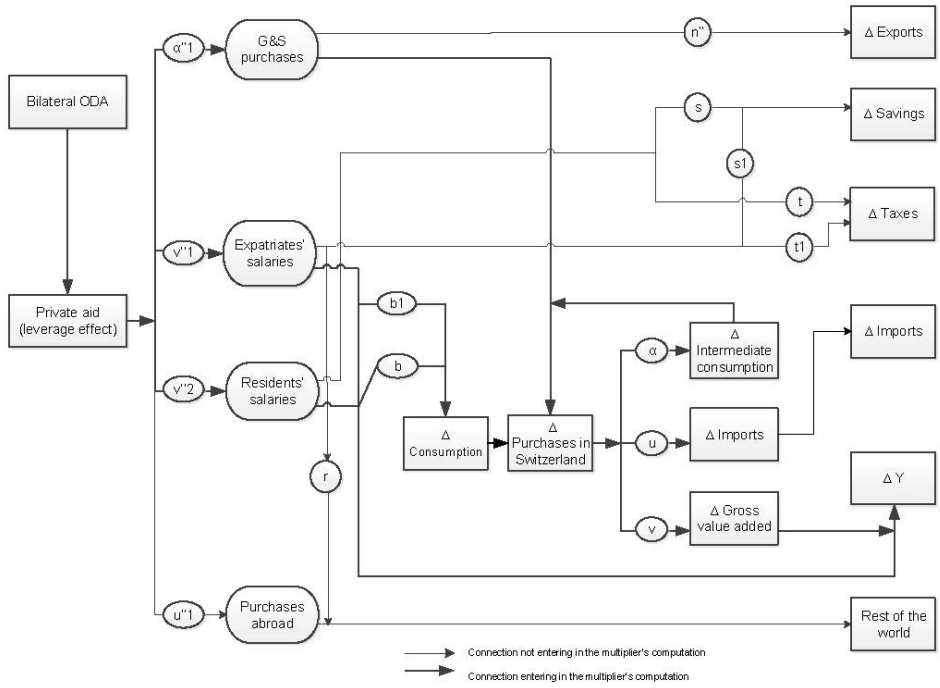
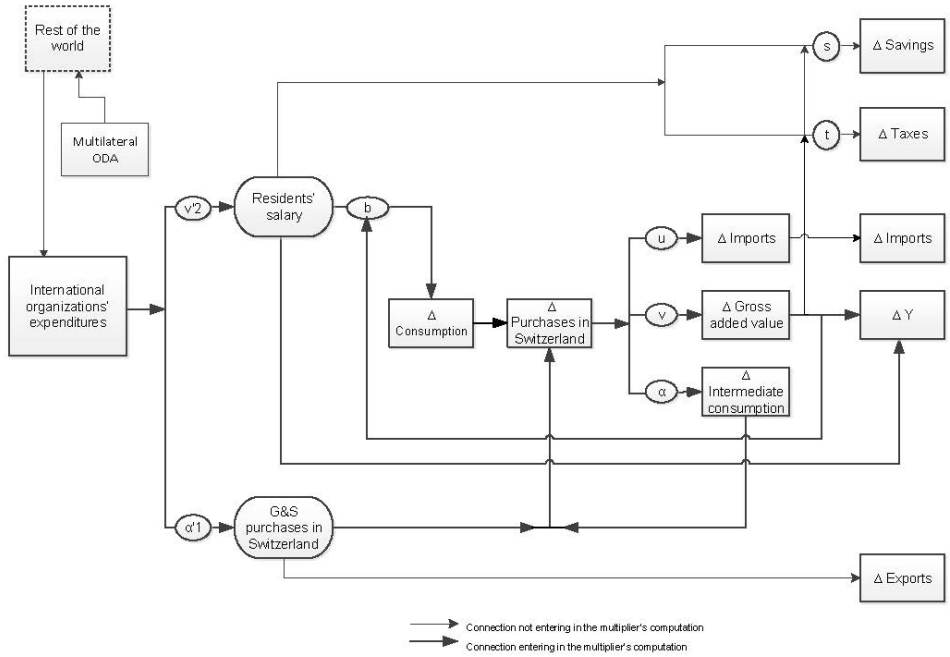


Figure A.3: Diagram of the multiplier effect of multilateral ODA (indirect effect)



Appendix B

The direct effect's multiplier k_1, the leverage effect's multiplier k_2 and the indirect effect's multiplier k_3 are:

$$k_1 = \frac{\upsilon_1(b_1-b)+(1-\alpha_1-\mu_1)(1+\tilde{m}b)+\alpha_1}{1-b(1-\tilde{m})}$$
$$k_2 = \frac{\upsilon_1^{''}(b_1-b)+(1-\alpha_1^{''}-\mu_1^{''})(1+\tilde{m}b)+\alpha_1^{''}}{1-b(1-\tilde{m})}$$
$$k_3 = \frac{1+(1-\alpha_1^{'})\tilde{m}b}{1-b(1-\tilde{m})}$$

where:

- α_1 share of Swiss G&S provided by Switzerland and purchased by international organizations,
- $\alpha_1^{'}$ share of G&S provided by Switzerland and purchased by international organizations,
- $\alpha_1^{''}$ share of G&S provided by Switzerland and purchased with funds levied thanks to bilateral ODA,
- b Swiss residents' marginal propensity to consume (relative to gross income),
- b_1 Swiss expatriate's marginal propensity to consume (relative to gross income),
- $\tilde{m}$ marginal propensity to import relative to consumption,
- μ_1 share of imports in bilateral ODA,
- $\mu_1^{''}$ share of imports in funds levied thanks to bilateral ODA,
- υ_1 share of expatriates' salaries in bilateral ODA,
- $\upsilon_1^{''}$ share of Swiss resident's salaries in funds levied thanks to bilateral ODA.

Glossary

ODA	Official Development Assistance. Must originate from official agencies, i.e. state and local governments. Can be provided either directly by the government or through its executing agency.
DAC	Development Assistance Committee (provides a precise statistical definition of ODA and coordinates its member countries).
Donor	Country providing ODA.
Recipient	Country receiving ODA.
Bilateral ODA	ODA contributions directly allocated to recipients (if ODA contributions are allocated to international organizations to be further directed to specific recipients, they are considered in the present study as multilateral ODA.
Multilateral ODA *in the broad sense*	ODA contributions allocated to international organizations.
Executing agencies	Bodies that allocate ODA funds on behalf of the donor country. These can be NGOs, other institutions or private firms (but mostly NGOs) if we refer to bilateral ODA and international organizations if we refer to multilateral ODA.
Direct effect	Effect produced on the donor's aggregate demand through expenses on domestic goods and services (including experts' remunerations) using bilateral ODA contributions.
Leverage effect	Effect produced on the donor's aggregate demand through aid-related expenses on domestic goods and services (including experts' remunerations) using funds collected by NGOs, other institutions or private firms owing to bilateral ODA contributions received.

Indirect effect	Effect produced on the donor's aggregate demand through aid-related expenses on domestic goods and services (including experts' remunerations) by international organizations at least partially financed by multilateral ODA.
Primary effect	The sum of the direct, leverage and indirect effects.
Multiplier	Coefficient obtained using detailed data on ODA, the spending patterns of actors involved and macroeconomic parameters. The number reflects the magnitude of the effect of an initial one-monetary-unit impulse on the aggregate demand at the end of the Keynesian multiplier process.
Multiplier effect	Magnitude of the total effect minus the initial impact.
Total or final effect	Effect produced on the donor country's GDP due to ODA. Computed as the primary effect times the multiplier or the primary effect plus the multiplier effect.
Employment effect	Effect on the donor's employment computed as the final effect divided by the average (apparent) productivity of labor.

Chapter 2: Testing for Granger Causality in Panel Data*

1 Introduction

Panel datasets comprised of many individuals and many time periods are becoming widely available. A particularly salient case is the growing availability of cross-country data over time. As a consequence, the focus of panel data econometrics is shifting from micro panel, with large N and small T, to macro panels, where both N and T are large. In this setting, classical issues of time-series econometrics, such as (non-)stationarity and (non-)causality, also arise. This paper discusses the user-written command `xtgcause`, which implements a procedure recently developed by Dumitrescu and Hurlin (2012) (hereafter DH) in order to test for Granger causality in panel datasets.

Considering the fast evolution of the literature, practitioners may find it difficult to implement the latest econometric tests. In this paper, we therefore summarize the test built by DH and present `xtgcause` using examples based on simulated and real data. The objective of our contribution is to support the empirical literature using panel causality techniques. One recurrent concern being related to the selection of the number of lags to be included in the estimations, we have implemented an extension of the test based on Akaike, Bayesian, and Hannan-Quinn information criteria to facilitate this task. Finally, and to deal with the empirical issue of cross-sectional dependence, we have implemented an option to compute p-values and critical values based on a bootstrap procedure.

2 The Dumitrescu-Hurlin test

In a seminal paper, Granger (1969) developed a methodology for analyzing the causal relationships between time series. Suppose x_t and y_t are two stationary series. Then the following model:

$$y_t = \alpha + \sum_{k=1}^{K} \gamma_k y_{t-k} + \sum_{k=1}^{K} \beta_k x_{t-k} + \varepsilon_t \qquad \text{with } t = 1, ..., T \tag{1}$$

can be used to test whether x causes y. The basic idea is that if past values of x are significant predictors of the current value of y even when past values

*This paper is co-authored with Sylvain Weber and was published in the Stata Journal (2017, volume 4: 972-984)

of y have been included in the model, then x exerts a causal influence on y. Using (1), one might easily investigate this causality based on an F-test with the following null hypothesis:

$$H_0 : \beta_1 = ... = \beta_K = 0 \tag{2}$$

If H_0 is rejected, one can conclude that causality from x to y exists. The x and y variables can of course be interchanged to test for causality in the other direction, and it is possible to observe bidirectional causality (also called feedback).

DH provide an extension designed to detect causality in panel data. The underlying regression writes:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{i,t} \qquad \text{with } i = 1, ..., N \text{ and } t = 1, ..., T \tag{3}$$

where $x_{i,t}$ and $y_{i,t}$ are the observations of two stationary variables for individual i in period t. Coefficients are allowed to differ across individuals (note the i subscripts attached to coefficients) but are assumed time-invariant. The lag order K is assumed to be identical for all individuals and the panel must be balanced.

As in Granger (1969), the procedure to determine the existence of causality is to test for significant effects of past values of x on the present value of y. The null hypothesis is therefore defined as:

$$H_0 : \beta_{i1} = ... = \beta_{iK} = 0 \qquad \forall\, i = 1, ..., N \tag{4}$$

which corresponds to the absence of causality for all individuals in the panel.

DH test assumes there can be causality for some individuals but not necessarily for all. The alternative hypothesis thus writes:

$$\begin{aligned} H_1 : \ & \beta_{i1} = ... = \beta_{iK} = 0 && \forall\, i = 1, ..., N_1 \\ & \beta_{i1} \neq 0 \text{ or } ... \text{ or } \beta_{iK} \neq 0 && \forall\, i = N_1 + 1, ..., N \end{aligned}$$

where $N_1 \in [0, N-1]$ is unknown. If $N_1 = 0$, there is causality for all individuals in the panel. N_1 must be strictly smaller than N, otherwise there is no causality for all individuals and H_1 reduces to H_0.

Against this backdrop, DH propose the following procedure: run the N individual regressions implicitly enclosed in (3), perform F-tests of the K linear hypotheses $\beta_{i1} = ... = \beta_{iK} = 0$ to retrieve the individual Wald statistic

W_i, and finally compute the average Wald statistic $\overline{W}$:[24]

$$\overline{W} = \frac{1}{N}\sum_{i=1}^{N} W_i \tag{5}$$

We emphasize that the test is designed to detect causality at the panel-level, and rejecting H_0 does not exclude non-causality for some individuals. Using Monte Carlo simulations, DH show that $\overline{W}$ is asymptotically well-behaved and can genuinely be used to investigate panel causality.

Under the assumption that the Wald statistics W_i are independently and identically distributed across individuals, it can be shown that the standardized statistic $\bar{Z}$ when $T \to \infty$ first and then $N \to \infty$ (sometimes interpreted as "T should be large relative to N") follows a standard normal distribution:

$$\bar{Z} = \sqrt{\frac{N}{2K}} \cdot \left(\overline{W} - K\right) \quad \xrightarrow[T,N\to\infty]{d} \quad \mathcal{N}(0,1) \tag{6}$$

Also, for a fixed T dimension with $T > 5 + 3K$, the approximated standardized statistic $\widetilde{Z}$ follows a standard normal distribution:

$$\widetilde{Z} = \sqrt{\frac{N}{2K} \cdot \frac{T-3K-5}{T-2K-3}} \cdot \left[\frac{T-3K-3}{T-3K-1} \cdot \overline{W} - K\right] \quad \xrightarrow[N\to\infty]{d} \quad \mathcal{N}(0,1) \tag{7}$$

The testing procedure of the null hypothesis in (4) is finally based on $\bar{Z}$ and $\widetilde{Z}$. If these are larger than the standard critical values, then one should reject H_0 and conclude that Granger causality exists. For large N and T panel datasets, $\bar{Z}$ can be reasonably considered. For large N but relatively small T datasets, $\widetilde{Z}$ should be favored. Using Monte Carlo simulations, DH have shown that the test exhibits very good finite sample properties, even with both T and N small.

The lag order (K) selection is an empirical issue for which DH provide no guidance. One way to tackle this issue is to select the number of lags based on an information criterion (AIC/BIC/HQIC). In this process, all estimations have to be conducted on a common sample in order to be nested and therefore comparable.[25] Practically, this implies that the first $K_{\max}$[26] time periods must be omitted during the entire lag selection process.

[24] See Dumitrescu and Hurlin (2012, p. 1453) for the mathematical definition of W_i. Note however that T in DH's formulas must be understood as the number of observations remaining in the estimations, that is the number of periods minus the number of lags included. In order to be consistent with our notation, we therefore replaced DH's T by $T - K$ in the following formulas of the present paper.

[25] We thank Gareth Thomas (IHS Markit EViews) for bringing this point to our attention.

[26] $K_{\max}$ stands for the maximum possible number of lags to be considered in the entire procedure.

Another empirical issue to consider in panel data is that of cross-sectional dependence. To this end, a block bootstrap procedure is proposed in section 6.2 of DH to compute bootstrapped critical values for $\bar{Z}$ and $\widetilde{Z}$ instead of asymptotic critical values. The procedure is composed of the following steps:[27]

1. Estimate (3) and obtain $\bar{Z}$ and $\widetilde{Z}$ as defined in (6) and (7).
2. Estimate the model under H_0: $y_{i,t} = \alpha_i^0 + \sum_{k=1}^{K} \gamma_{ik}^0 y_{i,t-k} + \varepsilon_{i,t}$, and collect the residuals in matrix $\widehat{\boldsymbol{\varepsilon}}_{(T-K)\times N}$.
3. Build a matrix $\boldsymbol{\varepsilon}^{\star}_{(T-K)\times N}$ by resampling (overlapping blocks of) rows (i.e., time periods) of matrix $\widehat{\boldsymbol{\varepsilon}}$. Block bootstrap is useful in presence of autocorrelation.
4. Generate a random draw $(\mathbf{y_1^{\star}}, ..., \mathbf{y_K^{\star}})'$, with $\mathbf{y_t^{\star}} = \left(y_{1,t}^{\star}, y_{2,t}^{\star}, \cdots, y_{N,t}^{\star}\right)$, by randomly selecting a block of K consecutive time periods with replacement (see Stine, 1987; Berkowitz and Kilian, 2000).
5. Construct the resampled series $y_{i,t}^{\star} = \widehat{\alpha}_i^0 + \sum_{k=1}^{K} \widehat{\beta}_{ik}^0 y_{i,t-k}^{\star} + \varepsilon_{i,t}^{\star}$ conditional on the random draw for the first K periods.
6. Estimate the model: $y_{i,t}^{\star} = \alpha_i^b + \sum_{k=1}^{K} \gamma_{ik}^b y_{i,t-k}^{\star} + \sum_{k=1}^{K} \beta_{ik}^b x_{i,t-k} + \varepsilon_{i,t}$, and compute $\bar{Z}^b$ and $\widetilde{Z}^b$.
7. Run B replications of steps 3 to 6.
8. Compute p-values and critical values for $\bar{Z}$ and $\widetilde{Z}$ based on the distributions of $\bar{Z}^b$ and $\widetilde{Z}^b$, $b = 1, ..., B$.

