
NEW EU MEMBER COUNTRIES ARE PHASING OUT LABOR-INTENSIVE ACTIVITIES: AN ECONOMETRIC APPROACH

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Abstract:

This paper deals with the process of industrial development that has been unfolding in Central and East-European Countries during the last two decades, with special focus on changes in international specialization induced by successive shifts in comparative advantage. As it was to be expected, these advances have gradually improved the respective countries' exports structure, the most important mutation residing in the gradual abandoning of subcontracting agreements – mostly confined to assembly-of-imported-inputs – and the expansion of the production of knowledge and human capital-intensive goods and services. European integration has most certainly been acting as a catalyst for this process. However, the group is not moving evenly: Central European economies, belonging to the so-called Vishegrad Group are more advanced in this process as compared to the ones located closer to the Eastern boundary of the European Union such as Romania and Bulgaria.

Keywords: comparative advantage, industrial competitiveness, elasticity of factor substitution, foreign trade structure, factor productivity

1. Introduction

Since the early 1990s scholars have been endeavoring to explain the mechanisms that generated successive changes in Central and East-European countries' post-COMECON international specialization. Several models were employed (mostly developed from a neoclassical perspective) to explain how Central and East-European countries (CEEs) had lost their alleged comparative advantage in so-called "high concentration" goods. The term was coined by Audretsch (1993), designating industries such as "tobacco, petroleum products, edible oils, tubes, office machines,

telecommunications and domestic electrical equipment, motor vehicles, railway vehicles and aircraft sectors". In the morass that followed the dismantling of the COMECON, industries in the CEEs had no alternative but to compete in cost, which in turn, could only be achieved by substituting cheap low skilled labor for expensive capital. Obviously, industries that used unskilled and semi-skilled labor intensively were in a position to take greatest advantage of this situation through heavy use of subcontracting, while the ones that used physical capital intensively shrank, pending forthcoming FDI.

In the course of the last two decades, the CEEs have been phasing-out low skilled labor-intensive operations such as assembly of imported inputs, concomitantly with the technological upgrading of their industries. Fired up by the European Union's commitment to become the world's most competitive entity, manufacturing firms in the new member countries are striving to integrate skilled labor-intensive operations in production i.e. to offer knowledge-intensive services in addition to physical products. This process – which has been accelerated by EU' enlargement toward the East – is driving CEEs' firms into higher segments of the value chain, raising their competitiveness on both the European market and worldwide. Furthermore, European integration has made productivity and earnings in manufacturing industries edge upwards thereby substantially improving the respective countries' export structures. According to Feenstra and Hanson (1996) outsourcing acts as a type of "endogenous technical change" in favor of skilled labor, raising the relative wage of skilled workers in both countries that engage in bilateral production-sharing arrangements. The model included in the main part of the paper is aimed to ascertain whether and to what extent the above hypotheses are supported by statistical evidence.

2. Objectives and methodology

The analysis below investigates the possible impact of industrial upgrading upon the foreign trade structure of two selected CEEs (Czech Republic and Poland) during the 1995-2007period. The process has been apparent in the clothing sector, especially in the Vishegrad group of countries, where reform has been advancing at a relatively higher speed.

The core instrument used in the paper is the "relevant comparative advantage" (RCA) index, formulated by Balassa (1965), widely accepted as a practical measure for countries' international specialization. (The index is computed by "comparing the relative shares of a country in the world exports of individual commodities".) In the CEEs' case, the variation in RCA index in clothing might be an indicator of the direction in which the respective countries' specialization has advanced in the course of the last two decades. Since outsourcing allows for increases in productivity, which in turn makes average wages edge upwards, a causation relationship hypothetically exists between average earnings on the one hand and the evolution of international specialization (as measured by the RCA index in clothing) on the other hand. The main

objective is to assess – by means of time-series techniques – the presence of certain correlations (if any) among three macroeconomic variables: RCA index in clothing, earnings and industrial labor productivity in the manufacturing sector. Specifically, usual statistical tests are employed to check two main *hypotheses*: (1) the two time-series expressing earnings in the manufacturing sector respectively industrial labor productivity are co-integrated, i.e. they do not move independently from each other but make up a system that is in long-run equilibrium (as the diagram in figure 1 suggests). (2) There is a causation relationship between earnings and international specialization (as measured by the RCA index). The relationship between productivity and international specialization is disregarded.

