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Lansana Bangoura
CIAPHS/University of Rennes 2 ; CRESE-University of Franche-Comte

Diadié Diaw
CIAPHS/University of Rennes 2 ; CREAM/University of Rouen

Karim Barkat
CERGAM-CAE/University of Aix-Marseille 3

Abstract

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Contact: Lansana Bangoura - labangoura@gmail.com, Diadié Diaw - diadie.diaw@univ-rennes2.fr, Karim Barkat - barkat.karim@hotmail.fr.
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DOES NORTH-SOUTH TRADE FAVORS TRAINING EFFECTS : WHAT TO LEARN FROM TRADE SOPHISTICATION LINKS ?

Lansana Bangoura
CIAPHS/University of Rennes 2 ; CRESE-University of Franche-Comte

Diadié Diaw
CIAPHS/University of Rennes 2 ; CREAM/University of Rouen

Karim Barkat
CERGAM-CAE/University of Aix-Marseille 3

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1. Introduction

The economic literature has long emphasized the role of knowledge transmission in the improvement of countries' competitiveness and total factor productivity. Coe and Helpman (1995), Coe et *al.* (1997) and Schiff and Winters (2004) have shown that international trade is an important vector for the transmission of knowledge. But, Olarreaga et *al.* (2003) and Schiff and Winters (2004) argue that for developing countries, northern partners are better sources of knowledge. For these authors, the developing countries that would divert their trade to other southern partners can negatively affect their economic growth and delay their industrialization.

The technological advantage of the North is undeniable, but the question that arises is the ability of the South to implement the technologies embodied in northern products, given the technological gaps. In other words, are technologies available in the North compatible with production systems of developing countries? In addition, even if southern countries receive northern technologies, do North-South trade links allow southern companies to develop products that are more sophisticated? The main reason is that these products from the South will have difficulties accessing the markets of the North because of restrictive trade policies. Some studies support the idea that South-South trade is more conducive to learning and more effective for southern firms. For example, Amsden (1976, 1980 and 1986) and Richards (1983) showed that exports of the least developed countries have a better level of sophistication when the importing partners are in the South. Havrylyshyn (1985) finds that South-North trade is consistent with the Hecksher-Ohlin-Samuelson theory of comparative advantage. This trade structure often prevents southern countries from developing more sophisticated products.

In this paper, we propose to analyse for the North the effectiveness of knowledge transmission to the South by analysing the causal link between export and import sophistication. For us, export sophistication is a good proxy for total factor productivity. Without a direct measure of total factor productivity and knowledge transfer throughout the world, we will evaluate transmission through the causal links between the levels of productivity of exports (export-sophistication) and that of imports (import-sophistication). We calculate these indicators following the methodology of Hausmann et *al.* (2007).

The rest of the paper is organised as follows: the first part presents the measure of import and export sophistication. The second part discusses the role of international

trade in the transmission of knowledge and presents the empirical analysis relative to North-South trade. The last part will present the main conclusions.

2. Measuring export and import sophistication

The exposure of a country to foreign technologies is supposed to depend on its degree of openness, but also on the technological situation of its major trading partners (Coe and Helpman, 1995, Coe et *al.*, 1997; Schiff and Winters, 2004). Indeed, the more a country imports goods from countries with high levels of technology, the more it gains in terms of productivity improvement. Lumenga-Neso et *al.* (2005) further argue that countries import not only the technology of their direct suppliers; they also import the knowledge of the latters' suppliers. However, Olarreaga et *al.* (2003); Schiff and Winters (2004) argue that northern countries are better sources of technology. But, one may wonder about the effectiveness of knowledge transmission to the South.

After a brief presentation of the measures used to evaluate the technological content of trade flows, we discuss the reality of knowledge transfers from the North to the South.

2.1. Products Categorisation

Developed countries export more sophisticated goods (goods with higher productivity content) than developing countries. Hausmann et *al.* (2007) classify products according to the comparative advantages and the development levels of exporting countries. They propose an indicator they call "*PRODY*" to measure the productivity content of each exported product. For a given product, *PRODY* is the sum of exporting countries' real GDP *in purchasing power parity* weighted by their comparative advantage in that product. Hausmann et *al.* (2007) consider that products have the same *PRODY* whatever their origins or destinations. For us, this hypothesis is too restrictive because it leads to suppose for example that textiles exported by developed countries and those from developing countries have the same productivity content. Exporting countries tend to diversify their products according to destinations and they are constrained by their own available technologies. To better consider country heterogeneities, we relax this hypothesis and suppose that a product can have different *PRODYs* according to its origins.