3 The xtgcause command

The syntax of `xtgcause` is as follows:

`xtgcause` *depvar indepvar* [*if*] [*in*] [`, lags(# | aic [#] | bic [#] | hqic [#])`
`regress bootstrap breps(#) blevel(#) blength(#) seed(#) nodots`]

`lags` specifies the lag structure to use for the regressions performed in computing the test statistic. By default, 1 lag is included. Specifying `lags(#)`

[27] The procedure we present here differs slightly from that proposed by DH, in the numbering of the steps, but more importantly also in the definition of the initial conditions (our step 4), which is not addressed in DH, and the construction of the resampled series (our step 5). We are indebted to David Ardia (University of Neuchâtel) for his valuable advice on the bootstrap procedure.

requests that # lags of the series be used in the regressions. The maximum authorized number of lags is such that $T > 5 + 3 \cdot \#$. Specifying `lags(aic|bic|hqic [#])` requests that the number of lags of the series be chosen such that the average Akaike/Bayesian/Hannan-Quinn information criterion (AIC/BIC/HQIC) for the set of regressions is minimized. Regressions with 1 to # lags will be conducted, restricting the number of observations to $T-\#$ for all estimations to make the models nested and therefore comparable. Displayed statistics come from the set of regressions for which the average AIC/BIC/HQIC is minimized (re-estimated using the total number of observations available). If # is not specified in `lags(aic|bic|hqic [#])`, then it is set to the maximum number of lags authorized.

`regress` can be used to display the results of the N individual regressions on which the test is based. This option is useful to have a look at the coefficients of individual regressions. When the number of individuals in the panel is large, this option will result in a very long output.

`bootstrap` requests p-values and critical values to be computed using a bootstrap procedure as proposed in section 6.2 of Dumitrescu and Hurlin (2012). Bootstrap is useful in presence of cross-sectional dependence.

`breps` indicates the number of bootstrap replications to perform. By default, it is set to 1000.

`blevel` indicates the significance level (in %) for computing the bootstrapped critical values. By default, it is set to 95%.

`blength` indicates the size of the block length to be used in the bootstrap. By default, each time period is sampled independently with replacement (`blength(1)`). `blength(#)` allows to implement the bootstrap by dividing the sample into blocks of # time periods and sampling the blocks independently with replacement. Using blocks of more than one time period is useful if autocorrelation is suspected.

`seed` can be used to set the random-number seed. By default, the seed is not set.

`nodots` suppresses replication dots. By default, a dot is printed for each replication to provide an indication of the evolution of the bootstrap.

`breps`, `blevel`, `blength`, `seed` and `nodots` are `bootstrap` suboptions. They can only be used if `bootstrap` is also specified.

3.1 Saved results

`xtgcause` saves the following results in `r()`:

Scalars			
`r(wbar)`	average Wald statistic	`r(lags)`	number of lags used for the test
`r(zbar)`	Z-bar statistic	`r(zbar_pv)`	p-value of the Z-bar statistic
`r(zbart)`	Z-bar tilde statistic	`r(zbart_pv)`	p-value of the Z-bar tilde statistic
Bootstrap scalars			
`r(zbarb_cv)`	critical value for the Z-bar statistic	`r(zbartb_cv)`	critical value for the Z-bar tilde statistic
`r(breps)`	number of bootstrap replications	`r(blevel)`	significance level for bootstrap critical values
`r(blength)`	size of the block length		
Matrices			
`r(Wi)`	individual Wald statistics	`r(PVi)`	p-values of the individual Wald statistics
Bootstrap matrices			
`r(ZBARb)`	Z-bar statistics from the bootstrap procedure	`r(ZBARTb)`	Z-bar tilde statistics from the bootstrap procedure

4 Examples

Before presenting a couple of examples, we recall that the test implemented in `xtgcause` assumes that the variables are stationary. We will not go through this first step here, but it is the user's responsibility to check his data satisfy this condition. To this end, the user might consider `xtunitroot`, which provides various panel stationarity tests with alternative null hypotheses (in particular Breitung, 2000; Hadri, 2000; Harris and Tzavalis, 1999; Im et al., 2003; Levin et al., 2002). The user may also want to perform second generation panel unit root tests such as the one proposed by Pesaran (2007) to control for cross-sectional dependence.

4.1 Example based on simulated data

To illustrate the functioning of `xtgcause`, we first use simulated data provided by DH at http://www.execandshare.org in the file data-demo.csv.[28] We start by importing the original Excel dataset directly from the website. In the original CSV file, the dataset is organized as a matrix, with all observations for the each individual in a single cell. Within this cell, the (10) values of variable x are separated by tabs, a comma separates the last value of x and the first value of y, and the (10) values of variable y are then separated by tabs. Hence, the following lines of code allow shaping the data so as to be understood as a panel by Stata.

```
. import delimited using "http://www.execandshare.org/execandshare/htdocs/data/M
```

[28] Data and MATLAB code are also available at http://www.runmycode.org/companion/view/42 in a zip file.

```
> etaSite/upload/companionSite51/data/data-demo.csv", clear delimiter(",")
> colrange(1:2) varnames(1)
(2 vars, 20 obs)
. qui: split x, parse(`=char(9)´) destring
. qui: split y, parse(`=char(9)´) destring
. drop x y
. gen t = _n
. reshape long x y, i(t) j(id)
(note: j = 1 2 3 4 5 6 7 8 9 10)
Data                                wide   ->   long
-----------------------------------------------------------------------------
Number of obs.                        20   ->     200
Number of variables                   21   ->       4
j variable (10 values)                     ->   id
xij variables:
                          x1 x2 ... x10   ->   x
                          y1 y2 ... y10   ->   y
-----------------------------------------------------------------------------
. xtset id t
       panel variable:  id (strongly balanced)
        time variable:  t, 1 to 20
                delta:  1 unit
. l id t x y in 1/5
```

	id	t	x	y
1.	1	1	.55149203	.81872837
2.	1	2	.64373514	-.42077179
3.	1	3	-.58843258	-.40312278
4.	1	4	-.55873336	.14674849
5.	1	5	-.32486386	.42924677

```
. l id t x y in 21/25
```

	id	t	x	y
21.	2	1	-1.4703536	1.2586422
22.	2	2	1.3356281	-.71173904
23.	2	3	-.21564623	-.73264199
24.	2	4	.08435614	-.67841901
25.	2	5	1.5766581	-.2562083

Some sections of the above piece of code are quite involved, and a few explanations are in order. We started by importing the data as if values were separated by commas, which is only partly true. This created two string variables, named x and y, each containing 10 values (separated by tabs) in each observation. We then invoked `split`, using `char(9)` (which indeed corresponds to a tab) as the *parse string*. We used the prefix `quietly` in order to avoid a long output indicating that 2 sets of 10 variables ($x_1, ..., x_{10}$, and $y_1, ..., y_{10}$) were created. These variables were immediately converted from string to numeric thanks to `split`'s `destring` option. In order to have a well-shaped panel that Stata can correctly interpret, we combined these 2 sets of 10 variables into only 2 variables, which we did using `reshape`. A few

observations (the first five for individuals 1 and 2) are displayed to show how the data is finally organized.

Using the formatted and `xtset`ted data, we can now run `xtgcause`. The simplest possible test in order to investigate whether x causes y would be:

```
. xtgcause y x

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Lag order: 1
W-bar =          1.2909
Z-bar =          0.6504   (p-value = 0.5155)
Z-bar tilde =    0.2590   (p-value = 0.7956)
------------------------------------------------------------
H0: x does not Granger-cause y.
H1: x does Granger-cause y for at least one panelvar (id).
```

Since we did not specify any lag order, `xtgcause` introduced a single lag by default. In this case, the outcome of the test does not reject the null hypothesis. The output reports the values obtained for $\overline{W}$ (W-bar), $\bar{Z}$ (Z-bar), and $\tilde{Z}$ (Z-bar tilde). For the latter two statistics, p-values are provided based on the standard normal distribution.

One could additionally display the individual Wald statistics and their corresponding values by displaying the stored matrices `r(Wi)` and `r(PVi)` (which we first combine into a single matrix for the sake of space):

```
. mat Wi_PVi = r(Wi) , r(PVi)
. mat li Wi_PVi
Wi_PVi[10,2]
              Wi        PVi
 id1   .56655945  .46256089
 id2   .11648998  .73731411
 id3   .09081952  .76701924
 id4  8.1263612   .01156476
 id5   .18687517  .67129995
 id6   .80060395  .38417583
 id7   .53075859  .47681675
 id8   .00158371  .96874825
 id9   .43635413   .5182858
id10  2.0521113   .17124367
```

Using the `lags()` option, we run a similar test introducing 2 lags of the variables x and y:

```
. xtgcause y x, lags(2)

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Lag order: 2
W-bar =          1.7302
Z-bar =         -0.4266   (p-value = 0.6696)
Z-bar tilde =   -0.7052   (p-value = 0.4807)
------------------------------------------------------------
H0: x does not Granger-cause y.
H1: x does Granger-cause y for at least one panelvar (id).
```

The conclusion of the test is similar as before.

Alternatively, the test could also be conducted using a bootstrap procedure to compute p-values and critical values:

```
. xtgcause y x, bootstrap l(1) breps(100) seed(20171020)
----------------------------
Bootstrap replications (100)
----------------------------
..................................................    50
..................................................   100

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Lag order: 1
W-bar =          1.2909
Z-bar =          0.6504   (p-value* = 0.4700, 95% critical value = 1.7316)
Z-bar tilde =    0.2590   (p-value* = 0.7100, 95% critical value = 1.3967)
------------------------------------------------------------
H0: x does not Granger-cause y.
H1: x does Granger-cause y for at least one panelvar (id).
*p-values computed using 100 bootstrap replications.
```

In this case, the bootstrapped p-values are relatively close to the asymptotic ones displayed in the first test above.

4.2 Example based on real data

In order to provide an example based on real data, we searched for papers reporting Dumitrescu and Hurlin's tests and published in journals that make authors' datasets available. We found several such papers (e.g., Paramati et al., 2016, 2017; Salahuddin et al., 2016). In particular, Paramati et al. (2016) (hereafter PUA) investigate the effect of foreign direct investment and stock market growth on clean energy use.[29] In their Table 8, they report a series of pairwise panel causality tests between variables such as economic output, CO_2 emissions, or clean energy consumption. As indicated in their online supplementary data (file Results.xlsx), they conduct the tests using EViews 8. We replicate some of their results:

```
. import excel using Data-WDI.xlsx, clear first case(lower) cellrange(A1:I421)
> sheet(FirstDif-Data)
. xtset id year
       panel variable:  id (strongly balanced)
        time variable:  year, 1992 to 2012
                delta:  1 unit
. xtgcause co2 output, l(2)

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Lag order: 2
W-bar =          2.4223
Z-bar =          0.9442   (p-value = 0.3451)
Z-bar tilde =    0.1441   (p-value = 0.8855)
------------------------------------------------------------
H0: output does not Granger-cause co2.
```

[29] See http://www.sciencedirect.com/science/article/pii/S0140988316300214.

```
H1: output does Granger-cause co2 for at least one panelvar (id).
. xtgcause fdi output, l(2)

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Lag order: 2
W-bar =          4.6432
Z-bar =          5.9103   (p-value = 0.0000)
Z-bar tilde =    3.7416   (p-value = 0.0002)
------------------------------------------------------------
H0: output does not Granger-cause fdi.
H1: output does Granger-cause fdi for at least one panelvar (id).
```

The first line of the above code imports the dataset constructed by PUA (file Data-WDI.xlsx, sheet "FirstDif-Data"). We then use `xtgcause` to test for the causality from *output* to *co2* and from *output* to *fdi*, which correspond to some tests reported in PUA's Table 8. We use 2 lags in both cases to match the numbers indicated by PUA in their accompanying appendix file. Comparing with PUA's output, it turns out that the denomination "Zbar-Stat" used in EViews corresponds to the Z-bar tilde statistic (while the Z-bar statistic is not provided).

Optionally, `xtgcause` allows the user to request the lag order to be chosen so that the Akaike, Bayesian, or Hannan-Quinn information criteria be minimized. Given that DH offer no guidance regarding the choice of the lag order, this feature might be appealing to practitioners. We can for instance test the causality from *output* to *fdi* specifying the option `lags(bic)`:

```
. xtgcause fdi output, l(bic)

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Optimal number of lags (BIC): 1 (lags tested: 1 to 5).
W-bar =          1.3027
Z-bar =          0.9572   (p-value = 0.3385)
Z-bar tilde =    0.4260   (p-value = 0.6701)
------------------------------------------------------------
H0: output does not Granger-cause fdi.
H1: output does Granger-cause fdi for at least one panelvar (id).
```

In practice, `xtgcause` runs all sets of regressions with a lag order from 1 to the highest possible number (i.e., such that $T > 5 + 3K$ or optionally specified by the user below this limit), maintaining a common sample. Said otherwise, if at most 5 lags are to be considered, the first 5 observations of the panel will never be considered in the estimations, even if it would be possible to do so with fewer than 5 lags. This is required in order to have nested models, which can then be appropriately compared using AIC, BIC, or HQIC. After this series of estimations, `xtgcause` selects the optimal outcome (i.e., such that the average AIC/BIC/HQIC of the N individual estimations is the lowest) and re-runs all estimations with the optimal number of lags and using the maximal number of observations available. Statistics based on the latter are reported as output.

In the above example, the optimal lag order using BIC appears to be 1, which is different from the lag order selected by PUA for this test.[30] Worryingly, this difference is not without consequences, since the conclusion of the test in this case is reversed. More precisely, the null hypothesis is not rejected with the optimally-selected single lag, but PUA use 2 lags and therefore reject the null hypothesis. Considering that empirical research in economics is used to formulate policy recommendations, such inaccurate conclusions may potentially be harmful. We therefore consider `xtgcause`'s option allowing to select the number of lags based on AIC/BIC/HQIC as an important improvement. It will allow researchers to rely on these widely accepted criteria and make the selection in a transparent way.

Finally, `xtgcause` makes it possible to compute the p-values and critical values associated with the Z-bar and Z-bar tilde via a bootstrap procedure. Computing bootstrapped critical values (rather than asymptotic ones) may be useful in presence of cross-sectional dependence. Extending our example based on PUA data, we test the causality from *output* to *fdi* by adding the `bootstrap` option (we also use `seed` for replicability reasons and `nodots` for the sake of space):

```
. xtgcause fdi output, l(bic) bootstrap seed(20171020) nodots
------------------------------
Bootstrap replications (1000)
------------------------------

Dumitrescu & Hurlin (2012) Granger non-causality test results:
------------------------------------------------------------
Optimal number of lags (BIC): 1 (lags tested: 1 to 5).
W-bar =          1.3027
Z-bar =          0.9572   (p-value* = 0.4530, 95% critical value = 3.0746)
Z-bar tilde =    0.4260   (p-value* = 0.7080, 95% critical value = 2.1234)
------------------------------------------------------------
H0: output does not Granger-cause fdi.
H1: output does Granger-cause fdi for at least one panelvar (id).
*p-values computed using 1000 bootstrap replications.
```

What `xtgcause` does in this case is first to compute the Z-bar and Z-bar tilde statistics using the optimal number of lags as in previous series of estimations, and it then computes the bootstrapped p-values and critical values. By default, 1,000 bootstrap replications are performed. We observe that the bootstrapped p-value for the Z-bar increases substantially compared to the asymptotic p-value obtained before (from 0.34 to 0.45), while that for the Z-bar tilde remains closer. This should be interpreted as a signal that the estimations suffer from small sample biases, so that asymptotic p-values are under-estimated. Bootstrapped p-values indicate that the null hypothesis

[30]The number of lags would be 3 using HQIC and 4 using AIC. Therefore, while PUA state in their Table 8 that "the appropriate lag length is chosen based on SIC", we do not find the same number with any of the information criterion considered.

is far from being rejected, strengthening our above concerns about PUA conclusions based on the asymptotic p-values and obtained with 2 lags.

5 Conclusion

This paper has presented the user-written command `xtgcause`, which automates a procedure introduced by Dumitrescu and Hurlin (2012) in order to detect Granger causality in panel datasets. In this branch of econometrics, the empirical literature appears to be lagging, with the latest theoretical developments being not always available in statistical packages. One important contribution of our command is to allow the user to select the number of lags based on the Akaike, the Bayesian, or the Hannan-Quinn information criterion. This choice may have an impact on the conclusion of the test, but some researchers may have overlooked it. As a consequence, several empirical papers might have reached erroneous conclusions. Another useful contribution of `xtgcause` is that it allows to calculate bootstrapped critical values, a very useful option in presence of cross-sectional dependence. With this command and this article, we therefore hope to bring some useful clarifications and help practitioners conduct sound research.

Chapter 3: Causal Links Between Bilateral Official Development Assistance and Exports: The Swiss Case[§]

1 Introduction

An important feature of today's economy is that nations increasingly trade with each other. Economically, this is a blessing as Ricardo's theory of comparative advantage proved two centuries ago: trade has the potential to make everyone better-off. It is precisely to promote trade that the OECD put in place in 1961 a committee in charge of encouraging wealthy nations to assist developing countries. This assistance is nowadays commonly known as the "Official Development Assistance" (ODA) (also called aid).

