The determinants of the intermediate products export: The case of Switzerland

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Abstract. International trade relations are an important aspect of the international economy. The form and structure of international trade has changed in recent years and this fact deserves particular analysis. Global value chains are an significant objectivity in today's times. It is noteworthy that global supply (or value) chains are basically the production networks that span multiple countries, with at least one country importing inputs (intermediate goods) and exporting production (final goods). Many products in today's era consist of intermediate inputs from other countries. The proportion of intermediate goods that a country exports helps it to become a key trading partner. Value-added imports have such an essential role in the exports of countries that they ultimately determine the price of final goods. Moreover, intermediate goods have the characteristic of being shaped on the basis of their technological level. That is, an input can be labour-intensive or technology-intensive. Virtually any commodity can be considered an intermediary. There is no clear definition of intermediate goods. This point, of course, makes it difficult to identify those factors which determine the exports of intermediate goods. In this reality the exports of intermediate goods are worthy of further research. The present study will attempt to investigate the determinants of intermediate goods exports using Switzerland as a case study. The methodology adopted is Linear Regression - Ordinary Least Squares (OLS).

Keywords. Global Trade, Switzerland, Intermediate Product Exports, OLS.

JEL. F10, F14, F40.

1. Introduction

Much research in both the theoretical and empirical parts has focused on the final goods. Many international trade theorists had not given the appropriate center of gravity of research to intermediate goods in the past (Kleinert, 2003). The trade in value added is very significant. As far as the determinants of trade in value added examples are: Choi, (2013); Yücer *et al.* (2014); Nakazawa *et al.* (2014); Guilhoto *et al.* (2015) and concerning the measurement of value-added trade Johnson & Noguera (2009). The trade in value added is very significant because Global Value Chains (GVCs) and trade in intermediate goods (parts or components that are embedded in final goods) are an indisputable fact of the current international economic system. As far as the

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GVCs examples are: Daudin *et al.* (2011); Johnson & Noguera (2012); Timmer *et al.* (2013, 2014); Koopman *et al.* (2014); Baldwin & Lopez-Gonzalez (2015). As Choi (2020) mentions the GVCs have become the basis for the national development strategies. Nowadays, two basic characteristics should be mentioned, firstly, the GVCs determine not only the level but also the composition of international trade and secondly, the intermediate inputs could control the growth in trade (Kelly & La Cava, 2013).

A key element of today's international trade is what Postelnicu (2021) mentions. She essentially states that international trade nowadays should be defined as a system of contractual agreements that binds and unites companies in real chains of research and development, production and sales, and not as a system of individual transactions. The GVCs have developed due to the ongoing international fragmentation of production (De Backer & Miroudot, 2014). The increase in the international fragmentation of production results in an increase in trade in intermediate goods (Feenstra & Hanson, 1998). The question that arises is what are the factors that determine the exports of a country's intermediate goods?

The purpose of this study is to clarify the factors that determine the exports of intermediate goods. The assumption of the study is that the comparative advantage of the country in intermediate goods over trading partners, the industrial production of trading partners and the course in exports of trading partners are the factors that determine the exports of intermediate goods of a country.

The remainder of this paper is structured as follows: in the second part, the theoretical the review of the literature is cited. In the third part of this paper the methodology is cited. In the fourth part the results of the regression are cited. The last part concludes. This research it was based on the Linear Regression Analysis - Ordinary Least Squares (OLS).

2. Review of the literature

Intermediate inputs (intermediate goods) have been analyzed in many cases. It is important in this section to make a brief reference to the role that intermediate goods have in international economic relations. There are many studies that prove that the productivity of the business is linked to imported inputs. Examples are: Kasahara & Rodrigue (2008), Halpern *et al.* (2009), Smeets & Warzynski (2010), Castellani & Fassio (2019) and, Bas & Strauss-Kahn (2011); Romer, (1987); Rivera-Batiz & Romer, (1991); Backus *et al.* (1992). The importance of intermediate goods can be seen from the treatment of taxes on intermediate goods. Still, there are studies that prove that the reduction in tariffs on imported inputs helps the productivity of businesses (Amiti & Konings, 2009; Goldberg, *et al.,* 2010; Lileeva & Trefler, 2010; Feng *et al.,* 2012; Yu, 2011; Ethier, 1979, 1982; Markusen, 1989; Romer, 1987, 1990; Grossman & Helpman, 1991). It can be said essentially that imported intermediates have a strengthening effect on the productivity of companies. An important point is made by Grossman & Helpman (2021).