$$PRODY_{kr} = \sum_i \underbrace{\frac{\frac{x_{ik}}{\sum_k x_{ik}}}{\sum_i \frac{x_{ik}}{\sum_k x_{ik}}}}_{PRODY_{ik}} \cdot GDP_i, \forall i \in \text{Region}(r) \quad (1)$$

where GDP_i (Gross Domestic Product of country i) is the *GDP* of $Country_i$ and x_{ik} are exports of product k by $Country_i$. Thus, the products mainly exported by the more developed countries of the region (*r*) will have higher *PRODYs* than those in which lesser-developed countries of the region (*r*) are more efficient.

To calculate these indicators, we use *GDP* data from the World Development Indicators of the World Bank (WDI, 2012). Trade data are from BACI (Database for the Analysis of International Trade)[1]. They are classified according the 6-digit harmonisation system, they extend from 1995 to 2010 and concern three country groups (North, Sub-Saharan Africa (SSA) and Developing Asia (DA)). These country groups are presented in Table 1 in appendix.

2.2. Exports and Imports sophistication

Hausmann et *al.* (2007) propose another indicator to evaluate the level of productivity relative to each country's exports (*EXPY*). For a given country, *EXPY* depends on the nature of exported goods (in particular on the value of their *PRODY*) and their share in total exports. We compute for each country (*i*) the level of sophistication associated with its exports to the region (*r*) ($EXPY_{ir}$) :

$$EXPY_{ir} = \sum_k (PRODY_{kr} \cdot \frac{x_{ikr}}{\sum_k x_{ikr}}) \quad (2)$$

Following this formulation, countries for which exports are more concentrated in high *PRODY* products will have higher *EXPY* (e.g. higher total factor productivity). This same approach can be used to assess productivity content of goods imported by a country. The level of sophistication of the country (*i*)'s imports from a region (*r*) ($IMPY_{ir}$) is also a function of the nature of imported goods (in particular on the value of their *PRODY*) and their share in total imports.

[1] BACI provides trade flows for more than 200 countries and territories. Trade flows are expressed in current US dollars.

$$IMPY_{ir} = \sum_{k} (PRODY_{kr} \cdot \frac{m_{ikr}}{\sum_{k} m_{ikr}}) \quad (3)$$

Similarly, countries for which imports are more concentrated in high *PRODY* products will have higher *IMPY* (they will be more exposed to foreign knowledge).

3. Sophistication transmission in North-South trade

Hausmann et *al.* (2007) and Veeramani (2009) proved that *EXPY* and *IMPY* are highly positively correlated with the level of development of countries. But, we think that beyond the level of development, *EXPY* and *IMPY* may also depend on the nature of countries international relationships. Santos Paulino (2010) shows a strong correlation between a country's *EXPY* and its technological level. This high correlation suggests that *PRODY* can be an interesting proxy for knowledge transmission through international trade. We propose in this paper to analyse the technological transmission process developed by international trade. In a first step, we investigate the determinants of export and import sophistications using panel estimation techniques. In a second step, we analyse transmission properties of international trade through the causal links between *IMPY* and *EXPY*. For this purpose, we use heterogeneous Granger causality techniques developed by Hurlin and Venet (2001).

3.1. Determinants of export and import sophistications

Like Hausmann et *al.* (2007) and Veeramani (2009), we consider that export and import sophistications depend first on the level of development of countries. But we believe that the nature of external relationships can affect positively or negatively a country's trade sophistication. In particular, given the international division of production activities, countries that integrate more efficiently production networks will probably receive more foreign technologies. These countries can use technologies embodied in imports to improve the quality and the productivity content of their exports. So we hope through this analysis to show that in countries that are more exposed to international trade there will exist a strong causal link between *EXPY* and *IMPY*.

$$LnEXPY_{iRt} = \alpha_i . LnIMPY_{iRt} + \sum_{z=1}^{n} \gamma_z . Z_{it} + \mu_i + \varepsilon_{it} \qquad for\ R = SSA; DA\ or\ North \quad (4)$$

$$LnIMPY_{iRt} = \beta_i . LnEXPY_{iRt} + \sum_{z=1}^{n} \gamma_z . Z_{it} + \mu_i + \varepsilon_{it} \qquad for\ R = SSA; DA\ or\ North \quad (5)$$

We estimate the parameters of these two relations (4 and 5) using the fixed-effect estimation. *Z* regroups a set of control variables in addition to *GDP per capita*. We use the *GDP per capita* in purchasing power parity as a proxy for the level of economic

development. *GDP per capita* data are from the World Development Indicators of the World Bank (WDI, 2012). The set of control variables measures the quality of the business environment (business freedom, economic stability, etc.) in the studied countries. These variables come from the Heritage Foundation (Economic freedom measures): Business Freedom, Trade Freedom, Investment Freedom etc.