Even if a purely altruistic behavior cannot be excluded (see for instance Berthélemy, 2006), donor countries may have different reasons to donate to a particular country. For instance, a hidden rationale, or at least not publicly admitted, to favor a country can be the current trade situation. It is indeed possible and understandable that donor countries will likely consider important trading partners first when allocating aid. We may thus expect causal links from exports to aid. On the other hand, causality from aid to exports can also be expected due to, for instance, the creation of a longstanding relationship, referred to as "goodwill" in the literature (see for instance Arvin et al., 2000; Wagner, 2003; Martínez-Zarzoso et al., 2009) between the donor and the recipient country. The goodwill effect can be simplistically viewed as the fact that if you help someone one day, they may reciprocate in time. In the present topic the goodwill effect is built through ODA contributions. Using a model that considers tied and untied aid simultaneously, Arvin and Baum (1997) identified the optimal paths of both types of aid in order to maximize the goodwill and concluded that the two kinds of aid foster the so-called goodwill. In their contribution Martínez-Zarzoso et al. (2009) also point out two other reasons why giving aid may affect the donor exports, namely tied aid and habit-formation. The tied aid effect is basically the fact

[§]This paper was presented at the International Panel Data Conference (IPDC), Thessaloniki (Greece), July 2017; at a Trent University seminar, Peterborough (Canada), April 2018; and at the annual Congress of the Swiss Society of Economics and Statistics, St-Gallen (Switzerland), June 2018.

that the donor's aid is restricted to the procurement of goods and services from the donor. Then, habit-formation is, in a sense, the continuity of the direct impact of tied aid.[31] Indeed, having sent your own goods may create a dependence/familiarity with those goods (see Djajić et al. (2004) for more details on habit-formation).

Switzerland is a very interesting country to analyze in this respect because the tied aid effect, and consequently but, to a lesser extent the habit-formation effect, are likely to be weak since this country is considered as one of the most altruistic donor countries due to the high share of untied aid it provides. For instance Berthélemy (2006) categorizes 19 donor countries according to their aid providers' behavior, i.e., altruistic, average or egoistic and Switzerland is found by the author to be the most altruistic country. In addition, in the report by Clay et al. (2009), undertaken under the auspices of the Secretariat for the Evaluation of the Paris Declaration and the OECD/DAC, Switzerland is classified as a highly altruistic country with an untied aid ratio of 98.4% in 2007.[32] It is worth noting that this ratio was already of 84% (on average) for the period 1979-2016 and of 96% for the period 2000-2016 (OECD database). To summarize, out of the three economic explanations on why aid may create exports for the donor country, the most valid in the Swiss case is apparently the "goodwill" effect. Thus, the fact that we will focus on Switzerland in the present study is particularly path-breaking since we are analyzing the statistical link between aid and exports (and conversely) for a country with a very high proportion of untied aid.

Studies that test for any kind of causality between aid and exports and that focus on one donor country as we do, are rather scarce. To our knowledge, the only such papers are Arvin and Choudhry (1997) who focus on Canada as aid provider, Arvin et al. (2003) who use Italy as donor country, Arvin et al. (2000) who analyze Germany and Lloyd et al. (2000) who use France, Germany, the Netherlands and the United Kingdom as donor countries. All studies use the method developed by Granger (1969) to test for causality. The conclusion reached by Arvin and Choudhry (1997) and Arvin et al. (2000) is that causal relations are not all of one type and highly depend on the set of recipients analyzed (grouped by region, income and existing ties with Canada, respectively Germany). In the same vein, Arvin et al. (2003) found that causality (unilateral or bilateral) between Italian aid and exports exists only towards some recipient countries. Lloyd et al.'s (2000) conclusion is less nuanced: a statistical link between aid and trade is an exception rather

[31] In fact, untied aid can also be the in form of the donor's goods and services (winning a tendering process, desired by the recipient country, etc.). Thus, untied aid may also set up the habit-formation effect.

[32] See Clay et al. (2009) Table 3.3 (page 12) for details on the untied aid ratio.

than the norm. The present study differs in two major ways: 1) it focuses on a country considered as highly altruistic in its way of allocating aid, namely Switzerland, 2) it uses current econometric tools to test for causality in an heterogeneous panel data set. To do so, four different unit root tests and the Dumitrescu-Hurlin Granger non-causality test are employed.

In the present study we will test for causality in both directions, that is exports towards aid and aid towards exports. It is however the existence of the latter relation that may interest the most Swiss supporters of official development assistance. If causality is found, it will give them a strong argument to ask for an increase of the total amount of aid (or at least not cut current amounts). On the other hand, if there is no evidence of causality from aid towards exports, it will allow them to claim Switzerland is so altruistic that the aid the country allocates is not meant to influence its trade.

The rest of the paper is organized as follows. Section 2 discusses some literature on ODA and Granger causality tests. Section 3 presents the data used in the present study and describes the different groups of countries created. Section 4 details the panel unit root tests used (4.1) as well as the Granger causality test employed (4.2). Section 5 presents the results of all tests. Section 6 discusses some important issues and gives some limitations of the present study. Section 7 concludes and provides policy implications.

2 Literature review

ODA has been the subject of numerous studies, dealing with various issues. A large body of literature focuses on recipient countries and is concerned with the degree of efficiency of such aid on their growth rate (see for instance Burnside and Dollar, 2000; Easterly, 2003) or on their trade capacity (see for instance Nowak-Lehmann et al., 2013). A striking feature of this literature is that results do not provide clear-cut evidence on the effective impact of ODA on recipient countries' growth or trade.

Then, some authors have started to look at the effects of aid on the donor countries. Among them stand the ones measuring the impact of aid on the donor country through trade (see the book of Arvin and Lew (2015) on the economics of foreign aid for a thorough overview in this topic). McCallum (1995) and Anderson and van Wincoop (2003), have shown in their contributions that a good way to adequately compute aid's impact on trade is by using a modified/augmented trade gravity model. Since 2003, several authors have tried to measure the impact of ODA on the donor country's exports, all convinced that aid creates a "goodwill" which then becomes source of future partnerships. Moreover, using Canadian data, Arvin et al. (1996) found

evidence that untied aid produces a lingering effect on exports in the same way an advertisement does on sales. We believe these lingering and/or goodwill effects constitute the foundation for a possible statistical link between ODA and exports. Each contribution aiming at computing the impact of aid on trade is of course unique due to its specific assumptions or methods but nearly all conclude that there is indeed a positive relationship between aid and exports in the donor country (see for instance recently Helble et al. (2012); Silva and Nelson (2012); Pettersson and Johansson (2013); Hühne et al. (2014) or Wagner (2003), one of the first to use a gravity model in this framework). These studies use databases with many donor countries and several recipient countries.

Studies analyzing thoroughly a single country (at least the ones using a gravity model) are scarce. We can still mention Martínez-Zarzoso et al. (2009), Nowak-Lehmann et al. (2009), Martínez-Zarzoso et al. (2010) or Martínez-Zarzoso et al. (2013) looking in detail at the German case or Skärvall (2012) looking at the Swedish case. For a good overview of studies employing a gravity model (single or multiple donor approach) see Martínez-Zarzoso (2015). The present study does not aim at quantifying the impact of ODA on trade (exports) but at determining the direction of Granger causality, if Granger causality there is, between ODA and exports within a heterogeneous panel data set (see Arvin et al., 2003, for a similar approach in a time series framework).

Granger causality between two series is an old issue in time series literature but a relatively recent topic in terms of panel data. Indeed, there is a growing availability of panel databases with not only a large number of individuals N but also a large number of time periods T. This shift from micro to macro panels implies that classical issues from time series extend to panel data, such as spurious regressions due to unit roots, but also consequently implies that time series techniques, such as Granger causality, can now also be used in panel data. The term "Granger causality" refers to a specific form of causality (temporal sense) that has been developed by Granger (1969, 1980) and that differs from the usual definition of causality. Indeed, Granger causality tests do not evaluate cause-and-effect relationships between two variables but look for a statistical relationship instead. In a nutshell Granger causality exists if a variable has a predictive capability on another variable. Although nearly half a century old, the model and the technique proposed by Granger are still currently used in many studies, the present one being one of them. The main difference between employing Granger causality tests in a times series framework or in a panel one is that with panels there are as many coefficients as individuals N in the data set. Therefore, the different models adapting Granger causality to panel data will basically differ in the

way they treat and test the individuals coefficients.

One of the first studies in such framework is the one by Holtz-Eakin et al. (1988). The authors first-difference their data in order to eliminate fixed effects and then, estimate the model by applying instrumental variables. Their model assumes a common coefficient on the independent variable for all individuals. To relax this strong assumption, Nair-Reichert and Weinhold (2001) have used Mixed Fixed and Random (MFR) models as first proposed by Hsiao et al. (1989) and then adapted to the present panel data framework by Weinhold (1996). A closely related approach is the one by Kónya (2006), who uses seemingly unrelated regression (SUR) systems and Wald tests with country specific bootstrapped critical values. Finally, in the same kind of framework but with a slightly different approach, Dumitrescu and Hurlin (2012) propose to test for Granger non-causality based on an averaged across individuals Wald statistic. This is the strategy we follow in this paper.

3 Data

The two variables of interest in the present study are Swiss bilateral ODA[33] and Swiss exports (annual data). Regarding Swiss bilateral ODA in Swiss francs (CHF)[34], data are available on the "Federal Department of Foreign Affairs" website under the " Swiss Agency for Development and Cooperation (SDC)" section. In the present study we will use Swiss bilateral ODA from 1974 to 2016 directed towards a total of 50 recipient countries.[35] Concerning Swiss exports towards the same 50 ODA recipient countries and for the same period, data are collected on the UN Comtrade database. All data (in absolute and nominal terms) are directly available or converted into USD using annualized exchange rates from the OECD database. All the tests and regressions are done using the logarithms (natural) of our series. The loga-

[33]Bilateral ODA is ODA that is directly donated to a country. Multilateral ODA is ODA that is donated to international organizations that are active in several least developed countries. In our study only bilateral ODA is considered since data on multilateral ODA are difficult, if not impossible, to correctly spread across recipient countries. Together, bilateral ODA and multilateral ODA sum up to the so-called "official development assistance" to poorer countries.

[34]In 2016, 1 USD was equivalent to 0.985 CHF according to the OECD statistics website.

[35]Data on Swiss bilateral ODA on the SDC website is available from 1960 to 2017 and towards 105 recipient countries but with an important number of missing values. Since some econometric tests used in this study require a balanced panel data set, only 50 countries are kept over 43 years (1974 to 2016). As mentioned, 2017 ODA figures are also available but provisional (and with unreported values for some recipients) and therefore not considered for the analysis.

rithmic transformation allows to normalize the data - a common procedure in particular when using macroeconomic series that are more disposed to be skewed.

The nature of the relationship between ODA and exports might differ across recipient countries. In order to investigate this issue, we will evaluate the causality between our series for various groups of countries. We will first consider geographical regions with the "African", "Latin American" and "Asian" group of countries. Then, to capture level effects, we create the "high" and the "low" exports group of countries. In the former group stand the countries with which Switzerland trades more (i.e. above the entire period median) and in the latter group stand the countries with which Switzerland trades less. Exactly the same procedure is used to create the two last group of countries, i.e. the "high" and the "low" bilateral aid groups. Appendix A enumerates the 50 countries kept and shows their classification into specific group of countries.

4 Tests

Non-stationarity is a well-known potential issue in time-series, and it could also arise in long panel datasets. Therefore, a necessary first step before testing causality is to test for the presence of unit roots. If the series contain unit roots, the issue of spurious regression arises and one has to employ cointegration and error correction techniques in order to ensure the correct identification of causal relationships. On the contrary, if the series follow a stationary process, then causality tests as developed by Granger (1969, 1980) are valid to detect the presence and the direction of a statistical link.

4.1 Unit root tests

Several panel unit root tests have been developed in the literature and this study will apply some of them.[36] Four different tests are applied, the HT test (Harris and Tzavalis, 1999), the LLC test (Levin et al., 2002), the IPS test (Im et al., 2003) and the PESCADF test (Pesaran, 2007). A brief description of the four unit root tests follows below.

A general autoregressive panel equation serves as a basis to all tests:

$$\Delta y_{it} = \beta y_{i,t-1} + \alpha_{mi} d_{mt} + \mu_{it} \qquad i = 1, ..., N;\ t = 1, ..., T;\ m = 1, 2, 3 \quad (1)$$

[36] As additional well-known panel unit root tests (not employed in this contribution), we can mention, for instance, the Fisher-Type tests: Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests discussed by Maddala and Wu (1999) and Choi (2001).

where d_{mt} allows to implement different specifications, with $d_{1t} = \emptyset$ (empty set) which implies that there is no fixed effect and therefore a homogeneous panel is assumed, $d_{2t} = \{1\}$ which includes individual fixed effects and therefore allows for heterogeneity across individuals of the panel, and $d_{3t} = \{1, t\}$ which includes individual fixed effects as well as an individual time trend.

Although every test relies on the above general equation, they still differ for instance, depending on the method used to estimate the coefficients, on the test statistic, on the assumption regarding the disturbances (μ_{it}), i.e. cross-sectional dependence versus cross-sectional independence[37] or, on the definition of the coefficient β, i.e. whether it is homogeneous across all individuals in the panel or not.

For instance, in their paper, Harris and Tzavalis (1999) test for unit roots based on the normalized pooled least squares estimator of the autoregressive coefficient (that is corrected depending on the model used) coming from the pooled regression. They assume a fixed time dimension (T). The models they use are the ones from equation (1). The assumptions made by Harris and Tzavalis (1999) imply cross-sectional independence by design. The authors argue that one option to relax, or at least mitigate this assumption, is by subtracting the cross-section mean from the data. Their assumptions also imply serially uncorrelated errors.

Levin et al. (2002) propose a unit root test based on the t statistic (and not on the estimator itself as in Harris and Tzavalis (1999)) obtained from a pooled regression. Although the authors assume that all individuals in the panel have identical first-order partial correlation (i.e. β and not β_i), the test is based on the Augmented Dickey-Fuller (ADF) method.[38] The authors point as an important limit of their test the requirement of cross-sectional independence and add that sometimes subtracting the cross-sectional averages is not sufficient to remove contemporaneous correlation. By construction the authors' assumptions allow for serial correlation.

Im et al. (2003) propose a different approach to test for unit roots in the sense that they use a t-statistic based on ADF statistics averaged across individuals. Their test allows for serial correlation when T and N are sufficiently large. In addition to the change in the method used, the other observable dissimilarity between the HT and LLC procedures and the one proposed by Im et al. (2003) is that the first-order autoregressive parameter β_i can differ across countries in the latter, which implies that the interpretation of the alternative hypothesis differs substantially. Indeed, in Im et al. (2003) if the

[37]Serial correlation can also be an issue in panel data, but all tests except Harris and Tzavalis (1999) allow for serial correlation. We will therefore not further discuss this issue.

[38]See the proposed three-step procedure in section 2.2 of Levin et al. (2002) for more details.

null is rejected it is stated that some panels are stationary (not necessarily all but at least one)[39] whereas in Harris and Tzavalis (1999) and Levin et al. (2002) if the null is rejected it is stated that all individuals in the panel are stationary. As in HT and LLC, the IPS test does not deal with cross-sectional dependence but again, subtracting the cross-sectional averages may mitigate this issue.

Finally, Pesaran (2007) proposes a unit root test that allows for cross-sectional dependence and serial correlation. To do so he uses an extended version of the standard augmented Dickey-Fuller regression. Concretely, standard ADF regressions for the individuals series are augmented with current and lagged cross-section averages of all the series in the panel. As in Im et al. (2003), the alternative hypothesis has to be cautiously interpreted when the null is rejected.

4.2 Dumitrescu-Hurlin Granger non-causality test

This study uses the Dumitrescu-Hurlin Granger non-causality test recently developed by Dumitrescu and Hurlin (2012), which is a modified version of the well-known Granger test. The simple model developed by Granger (1969) with two series (that have to be stationary) is given by:

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \epsilon_t$$

$$Y_t = \sum_{j=1}^{m} c_j Y_{t-j} + \sum_{j=1}^{m} d_j X_{t-j} + \eta_t$$

where ϵ_t and η_t are two uncorrelated white-noise series. If some b_j or c_j are not zero, then Y_t is causing X_t or X_t is causing Y_t respectively. The two causal relationships are not mutually exclusive.