That is, they say that large tariffs are unusable because they basically force businesses to procure from less efficient suppliers either domestically or from countries that are exempt from the tariffs. An important element to mention is what Zaclicever (2019) reports. That is to say, it states that the variety in terms of the geographical origin of foreign intermediate products and the different types of intermediate foreign products lead to positive results on the export activity of the industries.

A further point is that changes occurring in trade barriers in the intermediate input sector usually have a significant impact on export performance in the final products sector (Navas *et al.,* 2014). Moreover, as reported by Jamil & Arif (2019) through the reduction in tariffs on intermediate inflows there may be gains for countries because there will be better export performance. They also go on to say that imported intermediate inputs can improve both the export value and the volume index as well as the export unit value. Imports of intermediate goods are important for a country's production. An important element of intermediate goods is that they only cause distortion of domestic production and, this is because the country's consumers do not directly address the domestic price of the intermediate good (Batra & Naqvi, 1989). The importance of intermediate goods can also be seen from the effect they have on the prices of goods through cost. Clark (1995) explains the process by which intermediate goods can influence the final prices of goods. In particular, it states that an increase in the prices of these raw materials will lead to an increase in the prices of both intermediate and certain finished products.

Pirzada (2017), on the role of intermediate goods, states that essentially the prices of final products are determined on the basis of an increase. It should be noted that intermediate goods are part of imported inflation. It can be said that there is a link between the flows of international trade and the use of intermediate goods (Hummels *et al.* 1998). According to Miroudot *et al.* (2009) intermediate inputs represent 56% of goods trade and 73% of services trade in OECD countries. In conclusion it can be said that intermediate goods have the ability to determine and shape the competitiveness of countries (Beltramello *et al.,* 2012). In the next section the methodology of the present research effort.

3. Methodology

The present study attempts to investigate the factors that determine the exports of intermediate goods to Switzerland. A key point to mention is the importance of the intermediate goods. The spread and the growth of global value chains has made the methodical distinction between trade in intermediates and trade in final goods more vital (UN, 2016). The definition of intermediate goods is unclear. As Pittiglio (2014) mentions many goods could be both final and intermediate depending on the context. The present research effort uses the percentage of exports of intermediate goods from WITS. The trading partners selected are Germany, France, United

Kingdom, Italy, United States and Austria. The countries have been selected because for most of the period under review they are among Switzerland's ten largest trading export destinations of intermediate goods for the period under review.

The assumption of the present study is that the exports of intermediate goods are determined firstly by the exports of the trading partners. Changes in trade flows and trade-generated frictions can explain almost the entire decline in the value added-to-gross trade ratio (Johnson, 2014). Secondly, by the comparative advantage of the country's exports. As Brakman & Van Marrewijk (2017) mention the RCA is a proper informative measure regarding the real economy and the value added data. Thirdly, by the industrial production of the trading partners. As industrialization increases, so does the share of intermediate inputs in the value of total production (Ciccone, 2002).

The database for this study is OECD, World Bank and WITS. The time period and the examining country has chosen firstly and mostly due to the availability of data. Moreover, the time period has chosen due to the fact that covers the range of twenty four (24) years and includes the 2008 financial crisis.

This study uses multiple-regression model as an estimator of annual time series data. The dependent variable is the percent of the Intermediate Exports of Switzerland. The study model expresses the percent of the Intermediate Exports of Switzerland as a function of: firstly, the Exports of goods and services of Germany, France, Italy, United Kingdom, United States and Austria, secondly, the Revealed Comparative Advantage (RCA) (RCA identification, described by Balassa (1965), concentrates on a country's relative export performance) of Switzerland to Germany, France, Italy, United Kingdom, United States and Austria for intermediate Goods and thirdly, the Industrial Production for Germany, France, Italy, United Kingdom, United States and Austria. The above are the independent variables.

The study uses R software to estimate the model via the traditional Multiple Regression technique, especially the traditional Ordinary Least Squared (OLS) technique (Hutcheson, 2011).

The Table 1. shows the dependent variable and the explanatory variables of the model.