The experiment is focused on the clothing industry because, in my judgment, it reflects CEEs' shift from subcontracting to more complex industrial operations in the most conspicuous way: in the mid 1990s, clothing and accessories accounted for almost one tenth of the respective countries' merchandise exports, with slight differences from one country to another. In the mid 2000s, things had radically changed: in countries belonging to the so-called Vishegard group (Czech Republic, Hungary, Poland and Slovak Republic), the average share more than halved, dropping to about four percent (plus or minus two percentage points), while in fringe countries like Romania and Bulgaria, the average share almost doubled, going up to about nineteen percent.¹ Hypothetically, this divergent change of course might have had two main causes: (1) firstly, in the more advanced Vishegrad group, other industries grew faster than clothing thereby coming to hold larger shares in total merchandise exports, whereas the latter group has been lagging behind in this respect. (2) Secondly, the speedier industrial upgrading in the former group has pushed the bulk of clothing production that uses unskilled labor intensively (mostly assembly-of-imported-inputs) toward fringe countries, where modernization of industries is still in an incipient stage. Not surprisingly, findings differ between the two groups of countries observed (Poland and Czech Republic respectively Romania and Bulgaria): statistical tests all but confirm the presence of the said relationship in the former group (Poland and Czech Republic) whereas there is no evidence of it in the latter group. It is for this reason that only the results for the former group, which are statistically significant, are shown in the paper.

The clothing industry is significant yet for another reason: in the course of time, it has shown considerable resistance to automation. Unlike other industrial processes, clothing manufacturing requires, especially in the assembly stage, a number of operations such as sewing, embroidering etc., which are extremely hard to mechanize and therefore, must be made by hand (Sharpston, 1975); this particular feature makes it best suited for outsourcing because, as *The Economist* noted, "hands have remained

¹ The other new EU member countries (Slovenia, the Baltic group etc.) are left out of this study.

cheap in some places and the cost of transporting their products has dropped enormously.”¹

Data in table 1 are laid out as follows: columns 3 and 5 show Czech Republic's respectively Poland's exports of clothing (in value terms), during 1995-2007, while columns 4 and 6 show total merchandise exports by the respective countries during the same period. Columns 1 and 2 show the world's exports of clothing (in value terms) respectively total merchandise exports between 1995 and 2007. The shortness of the time-series under consideration is due to the fact that: a) periods outside the 1995 to 2007 time interval are less relevant for the purpose of the present study; b) intermediary (interspersed) data hardly make economic sense in the case of derived variables such as the RCA index. The scarcity of observations obviously renders statistical tests less powerful; the interpretation of results will therefore be handled with utmost circumspection.

Symbols and abbreviations used in the text:

i_t^m = logarithm of RCA index for country m (as per data in table 3, columns 1 and 4) at time t ;

j_t^m = logarithm of earnings in the manufacturing sector for country m (as per data in table 3, columns 2 and 5) at time t ;

k_t^m = logarithm of industrial labor productivity for country m (as per data in table 3, columns 3 and 6) at time t ;

$\Delta^{(n)}i_t^m, \Delta^{(n)}j_t^m, \Delta^{(n)}k_t^m = n^{\text{th}}$ order difference of the i_t^m, j_t^m, k_t^m time-series respectively;

DF = Dickey-Fuller; ECM = error correction model;

$I(d)$ = integrated of order d ;

$C(d, b)$ = co-integrated of order d, b ;

$Q(\delta)$ = Ljung-Box statistics (δ lags);

VAR = vector auto-regression

SE = standard error

τ_μ = t-statistic for unit roots (constant but no time trend).