As we will do below for the Dumitrescu-Hurlin model, Hsiao (1979, 1981, 1982) has proposed an augmented version of the above Granger causality test by allowing different lag length for each series and where the latter are chosen to minimize the Akaike (1969, 1970) final prediction error. The Hsiao version of the Granger causality test is thus based on the following equations:

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{n} b_j Y_{t-j} + \epsilon_t$$

[39] According to the authors, it is not possible to identify the exact proportion of stationary individuals.

$$Y_t = \sum_{j=1}^{o} c_j X_{t-j} + \sum_{j=1}^{p} d_j Y_{t-j} + \eta_t$$

Dumitrescu and Hurlin (2012) have proposed a modified version of the Granger causality test in order to use it in heterogeneous panel datasets. As in Granger (1969) the test requires two stationary series and the model is given by:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \epsilon_{i,t} \tag{2}$$

with $K \in N^\star$ and $\beta_i = (\beta_i^{(1)}, ..., \beta_i^{(k)})'$. The lag order K is identical for all individuals in the panel. The authors do not discuss in their paper the optimal lag length to include in the model. The autoregressive parameters $\gamma_i^{(k)}$ and the coefficients $\beta_i^{(k)}$ can differ across individuals but are constant in time. The null and the alternative hypotheses associated with the model are given by:

H_0: $\beta_i = 0 \ \forall i = 1, ..., N$ (non causality in all panels)

$$H_a = \begin{cases} \beta_i = 0 \ \forall i = 1, ..., N_1 \\ \beta_i \neq 0 \ \forall i = N_1 + 1, N_1 + 2, ..., N \end{cases} \qquad \text{causality in some panels}$$

where N_1 is unknown but satisfies the condition $0 \leq N_1 < N$. This structure is similar to the one proposed by Im et al. (2003) and Pesaran (2007) discussed above.[40]

Dumitrescu and Hurlin (2012) propose to associate the Wald statistics averaged across individuals to the test of the non causality hypothesis for individuals $i = 1, ..., N$:

$$W_{N,T} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T}$$

where $W_{i,T}$ is the standard adjusted Wald statistic for individual i calculated over T periods.[41] Although the individual Wald statistics converge to a chi-squared distribution with K degrees of freedom[42] (where K stands for the number of lags), the authors show that the distribution of the average Wald statistic when $T \to \infty$ first and then $N \to \infty$, can be deduced from

[40]The alternative has to be read as follows: if we have 50 ($= N$) recipient countries in our panel, and 20 ($= N_1$) do not show causal link ($\beta_i = 0$), then 30 ($= N - N_1$) do show causal link ($\beta_i \neq 0$).

[41]See Dumitrescu and Hurlin (2012) page 1453 for the exact mathematical definition of $W_{i,T}$.

[42]$W_{i,T} \xrightarrow[T \to \infty]{d} \chi^2(K), \forall i = 1, ..., N$.

a standard Lindberg-Levy central limit theorem and thus infer that $W_{N,T}$ sequentially converges in distribution in the following way:

$$Z_{N,T} = \sqrt{\frac{N}{2K}}(W_{N,T} - K) \quad \xrightarrow[T,N\to\infty]{d} \mathcal{N}(0,1) \tag{3}$$

In addition to this Z-statistic, Dumitrescu and Hurlin (2012) also propose the $\tilde{Z}$-statistic allowing for a fixed T dimension (under the assumption of $T > 5 + 2K$). Their standardized average $\tilde{Z}$ is given by:

$$\tilde{Z}_N = \sqrt{\frac{N}{2K}\frac{(T-2K-5)}{(T-K-3)}}\left[\frac{(T-2K-3)}{(T-2K-1)}W_{N,T} - K\right] \quad \xrightarrow[N\to\infty]{d} N(0,1) \tag{4}$$

This latter statistic, i.e. $\tilde{Z}_N$, has been closely examined by Dumitrescu and Hurlin by running Monte-Carlo simulations. Their conclusion is that $\tilde{Z}_N$ has the desired properties even with small T and N. They also show that their standardized panel statistics have good small sample properties even in the presence of cross-sectional dependence.

Finally, it is important noting that in such autoregressive models the optimal number of lags to include is often an issue. In the present study, we propose to select the optimal number of lags so as to minimize the Akaike Information Criteria (AIC) as in Hsiao (1979, 1981, 1982) or, the Hannan-Quinn Information Criteria (HQIC) or alternatively, the Bayesian Information Criteria (BIC). To do so model (2) is run using a Stata routine developed by Lopez and Weber (2017). As the authors explain in their contribution, if for instance the AIC is used, what is done is that all sets of regressions containing a lag order from 1 to the upper limit number of lags (see Lopez and Weber (2017) or Dumitrescu and Hurlin (2012) for more information on the upper limit number of lags) are run keeping the number of observations in all estimations constant. In other words, if the upper limit number of lags is 5, the first 5 observations of the panel will never be considered in the estimations. After this series of estimations, the "best" model is selected (that is, the one that minimizes say the average AIC of the N individual estimations). The results of both the unit root tests and the Dumitrescu-Hurlin Granger non-causality tests are presented below in, respectively, subsections 5.1 and 5.2.

5 Results

5.1 Unit root

The motivation for selecting the four tests discussed above is that they cover two major panel data issues. Indeed, whereas one test (HT) assumes serial uncorrelated errors, the others allow for serial correlation (LLC, IPS and PESCADF). Most tests assume cross-sectional independence although this issue can be mitigated (HT, LLC and IPS) but one allows for cross-sectional dependence (PESCADF).

Concerning the optimal lag length to include in the tests, it is based on the Akaike Information Criteria (AIC) for the LLC and IPS tests (with a restriction of a maximum of five lags in order to keep sufficient degrees of freedom). In the PESCADF test, one lag is included. Finally, in the HT test, no lags are included.

With regard to the models, only the model specifications 2 and 3 presented in equation (1) are run. Indeed, model specification 1 assumes homogeneity of the panel, an assumption that does not hold in this study given the nature of our data. Then, as a second step, the HT, LLC and IPS tests are run with the option of subtracting the cross-sectional mean to mitigate eventual cross-sectional dependence.

Furthermore, we sequentially apply these tests to ODA and exports first to the full panel of 50 countries, then to the "African", "Asian" and "Latin American" groups of countries, finally to the so-called "high" and "low" exports and aid countries respectively.

Results are reported in tables 1 to 8 and are rather unambiguous. All series seem to follow a stationary process. There is no model, regardless of the set of countries considered, where all tests show unit root process. Demeaning does not seem to bring much information which is an indication that cross-sectional dependence is not a serious issue in our data. This conclusion is reinforced by the fact that the results of the PESCADF test, that allows for cross sectional dependence, are not different from the other tests' results. These results which point towards stationarity of our series allow us to confidently run Dumitrescu-Hurlin Granger causality test in the next section.

Table 1: Panel unit root tests

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.543^{***}$	-	$.318^{***}$	-	$.275^{***}$	-
	LLC	-7.681^{***}	1.64	-7.102^{***}	1.4	-8.831^{***}	1.3
	IPS	-6.655^{***}	1.64	-8.364^{***}	1.4	-11.623^{***}	1.3
	PESCADF	-2.672^{***}	1	-3.126^{***}	1	-	-
EXP	HT	$.865^{***}$	-	$.618^{***}$	-	$.559^{***}$	-
	LLC	-4.024^{***}	1.04	-5.362^{***}	1.1	-7.023^{***}	1.22
	IPS	-1.747^{**}	1.04	-6.822^{***}	1.1	-9.287^{***}	1.22
	PESCADF	-2.563^{***}	1	-3.086^{***}	1	-	-

Note: *p < 0.10, **p < 0.05, ***p < 0.01. I = Intercept, T = Trend, D = Demean.

Table 2: Panel unit root tests "Africa"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.566^{***}$	-	$.298^{***}$	-	$.183^{***}$	-
	LLC	-6.864^{***}	1.81	-6.378^{***}	1.54	-9.46^{***}	1.04
	IPS	-5.632^{***}	1.81	-5.856^{***}	1.54	-9.73^{***}	1.04
	PESCADF	-2.592^{***}	1	-3.236^{***}	1	-	-
EXP	HT	$.766^{***}$	-	$.607^{***}$	-	$.509^{***}$	-
	LLC	-3.704^{***}	1	-2.997^{***}	1.08	-7.662^{***}	.5
	IPS	-3.447^{***}	1	-4.734^{***}	1.08	-9.381^{***}	.5
	PESCADF	-2.685^{***}	1	-3.431^{***}	1	-	-

Note: *p < 0.10, **p < 0.05, ***p < 0.01. I = Intercept, T = Trend, D = Demean.

Table 3: Panel unit root tests "Asia"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.602^{***}$	-	$.463^{***}$	-	$.463^{***}$	-
	LLC	-4.267^{***}	1.55	-4.421^{***}	1.36	-6.38^{***}	.91
	IPS	-3.373^{***}	1.55	-5.665^{***}	1.36	-6.22^{***}	.91
	PESCADF	-2.955^{***}	1	-3.138^{***}	1	-	-
EXP	HT	.954	-	$.635^{***}$	-	$.624^{***}$	-
	LLC	-1.506^{*}	1.55	-2.552^{***}	1.45	-2.931^{***}	1.73
	IPS	1.657	1.55	-3.543^{***}	1.45	-3.06^{***}	1.73
	PESCADF	-2.323^{**}	1	−2.594	1	-	-

Note: *p < 0.10, **p < 0.05, ***p < 0.01. I = Intercept, T = Trend, D = Demean.

Table 4: Panel unit root tests "Latin America"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.754^{***}$	-	$.666^{***}$	-	$.634^{***}$	-
	LLC	-1.924^{**}	1.33	−.816	1.08	−.165	1
	IPS	-2.07^{**}	1.33	-2.945^{***}	1.08	-3.399^{***}	1
	PESCADF	−1.795	1	−2.498	1	-	-
EXP	HT	$.866^{***}$	-	$.65^{***}$	-	$.613^{***}$	-
	LLC	-1.723^{**}	.58	-3.538^{***}	.92	-3.085^{***}	1
	IPS	−.248	.58	-2.888^{***}	.92	-2.133^{**}	1
	PESCADF	-2.284^{**}	1	-2.893^{**}	1	-	-

Note: *p < 0.10, **p < 0.05, ***p < 0.01. I = Intercept, T = Trend, D = Demean.

Table 5: Panel unit root tests "High aid"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.751^{***}$	-	$.624^{***}$	-	$.585^{***}$	-
	LLC	-6.276^{***}	2.04	-4.467^{***}	1.92	-6.638^{***}	1.12
	IPS	-5.509^{***}	2.04	-6.508^{***}	1.92	-8.639^{***}	1.12
	PESCADF	-2.594^{***}	1	-3.197^{***}	1	-	-
EXP	HT	$.871^{***}$	-	$.61^{***}$	-	$.553^{***}$	-
	LLC	-2.153^{**}	1.31	-2.475^{***}	1.31	-5.61^{***}	.96
	IPS	.059	1.31	-3.813^{***}	1.31	-7.801^{***}	.96
	PESCADF	-2.829^{***}	1	-3.335^{***}	1	-	-

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. I = Intercept, T = Trend, D = Demean. This group of countries includes recipients to which Switzerland has provided ODA above the median (based on the whole period).

Table 6: Panel unit root tests "Low aid"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.406^{***}$	-	$.156^{***}$	-	$.132^{***}$	-
	LLC	-4.52^{***}	1.21	-5.88^{***}	.83	-9.058^{***}	.83
	IPS	-3.863^{***}	1.21	-5.29^{***}	.83	-9.226^{***}	.83
	PESCADF	-2.607^{***}	1	-3.037^{***}	1	-	-
EXP	HT	$.855^{***}$	-	$.629^{***}$	-	$.569^{***}$	-
	LLC	-3.472^{***}	.75	-5.157^{***}	.88	-5.25^{***}	.54
	IPS	-2.595^{***}	.75	-5.886^{***}	.88	-5.686^{***}	.54
	PESCADF	-2.18^{**}	1	-2.812^{***}	1	-	-

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. I = Intercept, T = Trend, D = Demean. This group of countries includes recipients to which Switzerland has provided ODA below the median (based on the whole period).

Table 7: Panel unit root tests "High exports"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.47^{***}$	-	$.218^{***}$	-	$.188^{***}$	-
	LLC	-4.362^{***}	1.5	-5.095^{***}	1.21	-7.044^{***}	1.38
	IPS	-3.168^{***}	1.5	-5.648^{***}	1.21	-8.629^{***}	1.38
	PESCADF	-2.637^{***}	1	-2.991^{***}	1	-	-
EXP	HT	.954	-	$.692^{***}$	-	$.675^{***}$	-
	LLC	-2.72^{***}	1.13	-4.547^{***}	1.04	-5.015^{***}	1.33
	IPS	1.317	1.13	-6.168^{***}	1.04	-5.762^{***}	1.33
	PESCADF	-2.5^{***}	1	-2.879^{***}	1	-	-

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. I = Intercept, T = Trend, D = Demean. This group of countries includes recipients to which Switzerland has exported above the median (based on the whole period).

Table 8: Panel unit root tests "Low exports"

Variable	Test	I		I + T		I + T + D	
		stat	lags	stat	lags	stat	lags
AID	HT	$.637^{***}$	-	$.459^{***}$	-	$.372^{***}$	-
	LLC	-6.354^{***}	1.77	-5.015^{***}	1.58	-8.629^{***}	1.23
	IPS	-6.179^{***}	1.77	-6.171^{***}	1.58	-11.276^{***}	1.23
	PESCADF	-2.595^{***}	1	-3.225^{***}	1	-	-
EXP	HT	$.741^{***}$	-	$.591^{***}$	-	$.503^{***}$	-
	LLC	-3.775^{***}	.96	-2.928^{***}	1.15	-7.612^{***}	.81
	IPS	-3.693^{***}	.96	-3.538^{***}	1.15	-9.705^{***}	.81
	PESCADF	-2.728^{***}	1	-3.521^{***}	1	-	-

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. I = Intercept, T = Trend, D = Demean. This group of countries includes recipients to which Switzerland has exported below the median (based on the whole period).

5.2 Dumitrescu-Hurlin Granger non-causality

The Dumitrescu-Hurlin Granger non-causality test explained above (see section 4.2) is run on each of the eight group of countries described earlier and in both directions, i.e. from exports towards ODA and from ODA towards exports. This gives us 16 different models. The expected results are not obvious since one may expect causality running from ODA to exports due to the

creation of a longstanding relationship ("goodwill") between the donor and the recipient countries but, on the other hand, one may also expect causality from exports to ODA since donor countries may consider trade when allocating the total amount of ODA to be distributed.

Again, Dumitrescu and Hurlin (2012) propose two different statistics in their paper, i.e. $Z_{N,T}$ (see equation (3)) and $\tilde{Z}_N$ (see equation (4)) depending on the size of T as explained earlier. Since in our case T is equal to 43, it is not clear what statistic should be used. Indeed, even if it is far from infinity, a T equal to 43 is sufficiently large according to table 1 in Dumitrescu and Hurlin (2012) to have a powerful panel Granger (non-)causality test. In this context, we have decided to compute both statistics.

Table 9 shows the results of the Dumitrescu-Hurlin Granger non-causality test with one lag. Including one lag means that the test is based on the individual averaged Wald statistics from the model: $y_{i,t} = \alpha_i + \gamma_i y_{i,t-1} + \beta_i x_{i,t-1} + \epsilon_{i,t}$. The results are unambiguous (and similar whether we look at $Z_{N,T}$ or $\tilde{Z}_N$). Granger causality seems to run from exports to ODA as well as from ODA to exports and for all countries. The only potential doubt of Granger causality is regarding the African countries and from ODA to exports. Indeed, according to the $Z_{N,T}$ statistic Granger causality is present, whereas in accordance to the $\tilde{Z}_N$ statistic, there is no Granger causality. When the assumption on the number of lags is either by minimizing the Akaike, the Hannan-Quinn or the Bayesian information criteria, conclusions remain relatively unaltered despite the slight changes in $Z_{N,T}$ and $\tilde{Z}_N$ (see tables 10, 11 and 12)[43]. As for the unit root tests, we have set a maximum number of lags equal to 5 to avoid losing too many degrees of freedom.

To summarize, results show that causality is bidirectional (also called feedback). On the one hand, some amount of ODA may thus have been allocated on the basis of existing trade relationships. On the other hand, exports to a given country may have occurred thanks to the existence of "goodwill" created by past and current flows of ODA.

[43]The optimal number of lags obtained when applying the BIC criterion is 1 for all panels. Table 9 and 12 therefore display the same results.