Table 1. *The dependent variable and the explanatory variables of the model*

Years	Switzerland exports of intermediate products to World (%)*	Exports of goods and services (annual % growth) for Germany**	Exports of goods and services (annual % growth) for France**	Exports of goods and services (annual % growth) for United Kingdom**	Exports of goods and services (annual % growth) for Italy**	Exports of goods and services (annual % growth) for United States**	Exports of goods and services (annual % growth) for Austria**	Revealed Comparative Advantage (RCA) of Switzerland - Germany for Intermediate Goods****	Revealed Comparative Advantage (RCA) of Switzerland - France for Intermediate Goods****	Revealed Comparative Advantage (RCA) of Switzerland - United Kingdom for Intermediate Goods****	Revealed Comparative Advantage (RCA) of Switzerland - Italy for Intermediate Goods****	Revealed Comparative Advantage (RCA) of Switzerland - United States for Intermediate Goods****	Revealed Comparative Advantage (RCA) of Switzerland - Austria for Intermediate Goods****	Industrial Production of Germany (Total, 2015=100)***	Industrial Production of France (Total, 2015=100)***	Industrial Production United Kingdom of (Total, 2015=100)***	Industrial Production of Italy (Total, 2015=100)***	Industrial Production of United States (Total, 2015=100)***	Industrial Production of Austria (Total, 2015=100)***
1995	28,33	6,61	8,85	9,45	12,58	10,28	7,21	1,28	1,58	0,97	1,33	1,73	1,31	69,80	92,70	102,40	118,70	71,6	52,20
1996	27,81	5,89	4,27	7,10	1,44	8,18	4,64	1,39	1,62	0,70	1,43	1,74	1,39	69,40	93,50	103,80	116,80	74,8	52,70
1997	28,83	12,24	13,04	12,30	5,04	11,91	11,03	1,56	1,64	0,75	1,44	1,86	1,49	71,80	97,50	106,60	121,30	80,2	56,10
1998	28,88	7,68	8,81	2,65	2,69	2,34	7,85	1,45	1,57	0,95	1,45	1,53	1,68	75,00	101,60	107,50	122,80	84,9	60,60
1999	28,81	5,28	5,11	2,80	-0,98	4,98	6,43	1,43	1,64	0,91	1,68	1,68	1,52	76,20	104,30	108,70	122,50	88,6	64,20
2000	28,91	13,82	12,89	8,93	12,08	8,34	13,52	1,42	1,67	1,01	1,80	1,63	1,30	80,40	108,60	110,50	127,70	92,1	70,10
2001	28,79	5,67	3,07	2,19	2,57	-5,78	5,77	1,25	1,68	1,15	2,02	1,73	1,63	80,50	109,90	108,80	125,40	89,2	72,20
2002	31,78	4,21	2,00	1,08	-2,80	-1,74	4,29	1,41	1,67	1,69	2,08	1,58	1,71	79,50	108,60	107,30	123,50	89,4	72,70
2003	30,96	1,90	-0,96	2,33	-1,30	2,18	0,53	1,48	1,64	1,46	2,11	1,57	1,39	79,70	107,70	106,90	122,70	90,6	74,20
2004	30,41	11,53	5,36	4,66	6,13	9,67	8,66	1,49	1,72	1,38	2,02	1,48	1,26	83,10	110,10	107,90	122,50	93	78,80
2005	30,52	6,69	3,98	7,89	3,22	7,13	6,67	1,37	1,73	1,46	2,06	1,58	1,76	85,90	110,00	107,20	121,70	96,1	82,20
2006	30,44	12,29	6,00	12,72	8,31	9,34	7,58	1,35	1,78	1,46	2,11	1,44	1,66	90,90	110,80	108,40	126,10	98,2	88,60
2007	30,17	8,89	2,79	-2,01	6,20	8,70	7,57	1,45	1,50	1,41	2,10	1,39	1,57	96,90	112,00	109,20	129,10	100,8	93,50
2008	30,64	1,94	0,44	0,39	-3,17	5,66	2,17	1,42	1,52	2,14	2,28	1,39	2,09	97,70	109,00	106,70	123,70	97,3	95,30
2009	31,91	-14,28	-10,90	-8,39	-17,82	-8,40	-14,37	1,58	1,54	0,66	2,54	1,54	2,61	80,80	95,40	98,30	100,70	86,1	84,70
2010	32,82	14,41	8,70	5,82	11,76	12,14	13,13	1,50	1,56	2,40	2,17	1,50	2,41	90,40	99,90	101,80	107,80	90,9	90,60
2011	32,05	8,35	6,36	7,22	5,42	7,14	5,94	1,51	1,38	2,88	2,08	1,42	2,41	98,10	102,40	101,70	108,60	93,7	96,00
2012	51,60	2,91	2,84	0,64	2,03	3,41	1,44	1,65	1,41	1,33	2,14	1,48	2,63	97,10	99,80	99,20	102,40	96,5	97,50
2013	56,51	1,00	2,14	0,86	0,37	3,58	0,64	1,75	1,35	2,58	1,98	1,20	2,49	97,00	99,50	98,20	99,30	98,5	97,90
2014	47,35	4,80	3,27	0,24	2,62	4,21	2,89	1,67	1,30	1,96	1,93	1,14	2,35	99,00	98,40	99,70	98,60	101,4	97,90
2015	47,91	5,44	4,65	2,80	4,27	0,42	3,05	1,77	1,29	1,57	1,82	1,11	2,35	100,00	100,00	100,00	99,60	100	100,00
2016	49,41	2,47	1,78	2,74	1,87	0,30	2,99	1,81	1,29	3,23	1,85	1,76	2,32	101,50	100,50	101,10	101,70	97,8	102,50
2017	45,99	4,74	4,39	5,41	5,44	3,92	4,90	1,73	1,38	2,39	1,83	1,49	2,30	104,50	102,50	102,90	105,50	99,1	107,70
2018	44,08	2,28	4,44	3,03	2,14	2,99	5,55	1,66	1,45	1,85	1,73	1,36	2,15	105,70	103,20	103,80	106,40	102,3	112,80
2019	45,06	0,96	1,90	2,66	1,62	-0,12	2,94	1,77	1,49	3,45	1,83	1,36	1,94	101,20	103,60	102,70	105,20	101,4	113,20