3. The model

The first hypothesis can be tested using the standard Engle-Granger (1987) procedure in two steps. “In the first step the parameters of the co-integrating vector are estimated and in the second these are used in the error correction form.” Before proceeding, the two variables, j_t^m and k_t^m must be tested for their order of integration by means of the simple DF test, i.e. comparing the calculated values of τ_μ (given by the formula: $t = \gamma/SE(a_1)$) with table values. As a rule, any x_t series can be expressed in the form of a 1st order auto-regression as follows:

$$x_t = a_0 + a_1 x_{t-1} + \mu_t \quad (1)$$

¹ “Automated tailoring comes closer”, *The Economist*, July 13th, 2006

where a_0 , a_1 are parameters and μ_t is a white noise disturbance. By subtracting x_{t-1} from both members of the equation (1) and making the notation $\gamma = a_1 - 1$, we get:

$$\Delta x_t = a_0 + \gamma x_{t-1} + \mu_t \tag{2}$$

All we have to do is to replace x_t with j_t respectively k_t in equations (1) and (2) and calculate the corresponding values of τ_μ ; the same procedure will then apply successively to the 1st and 2nd order difference time-series of the respective variables ($\Delta^{(1)}j_t$, $\Delta^{(2)}j_t$ respectively $\Delta^{(1)}k_t$, $\Delta^{(2)}k_t$). By comparing the calculated values (shown in table 4, columns 3, 4, 5 respectively 6, 7, 8)¹ with the table ones for 5 percent significance level and the least number of observations (the table value is - 3.00), the null hypothesis that the series has a unit root clearly cannot be rejected in the case of the raw series (j_t and k_t) but can be rejected in the case of the differenced series as follows: for the 1st difference series, the null cannot be rejected for Czech Republic but can be rejected for Poland (although the value is not highly significant). Finally, if the 2nd order differences series are employed, both calculated values are significant so that the null can be rejected for either country.

Table 1 – Exports of clothing (XC) and total merchandise exports (XM) for two selected CEE's and the world as a whole (€ bn.)

	World		Czech Republic		Poland	
	XC (1)	XM (2)	XC (3)	XM (4)	XC (5)	XM (6)
1995	157	5,079	0.52	21.60	2.30	22.89
1996	164	5,391	0.62	21.90	2.37	24.44
1997	182	5,577	0.62	22.77	2.22	25.75
1998	183	5,499	0.70	26.35	2.38	28.23
1999	186	5,709	0.67	26.85	2.20	27.39
2000	199	6,452	0.63	28.99	1.88	31.65
2001	194	6,186	0.67	33.40	1.94	35.09
2002	200	6,486	0.64	38.46	1.91	41.01
2003	232	7,578	0.72	48.74	2.04	53.76
2004	259	9,203	0.91	68.65	1.77 ^(b)	75.04
2005	276	10,431	1.12	78.11	1.40 ^(b)	89.43
2006	311	12,083	1.06	94.92	1.25	110.30
2007	345	13,619	1.26	122.40	1.23	138.80

Sources: 1) WTO – International Trade Statistics (1996 -2008) 2) Statistical Yearbook of the Czech Republic 2006-09, http://www.czso.cz/eng/redakce.nsf/i/statistical_yearbooks_of_the_czech_republic; Yearbook of Foreign Trade Statistics of Poland, 2007-09, http://www.stat.gov.pl/gus/5840_3543_ENG_HTML.htm

^{(a), (b)} Estimations

¹ The critical values are taken from Banerjee et al. (2003), p.102-3, and Enders (2010), p. 488-94.

Table 2 – Industrial output and employment in industry* for two selected CEE economies

	Czech Rep.		Poland	
	Industrial output (US\$ bn.)	Employment (thousands)	Industrial output (US\$ bn.)	Employment (thousands)
1995	18.42	2,076	45.08	4,729
1996	20.99	2,064	48.14	4,740
1997	20.50	2,031	47.93	4,846
1998	22.80	1,993	52.00	4,922
1999	21.34	1,912	49.42	4,622
2000	20.41	1,868	54.86	4,481
2001	23.20	1,892	56.07	4,331
2002	28.25	1,888	56.58	3,947
2003	34.90	1,863	63.97	3,982
2004	43.84	1,845	76.94	3,978
2005	50.23	1,881	95.25	4,127
2006	59.70	1,930	106.94	4,373
2007	73.12	1,980	143.31	4,682

* Mining & Quarrying; Manufacturing; Electricity, Gas & Water Supply; Construction

Sources: BERD: Macroeconomic indicators, <http://www.ebrd.com/pages/research/economics/data/macro.shtml#macro>

Table 3 – RCA index in exports of clothing*, earnings in the manufacturing sector (on an annual basis) and industrial labor productivity for two selected CEE countries during 1995-2007**