We observe in Table 2 that export and import sophistications for the North are higher in North-North trade directions. This table suggests a positive correlation between *EXPY* and *IMPY* for a same trade direction given that these two variables are of the same order. Table 3 and Table 4 in the appendix present the estimation results respectively for the determinants of *EXPY* and the determinants of *IMPY*. From these estimation results, we can first notice that the correlation between *GDP* and export or import sophistication is not significant. This result contrasts with Hausmann et *al*. (2007) and Veeramani (2009), but we think that it can be explained by the fact that the estimations are done on a homogeneous country group in terms of economic development. The impact of the other control variables on trade sophistication seems also weak. We will interpret trade related determinants by considering simultaneously the results of the causality analysis.

3.2. Heterogeneous causality analysis

Granger (1969) proposed the concept of causality between two stationary variables X and Y : X causes Y if the prediction of Y is improved when lagged values of X are included in the analysis. On panel data analysis, Granger causality tests face a major problem that is the heterogeneity of individuals. Indeed, a causal relationship observed in a group may not concern some members of this group. When the causal relationship is not homogeneous, interpretations cannot be generalized. Several studies have minimized this problem and developed causal analysis on panel data assuming homogeneity. We can cite the work of Holtz-Eakin et *al*. (1988) or Arellano and Bond (1991) on dynamic panels. We follow the heterogeneous causality approach of Hurlin and Venet (2001) exposed again in Hurlin (2005). This approach is based on the estimation of the model (6) below, and comparing the sum of squared residuals (SCR1) with those of three other constrained models.

$$LnEXPY_{iRt} = \sum_{l=1}^{p} \alpha_{i,l}.LnEXPY_{iR(t-l)} + \sum_{l=0}^{p} \beta_{i,l}.LnIMPY_{iR^*(t-l)} + \sum_{z=1}^{n} \gamma_z.Z_{it} + \mu_i + \varepsilon_{it} \qquad (6)$$

$$i = 1, \dots, N; t = 1, \dots T; R = SSA, DA, North; R^* = SSA, DA, North$$

Hurlin and Venet (2001) propose first to test the presence of a Homogeneous Non-Causality (HNC) situation in the whole group. The HNC hypothesis will be accepted if all $\beta_{i,l}$ of model (6) are equal to zero. We have to compare the model (6) with a

constrained model where $\beta_{i,l} = 0, \forall(i,l)$. If the HNC hypothesis is rejected, we can consider the presence of causality. In this case, a second step is to verify the homogeneity of the causal relationship (Homogeneous causality - HC). The causal relationship is considered uniform if it is valid for all individuals in the group, that is to say, if all $\beta_{i,l}$ are simultaneously significant. We have to compare the model (6) with another constrained model in which $\beta_{i,l} = \beta_l, \forall i$. If HC is rejected, then the test indicates the presence of a heterogeneous causality. In this case, a final stage consists in the identification of individuals for which the causal relationship exists. To do so, we compare the model (6) with a last model in which $\beta_{i,l}$ for a given individual (i) is assumed not significant. For each individual, causality will be rejected if the test is not significant.

Recall that the study of causality between *IMPY* and *EXPY* requires stationary series that we test using the unit root test[2] of Levin-Lin-Chu (2002) presented in Table 5.

Table 5 : P-values of the unit root test (Levin-Lin-Chu)

Variables	SSA	DA	North
LnEXPY	0,000	0,000	0,000
LnIMPY	0,000	0,000	0,000

Table 5 above shows that all variables are stationary in log-transformation. This gives us the possibility to do a Granger causality test between variables, starting from the idea that there may exist a causal relationship between them.

Table 6 : P-values of homogeneous causality and non-causality tests (*IMPY* cause *EXPY* ?)

Sample (North)		LnEXPYSSA	LnEXPYDA	LnEXPYNorth
HNC test	LnIMPYSSA	0,997 HNC	0,000	0,364 HNC
	LnIMPYDA	0,907 HNC	0,000	0,993 HNC
	LnIMPYNorth	0,439 HNC	0,000	0,898 HNC
HC test	LnIMPYSSA	HNC	0,000	HNC
	LnIMPYDA	HNC	0,000	HNC
	LnIMPYNorth	HNC	0,000	HNC

Table 7 : P-values of homogeneous causality and non-causality tests (*EXPY* cause *IMPY* ?)