Source: (WITS, 2021a*; World Bank, 2021**; OECD, 2021***; WITS, 2021b****).

The study sets up the estimated multiple-regression model to test the above -mentioned hypotheses as follows:

$$InterExpSwit_{it} = \beta_0 + \beta_1 ExpGerm_t + \beta_2 ExpFran_t + \beta_3 ExpUnK_t + \beta_4 ExpItal_t + \beta_5 ExpUnS_t + \beta_6 ExpAus_t + \beta_7 RCAGerm_t + \beta_8 RCAFran_t + \beta_9 RCAUnK_t + \beta_{10} RCAItal_t + \beta_{11} RCAUnS_t + \beta_{12} RCAAus_t + \beta_{13} InProdGerm_t + \beta_{14} InProdFran_t + \beta_{15} InProdUnK_t + \beta_{16} InProdItal_t + \beta_{17} InProdUns_t + \beta_{18} InProdAust_t + e_t \qquad (1)$$

Where:

InterExpSwit_t: stands for Switzerland's exports of intermediate products to world (%)

β_0: stands for the constant amount or the intercept.

β_1-β_{18}: are coefficients of the explanatory variables.

ExpGerm_t: stands for the exports of goods and services (annual % growth) for Germany.

ExpFran_t: stands for the exports of goods and services (annual % growth) for France.

ExpUnK$_t$: stands for the exports of goods and services (annual % growth) for United Kingdom.

ExpItal$_t$: stands for the exports of goods and services (annual % growth) for Italy.

ExpUnS$_t$: stands for the exports of goods and services (annual % growth) for United States.

ExpAus$_t$: stands for the exports of goods and services (annual % growth) for Austria.

RCAGerm$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to Germany for intermediate Goods.

RCAFran$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to France for intermediate Goods.

RCAUnK$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to United Kingdom for intermediate Goods.

RCAItal$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to Italy for intermediate Goods.

RCAUnS$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to United States for intermediate Goods.

RCAAus$_t$: stands for the revealed comparative advantage (RCA) of Switzerland to Austria for intermediate Goods.

InProdGerm$_t$: stands for the industrial production for Germany (Total, 2015=100).