	Czech Rep.			Poland		
	RCA index	Earnings	Productivity	RCA index	Earnings	
	Productivity	(US\$)	(US\$/person employed)		(US\$)	(US\$/person employed)
	(1)	(2)	(3)	(4)	(5)	(6)
1995	0.77	3,463	8,872	3.24	3,283	9,532
1996	0.93	3,981	10,169	3.18	3,701	10,156
1997	0.69	3,878	10,093	2.65	3,690	9,890
1998	0.79	4,175	11,440	2.54	3,992	10,564
1999	0.76	4,126	11,161	2.47	4,796	10,692
2000	0.70	3,973	10,926	1.92	4,901	12,242
2001	0.64	4,326	12,262	1.76	5,462	12,946
2002	0.53	5,353	14,962	1.51	5,594	14,334
2003	0.48	6,522	18,733	1.23	6,094	16,064
2004	0.47	7,732	23,761	0.83	6,660	19,341
2005	0.54	8,704	26,703	0.59	7,963	23,079
2006	0.43	9,813	30,932	0.44	8,693	24,454
2007	0.40	11,455	36,929	0.36	10,502	30,608

*Calculated by applying Balassa's formula to the data in table 1, i.e. as a ratio of shares: the share of country *i*'s exports of product *j* in its total merchandise exports divided by the share of world exports of product *j* in world merchandise exports. If the index is greater than one, country *i* is said to have "revealed comparative advantage" in exports of product *j*.

** Calculated using data in table 2 (value of industrial output/nr. of people employed in the manufacturing sector)

Sources: International Labor Organization, Bureau of Library and Information Services, <http://www.ilo.org/public/english/support/lib/resource/subject/labourstat.htm>; Eurostat: Database, Data Navigation Tree, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database; BERD: Macroeconomic indicators, <http://www.ebrd.com/pages/research/economics/data/macro.shtml#macro>

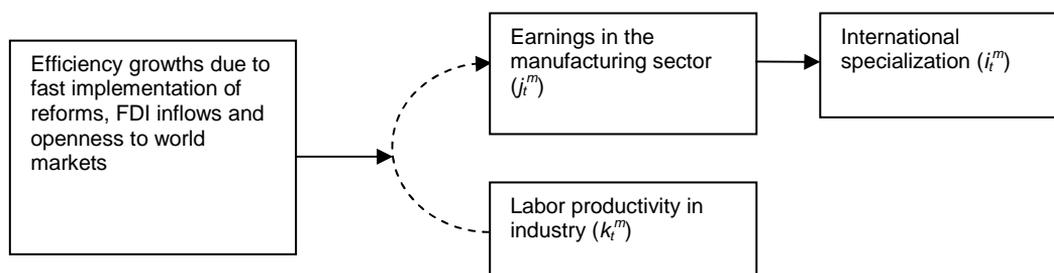


Figure 1

In conclusion, the raw series (j_t and k_t) as well as their 1st order differences are $I(1)$, while the 2nd order differences are $I(0)$. (These results are supported by the Ljung-Box Q statistics, listed in table 4, bottom). The high values of the calculated τ_μ for the 2nd order differences are indicative of the presence of a deterministic trend (a time trend or a drift), which nevertheless could have been guessed in the first place. However, this particular aspect does not vitiate the results because in the case of co-integrating variables it is stochastic trends that matter (Enders, 2010). Assuming the growths in earnings and productivity (expressed by the time-series $\Delta^{(1)}j_t$ respectively $\Delta^{(1)}k_t$) are co-integrated i.e. they move together, not independently from each other, the co-integrating vector results from the long-run relationship:

$$u_t = \bar{\delta}_0 + \bar{\delta}_1 v_t + \omega_t \quad (3)$$

where:

$u_t = \Delta^{(1)}j_t$, so u_t is $I(1)$ and $\Delta u_t = I(0)$;

$v_t = \Delta^{(1)}k_t$, so v_t is $I(1)$ and $\Delta v_t = I(0)$;

$\bar{\delta}_0, \bar{\delta}_1 =$ parameters;

$\omega_t =$ white noise disturbance.