Sample (North)		LnIMPYSSA	LnIMPYDA	LnIMPYNorth
HNC test	LnEXPYSSA	0,159 HNC	0,000	0,727 HNC
	LnEXPYDA	0,000	0,000	1,000 HNC
	LnEXPYNorth	0,000	0,000	0,916 HNC
HC test	LnEXPYSSA	HNC	0,000	HNC
	LnEXPYDA	0,000	0,000	HNC
	LnEXPYNorth	0,000	0,000	HNC

[2] See Hurlin C. and Mignon V. (2004) for complete review of the literature on panel stationary.

Tables 6 and 7 below show the results of the HNC and HC tests respectively for *EXPY* and *IMPY*. As we can see, when they exist, causal relationships are all heterogeneous. The results summarized in Table 8 confirm the strong heterogeneity of the causal relationship between *EXPY* and *IMPY* for northern countries.

Table 8 : Heterogeneous non-causality tests for northern countries

IMPYi causes EXPYi?

Sample (North)	LnEXPYDA		
	SSA	DA	North
Albania	0	0	0,001
Australia	0,014	0,152	0,003
Austria	0,989	0,483	0,675
Bulgaria	0,701	0,214	0,212
Canada	0,935	0,543	0,561
Switzerland	0,558	0,452	0,452
Cyprus	0,209	0,158	0,088
Czech Rep	0,064	0,134	0,115
Germany	0,439	0,264	0,22
Denmark	0,002	0,124	0,04
Spain	0,428	0,761	0,036
Estonia	0,65	0,254	0,119
Finland	0,294	0,107	0,334
France	0	0,061	0
UK	0,015	0	0,053
Greece	0,063	0,032	0,061
Croatia	0,31	0	0,002
Hungary	0,001	0,331	0,015
Ireland	0,233	0,141	0,009
Iceland	0,007	0,115	0,286
Italy	0,01	0,014	0,361
Japan	0,475	0,461	0,222
Lithuania	0,536	0,565	0,524
Malta	0,72	0,01	0,049
Netherlands	0,667	0,084	0,012
Norway	0,31	0,156	0,514
Poland	0,249	0,742	0,21
Portugal	0,556	0,412	0,817
Romania	0,822	0,026	0,018
Slovakia	0,386	0,024	0,271
Slovenia	0,797	0,522	0,573
Sweden	0,182	0,075	0,087
Ukraine	0,359	0,097	0,128
USA	0,025	0,021	0,01

Note: SSA, DA and North represent respectively *LnIMPYSSA*, *LnIMPYDA* and *LnIMPYNorth* of the countries

EXPYi causes IMPYi?

LnIMPYSSA		LnIMPYDA		
DA	North	SSA	DA	North
0,035	0,008	0	0	0
0,132	0,007	0,936	0,965	0,555
0,444	0,559	0,68	0,284	0,113
0,102	0,002	0,479	0,601	0,656
0,633	0,61	0,7	0,78	0,739
0,244	0,384	0,846	0,234	0,721
0,089	0,139	0,009	0,278	0,101
0,063	0,473	0,031	0,192	0,106
0,378	0,732	0,654	0,814	0,786
0,005	0,009	0,738	0,007	0,063
0,271	0,182	0,299	0,178	0,819
0,11	0,038	0,598	0,342	0,729
0,28	0,376	0,569	0,11	0,579
0,844	0,417	0,248	0,125	0,132
0,193	0,078	0,287	0,037	0,518
0,113	0,11	0,382	0,015	0,002
0,845	0,597	0,062	0,001	0,574
0,04	0,011	0	0,519	0,226
0,381	0,202	0,053	0,019	0,091
0,012	0,021	0,097	0,108	0,753
0,604	0,521	0,59	0,563	0,721
0,075	0,334	0,968	0,217	0,813
0,99	0,962	0,287	0,54	0,391
0,488	0,029	0	0,001	0,025
0,228	0,051	0,069	0,173	0,257
0,298	0	0,21	0,233	0,174
0,553	0,086	0,632	0,129	0,061
0,929	0,448	0,016	0,386	0,659
0,43	0,107	0,02	0	0,003
0,431	0,403	0,001	0	0,004
0,958	0,911	0,565	0,258	0,429
0,083	0,194	0,206	0,6	0,082
0,225	0,006	0,05	0,034	0,665
0,043	0,441	0,135	0,01	0,282