InProdFran$_t$: stands for the industrial production for France (Total, 2015=100).

InProdUnK$_t$: stands for the industrial production for United Kingdom (Total, 2015=100).

InProdItal$_t$: stands for the industrial production for Italy (Total, 2015=100).

InProdUns$_t$: stands for the industrial production for United States (Total, 2015=100).

InProdAust$_t$: stands for the industrial production for Austria (Total, 2015=100).

e: stands for the error term.

t: stands for the year from the period 1995-2019.

i: stands for the country.

The next section presents the results of linear regression.

4. Results

This section shows the results of the model. Table 2 shows the results.

Table 2. *Regression Results*

	Dependent variable:
	InterExpSwit
ExpGerm	-1.370*
	(0.678)
ExpFran	0.683
	(0.903)
ExpUnK	-0.886
	(0.526)
ExpItal	0.574
	(0.446)
ExpUnS	-0.750*
	(0.330)
ExpAus	0.825
	(1.051)
RCAGerm	57.968**
	(15.647)
RCAFran	109.792**
	(32.141)
RCAUnK	2.018
	(1.870)
RCAItal	5.167
	(9.631)
RCAUnS	2.041
	(7.443)
RCAAus	-7.156
	(6.607)
InProdGerm	3.802**
	(1.141)
InProdFran	-0.275
	(0.698)
InProdUnK	-3.729**
	(1.283)
InProdItal	0.211
	(0.472)
InProdUnS	0.797
	(0.446)
InProdAus	-2.428**
	(0.667)
e	-0.559
	(0.843)
Constant	-29.034
	(121.252)
Observations	25
R^2	0.986
Adjusted R^2	0.934
Residual Std. Error	2.331 (df = 5)
F Statistic	18.958*** (df = 19; 5)

Note: *p<0.1; **p<0.05; ***p<0.01
Source: (Author's elaboration).