Table 9: Dumitrescu-Hurlin Granger non-causality test with 1 lag

	Direction	Zbar ($Z_{N,T}$)	Zbar tilde ($\tilde{Z}_N$)	Lags
All panel	Exp → Aid	14.360^{***}	12.829^{***}	1
All panel	Aid → Exp	4.091^{***}	3.478^{***}	1
Asia	Exp → Aid	11.066^{***}	9.898^{***}	1
Asia	Aid → Exp	2.603^{***}	2.192^{**}	1
Africa	Exp → Aid	8.057^{***}	7.220^{***}	1
Africa	Aid → Exp	1.763^{*}	1.490	1
Latin America	Exp → Aid	2.633^{***}	2.277^{**}	1
Latin America	Aid → Exp	2.849^{***}	2.474^{**}	1
High exports	Exp → Aid	12.911^{***}	11.581^{***}	1
High exports	Aid → Exp	2.596^{***}	2.190^{**}	1
Low exports	Exp → Aid	7.397^{***}	6.561^{***}	1
Low exports	Aid → Exp	3.189^{***}	2.729^{***}	1
High aid	Exp → Aid	9.942^{***}	8.879^{***}	1
High aid	Aid → Exp	2.921^{***}	2.485^{**}	1
Low aid	Exp → Aid	10.365^{***}	9.264^{***}	1
Low aid	Aid → Exp	2.865^{***}	2.434^{**}	1

Note: *p < 0.10, **p < 0.05, ***p < 0.01.

Table 10: Dumitrescu-Hurlin Granger non-causality test with AIC option for lags

	Direction	Zbar ($Z_{N,T}$)	Zbar tilde ($\tilde{Z}_N$)	Lags
All panel	Exp $\rightarrow$ Aid	6.452^{***}	5.374^{***}	2
All panel	Aid $\rightarrow$ Exp	4.091^{***}	3.478^{***}	1
Asia	Exp $\rightarrow$ Aid	5.365^{***}	4.305^{***}	3
Asia	Aid $\rightarrow$ Exp	2.603^{***}	2.192^{**}	1
Africa	Exp $\rightarrow$ Aid	5.740^{***}	4.937^{***}	2
Africa	Aid $\rightarrow$ Exp	1.763^{*}	1.490	1
Latin America	Exp $\rightarrow$ Aid	0.618	0.299	3
Latin America	Aid $\rightarrow$ Exp	3.300^{***}	2.757^{***}	2
High exports	Exp $\rightarrow$ Aid	12.911^{***}	11.581^{***}	1
High exports	Aid $\rightarrow$ Exp	2.596^{***}	2.190^{**}	1
Low exports	Exp $\rightarrow$ Aid	4.199^{***}	3.301^{***}	3
Low exports	Aid $\rightarrow$ Exp	3.189^{***}	2.729^{***}	1
High aid	Exp $\rightarrow$ Aid	8.430^{***}	6.971^{***}	3
High aid	Aid $\rightarrow$ Exp	2.921^{***}	2.485^{**}	1
Low aid	Exp $\rightarrow$ Aid	3.346^{***}	2.718^{***}	2
Low aid	Aid $\rightarrow$ Exp	2.865^{***}	2.434^{**}	1

Note: *p < 0.10, **p < 0.05, ***p < 0.01.

Table 11: Dumitrescu-Hurlin Granger non-causality test with HQIC option for lags

	Direction	Zbar ($Z_{N,T}$)	Zbar tilde ($\tilde{Z}_N$)	Lags
All panel	Exp $\rightarrow$ Aid	14.360^{***}	12.829^{***}	1
All panel	Aid $\rightarrow$ Exp	4.091^{***}	3.478^{***}	1
Asia	Exp $\rightarrow$ Aid	11.066^{***}	9.898^{***}	1
Asia	Aid $\rightarrow$ Exp	2.603^{***}	2.192^{**}	1
Africa	Exp $\rightarrow$ Aid	8.057^{***}	7.220^{***}	1
Africa	Aid $\rightarrow$ Exp	1.763^{*}	1.490	1
Latin America	Exp $\rightarrow$ Aid	2.633^{***}	2.277^{**}	1
Latin America	Aid $\rightarrow$ Exp	2.849^{***}	2.474^{**}	1
High exports	Exp $\rightarrow$ Aid	12.911^{***}	11.581^{***}	1
High exports	Aid $\rightarrow$ Exp	2.596^{***}	2.190^{**}	1
Low exports	Exp $\rightarrow$ Aid	3.154^{***}	2.546^{**}	2
Low exports	Aid $\rightarrow$ Exp	3.189^{***}	2.729^{***}	1
High aid	Exp $\rightarrow$ Aid	8.430^{***}	6.971^{***}	3
High aid	Aid $\rightarrow$ Exp	2.921^{***}	2.485^{**}	1
Low aid	Exp $\rightarrow$ Aid	10.365^{***}	9.264^{***}	1
Low aid	Aid $\rightarrow$ Exp	2.865^{***}	2.434^{**}	1

Note: *p < 0.10, **p < 0.05, ***p < 0.01.

Table 12: Dumitrescu-Hurlin Granger non-causality test with BIC option for lags

	Direction	Zbar ($Z_{N,T}$)	Zbar tilde ($\tilde{Z}_N$)	Lags
All panel	Exp → Aid	14.360^{***}	12.829^{***}	1
All panel	Aid → Exp	4.091^{***}	3.478^{***}	1
Asia	Exp → Aid	11.066^{***}	9.898^{***}	1
Asia	Aid → Exp	2.603^{***}	2.192^{**}	1
Africa	Exp → Aid	8.057^{***}	7.220^{***}	1
Africa	Aid → Exp	1.763^{*}	1.490	1
Latin America	Exp → Aid	2.633^{***}	2.277^{**}	1
Latin America	Aid → Exp	2.849^{***}	2.474^{**}	1
High exports	Exp → Aid	12.911^{***}	11.581^{***}	1
High exports	Aid → Exp	2.596^{***}	2.190^{**}	1
Low exports	Exp → Aid	7.397^{***}	6.561^{***}	1
Low exports	Aid → Exp	3.189^{***}	2.729^{***}	1
High aid	Exp → Aid	9.942^{***}	8.879^{***}	1
High aid	Aid → Exp	2.921^{***}	2.485^{**}	1
Low aid	Exp → Aid	10.365^{***}	9.264^{***}	1
Low aid	Aid → Exp	2.865^{***}	2.434^{**}	1

Note: *p < 0.10, **p < 0.05, ***p < 0.01.

6 Discussion and limitations

As we have seen, there are different tests to check for unit roots in time-series and there are also different methods to test for causality. These differences arise because each method is based on particular hypotheses and therefore each has its own pros and cons. Two main issues discussed in the literature of unit root/panel non-causality tests are serial correlation and cross sectional dependence. In the present study, we have used four different unit root tests in order get robust results. Three of the four unit root tests allow for serial correlation and one allows for cross-sectional dependence. Concerning the latter issue, and to hopefully definitely discard the possibility of non-robust results due to cross-sectional dependence, we have run the three tests that do not control for cross-sectional dependence with the specification of subtracting the cross-sectional means in order to mitigate this issue.

The same problem of cross-sectional dependence can potentially also alter the results obtained with the Dumitrescu-Hurlin Granger non-causality test. However, as already mentioned, the authors have run Monte-Carlo sim-

ulations and their conclusion is that their statistics have good small sample properties even in the presence of cross-sectional dependence.

Another topic of discussion is the bivariate model used in the present study to test for Granger causality (see equation (2)). Indeed, even if such a bivariate model, that is a model with a single independent variable, is what is mainly used in studies testing for Granger causality, one could argue that an additional variable may be included as control variable (trivariate model). For instance, in our case, we may want to account for trade agreements, Gross Domestic Product, growth rate or trade openness of the recipients.[44] To do so, the technique proposed by Dumitrescu and Hurlin (2012), developed within a bivariate model, needs to be extended to multivariate models. Further work in this direction would be a clear improvement.

Then, a limitation specific to our study is that since the tests implemented require a balanced panel dataset, we had to drop some available observations. However, since the remaining data set is still large, we believe this issue does not affect the results.

Finally, another limitation is the number of lags to include when running the Dumitrescu-Hurlin Granger non-causality tests. In their paper, Dumitrescu and Hurlin (2012) do not give any hint concerning how to select the number of lags. Lopez and Weber (2017) have proposed to select the number of lags by minimizing standard information criteria. In the panel data context, tests being based on individual-specific regressions, the information criteria have to be calculated as averages of individual statistics. This

[44] As a robustness check (of potential spurious results due to the lack of other relevant variables in the model), we ran, on the same panel and group of countries as the ones presented in section 3, standard Granger causality tests on equations estimated thanks to panel vector autoregression models (bivariate and trivariate) as discussed and implemented in the Stata software by Abrigo and Love (2016). Results (not reported in this study, available upon request) on bivariate models are more nuanced than those in the present contribution, that is, whereas exports seem to Granger cause ODA regardless of the group of countries under investigation, Granger causality is bi-directional only for two group of countries, namely, the group of countries with which Switzerland trades the least and the one to which Switzerland donates the most. Regarding the results on trivariate models, augmented with the use of three different variables (i.e., recipients' GDP, free trade agreement between Switzerland and the recipients and a variable on the independence status of the recipient), they qualify the statement that exports Granger cause ODA regardless of the group of countries but on the other hand reinforces the result that Granger causality exists and is bi-directional for the group of countries with which Switzerland trades the least. With respect to the present contribution, a further development of the Dumitrescu-Hurlin Granger non-causality test for trivariate models would be necessary to check the robustness of the results. One could even go further and test for Granger causality in models with more than one additional variable (see for instance Pradhan et al. (2017)).

may lead to situations where the average information criteria are driven by a few individuals of the panel. There is probably still room for improvements here.

7 Conclusion

In this study, we investigated the causal relationships between bilateral ODA and exports. Four different unit root tests, carefully selected to mitigate possible serial correlation and cross sectional dependence issues, have been implemented. Bilateral ODA and exports are found to be stationary processes. This result allows us to use Dumitrescu-Hurlin Granger non-causality tests to investigate causality in a second step. The null hypothesis, of non-causality for all countries, is systematically rejected except for the "African" countries, in the direction from ODA to exports, where a doubt of Granger causality remains. ODA and trade flows towards African countries (that represent more than 50% of the countries included in our data set) vary substantially across years and nations of the continent, probably due the highly unstable economic and political situation of many of those countries. We believe this instability to be the reason why Granger causality is not found from ODA to exports, at least according to the $\tilde{Z}_N$ statistic.

On the whole, some amounts of ODA may have been allocated due to past amounts of exports towards the recipient country. But, and as an interesting result for politicians, some exports to a given country seem to have been realized thanks to past amounts of bilateral ODA. The political message that should go along with this result is that when bilateral ODA is allocated, Switzerland gets some economic benefit later on, through its exports. This result basically means that when Switzerland gives 1CHF it is actually giving up less than 1CHF since the 1CHF donated will bring back some revenues through induced Swiss exports (and because providing ODA has some effects on the donor's aggregate demand as discussed by Lopez and Schönenberger (2018)). Two implications arise from this fact: 1) total ODA allocated can be increased as a kind of investment since there is an economic return through exports, 2) if total ODA allocated is cut, Switzerland should expect a drop in exports or at least a change in its geographical allocation.

Aid allocation is always a topic of discussion in Switzerland and more generally in all donor countries. In 2016, Switzerland has disbursed as official development assistance 3,529.1 millions of CHF. Even if this amount seems large, it is equivalent to only 0.53% of the Swiss Gross National Income (GNI), which is still far from the 0.7% prescribed by Pearson Commission in 1970. Switzerland ranks 8th among the 29 member countries of the OECD

Development Assistance Committee (DAC) but comes second in terms of the highest GNI per capita (Norway is first).[45] Together, this ascertainment and our results, should give Swiss politicians confidence to increase the total amount of official development assistance.

The procedure proposed in this study can be applied to any donor country but with some modifications in particular when the unit root tests show non-stationarity in the series. Obviously, further work is still required in order to deal with some limitations such as cross-sectional dependence or absence of exogenous explanatory variables. However, we strongly believe the method employed here is a good starting point to analyze if there exists a statistical link between official development assistance and trade.

[45]Data comes from the World Bank statistic portal.

Appendix A

Table A.1: Country characteristics

Country	Continent	High/low exports	High/low aid
Algeria	Africa	H	L
Angola	Africa	L	L
Bangladesh	Asia	H	H
Benin	Africa	L	H
Bolivia	Latin America	L	H
Brazil	Latin America	H	L
Burkina Faso	Africa	L	H
Burundi	Africa	L	L
Cameroon	Africa	L	L
Chad	Africa	L	H
Chile	Latin America	H	L
Colombia	Latin America	H	H
Congo, Dem. Rep.	Africa	L	L
Costa Rica	Latin America	H	L
Cote d'Ivoire	Africa	H	L
Ecuador	Latin America	H	L
Egypt	Africa	H	H
Ethiopia	Africa	L	H
Ghana	Africa	L	H
Guatemala	Latin America	H	L
Haiti	Latin America	L	L
Honduras	Latin America	L	H
India	Asia	H	H
Indonesia	Asia	H	H
Jordan	Asia	H	L
Kenya	Africa	H	H
Lebanon	Asia	H	L
Madagascar	Africa	L	H
Mali	Africa	L	H
Morocco	Africa	H	L
Mozambique	Africa	L	H
Myanmar	Asia	L	L
Nepal	Asia	L	H
Nicaragua	Latin America	L	H
Niger	Africa	L	H
Pakistan	Asia	H	H
Paraguay	Latin America	L	L
Peru	Latin America	H	H
Rwanda	Africa	L	H
Senegal	Africa	L	L
Sri Lanka	Asia	H	H
Sudan	Africa	H	H
Tanzania	Africa	L	H
Thailand	Asia	H	L
Tunisia	Africa	H	L
Turkey	Europe	H	L
Uganda	Africa	L	L
Vietnam	Asia	H	H
Zambia	Africa	L	L
Zimbabwe	Africa	L	L

Notes: high/low exports/aid = above/below median exports/aid. H = High and L = Low. Given that Turkey is the only European country in the panel, an "European" group of countries has not been created.

Chapter 4: The Impact of Bilateral Official Development Assistance on the Donor Exports: Empirical Evidence for Switzerland[§]

1 Introduction

Our economies have drastically changed during the past centuries, in many ways. For instance, if it was difficult some decades ago to find foreign food in the supermarkets, it is not the case anymore in most of the countries. Even if borders still exist and will probably continue to do so for a long time, trade intensity has tremendously risen, particularly among developed nations. Indeed, in some of the latter, exports are now a major component of GDP. For instance, according to the Swiss Federal Statistical Office, Swiss exports of goods and services accounted for more than 65% of the Swiss GDP in 2016[46]. Conversely, the World Bank has reported that exports relative to GDP reach only 27.1% in the sub-Saharan Africa region.[47] These differences in trade intensities may foster gaps in wealth among countries or world regions. To mitigate those gaps, the OECD has been encouraging its member countries to assist less developed countries. Those industrialized nations that have adhered to the OECD mission are members of the Development Assistance Committee (DAC). In the present study we refer to them as "donor countries". The assistance they provide that meets the eligibility criteria of the DAC is known as "Official Development Assistance" (ODA) (also called aid). Beneficiaries of ODA are called "recipient countries".

Currently, around thirty countries are members of the DAC. They basically use two channels to provide ODA, bilateral or multilateral. The former comprises ODA flows directly going to recipient countries whereas the latter

[§]This paper was presented at a Trent University seminar, Peterborough (Canada), April 2018

[46]The complete report is available in French, German or Italian on the Swiss Federal Statistical Office website. The following provisional numbers for 2016 are given in the report: Swiss nominal GDP in millions is 658,978 CHF and Swiss exports of goods and services, also in nominal terms and in millions, amounts to 433,682 CHF.

[47]Exports and GDP in nominal terms.

encompasses contributions to international institutions that, in turn, distribute the amount collected among several recipients. Bilateral ODA is of primary interest in the present study since it allows to identify who donates to whom, when and by how much. Thus, one can therefore enquire what impact those bilateral flows may have on the countries involved. More precisely, can bilateral ODA at least partially explain other economic or financial flows between the donor and the recipient or enlighten some of their economic features? From this questioning have originated a large scope of studies. We can classify them in basically two strands: 1) the ones that have looked at recipient countries to see if ODA flows received have allowed them to, for instance, grow faster (see Burnside and Dollar (2000)) or increase their exports (see Nowak-Lehmann et al. (2013)) and, 2) the ones that have focused on donor countries to find out if the aid they have donated has had an impact on, for instance, their trade balance with the recipient countries (see for instance Martínez-Zarzoso et al. (2009) or Nowak-Lehmann et al. (2009)). A common model used in both categories (at least whenever ODA is used to explain trade flows) during the last two decades, is the so-called gravity model of trade. The present study belongs to the second literature strand since we focus on Switzerland, a donor country which happens to be one of the richest nations on earth.