Note: SSA, DA and North represent respectively *LnEXPYSSA*, *LnEXPYDA* and *LnEXPYNorth* of the countries

For developed countries, imports from the north influence the sophistication of their exports to Asia. Bidirectional causality is likely to exist in some countries, because the different *EXPYs* also cause the sophistication of imports from DA. The question we ask is

which northern countries encourage knowledge transfer to the South. The results show that in the case of trade with Africa, there is no transmission. Some northern countries tend to use their imports from Africa to export goods that are more sophisticated to Asia and to other northern countries. Indeed, we find in the North that *EXPY-DA* and *EXPY-North* cause negatively *IMPY-SSA* for many countries.

The results in Tables 3 and 4 show that in the North, the various *IMPY* are significant determinants for *EXPY-DA*. This result is not uniform for all countries: for some of them *IMPY* negatively affects *EXPY* while for others the relationship is positive. This relationship remains insignificant for many countries. Bilateral trade (*EXPY-SSA/IMPY-SSA; EXPY-DA/IMPY-DA* and *EXPY-North/IMPY-North*) have higher levels of significance and are generally positively connected. Although this relationship is commonly accepted for *EXPY-North/IMPY-North*, in the case of *EXPY-SSA/IMPY-SSA* and *EXPY-DA/IMPY-DA* the positive relationship is not verified for some countries. In the case of *EXPY-DA/IMPY-DA*, it is negative for Albania (-0.32), Canada (-0.10), Switzerland (-0.26), the Iceland (-0.43), Japan (-0.14) and Portugal (-0.14). In addition, for *EXPY-SSA/IMPY-SSA* the link is also negative for Austria (-0.44), Germany (-0.05), Spain (-0.23), Finland (-0.08), Lithuania (-11.58), Slovenia (-0.80) and the United States (-0.18). These countries, for which the relationship is negative, do not promote learning effects for developing countries. The transmission is however assured for several developed countries like UK, France, Italy, etc.

The beneficial effects of North-South trade depend on the access that northern countries give to less sophisticated products from the South. They depend also to the capacity of southern countries to reduce technological gap. The example of China is quite striking since it benefits both from learning dynamics through the installation of multinationals on its territory (Jarreau and Poncet, 2012) and from its exports of less-sophisticated products to the North. For many other developing countries, international trade consists in exporting less-sophisticated products against more-sophisticated products from the North. The technological content of products is the result of the accumulated experience and therefore of the learning process in which multinational firms are central actors. Some products with a high degree of processing or technological content are therefore subject to intra-industry trade (often intra-firm). Some developing countries certainly have the ability to produce and export more sophisticated products, but they (especially SSA countries) continue to receive manufacturing activities with low-value added (textiles, steel, leather, automotive components, electrical components, food products, etc.) which limits the scope of transmission.

4. Conclusion

The aim of this study was to analyse the causal link between the sophistication of imported products (as a measure of the potential knowledge that a country can acquire from a partner) and the sophistication of exported products by a country (as a measure of its total factor productivity). The main goal was to have a clear idea on the transmission potentials of trade between developing and developed countries. This work considers again a theoretical argument often cited to justify the preference for North-South trade over South-South trade.

Indeed, for all southern countries, because of the technological advance of the North, trade with developed countries should be preferred to South-South trade. However, analysing the relation between imports and exports of developed countries with developing countries, we see that North-South trade does not always favour knowledge transmission. Indeed, in North-South trade, there is an important asymmetry in the technological content of flows, so that even if the technological content of imports is more important, the benefits for export sectors in the South remain limited. This result suggests that firms in developing countries cannot always implement northern technologies, and thus stay specialised in low *PRODY* products.

As mentioned before, the productivity content of a product depends on the learning process that leads to its development. This learning process strongly suggests that multinationals are the basis of the international mobility of factors and products. Southern countries that are unable to host MNF remain confined to the supply of products with low technological content. Nevertheless, some northern countries maintain this specialisation by leaving no opportunity in terms of market access for southern products that are relatively more sophisticated.