From the presentation of the results of linear regression we can say that the value of R^2 is 0.986 the value of adjusted R^2 is 0.934, which means that the model fits to the data in a great extent. This is because the higher the value of R^2 and adjusted R^2, the better the model fits to the data. The
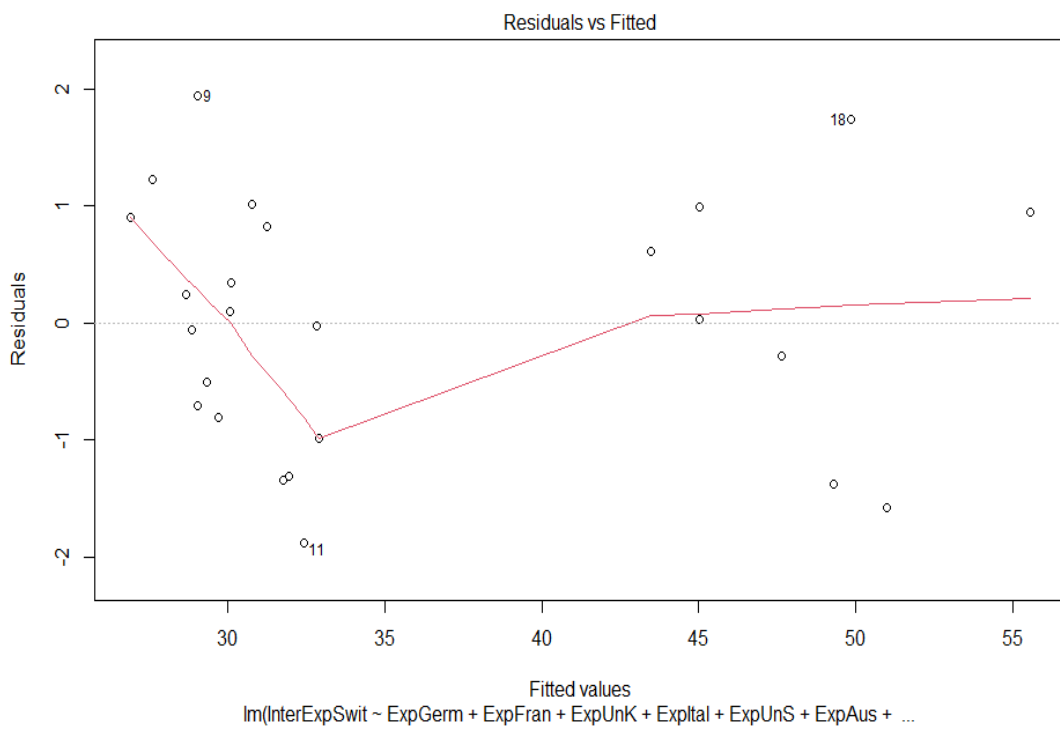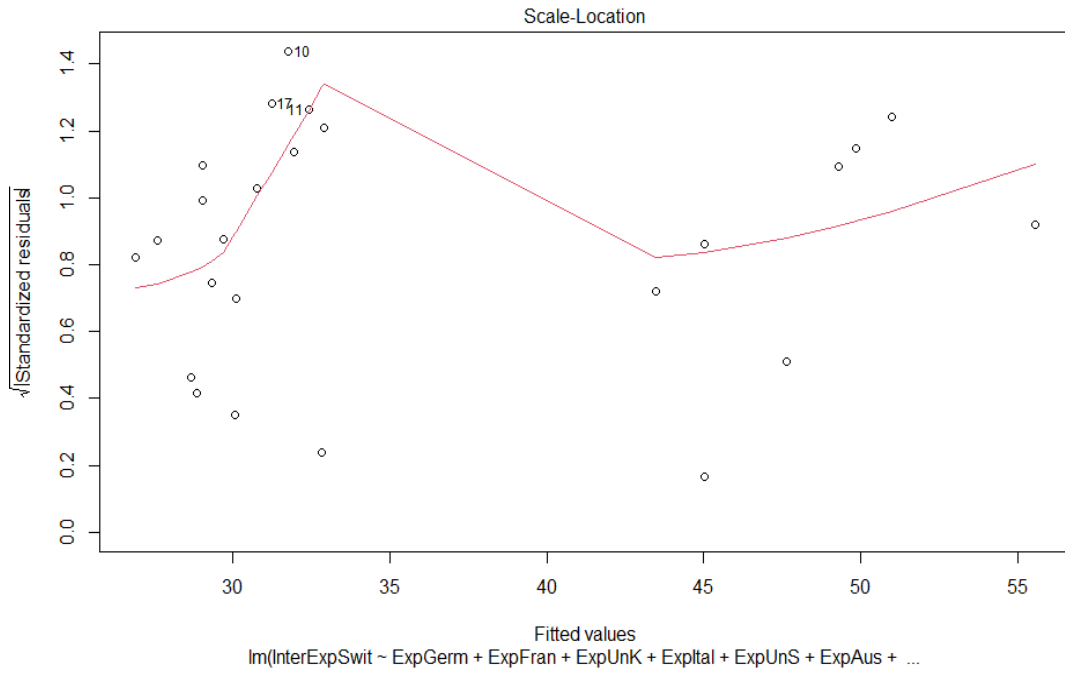