Since the residuals from the regression in (3) contain the estimated values of the deviation from long-run equilibrium, the necessary and sufficient condition for the variables u_t and v_t to be co-integrated is that the estimated ω_t series to be stationary. This can be checked by applying the DF test to the estimated ω_t series:

$$\Delta \hat{\omega} = a_1 \hat{\omega}_{t-1} + \varepsilon_t \quad (4)$$

where a_1 is a coefficient and ε_t is a white noise disturbance. The t-statistic for the estimated coefficient \hat{a}_1 is minus 4.603 for Czech Republic and minus 4.747 for Poland (table 5, column 1). Since the critical value for 1percent significance level and 50

observations is minus 4.123, the null hypothesis can be rejected, which means the variables u_t and v_t are co-integrated of order 1. Based on the above result, an error correction model can be built in the form of a bivariate VAR in first differences, as follows:

$$\Delta u_t = a_{10} + \lambda_u [u_{t-1} - \gamma v_{t-1}] + a_{11} \Delta u_{t-1} + a_{12} \Delta v_{t-1} + \eta_{ut} \quad (5)$$

$$\Delta v_t = a_{20} + \lambda_v [u_{t-1} - \gamma v_{t-1}] + a_{21} \Delta u_{t-1} + a_{22} \Delta v_{t-1} + \eta_{vt} \quad (6)$$

where:

$\lambda_u, \lambda_v, a_{11}, a_{12}, a_{21}, a_{22}$ = parameters;

η_{ut}, η_{vt} = white noise disturbance terms that may be correlated.

The error correction terms $\lambda_u [u_{t-1} - \gamma v_{t-1}]$ and $\lambda_v [u_{t-1} - \gamma v_{t-1}]$ emphasize the short-run response of the variables to deviations from equilibrium. Parameters λ_u and λ_v measure the speed-of-adjustment to the previous period's deviations from long-run equilibrium (Enders, 2010). Parameters a_{12} and a_{21} reveal Granger causation relations if any. According to Engle and Granger (1987), equations (5) and (6) can be rewritten in a different way, replacing the error correction terms with the estimated residuals series $\hat{\omega}_{t-1}$:

$$\Delta u_t = a_{10} + \lambda_u \hat{\omega}_{t-1} + a_{11} \Delta u_{t-1} + a_{12} \Delta v_{t-1} + \eta_{ut} \quad (7)$$

$$\Delta v_t = a_{20} + \lambda_v \hat{\omega}_{t-1} + a_{21} \Delta u_{t-1} + a_{22} \Delta v_{t-1} + \eta_{vt} \quad (8)$$

Table 4 – T-statistics for DF tests and Ljung-Box Q-statistics (SE in parentheses)

	i_t	j_t	$\Delta^{(1)}j_t$	$\Delta^{(2)}j_t$	k_t	$\Delta^{(1)}k_t$	$\Delta^{(2)}k_t$	
	(1)	(2)	(3)		(4)	(5)	(6)	
(7)	(8)							
<u>T_u (no time trend)</u>								
- Czech Republic	0.486		- 1.405	1.746	4.053		- 1.532	1.893
4.580	(0.191)		(0.069)	(0.296)	(0.278)		(0.062)	(0.311)
- Poland	- 2.380		- 1.064	3.740	6.755		- 2.590	2.174
(0.261)	(0.047)		(0.062)	(0.355)	(0.245)		(0.054)	(0.389)
<u>Ljung-Box Q(8)</u>								
- Czech Republic	29.69	7.59	27.85	9.34	2.33		27.22	10.04
9.25	(0.00)	(0.47)	(0.00)	(0.31)	(0.96)		(0.00)	(0.26)
(0.32)								
- Poland	25.50	12.66	21.90	4.06	9.08		27.41	11.60
12.72	(0.00)	(0.12)	(0.00)	(0.85)	(0.24)		(0.00)	(0.17)
(0.12)								

Table 5 – Estimated error-correction and Granger causation parameters, and associated t-statistics (SE in parent.)