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6. Appendix

Table 1 : Composition of regions

SSA			DA	North		
Angola	Ethiopia	Mozambique	Bangladesh	Albania	Finland	Netherlands
Benin	Gabon	Niger	China	Australia	France	Norway
Burkina F	Gambia	Nigeria	Indonesia	Austria	UK	Poland
Burundi	Ghana	Rwanda	India	Bulgaria	Greece	Portugal
Cameroon	Guinea	Senegal	Cambodia	Canada	Croatia	Romania
Cape verde	Guinea-B	Seychelles	Sri Lanka	Switzerland	Hungary	Slovakia
Central Afr	Kenya	Sierra Leone	Malaysia	Cyprus	Ireland	Slovenia
Chad	Madagascar	Togo	Nepal	Czech Rep	Iceland	Sweden
Congo, D R	Malawi	Uganda	Pakistan	Germany	Italy	Ukraine
Congo	Mali	Zambia	Philippines	Denmark	Japan	USA
Cote d'Ivoire	Mauritania		Thailand	Spain	Lithuania	
Djibouti	Mauritius		Viet nam	Estonia	Malta	

Table 2 : Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
LnEXPYiSSA	20,62	2,17	10,67	25,95
LnEXPYiDA	23,30	0,77	19,84	27,32
LnEXPYiN	24,09	0,62	22,52	25,95
LnIMPYiSSA	20,34	1,96	13,26	26,54
LnIMPYiDA	23,08	0,86	16,40	25,78
LnIMPYiN	24,96	0,82	22,66	26,77

Table 3 : Determinants of EXPY for northern countries

Sample (North)	LnEXPYSSA			LnEXPYDA			LnEXPYNorth		
	SSA^{NC}	DA^{NC}	$North^{NC}$	SSA	DA	North	SSA^{NC}	DA^{NC}	$North^{NC}$
Albania	0.07**	-0.12***	-7.14***	-0.35***	-0.32***	2.88***	-0.08***	-0.06***	1.02***
Australia	0.23***	-0.67**	-0.81***	0.03**	0.16	0.29***	-0.09***	0.10	0.15***
Austria	-0.44***	-0.63***	2.22***	0.05***	0.01	-0.07**	-0.01	0.04*	0.85***
Bulgaria	0.59***	-0.30	0.28	0.00	0.37***	-0.71***	0.03***	-0.00	0.22*
Canada	0.53***	1.29***	-1.72***	-0.05***	-0.10**	-0.59***	0.01***	-0.16***	0.88***
Switzerland	0.11***	-0.23**	1.27***	0.03***	-0.26***	-0.08	-0.16***	0.24***	1.22***
Cyprus	0.85***	0.89***	-1.89***	0.00	0.01	-0.40**	-0.02**	-0.14***	0.89***
Czech Rep	-0.00	0.16	-1.17***	-0.03*	0.08	0.51**	-0.01	-0.22***	0.68***
Germany	-0.05*	-1.85***	-0.79***	-0.01	0.64***	-0.42***	-0.10***	-0.50***	1.02***
Denmark	0.14***	0.46***	-3.40***	-0.08***	0.74***	-0.99***	0.04***	-0.05	0.51***
Spain	-0.23***	0.23**	0.34***	0.03**	0.07	-0.04	0.03***	0.21***	0.73***
Estonia	0.11**	2.05***	-1.37	-0.08***	1.19***	-1.83***	0.08***	-0.63***	1.18***
Finland	-0.08**	-0.49***	-1.63***	0.08***	0.50***	0.94***	-0.01	0.04**	0.45***
France	0.01	0.20**	-0.43***	0.10***	0.22***	-0.23***	-0.05***	-0.41***	0.96***
UK	0.17***	0.12**	-0.01	0.19***	1.11***	0.05	0.14***	0.01	0.97***