From an economic policy perspective, the fact that bilateral official development assistance may have a positive impact on the donor's economy is far from being trivial. Indeed, if ODA implies economic returns, it could, or even should, be considered as an additional investment opportunity just as, for instance, foreign direct investments. Such an outcome can play a role when deciding the total ODA envelope (and its composition) a donor will allocate, simply because if there are positive returns, at least part of total ODA donated is actually not a donation but an (involuntary) investment. Furthermore, depending on the tying status of ODA, economic returns can vary substantially. As a matter of fact, tied aid, which is mostly aid in the form of goods or services produced by the donor, tends to exhibit higher economic returns as Pettersson and Johansson (2013) show. The fact that we focus on Switzerland is what makes our contribution depart from the existing literature. Indeed, a significant peculiarity of Swiss bilateral ODA is that it is almost totally untied. This observation does not mean that economic returns could not exist (see Arvin and Baum (1997)) but the pay-off structure from bilateral ODA may be very different from that of other countries that have so far been investigated in the literature.

Based on Prais-Winsten fixed-effect estimations of an augmented dynamic gravity model of trade using data on 95 recipient countries over 51 years, we find that the impact of one dollar of Swiss bilateral ODA on Swiss exports to

the recipient countries varies from 0.59 (short run) to 1.73 (long run) USD. Furthermore, we also find that significant effects only exist when ODA is allocated towards a specific group of recipients, namely the ones with which Switzerland trades the least but to which it donates the most. Moreover, returns on ODA are higher when bilateral ODA flows to African or Asian countries rather than to European or Latin American countries.

The rest of the paper is organized as follows. Section 2 discusses relevant literature on ODA and its possible link to other economic variables. Section 3 provides information on the data used and describes the various groups of countries studied. Section 4 presents the model, going through its variables as well as their expected signs. Section 5 presents the main results. Section 6 discusses the limitations of this study and directions for future research. Section 7 concludes and provides some policy implications.

2 Literature review

Since the seminal contribution by McCallum (1995), the effect of economic variables on trade flows has received considerable attention in the empirical macro-economic literature. For instance, and related to our topic, Arvin et al. (1996) have shown in their contribution that foreign Canadian aid has a lingering/persistent effect on the country's exports. Based on McCallum (1995), Anderson and van Wincoop (2003) and Silva and Nelson (2012) show that an appropriate model to use in this framework is an augmented gravity model of trade. Whereas most authors have focused on ODA's impact on recipient countries, some others have devoted their attention to the donor countries.

Considering that the main objective of ODA is to promote the economic development and welfare of developing countries, it is rather obvious why researchers have put energy in trying to find out if ODA was indeed helping recipients to increase their export flows (it is well-known that exports are key for growth). Conclusions of studies published within the last decade are however conflicting. For instance, Pettersson and Johansson (2009, 2013) do find a positive relationship between ODA and recipients' exports whereas Nowak-Lehmann et al. (2013) who use a model that takes into account dyadic fixed effects, autocorrelation and endogeneity, find no significant effect. The conclusion of Helble et al. (2012) corroborates this disagreement since they find evidence that only a small part of ODA, that is Aid for Trade (AfT), is related to higher exports for the recipient country. It is worth noting that these studies adopt a multi-recipient and multi-donor approach as opposed to those adopting a one-recipient and/or one-donor strategy. One can therefore

wonder if results would have been different if only one recipient country had been considered, therefore allowing the inclusion of country-specific explanatory variables.

Concerning the second literature strand, namely studies focusing on donor countries, there are also reasons why researchers have dedicated time to that topic, even though they are less straightforward. However, if in any way ODA contributions impact the donor's economy this must be known by the country's policy makers in order to properly ascertain the whys and wherefores of providing ODA, particularly if reductions or rises of total ODA are planned. In their contribution, Martínez-Zarzoso et al. (2009) give three different reasons why ODA could lead to higher exports for the donor country. First, part of ODA could be tied, meaning that ODA received has to be spent in the donor country. Such aid leads by definition to higher exports for the donor. Second, ODA provided may create habit-formation. For instance, if at time t, ODA is disbursed in the form of goods produced by the donor, it may create a dependence on those goods leading to a need for importing them again at time $t + 1$ (similar to the lingering effect discussed by Arvin et al. (1996)). This effect, largely discussed by Djajić et al. (2004), goes well beyond the initial impact of aid and since it spreads over time, it is much more difficult to measure. Last but not least, when a donor allocates ODA to a recipient country, it sends a positive signal to the recipient country in the same way as an advertisement paves the way for a product on the market. This is particularly true if ODA is untied. This phenomenon is known as the "goodwill effect". In their contribution, Arvin and Baum (1997) find evidence that donors grant a constant amount of untied aid over the years precisely to keep constant the stock of goodwill.

Whereas in the first literature strand, studies differ on the magnitude and on the significance of the coefficient attached to ODA, in the second strand, differences across studies are predominantly on the size rather than on the significance of the coefficient. Among "recent" studies adopting a multi-donor perspective, one can mention, for instance, Wagner (2003) who has shown that, depending on the method of estimation, the magnitude of the coefficient of interest changes drastically although it remains significant regardless of the estimation method. Using a pooled OLS, the author found a total impact of aid on exports of 2.29 USD for each dollar of aid whereas using a fixed effect model the total impact decreases to 0.73 USD. Pettersson and Johansson (2013) also find a statistically significant relationship between aid and exports of the donors, particularly when aid is disaggregated and only "Aid for Trade" is kept. Recently, also using a multi-donor approach and employing a model that controls for unobserved heterogeneity and includes multilateral resistance factors, Martínez-Zarzoso et al. (2014) found an av-

erage positive effect of aid on the donors' exports. However, the authors mitigate their finding by stating that the effect highly depends on the specification of the model. They further state that their discovered effect varies across donors as well as time and depends on the tying status of aid.

Regarding the very scarce literature with focus on a particular donor, one can first mention Vogler-Ludwig et al. (1999). The authors used a reduced version of a gravity model (with only recipient's GNP and ODA from the rest of the World as additional regressors) to compute German aid's marginal export elasticity. They found a surprisingly high elasticity of 0.366. In absolute terms and given that German exports and ODA were, respectively, 758 and 64 billion Deutsche Mark (DEM) (over the time period analyzed, that is, 1976 to 1995), an increase of 1 DEM was accompanied, on average, by an export increase of 4.3 DEM. We believe the lack of additional regressors to be the reason of their very high return on aid.[48] A decade later, Martínez-Zarzoso et al. (2009) found, also using German data, a significant impact of aid on German exports. In their preferred model, namely a dynamic two-stage feasible generalized least squares model (with fixed effects), they find that in the long run, each US dollar of bilateral aid increases exports by approximately 1.40 dollar. In the same vein and also for Germany, Nowak-Lehmann et al. (2009) found, using time series techniques, an average return of each dollar of aid allocated varying between 1.04 USD (using an error correction model) and 1.50 USD (using a dynamic OLS model).

The present contribution, in line with Martínez-Zarzoso et al. (2009), focuses on Switzerland, a country arguably considered as one of the most altruistic donor countries due to its relatively high share of untied aid.

3 Data sources

In order to investigate the relationship between Swiss bilateral ODA and exports, we had to construct a data set based on a multitude of different sources. The most relevant information, namely data on Swiss foreign aid and exports to other countries, are taken from Swiss Federal Department of Foreign Affairs[49] and UN COMTRADE, respectively. Data on gross domestic product are from the Penn World Table and those on population from the World Bank. Bilateral exchange rates are taken from the International Monetary Fund (IMF) database. ODA allocated by any other country different from Switzerland (and towards the same recipients to which Switzerland do-

[48]For a summary of Vogler-Ludwig et al. (1999) in English, see Schönherr and Vogler-Ludwig (2002).

[49]Data are available in CHF. We have converted data from CHF to USD using annualized exchange rates provided by the OECD.

nates) are obtained from the OECD database. Data on free trade agreements between Switzerland and the recipient countries are provided by the Swiss State Secretariat for Economic Affairs. The WTO provides membership of a recipient country to the GATT/WTO. Finally, the CIA World Fact book provides information on the "independence" status of the recipient country. The definition of independence is the one provided by the CIA World Fact book, that is, "a country is considered as independent if it is politically organized into a sovereign state and has a definite territory".

Switzerland has been assisting through its ODA programs and projects around one hundred countries over more than fifty years. However, data are unfortunately not available for all countries and all years. Nevertheless, our database, strongly unbalanced, remains rather large with 95 countries over 51 years (from 1963 to 2013).[50] To capture potential geographical effects, we have created several groups of countries, namely African, Latin American, Asian and European[51]. Then, to take into account possible level effects, we have divided our original panel in two, according to ODA disbursements (above and below whole period median ODA disbursements). We did the same grouping according to exports. Appendix A lists the 105 countries towards which Switzerland has donated ODA at least once and, more importantly, the subset of 95 countries[52] used in our regressions as well as their classification in their respective groups. Table 1 here below displays the descriptive statistics corresponding to the full panel (95 countries).

[50]Data has been collected until 2017 when available. However, since exchange rate figures (from the IMF) have been, at this time, published only until 2013, the time dimension of the panel is restricted.

[51]Aid towards the Part II list of countries and territories in transition, such as the Eastern European countries, is called Official Aid (OA).

[52]Countries are discarded when data on one or more variables used in our models are missing.

Table 1: Descriptive statistics

	Mean	Standard Deviation	Min.	Max.
ODA (in thousands)	4544.5	7714.3	23.1	163496
Exports (in thousands)	87283.6	381341.6	1.0	9971193
GDP (in millions)	168808.4	710492.8	147.8	15651357
Population (in thousands)	40669.5	143863.9	100.6	1357380
Exchange rate	106.5015	430.0278	5.69e-14	5716.965
Aid from others (in thousands)	276058.1	606359.8	0	21844320
Free Trade Agreement	.0281	.1652	0	1
WTO membership	.5350	.4988	0	1
Independent	.8745	.3313	0	1

Note: negative and zero figures of ODA (plausible due to the fact that "debt repayments" are considered as ODA) have been considered as missing in order to 1) log-linearize the variable, and 2) because data reported did not differentiate a zero aid figure due to no ODA or due to debt repayments canceling positive ODA figures. Population and GDP are from the recipient countries. Monetary variables are in US Dollars.

4 The model

4.1 Model specification

Once again, our aim is to relate Swiss bilateral ODA to Swiss bilateral exports. Particularly, we want to establish both the significance and the size of the impact of bilateral ODA on exports. Following the literature, we model Swiss exports to recipient country i in year t, Exp_{it}, using an augmented gravity model of the form:

$$Exp_{it} = \alpha Aid_{it}^{\beta_1} \prod_{k=1}^{K} (X_{kit}^{\beta k+1}) \tag{1}$$

where α is a constant, Aid_{it} is foreign bilateral aid from Switzerland to recipient i in the same year and X_{kit} is a set of k additional control variables describing the recipient country or some feature of its relationship with Switzerland that may augment or lower the "attraction", namely exports, between the two countries.

If we log-linearize equation (1) in order to obtain elasticities as coefficients, we end up estimating a model comparable to the one in Martínez-Zarzoso et al. (2009) or Martínez-Zarzoso et al. (2014)), that is:

$$\begin{aligned} lnExp_{it} = \phi_0 + \varphi_i + \beta_1 lnAid_{it} + \beta_2 lnGDP_{Tt} + \beta_3 lnPop_{Tt} + \beta_4 lnExR_{it} + \\ \beta_5 lnAidO_{it} + \beta_6 lnFTA_{it} + \beta_7 lnGATTWTO_{it} + \beta_8 lnInd_{it} + \epsilon_{it} \end{aligned} \tag{2}$$

where ln denotes variables in natural logs and Exp_{it} are exports from Switzerland to recipient country i in period t expressed in nominal USD. Aid_{it} is bi-

lateral gross official development assistance disbursement from Switzerland to recipient country i in period t in USD ; $lnGDP_{Tt} = ln(GDP_{st} * GDP_{it})$, where GDP_{st} and GDP_{it} are respectively the Swiss and recipient country i gross domestic products in period t in PPP USD; $lnPop_{Tt} = ln(Pop_{st} * Pop_{it})$[53], where Pop_{st} and Pop_{it} are respectively the Swiss and recipient country i populations in period t; ExR_{it} is the nominal annual bilateral exchange rate of recipient country i currency per CHF in period t; $AidO_{it}$ is the official development assistance allocated by other countries to recipient country i in period t in USD; FTA_{it} is a dummy variable taking the value of one if there is a trade agreement between Switzerland and recipient country i in period t; $GATTWTO_{it}$ is a dummy variable taking the value one if recipient country i is member of the GATT/WTO in period t; Ind_{it} is a dummy variable taking the value one if recipient country i is "independent" in period t. Finally, ϕ_0 is a constant, ϵ_{it} is an idiosyncratic error term and φ_i are individual (country) effects. Those effects capture everything that is country-pair specific and that does not vary over time, as for instance a fundamental variable in the basic gravity model, namely the distance between the two countries.

Intuitively, we expect the coefficient attached to GDP to be positive if significant simply because the more productive a pair of countries, the higher the probability to find trade opportunities between the two. Regarding the coefficient attached to population, there is no clear expectation on its sign since highly populated countries are not necessarily economically wealthier countries. Concerning the coefficients of variables FTA, GATT/WTO and Ind, we expect them to be positive since these variables may facilitate trade. Regarding the exchange rate coefficient, which is defined as the nominal bilateral exchange rate of the recipient country currency per CHF, we expect it to be negative. Indeed, an increase of the exchange rate is associated with a depreciation of the recipient country currency implying a drop in their capacity to import.

Regarding the variable aid from other countries, and before talking about the expected sign of the associated coefficient, an explanation on why we include this variable is necessary. As mentioned in our brief literature review, there are several reasons why we expect bilateral aid to have an impact on bilateral exports for the donor country, one of them being the so-called goodwill effect. We believe that if a recipient country receives bilateral aid only from Switzerland, this will not have the same impact on the two countries' trade relationship compared to the case where the aid received from Switzer-

[53]In a single donor approach, it does not make sense to include in the model variables such as Swiss GDP or Swiss Pop. Therefore, coefficients of Swiss GDP/Pop and recipient GDP/Pop are restricted to be equal.

land represents only a small share of the total aid obtained. Put differently, aid from others may diminish the goodwill effect and/or the habit formation effect on a given Swiss-recipient country-pair, we therefore expect the coefficient to be negative. Last but not least, and in view of what has been discussed earlier, we expect the coefficient attached to the variable of interest in the present study, that is bilateral aid, to be positive and significant.

4.2 Model estimation

Static estimations restrict the effect of aid on exports to take place during the same year but this may not necessarily be correct because of habit formation or because some of the purchases made related to this year's aid may be done (or disbursed) during the following year(s). This is precisely what Arvin et al. (1996) proved in their contribution when they found, using Canadian data, a lingering effect of aid on exports. Our model can therefore be extended to a habit formation/gradual adjustment specification where the observed temporal differences in (logarithm of) exports only reflect a fraction of the temporal difference in exports that would be needed to reach the aid-determined equilibrium. So, we assume: $lnExp_{it} - lnExp_{it-1} = \lambda(lnExp^*_{it} - lnExp_{it-1})$, where $\lambda \in [0, 1]$ is an adjustment parameter that represents the ratio between observed change in exports from change in exports necessary to attain the new equilibrium level of export flows, which depends (at least partially) on the new level of aid in t. Under the assumption that the long-term equilibrium export flow Exp^*_{it} can also be expressed in the form of a standard gravity model, we have: $Exp^*_{it} = \phi Aid^{\gamma_1}_{it} \prod_{k=1}^{K}(X^{\gamma k+1}_{kit})$ with γ_1 representing the long run aid elasticity of exports. This processing is called a Koyck transformation. Then, if we log-linearize and include a composite error term, θ_{it}, the above difference model can be reformulated to obtain:

$$lnExp_{it} = \lambda ln\phi + \lambda\gamma_1 lnAid_{it} + \sum_{k=1}^{K}\gamma_k lnX_{kit} + (1-\lambda)lnExp_{it-1} + \theta_{it} \quad (3)$$

where $\lambda\gamma_1$ give the short run elasticity. The corresponding long run elasticity can then be obtained by standardizing the short-term ones by the estimate of λ, which is easily obtained by subtracting the coefficient of the lag dependent variable from one. We expect the coefficient attached to the lagged dependent variable $(1 - \lambda)$ to be significant and relatively close to unity.
A wide variety of methods can be used due to recent developments in econometrics to estimate equations (2) or (3). This might to some extent explain why we find heterogeneous results on the magnitude of return on aid in the literature. To study the Swiss case, we use in the present study a mix of the methods employed in the recent relevant literature discussed above in section

2 as well as a method developed by Hsiao et al. (2002) that uses unconditional quasi-maximum likelihood estimators (method used as robustness check). As mentioned above, we include in the model individual effects that act as a proxy for multilateral "resistance factors". As initially argued by Anderson and van Wincoop (2003), these effects are important to include since a drop of resistance (i.e. a decline in trade costs) between Switzerland and a given recipient country leads to a relatively higher resistance between Switzerland and the other recipients and vice-versa. Encouraged by the results of a Hausman test, we assume these effects to be fixed (as opposed to random) and therefore estimate our model using within regressions. After a meticulous inspection of our preliminary regressions, we found the presence of autocorrelation (serial correlation) and heteroskedasticity. Thus, as a second step we ran Prais-Winsten fixed effect regressions (panel-corrected standard errors, PCSE). Then, as we have just argued, we modified our model from static to dynamic by adding a lag of the dependent variable as an additional regressor (from equation 2 to 3). Even if the inclusion in the model of the past value of exports as an explanatory variable may wrongly diminish the explanatory power of the exogenous variables in the model (see Achen (2001)), failure to include it would probably create omitted variable bias. But, it is important to note that since the additional regressor is endogenous, this could result in potential bias and inconsistent estimates as pointed out by Nickell (1981). However, as the author emphasizes, such a risk is particularly high when T is small, which is not our case. Nevertheless, as a robustness check, we used, besides a Prais-Winsten fixed effect regression, a second dynamic panel estimation method on our full panel, namely the one discussed by Hsiao et al. (2002). Their method uses the unconditional Quasi-Maximum Likelihood (QML) estimator for linear dynamic panel models with fixed effects. According to the authors, this method has better finite sample properties than the GMM approach. The QML method of estimation can be easily used by practitioners thanks to the work of Kripfganz (2016) who has implemented the method in the Stata software.