ExpGerm, the ExpUnK, the ExpUnS, the RCAAus, the InProdFran, the InProdUnK and the InProdAus variables have a negative effect on the InterExpSwit whereas the others variables have a positive effect. The variables RCAGerm, RCAFran, InProdGerm, InProdUnK and InProdAus are statistically significant at the 10% level. The variables ExpGerm, ExpUnS are statistically significant at the 5% level.
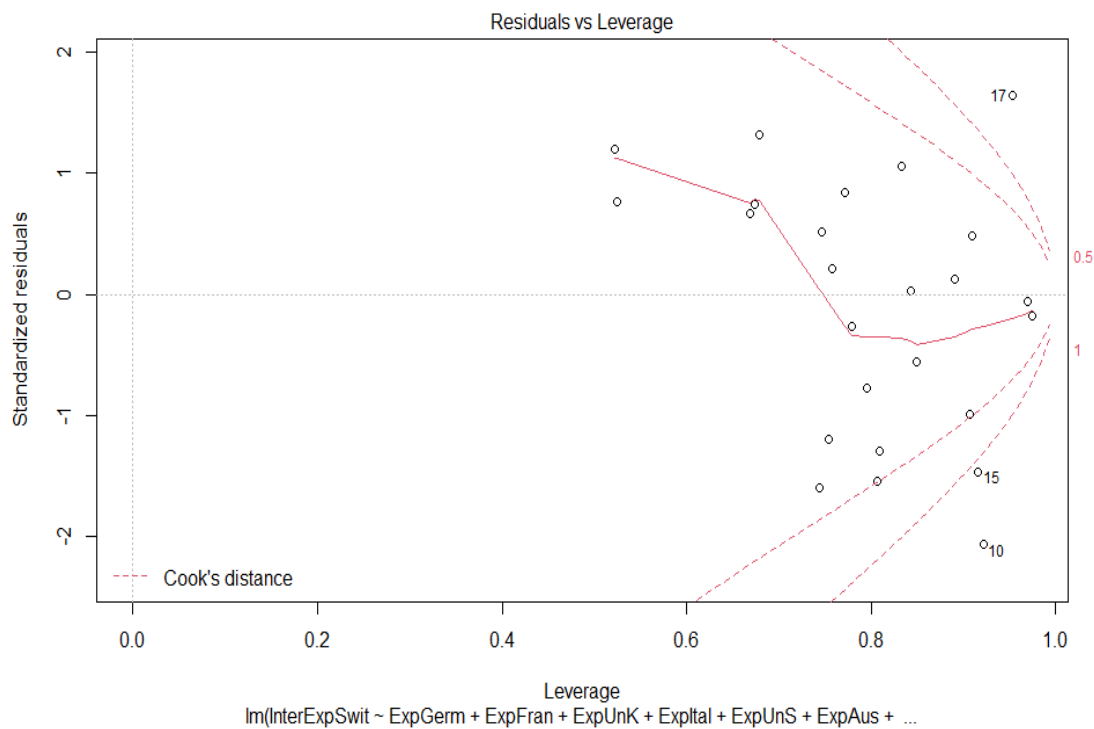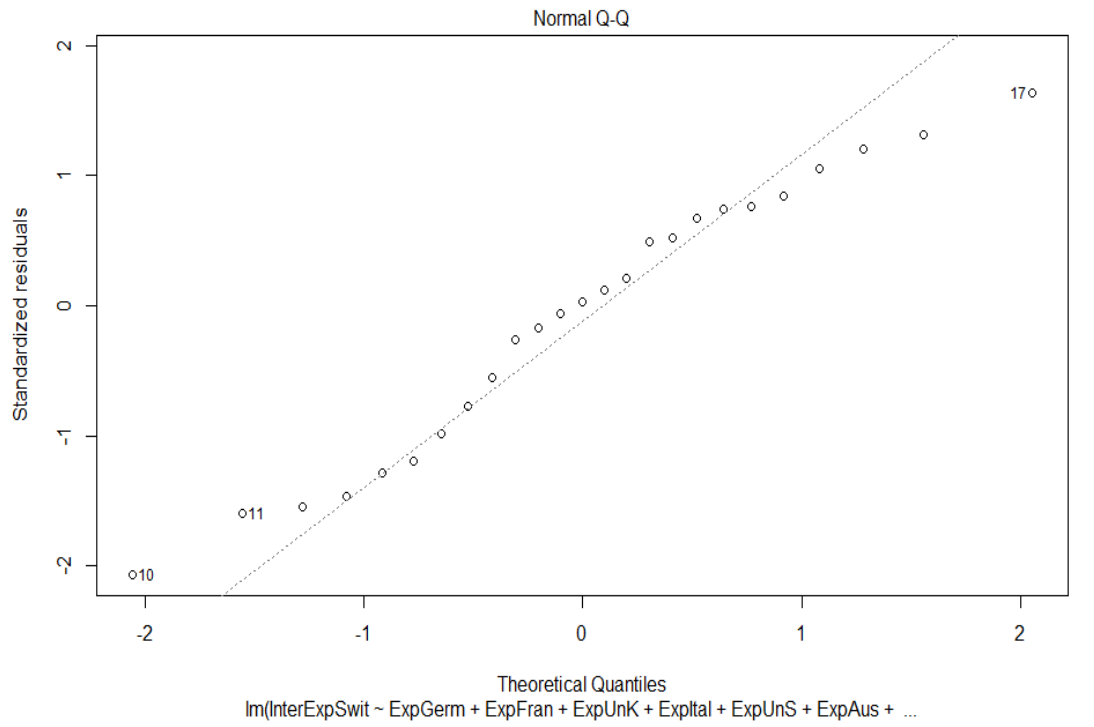
5. Conclusion