Greece	0.18***	-0.31**	1.37***	0.14***	0.06	-0.33**	-0.02***	-0.28***	0.55***
Croatia	0.79***	0.40***	-3.25***	-0.11***	0.77***	-3.42***	0.02*	0.06*	-0.23
Hungary	0.59***	-1.31***	-1.28***	0.22***	0.21***	-0.80***	-0.01	-0.07***	0.65***
Ireland	0.84***	-0.79***	-2.53***	0.11***	0.41***	0.83***	-0.03***	0.24***	0.22***
Iceland	0.43***	0.65***	5.27***	-0.20***	-0.43***	-0.89***	0.07***	0.05***	0.74***
Italy	0.47***	-0.11	0.42	0.14***	1.08***	-0.25**	-0.02**	-0.62***	0.73***
Japan	0.21***	-0.42***	0.73***	-0.05***	-0.14**	0.05	-0.07***	0.30***	0.83***
Lithuania	-11.58***	-3.13***	-55.31***	3.41***	0.83***	13.36***	-0.35	-0.07	-0.88
Malta	0.42***	-1.45***	0.53	0.09**	0.50***	0.79***	0.12***	0.11***	0.21***
Netherlands	0.20***	0.16***	0.47**	-0.06***	0.50***	1.33***	0.02***	0.16***	0.82***
Norway	0.24***	-1.94***	-0.71***	-0.08***	0.23***	0.01	0.05***	0.27***	0.46***
Poland	0.55***	0.27	-0.26	0.22***	0.21***	0.18	0.03***	-0.13***	0.39***
Portugal	0.38***	-0.38***	0.64***	-0.02**	-0.14***	0.13**	-0.03***	0.17***	0.48***
Romania	1.05***	0.41***	-2.34***	0.01	0.38***	-0.79**	-0.08***	0.04**	-0.09
Slovakia	0.54***	0.27**	-2.39**	0.28***	0.70***	1.33***	0.14***	-0.02	-0.37
Slovenia	-0.80***	0.58**	-2.02	-0.07	0.21**	0.64	-0.04*	-0.19**	1.56***
Sweden	0.81***	0.48**	-1.24***	0.05***	0.57***	0.97***	-0.00	0.53***	0.42***
Ukraine	0.52***	-1.78***	0.29	0.04***	0.64***	1.06***	0.03***	0.07*	0.03
USA	-0.18***	-0.32***	-0.54***	-0.32***	0.42***	-0.54***	0.10***	0.08***	0.39***
LnGDPpc	0.02	-0.09	-0.37	0.45	0.40	0.47	0.22	0.20	0.11
Business-F	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Trade-F	0.01	0.03	0.03*	-0.00	0.00	0.00	-0.00	-0.00	0.00
Fiscal-F	-0.01	-0.01	-0.01	0.01	0.01	0.01	-0.00	-0.00	-0.00
G-Spending	0.02**	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Monetary-F	-0.00	-0.00	-0.01	-0.00	-0.00	-0.00	0.00	0.00	0.00
Invest-F	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financial-F	-0.02**	-0.02*	-0.02**	0.00	0.00	0.00	-0.00**	-0.00*	-0.00
Prop-Right	-0.01	-0.02	-0.02	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Corrupt-F	0.01	0.00	0.01	-0.00	-0.00	-0.00	0.00	0.00	0.00
Labour-F	0.02	0.03	0.03	-0.03	-0.02	-0.03	-0.01	0.00	-0.00
N	557	557	557	557	557	557	557	557	557
r2_w	0.28	0.11	0.08	0.14	0.20	0.12	0.07	0.08	0.29
r2_b	0.02	0.00	0.03	0.05	0.05	0.07	0.00	0.01	0.01