5 Results

Table 2 reports our results using the above discussed estimation methods. Coefficients that are consistently significant exhibit the expected signs, with the notable exception of the one attached to population which is in one model significant and positive and in others significant but negative. As expected, GDP mass of the country-pair seems to have a sizable positive impact on donor exports. Unsurprisingly, the exchange rate coefficients turn out to be

negative and significant. Regarding the variable of interest in the present study, its coefficient is always significant and its size, namely the short run ODA-elasticity of exports, varies between 0.0276 and 0.0522 (putting aside the results of our first regression, i.e. column (1) of table 2, that cannot be relied upon as discussed in the previous section), our preferred model, that is, the dynamic model (i.e. column (3)) exhibiting an elasticity of 0.0306. It is worth noting that results of our fourth regression (that drops countries with gaps in the data), are in line with our expectation that due to the long time period available, our method of estimation (Prais-Winsten fixed effect) does not suffer from the so-called Nickell bias. We therefore confidently employ Prais-Winsten fixed effect regressions on all of our groupings of countries.

Table 2: Panel regressions, full dataset

	(1) FE	(2) Static PW	(3) Dynamic PW	(4) Dynamic QML
Lag 1 of Exports			0.6611^{***}	0.7082^{***}
			(0.0248)	(0.0180)
Aid	0.1148^{***}	0.0522^{***}	0.0306^{***}	0.0276^{**}
	(0.0116)	(0.0128)	(0.0108)	(0.0130)
GDP	0.8974^{***}	0.8722^{***}	0.3554^{***}	0.3665^{***}
	(0.0312)	(0.0678)	(0.0354)	(0.0391)
Population	0.0696	0.3646^{**}	-0.1221^{*}	-0.1582^{*}
	(0.0779)	(0.1851)	(0.0742)	(0.0829)
Exchange rate	-0.1079^{***}	-0.1147^{***}	-0.0241^{*}	-0.0416^{***}
	(0.0153)	(0.0303)	(0.0130)	(0.0142)
Aid from others	−0.0077	−0.0022	−0.0032	−0.0009
	(0.0053)	(0.0028)	(0.0026)	(0.0070)
Free Trade Agreement	0.1830^{**}	0.0879	0.0595	−0.0775
	(0.0796)	(0.1018)	(0.0506)	(0.0690)
WTO membership	−0.0771	0.0323	−0.0318	−0.0227
	(0.0479)	(0.0713)	(0.0335)	(0.0450)
Independent	0.1233	0.0859	0.0057	-0.3038^{*}
	(0.1333)	(0.1847)	(0.0974)	(0.1761)
#Obs.	3,420	3,420	3,388	1,784
#Countries	95	95	95	51

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Columns: (1) within regression, (2) static Prais-Winsten fixed effect regression, (3) dynamic fixed effect Prais-Winsten regression, (4) Quasi-Maximum Likelihood estimation.

The elasticities obtained are rather small. A 1% increase in aid only implies a 0.0306% increase in exports in the short run. However, since exports are so much larger than aid, it is worthwhile to transform our elasticities into impacts in absolute terms (slope) to get a more meaningful representation of the impact. Aid-elasticities of exports of our dynamic model (column (3)) can be used to compute, respectively, the short run and long run impacts of 1 USD of bilateral aid on Swiss bilateral exports. Thus, the short run impact of 1 USD of bilateral aid, is calculated by means of the following transformation:

$$\frac{\partial Exp}{\partial Aid} = \beta_{Aid} * \frac{Exp}{Aid} = 0.0306 * \frac{87{,}283{,}627}{4{,}544{,}491} = 0.59. \tag{4}$$

Regarding the long run impact, it can be computed as:

$$\frac{\beta_{Aid}}{1-\beta_{Exp_{t-1}}} * \frac{Exp}{Aid} = \frac{0.0306}{1-0.6611} * \frac{87{,}283{,}627}{4{,}544{,}491} = 1.73. \tag{5}$$

These latter results suggest that for each USD donated, Switzerland gets back, through an increase in exports towards the recipients, around 0.59 USD in the short run and 1.73 USD in the long run.

As a robustness check, the same kind of regressions (Prais-Winsten fixed effect regressions on our static and dynamic models) are run on the different group of countries discussed earlier. Results can be found in tables 4 to 10. In a nutshell, what those regressions on different groupings of countries tell us is that bilateral aid returns (in form of exports) are significant if ODA is allocated to countries towards which Switzerland has below-median export flows and above-median aid flows. Those countries are mainly located in the African continent. Our results based on grouping of countries based on their geographical location confirm our previous finding since returns appear to be statistically significant when aid is allocated to African countries. Additionally, results also show that positive (and particularly high) and significant bilateral aid return also exist for ODA allocated to Asian countries. Table 3 below summarizes the short run and long run returns of 1 US dollar of bilateral aid on exports for those two groups of countries.

Table 3: Return on aid by region

	Africa	Asia
Short run return	0.20 USD	1.04 USD
Long run return	0.55 USD	2.72 USD

A return of for instance 2.72 USD[54] means that for every dollar of bilateral aid given to Asian countries, Switzerland gains in the long run 2.72 dollars through an increase of exports towards those same Asian countries.

Table 4: Panel regressions, high-export group of countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.7884^{***}
			(0.0242)
Aid	0.0528^{***}	0.0037	0.0097
	(0.0134)	(0.0117)	(0.0090)
GDP	0.8722^{***}	0.8807^{***}	0.2345^{***}
	(0.0360)	(0.0849)	(0.0345)
Population	0.3156^{***}	0.6423^{***}	-0.1194
	(0.0957)	(0.2450)	(0.0848)
Exchange rate	-0.0524^{***}	-0.1139^{**}	-0.0002
	(0.0171)	(0.0445)	(0.0136)
Aid from others	-0.0106^{**}	-0.0022	-0.0018
	(0.0043)	(0.0023)	(0.0023)
Free Trade Agreement	0.1233^{*}	0.0306	0.0514
	(0.0693)	(0.0628)	(0.0329)
WTO membership	0.0247	0.0935	0.0173
	(0.0550)	(0.0626)	(0.0295)
Independent	0.0615	0.0042	-0.0734
	(0.1486)	(0.2617)	(0.1147)
#Obs.	1,671	1,671	1,653
#Countries	47	47	47

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Columns: (1) within regression, (2) static Prais-Winsten fixed effect regression, (3) dynamic fixed effect Prais-Winsten regression. This group of countries includes recipients to which Switzerland has exported above the median (based on the whole period).

[54]Even if we exclude China, results remain similar.

Table 5: Panel regressions, low-export group of countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.6559^{***}
			(0.0269)
Aid	0.1453^{***}	0.1024^{***}	0.0405^{**}
	(0.0205)	(0.0217)	(0.0169)
GDP	0.8250^{***}	0.8332^{***}	0.3554^{***}
	(0.0528)	(0.0900)	(0.0471)
Population	−0.0491	0.0910	−0.1387
	(0.1239)	(0.1977)	(0.0928)
Exchange rate	-0.1702^{***}	-0.1442^{***}	-0.0404^{**}
	(0.0253)	(0.0390)	(0.0204)
Aid from others	0.0808^{***}	0.0616^{*}	0.0024
	(0.0290)	(0.0326)	(0.0227)
Free Trade Agreement	0.1023	0.1134	−0.0897
	(0.2679)	(0.5178)	(0.3084)
WTO membership	-0.1271^{*}	−0.0426	−0.0735
	(0.0763)	(0.1055)	(0.0498)
Independent	−0.3212	−0.0987	−0.0072
	(0.2419)	(0.2480)	(0.1453)
#Obs.	1,749	1,749	1,735
#Countries	48	48	48

Note: *p < 0.10, **p < 0.05, ***p < 0.01. Columns: (1) within regression, (2) static Prais-Winsten fixed effect regression, (3) dynamic fixed effect Prais-Winsten regression. This group of countries includes recipients to which Switzerland has exported below the median (based on the whole period).

Table 6: Panel regressions, high-aid group of countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.6940^{***}
			(0.0248)
Aid	0.2100^{***}	0.1055^{***}	0.0422^{***}
	(0.0173)	(0.0214)	(0.0146)
GDP	1.1002^{***}	1.1139^{***}	0.4071^{***}
	(0.0515)	(0.0880)	(0.0478)
Population	-0.4862^{***}	-0.1439	-0.2714^{***}
	(0.1220)	(0.2243)	(0.1049)
Exchange rate	-0.1629^{***}	-0.1738^{***}	-0.0403^{**}
	(0.0252)	(0.0446)	(0.0191)
Aid from others	0.0069	0.0006	0.0006
	(0.0112)	(0.0069)	(0.0072)
Free Trade Agreement	-0.5141^{***}	-0.2420^{***}	-0.1541^{***}
	(0.1407)	(0.0910)	(0.0593)
WTO membership	-0.1026	0.0392	-0.0553
	(0.0720)	(0.0930)	(0.0459)
Independent	-1.4459^{***}	-0.7888^{**}	-0.5913^{**}
	(0.2729)	(0.3072)	(0.2324)
#Obs.	1,663	1,663	1,650
#Countries	47	47	47

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Columns: (1) within regression, (2) static Prais-Winsten fixed effect regression, (3) dynamic fixed effect Prais-Winsten regression. This group of countries includes recipients to which Switzerland has provided ODA above the median (based on the whole period).

Table 7: Panel regressions, low-aid group of countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.5898^{***}
			(0.0333)
Aid	0.0458^{***}	0.0344^{**}	0.0230
	(0.0158)	(0.0149)	(0.0147)
GDP	0.7944^{***}	0.7493^{***}	0.3653^{***}
	(0.0390)	(0.0839)	(0.0467)
Population	0.3114^{***}	0.5237^{**}	−0.0418
	(0.1036)	(0.2217)	(0.0994)
Exchange rate	-0.0821^{***}	-0.0832^{**}	−0.0200
	(0.0191)	(0.0389)	(0.0176)
Aid from others	-0.0110^{*}	−0.0023	−0.0039
	(0.0060)	(0.0028)	(0.0026)
Free Trade Agreement	0.4804^{***}	0.2482	0.1918^{**}
	(0.0969)	(0.1800)	(0.0771)
WTO membership	−0.0590	0.0384	−0.0099
	(0.0650)	(0.1032)	(0.0477)
Independent	0.5474^{***}	0.5056^{**}	0.2194^{**}
	(0.1552)	(0.2374)	(0.1068)
#Obs.	1,757	1,757	1,738
#Countries	48	48	48

Note: *p < 0.10, **p < 0.05, ***p < 0.01. Columns: (1) within regression, (2) static Prais-Winsten fixed effect regression, (3) dynamic fixed effect Prais-Winsten regression. This group of countries includes recipients to which Switzerland has provided ODA below the median (based on the whole period).

Table 8: Panel regressions, African countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.6394^{***}
			(0.0294)
Aid	0.1114^{***}	0.0693^{***}	0.0300^{**}
	(0.0182)	(0.0189)	(0.0148)
GDP	0.7105^{***}	0.6719^{***}	0.3174^{***}
	(0.0507)	(0.0994)	(0.0488)
Population	0.5242^{***}	0.7948^{***}	0.0455
	(0.1178)	(0.2140)	(0.1014)
Exchange rate	-0.2387^{***}	-0.2584^{***}	-0.0631^{***}
	(0.0253)	(0.0405)	(0.0204)
Aid from others	0.0179	0.0172	-0.0070
	(0.0218)	(0.0233)	(0.0172)
Free Trade Agreement	0.1571	0.0972	0.0271
	(0.1422)	(0.2182)	(0.1106)
WTO membership	-0.3472^{***}	-0.2260^{*}	-0.1419^{**}
	(0.0807)	(0.1195)	(0.0614)
Independent	0.0282	0.1238	0.0970
	(0.2026)	(0.1983)	(0.1439)
#Obs.	1,685	1,685	1,667
#Countries	42	42	42

Note: *p < 0.10, **p < 0.05, ***p < 0.01. Columns: (1) within regression, (2) static Prais-Winsten regression, (3) dynamic Prais-Winsten regression.

Table 9: Panel regressions, Latin American countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.7814^{***}
			(0.0326)
Aid	0.0469^{**}	0.0215	0.0100
	(0.0221)	(0.0188)	(0.0132)
GDP	0.7863^{***}	1.0820^{***}	0.2425^{***}
	(0.0742)	(0.1603)	(0.0523)
Population	-0.3936^{*}	-0.6436	-0.2772^{*}
	(0.2359)	(0.5027)	(0.1618)
Exchange rate	0.1071^{***}	0.0543	0.0231^{*}
	(0.0264)	(0.0480)	(0.0133)
Aid from others	-0.0031	-0.0029	-0.0017
	(0.0070)	(0.0026)	(0.0028)
Free Trade Agreement	0.4400^{***}	0.1237	0.1358^{***}
	(0.1189)	(0.0995)	(0.0501)
WTO membership	-0.0551	0.0037	-0.0143
	(0.0760)	(0.0896)	(0.0476)
#Obs.	683	683	679
#Countries	16	16	16

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Columns: (1) within regression, (2) static Prais-Winsten regression, (3) dynamic Prais-Winsten regression.

Table 10: Panel regressions, Asian countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.6172^{***}
			(0.0361)
Aid	0.1218^{***}	0.0497^{**}	0.0397^{**}
	(0.0223)	(0.0221)	(0.0186)
GDP	0.8066^{***}	0.9198^{***}	0.3691^{***}
	(0.0612)	(0.0957)	(0.0572)
Population	0.4763^{***}	0.3837	0.0078
	(0.1699)	(0.2764)	(0.1368)
Exchange rate	−0.0404	−0.0434	−0.0087
	(0.0263)	(0.0455)	(0.0225)
Aid from others	0.0041	−0.0016	0.0008
	(0.0072)	(0.0048)	(0.0038)
Free Trade Agreement	-0.3102^{*}	−0.0349	−0.0636
	(0.1872)	(0.1916)	(0.0956)
WTO membership	0.6263^{***}	0.4256^{***}	0.2132^{***}
	(0.0968)	(0.1306)	(0.0711)
Independent	−0.0974	−0.0414	−0.1720
	(0.2305)	(0.2852)	(0.1098)
#Obs.	907	907	900
#Countries	28	28	28

Note: *p < 0.10, **p < 0.05, ***p < 0.01. Columns: (1) within regression, (2) static Prais-Winsten regression, (3) dynamic Prais-Winsten regression.