The present study studied the exports of intermediate goods of Switzerland for the period 1995-2019. The present model can explain Switzerland's exports of intermediate goods by a large percentage. In other words, the choice of independent variables can explain the changes in the exports of intermediate goods in Switzerland. In particular, it can be said that the exports of the selected trading partners, the existence of a comparative advantage of Switzerland in intermediate goods and the industrial production of trading partners are the variables that explain the exports of intermediate goods of Switzerland. Further research is required in order for the selected variables to be able to form an analytical framework for explanation.

Appendix

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                              Model Summary
-------------------------------------------------------------------
R                       0.993       RMSE                   2.331
R-Squared               0.986       Coef. Var              6.476
Adj. R-Squared          0.934       MSE                    5.434
Pred R-Squared          0.405       MAE                    0.871
-------------------------------------------------------------------
 RMSE: Root Mean Square Error
 MSE: Mean Square Error
 MAE: Mean Absolute Error

                              ANOVA
-------------------------------------------------------------------
               Sum of
               Squares      DF    Mean Square      F        Sig.
-------------------------------------------------------------------
Regression    1957.417      19      103.022      18.958    0.0020
Residual        27.171       5        5.434
Total         1984.588      24
-------------------------------------------------------------------

                          Parameter Estimates
-------------------------------------------------------------------------------
   model       Beta    Std. Error   Std. Beta      t       Sig     lower     upper
-------------------------------------------------------------------------------
(Intercept)  -29.034    121.252                 -0.239    0.820  -340.721   282.653
   ExpGerm    -1.370      0.678      -0.864      -2.020    0.099    -3.112     0.373
   ExpFran     0.683      0.903       0.350       0.757    0.483    -1.638     3.003
   ExpUnK     -0.886      0.526      -0.445      -1.685    0.153    -2.238     0.466
   ExpItal     0.574      0.446       0.380       1.286    0.255    -0.573     1.720
   ExpUnS     -0.750      0.330      -0.425      -2.269    0.073    -1.599     0.100
   ExpAus      0.825      1.051       0.480       0.785    0.468    -1.876     3.526
   RCAGerm    57.968     15.647       1.026       3.705    0.014    17.748    98.189
   RCAFran   109.792     32.141       1.773       3.416    0.019    27.171   192.414
   RCAUnK      2.018      1.870       0.174       1.079    0.330    -2.789     6.824
   RCAItal     5.167      9.631       0.164       0.536    0.615   -19.591    29.925
   RCAUnS      2.041      7.443       0.043       0.274    0.795   -17.093    21.174
   RCAAus     -7.156      6.607      -0.361      -1.083    0.328   -24.140     9.828
InProdGerm     3.802      1.141       4.856       3.332    0.021     0.869     6.735
InProdFran    -0.275      0.698      -0.171      -0.395    0.709    -2.069     1.518
InProdUnK     -3.729      1.283      -1.560      -2.906    0.034    -7.027    -0.431
InProdItal     0.211      0.472       0.246       0.447    0.674    -1.002     1.424
InProdUnS      0.797      0.446       0.719       1.785    0.134    -0.350     1.944
InProdAus     -2.428      0.667      -4.913      -3.639    0.015    -4.143    -0.713
         e    -0.559      0.843      -0.061      -0.663    0.537    -2.726     1.608
-------------------------------------------------------------------------------
```

Scale-Location

Fitted values
lm(InterExpSwit ~ ExpGerm + ExpFran + ExpUnK + ExpItal + ExpUnS + ExpAus + ...

Residuals vs Fitted

Fitted values
lm(InterExpSwit ~ ExpGerm + ExpFran + ExpUnK + ExpItal + ExpUnS + ExpAus + ...

Normal Q-Q

Standardized residuals

Theoretical Quantiles
lm(InterExpSwit ~ ExpGerm + ExpFran + ExpUnK + ExpItal + ExpUnS + ExpAus + ...

Residuals vs Leverage

Standardized residuals

- - - Cook's distance

Leverage
lm(InterExpSwit ~ ExpGerm + ExpFran + ExpUnK + ExpItal + ExpUnS + ExpAus + ...

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