Notes: NC = Homogeneous non-causality
Country names represent LnIMPY of the corresponding countries
"LnGDPpc" means for Log of GDP per capita
"F" means for Freedom

Table 4 : Determinants of IMPY for northern countries

Sample (North)	LnIMPYSSA			LnIMPYDA			LnIMPYNorth		
	SSA^{NC}	DA	North	SSA	DA	North	SSA^{NC}	DA^{NC}	$North^{NC}$
Albania	0.36***	-0.77***	-6.95***	-0.31***	-0.92***	-5.72***	-0.08***	0.01	0.24***
Australia	0.20***	0.55***	-0.27***	-0.04**	-0.05	-0.01	-0.07***	0.09***	0.03***
Austria	-0.14***	1.04***	0.36**	-0.03***	-0.01	0.07	0.04***	-0.01	0.65***
Bulgaria	0.28***	-0.01	8.75***	0.01**	0.13**	0.38**	-0.01	-0.01	0.30***
Canada	0.42***	-0.33**	0.30	0.05***	0.01	-0.17**	-0.03***	-0.12***	0.48***
Switzerland	0.23***	0.46***	-1.16***	0.00	-0.21***	0.14***	0.15***	-0.05**	0.52***
Cyprus	0.98***	0.12**	-1.49***	0.02	0.02	-0.51***	-0.01	-0.05***	0.28***
Czech Rep	-0.04	-1.11***	-1.03***	-0.03	0.17***	-0.79***	-0.01	0.08***	0.49***
Germany	-0.03	-0.34***	-0.45***	-0.16***	0.13***	-0.14***	-0.12***	-0.31***	0.58***
Denmark	0.12***	-0.63***	1.50***	0.01***	0.35***	-0.06*	-0.02***	-0.05***	0.14***
Spain	-0.34***	0.57***	0.51***	0.00	0.05	0.15***	0.03***	-0.00	0.61***
Estonia	2.73***	-2.25***	5.83***	0.41***	0.52***	-0.68***	0.06***	-0.37***	0.72***
Finland	-0.08*	0.42***	-0.57***	-0.11***	0.18***	0.11***	-0.04***	0.10***	0.19***
France	-0.03	0.05***	-0.16**	0.27***	0.06***	-0.62***	-0.12***	-0.03***	0.55***
UK	0.31***	0.36***	0.65**	0.05***	0.31***	-0.01	0.03**	0.07***	0.82***
Greece	0.17***	1.03***	-0.23**	-0.00	-0.01	-1.30***	0.02**	-0.02	0.28***
Croatia	0.52***	-0.26***	3.07***	0.04***	0.59***	5.69***	-0.01	-0.06***	-0.37**
Hungary	0.41***	1.38***	-0.03	-0.32***	0.32***	-0.26***	-0.02***	-0.07***	0.12***
Ireland	0.40***	0.22***	-0.31***	-0.06***	0.17***	0.35***	-0.04***	0.06***	0.04***
Iceland	0.71***	-2.10***	4.18***	0.18***	-0.61***	0.55***	0.07***	-0.08***	0.38***
Italy	0.64***	0.83***	-1.08***	-0.00	0.17***	-0.30**	0.01	-0.17***	1.01***
Japan	0.18***	-1.61***	-0.25***	0.01	-0.07	0.01	0.04***	0.27***	0.17***
Lithuania	-0.13	-0.06	0.48	-0.60***	2.33***	-33.30***	0.00	0.00	-0.58
Malta	0.55***	0.80***	4.90***	-0.28***	0.61***	0.66***	0.00	0.18***	0.25***
Netherlands	1.13***	-1.16***	0.19**	0.07***	0.43***	0.28***	0.03**	0.26***	0.36***
Norway	0.71***	-1.18***	2.15***	-0.20***	0.19***	0.43***	-0.02***	-0.00	0.30***
Poland	0.30***	1.38***	1.10***	0.03***	0.24***	-0.82***	-0.02***	0.01	0.78***
Portugal	1.28***	-0.10***	-0.83***	-0.17***	-0.19***	0.53***	0.05***	-0.00	0.23***
Romania	0.34***	0.17	-3.73***	0.07***	0.79***	0.41**	-0.01	-0.13***	0.02
Slovakia	0.44***	0.69***	2.93***	0.09***	0.62***	-0.06*	-0.03***	0.02	-0.16***
Slovenia	-0.21**	0.12	0.90*	0.00	0.67***	-0.15	-0.01	0.00	0.15*
Sweden	0.64***	0.44***	-0.06	0.00	0.15***	0.58***	-0.00	0.10***	0.22***
Ukraine	0.34***	0.33*	8.13***	-0.11***	0.53***	0.30	-0.01	0.09**	0.21*
USA	-0.40***	-1.30***	1.00***	-0.09***	0.29***	0.17***	-0.11***	-0.20***	0.43***
LnGDPpc	0.54	0.68	0.30	0.10	-0.04	0.07	-0.10	-0.06	-0.16
Business-F	0.01	0.01	0.01	-0.00	-0.00	-0.00	0.00	0.00	0.00
Trade-F	0.03	0.02	0.03	0.01*	0.01	0.01	-0.00	-0.00	-0.00
Fiscal-F	-0.01	-0.02*	-0.01	0.01	0.00	0.01*	-0.00	-0.00	-0.00
G-Spending	-0.01	-0.01	-0.00	-0.01***	-0.01**	-0.01**	-0.00	-0.00	-0.00
Monetary-F	-0.01	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
Invest-F	-0.01	-0.00	-0.01	-0.00	-0.00	-0.00	0.00	0.00	-0.00
Financial-F	-0.01	-0.01	-0.01	0.01*	0.00	0.00	-0.00	-0.00	-0.00
Prop-Right	0.00	-0.00	0.00	-0.01*	-0.01	-0.00	0.00	0.00	0.00
Corrupt-F	-0.00	-0.00	-0.01	0.00	0.00	-0.00	0.00	-0.00	0.00
Labour-F	0.08**	0.08*	0.10**	-0.01	-0.01	-0.00	0.00	0.00	-0.00
N	557	557	557	557	557	557	557	557	557
r2_w	0.26	0.11	0.13	0.16	0.22	0.20	0.07	0.08	0.37
r2_b	0.02	0.00	0.13	0.00	0.01	0.01	0.03	0.02	0.31

Notes: NC = Homogeneous non-causality
Country names represent LnEXPY of the corresponding countries
"LnGDPpc" means for Log of GDP per capita
"F" means for Freedom