Table 11: Panel regressions, European countries

	(1) FE	(2) Static PW	(3) Dynamic PW
Lag 1 of Exports			0.4584^{***}
			(0.0878)
Aid	0.0291	-0.0042	0.0338
	(0.0374)	(0.0375)	(0.0354)
GDP	1.0622^{***}	1.1355^{***}	0.5152^{***}
	(0.1290)	(0.1737)	(0.1538)
Population	2.2604^{***}	1.8385^{***}	1.2887^{***}
	(0.3879)	(0.4664)	(0.3771)
Exchange rate	-0.4514^{***}	-0.6310^{***}	-0.3221^{*}
	(0.1694)	(0.2191)	(0.1700)
Aid from others	-0.0176^{*}	-0.0012	-0.0029
	(0.0092)	(0.0062)	(0.0059)
Free Trade Agreement	-0.5115^{***}	-0.2964^{**}	-0.2417^{**}
	(0.1238)	(0.1191)	(0.1066)
WTO membership	0.1958	0.1401	0.1363
	(0.1259)	(0.1520)	(0.1141)
#Obs.	145	145	142
#Countries	9	9	9

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Columns: (1) within regression, (2) static Prais-Winsten regression, (3) dynamic Prais-Winsten regression.

6 Limitations and further research

Some limitations of the present study need to be mentioned. First, further investigation on our variable of interest, namely bilateral aid, could be worthwhile. In the present contribution we have considered bilateral aid as exogenous whereas the literature mitigates this hypothesis by suggesting that causality may run in both directions, that is, from exports to bilateral aid and vice-versa.[55] Dealing with this potential issue of endogeneity would be a considerable improvement even if this task remains challenging given the difficulty of finding appropriate instrumental variables.

Second, bilateral aid could be further divided into different types of aid, one of them being the Aid for Trade (AfT) component. Pettersson and Johansson (2013) show that this type of aid, tends to exhibit higher returns. Thus, a replication of our work with AfT as an explanatory variable instead of bilateral aid would be a useful complement to the present contribution. In the same vein, we would also recommend the alternative use of total aid on top of bilateral aid as an explanatory variable of export flows provided. A clear and relevant method to correctly dispatch those multilateral flows to the recipient countries should be found. Indeed, multilateral aid represents a relatively important share of total aid (between 20 to 25%) and failure to include this component represents a substantial loss of information.

Last but least, the split of bilateral aid into tied and untied aid, to capture which one of the two types of aid exhibits the higher return would also be a useful complement in general. However, we expect this split to be superfluous regarding Switzerland. Indeed, over the last two decades, 95% of Swiss bilateral ODA was untied yielding tied aid nearly insignificant.

7 Conclusion

In this study we have related Swiss bilateral official development assistance flows to Swiss bilateral export flows (to 95 recipient countries) using an augmented static and dynamic gravity model of trade. Results show that there is indeed a positive and significant return on bilateral aid in form of bilateral

[55] In his contribution Brückner (2013) shows that if reverse causation between aid and growth is taken into account, that is, higher growth in the recipients lead to lower aid towards them, foreign aid does have a significant and positive effect on growth, contrary to the situation where reverse causality is not explicitly allowed for. Indeed, according to him, not taking this reverse causation into account is what leads some researchers to fail finding significant effects of foreign aid on economic growth. In this contribution, we did find a positive and significant impact of foreign aid on the donor's exports but what the finding of Brückner (2013) suggests is that the magnitude of the effect may be underestimated.

exports. On average, each US dollar donated implies in the long run a return through exports of 1.73 USD.

Even if the size of the returns on aid in the present study are rather low compared to some other studies using a multi-donor approach (see for instance Wagner (2003)), they are in line (or even stronger) with studies focusing on a single donor such as Martínez-Zarzoso et al. (2009) who focus on Germany. Again, the country we use as a case study, namely Switzerland, is significantly different from other donors since bilateral ODA it provides is almost entirely untied. Switzerland is considered as one of the most altruistic donors, as pointed out by Berthélemy (2006). This fact implies that two of the three reasons, mentioned earlier in this paper, that may explain why aid can have an impact on exports, do not really hold for Switzerland or at least their incidence on exports is negligible. What basically remains is the long-standing relationship impact generally known as, the goodwill effect. Thus, and even though Pettersson and Johansson (2013) show that explicitly tied aid (for instance grants allocated to recipient countries students to study in donor countries) has a greater effect on exports than untied aid or implicitly tied aid[56], our finding suggest that untied aid implies similar positive effects on the donor's exports than tied aid (in line with Arvin et al. (1996)).

Our results are not without consequences politically speaking. Indeed, even if it is obviously not the main and ultimate goal of aid, donating can be seen as an investment in the same way as any other types of real or financial investment. According to our results, this is especially true for amounts of bilateral aid donated to Asian countries where the return is particularly high. Of course, this does not mean that Switzerland should select recipient countries according expected returns since, the main goal of ODA is to promote growth of income, ideally in a fair manner, across least developed countries.

Thereupon, and in the light of our results, we believe the altruistic attitude of Switzerland upon dispatching their total bilateral aid envelope has not harmed the underlying economic return. As a concluding remark, and since the Swiss ratio of aid relative to GNI is 0.53% (2016) an increase of this share up to the 0.7% prescribed by the Pearson Commission, would be rather welcome especially since doing so will enable Switzerland to further increase their exports to the recipient countries and therefore potentially boast its own GDP over the years to come.

[56]If untied aid is shown to have an impact on donor exports, it is said to be implicitly tied aid.

Appendix A

Table A.1: Country characteristics

Country	Continent	High/low exports	High/low aid	Country	Continent	High/low exports	High/low aid
Afghanistan	Asia	-	-	Kyrgyz Republic	Asia	L	H
Albania	Europe	L	H	Laos	Asia	L	L
Algeria	Africa	H	L	Lebanon	Asia	H	L
Angola	Africa	H	L	Lesotho	Africa	L	L
Argentina	Latin America	H	L	Liberia	Africa	L	H
Armenia	Asia	L	H	Libya	Africa	-	-
Azerbaijan	Asia	H	H	Madagascar	Africa	L	H
Bangladesh	Asia	H	H	Malawi	Africa	L	L
Belarus	Europe	H	H	Mali	Africa	L	H
Benin	Africa	L	H	Mauritania	Africa	L	L
Bhutan	Asia	L	H	Mexico	Latin America	H	L
Bolivia	Latin America	L	H	Moldova	Europe	H	H
Bosnia and Herzegovina	Europe	H	H	Mongolia	Asia	L	L
Brazil	Latin America	H	L	Montenegro	Europe	H	L
Burkina Faso	Africa	L	H	Morocco	Africa	H	L
Burundi	Africa	L	H	Mozambique	Africa	L	H
Cambodia	Asia	L	L	Myanmar	Asia	L	L
Cameroon	Africa	L	H	Namibia	Africa	L	L
Cape Verde	Africa	L	L	Nepal	Asia	L	H
Central African Republic	Africa	L	L	Nicaragua	Latin America	L	H
Chad	Africa	L	H	Niger	Africa	L	H
Chile	Latin America	H	L	Nigeria	Africa	H	L
China	Asia	H	H	Pakistan	Asia	H	H
Colombia	Latin America	H	H	Paraguay	Latin America	L	L
Congo, Dem. Rep.	Africa	L	L	Peru	Latin America	H	H
Congo, Rep.	Africa	L	L	Philippines	Asia	H	L
Costa Rica	Latin America	H	L	Rwanda	Africa	L	H
Cote d'Ivoire	Africa	H	L	Senegal	Africa	L	H
Cuba	Latin America	-	-	Serbia	Europe	H	H
Djibouti	Africa	L	L	Sierra Leone	Africa	L	L
Ecuador	Latin America	H	H	Somalia	Africa	-	-
Egypt	Africa	H	H	South Africa	Africa	H	H
El Salvador	Latin America	L	L	South Sudan	Africa	-	-
Equatorial Guinea	Africa	L	L	Sri Lanka	Asia	H	H
Eritrea	Africa	-	-	Sudan	Africa	H	H
Ethiopia	Africa	L	H	Syria	Asia	H	L
Former Yugoslav Republic of Macedonia (FYROM)	Europe	H	H	Tajikistan	Asia	L	H
Georgia	Asia	L	H	Tanzania	Africa	L	H
Ghana	Africa	H	L	Thailand	Asia	H	L
Guatemala	Latin America	H	L	Togo	Africa	L	L
Guinea	Africa	L	L	Tunisia	Africa	H	L
Guinea-Bissau	Africa	L	L	Turkey	Europe	H	L
Haiti	Latin America	L	H	Turkmenistan	Asia	-	-
Honduras	Latin America	H	H	Uganda	Africa	L	L
India	Asia	H	H	Ukraine	Europe	H	H
Indonesia	Asia	H	H	Uruguay	Latin America	H	L
Iran	Asia	H	L	Uzbekistan	Asia	H	H
Iraq	Asia	H	H	Vietnam	Asia	L	L
Jordan	Asia	H	L	West Bank and Gaza	Asia	-	-
Kazakstan	Asia	H	L	Yemen	Asia	H	L
Kenya	Africa	H	H	Zambia	Africa	L	L
Korea, Dem. Rep.	Asia	-	-	Zimbabwe	Africa	L	L
Kosovo	Europe	-	-				

Notes: high/low exports/aid = above/below median exports/aid. H = High and L = Low. Countries not classified in the groups are not considered in the regressions due to missing values in one or more variables.

General Conclusion

1 Main findings

This thesis investigated the impact of Official Development Assistance (ODA) on the donor's economy in the case of Switzerland. Basically, two different approaches have been employed to this end, namely flow-of-funds and econometric approaches. Moreover, regarding the econometric methodology, both time-series and structural modeling have been used. Although distinct, these strategies complement each other perfectly and allow to comprehensively address this non-trivial research question. At this stage, three main findings can be singled out.

First, development assistance can be provided in many ways. Various components of ODA may by nature impact the donor's aggregate demand (GDP) to varying degrees. Chapter 1 documented and discussed extensively all the possible connections (direct, leverage and indirect) between ODA spending and the donor country's aggregate demand. For 2014, the immediate and final impacts of 1 Swiss franc of ODA on Swiss GDP have been estimated to reach at least 0.70 and 1.19 Swiss franc respectively.

Second, it has been argued in the literature that providing ODA, particularly bilateral aid, may in the long run spur exports from the donor to the recipients that may not have occurred without bilateral ODA flows. Chapter 3 investigated this potential statistical link between Swiss bilateral ODA and Swiss exports by using an econometric technique for panel data presented and further developed in chapter 2, namely Dumitrescu-Hurlin Granger non-causality tests. According to the results, in conformity with underlying theory, a bidirectional Granger causality can be detected between Swiss bilateral ODA and Swiss exports. This result holds regardless of the group of recipients under investigation with the exception of the African countries where Granger causality runs unidirectionally from exports to aid.

Third, based on these results, the next step was to investigate the relationship between ODA and exports in the framework of a structural model. Chapter 4 used an augmented gravity model of trade to provide an estimate of the magnitude of this relationship. On average, each USD of Swiss bilateral ODA implies a return through exports (towards the same set of recipients to which bilateral ODA is allocated) of 0.59 cents in the short run and of 1.73 USD in the long run. Returns are particularly and surprisingly high when aid is directed to Asian countries. Indeed, a long-run return on aid of 2.72 USD is found for this latter group of countries.

2 Policy implications

A certain number of policy lessons emerge from this thesis. First, the mere fact that public resources are used for international aid and cooperation, thereby diminishing available funds for other budgetary items, has policy implications. Indeed, in democracies, the government is accountable to taxpayers and citizens in general, who legitimately need to know the full extent of benefits and costs of various government outlays including ODA. Focusing only on the (expected) beneficial effects of aid on recipient countries to represent the whys and wherefores of ODA results in revealing only half of the story and blurs the image regarding the costs for the donor but also the (per monetary unit) benefits for the recipient of ODA. The main findings of this thesis undoubtedly stress the need for bringing into the picture the impact of ODA on the donor country's economy given the significant and important positive returns on aid found in general and particularly in terms of the long-term impact on exports.

From a purely economic perspective, our findings suggest that current ODA contributions are sub-optimal (too low). The economic theory tells us that the optimal amount of ODA should be determined by equalizing the underlying marginal cost to the marginal benefit. Regarding our subject, and according to the findings, the Swiss decision makers may well underestimate the marginal benefit (or overestimate the marginal cost) of providing ODA when deciding the strategy on international cooperation. Indeed, although the economic fallouts of ODA discussed in chapter 1 are probably considered to some extent (given that they are mentioned in the government's proposal submitted to the Parliament), the decision makers are hardly aware of the positive impact ODA exerts on Swiss exports. Being fully aware of such an additional (significant) marginal benefit would possibly facilitate the debates and prevent ODA budget cuts for the coming years. Actually, if we fully extend our reasoning, and given the underestimated domestic benefits of providing ODA, contributions would have been greater in order to satisfy the equality between marginal cost and marginal benefit of providing ODA.

In the same vein, and given the significant returns on ODA found, ODA contributions should be considered as "investments" and not sunk costs as many ODA critics claim. This new perception should put ODA (concept and contributions) to the same level as alternative government spending as for instance in infrastructure. Indeed, there is every reason to believe that if Switzerland decides to increase its aid effort to reach the ODA/GNI objective of 0.7% set by the United Nations, the Swiss economy will be positively impacted in the long run, even if the funds "invested" displace inevitably funds allocated to alternate uses.

Switzerland has one main characteristic that makes the country different from many other donors, namely its very low share of tied aid. It is the reason why Switzerland is recognized internationally as a one of the most altruistic donors. Given the low share of tied aid, one may expect low returns on ODA through exports. On the other hand, an altruistic behavior facilitates the development of a sound and lasting commercial relation between the donor and the recipient country (goodwill effect). Actually, the estimated return on aid through exports found for Switzerland is in line or even higher than the returns documented in studies that also focus on a single country (see for instance Martínez-Zarzoso et al. (2009) or Nowak-Lehmann et al. (2009)). Thus, what our finding suggests is that untied aid implies the same (or even greater) positive effect on the donor's exports than tied aid. Thus, untying aid, as recommended by DAC, will probably not undermine the current returns on ODA of the other donors. The reverse is likely to be the case.

In addition, our findings should be of particular interest for the international organizations involved in ODA, in particular the United Nations. Indeed, Switzerland is by far not the only country to have failed to reach the ODA target that the UN wishes the donors to attain. Thus, and in the light of the findings, it could be worthwhile to develop a unified framework for studies on the economic returns of ODA for the donor country. If significant returns on ODA are found in other countries, it will undoubtedly facilitate the achievement of the UN target.

As a concluding remark, it should be emphasized that, although it has been shown that returns on aid through exports can vary substantially across different groups of recipients, the aim is not to provide decision makers a list of countries or regions towards which ODA should be directed for the sake of the donor's economy. We strongly believe that ODA should be allocated as a function of recipient country specific conditions and needs.

3 General limitations and further research

Each of the four contributions presented in this thesis have drawbacks that have already been discussed in the corresponding chapters and therefore need not to be reiterated here. At this stage, two general limitations deserve to be mentioned which also point to directions for future research on this topic.

First, the returns on ODA we have found in chapter 1 and 4 are, in a way, gross returns. Indeed, we have not looked at the financing pattern of ODA neither at the opportunity costs of providing ODA. Regarding the former point, ODA can indeed be financed either through an increase of the

national debt, levied taxes or reduction of other expenditure, the selected funding model obviously affecting the net impact of ODA. Thus, a welcome improvement would be to adjust the returns in accordance with the financing pattern. This calibration is of particular interest to correctly compare ODA (net) returns across donors. Furthermore, it could also be argued that returns should take into account opportunity costs. Indeed, in the way the returns are computed in both chapters, it is indirectly assumed than if money is not spent on ODA, it is lost. However, if financial resources were not used for ODA, they would obviously have been spent on other government expenditures with possibly positive returns. Thus, an estimation of the opportunity costs of ODA would be a good complement to reach the real (net) returns on aid. Once more, this complement is of particular interest to compare returns across donors given that opportunity costs can substantially differ across them.

Second, to analyze the induced effect of ODA on the donor's exports (chapters 3 and 4), only bilateral ODA has been considered. The reasons are twofold. First, data by country and region are only available for bilateral ODA since multilateral aid is provided through international organizations active in several recipient countries. Second, bilateral ODA is expected to be the prime contributor to the long-term bond-creating relationship between the donor and the recipient. This latter assumption may however be too restrictive. Indeed, and even if it cannot be denied that by nature bilateral ODA may count more for the long-term relationship than multilateral ODA, the latter type of aid may bring its share of contribution to the effect. Based on field observations, it seems rather frequent that international organizations mention to the recipient country's authorities from which country aid's funding originates. Thereupon, multilateral aid behaves to some extent in the same way as bilateral aid. The Swiss State Secretariat for Economic Affairs (SECO) reports that Swiss multilateral ODA accounted for slightly more than 25% of total ODA in 2017. Thus, to fully capture the long-term relationship effect, a clear improvement would be to find an appropriate method (probably by devoting effort to collection of relevant data from international organizations) to decompose multilateral aid by recipient and region.

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