(6)	(7)	\hat{a} (1)	λ_u (2)	λ_v (3)	a_{12} (4)	a_{21} (5)	β_{11} (5)	β_{12}
- Czech Republic 0.224		- 1.369 (0.297)	- 1.672 (1.685)	- 3.814 (1.579)	0.963 (0.995)	- 1.829 (0.973)	- 1.063 (0.712)	-
(0.530) (t-statistic) 0.483		- 4.603	- 0.993	- 2.421	0.968	- 1.879	- 1.494	-
- Poland 0.243		- 1.453 (0.306)	- 1.260 (0.459)	- 0.165 (0.507)	0.386 (0.267)	- 0.042 (0.820)	- 1.018 (0.528)	-
(0.528) (t-statistic) 0.459		- 4.747	- 2.746	- 0.325	1.446	- 0.051	- 1.926	-

Since the Δu_t and Δv_t series are stationary, the right members of equations (7) and (8) respectively are also stationary, meaning the t-test is appropriate for all coefficients. The calculated t-statistics (listed in table 5, columns 2 to 5) indicate that:

i) in Czech Republic's case:

- λ_v is significant, meaning the growth in productivity is responsive to the previous period's deviation from long-run equilibrium;
- a_{21} is all but significant, meaning the growth in productivity is influenced by the previous period's growth in earnings (productivity is Granger caused by earnings).

ii) In Poland's case:

- λ_u is significant, meaning that the growth in earnings is responsive to the previous period's deviation from long-run equilibrium.

The second hypothesis can be tested by building a two variable VAR, as suggested by Sims, Stock and Watson (1990) and Enders (2010). A two legs equation can be formulated as follows:

$$w_t = \alpha_{11} w_{t-1} + \alpha_{12} w_{t-2} + \beta_{11} z_{t-1} + \beta_{12} z_{t-2} + \pi_t \quad (9)$$

where :

$$w_t = \Delta^{(1)} i_b \text{ so } w_t = I(1); z_t = \Delta^{(1)} j_b \text{ so } z_{t-1} = I(0);$$

$\alpha_{11}, \alpha_{12}, \beta_{11}, \beta_{12}$ = coefficients; π_t = white noise disturbance.

Equation (9) relates international specialization to its own lagged values as well as to lagged values of average earnings in manufacturing. Of most interest are coefficients β_{11} and β_{12} ; if any (not necessarily both) of them is significant, it is a signal that international specialization is influenced (Granger caused) by past earnings in manufacturing. Since z_{t-1} and z_{t-2} are stationary, the t-distribution is appropriate. The data in table 5 (columns 6 and 7) indicate a significant value of the t-test for β_{11} in Poland's case and a weakly significant value for the same coefficient in Czech Republic's case.

In sum, despite a few ambiguities and uncertainties, the results of the above analysis are indicative of the presence of the hypothesized relationships: the (co-integrated) rise in labor productivity and average earnings in the manufacturing sector in CEEs during the last two decades have exerted a meaningful influence upon the respective countries' international specialization, materialized in a gradual shift from unskilled labor- to skilled labor-intensive industrial activities.

4. Conclusions

In the course of the last two decades, Central and East-European economies have been grappling with a bequeathed flawed trade structure, in an attempt to increase their industrial competitiveness and improve their position within the international division of labor. Their industries successively shifted from "high concentration" goods to low skilled labor-intensive activities to products and services that use skilled labor and knowledge intensively.

CEEs' industrial development path has its own idiosyncrasies, stemming essentially from the respective countries' COMECON-related inheritance. During the age of center planning, resources had been channeled into industries whose chief economic characteristic was market concentration, requiring sizable capital investments and employing legions of unskilled and semi-skilled workers. Being left with such a burden, the freshly liberated economies had no (short-run) option but to capitalize on a readily available asset: plentiful labor. Technically, this entailed a generalized tendency to substitute labor for capital, at least by those industries that were able to continue to churn out goods; commercially, the widespread formula was subcontracting of labor-intensive operations, mostly final assembly of inputs delivered by western importers. For all its inconveniences, subcontracting not only helped CEEs to turn vast pools of labor to pretty good account but also enabled enterprises thereof to employ idle capacities and bring in vital export revenues. Yet it was but an intermediary stage, a way-out from the economic mire that ensued after the COMECON crumbled.

After the year 2000, exposure to stiff global competition compelled CEEs' industries to gradually abandon low value-added activities such as assembly of imported inputs and embark on skilled labor and knowledge-intensive ones. Eastern firms are putting this commitment into practice by: (1) integrating physical inputs in production, besides final assembly; (2) raising the value of the commercial offerings by providing customer-oriented services in addition to physical products etc. The technological capabilities required for this shift are being transferred from western companies to eastern producers through a host of channels but most often via intra-European trade.

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