Structural transformation of the Armenian exports in a product space model[1]

Karen Poghosyan & Aghassi Mkrtchyan[2]

Central Bank of Armenia, Economic Research Department

Abstract: This paper studies the structural transformation of the Armenian exports in a product space model. This issue is at the center of improving national welfare, because as it was shown in a number of similar papers the level of economic development is directly dependent on degree of export sophistication. The paper uses annual data on exports from 2001 to 2012, and shows that the Armenian economy could benefit from producing and exporting simpler goods which do not necessarily contain significant elements of high-tech inputs.

Key words: revealed comparative advantage (RCA), export productivity, export sophistication, Armenia

Jel codes: F14, F19, O33, O40

---

[1] The views expressed in this paper are those of the author, employees in the Economic Research Department of the Central Bank of Armenia.

[2] Karen Poghosyan, Central Bank of Armenia, Economic Research Department, Yerevan, Armenia, (email: karen.poghosyan@cba.am).

Aghassi Mkrtchyan, Central bank of Armenia, Economic Research Department, Yerevan, Armenia, (email: aghassi.mkrtchyan@cba.am).

We are grateful to Zareh Asatryan for helpful and constructive comments.

1. Introduction

The expansion of exports is traditionally regarded as one of the important ways of achieving sustainable growth rates in the long-run. Recent studies show that the long-run development of countries depends not only on the volume and growth rate of exports, but also on the qualitative structure of exports. The main purpose of the current paper is to review the structure of the Armenian exports and its dynamics over the last decade, from 2001 to 2012.

All calculations relating with the indices of structural transformation have been done according to the methodology proposed by R. Hausman and B. Klinger (2006). In this paper the authors suggest two main criteria for identifying "promising" goods. The first criterion is the relatively high value of the export productivity, and the second criterion is relatively small "distance" to the world export basket. Based on these two criterions we identify those goods that are more promising for future production and export diversification in Armenia. Based on the actual data set and our empirical calculations, we conclude that the Armenian economy could generate a greater welfare effect from producing and exporting simpler goods, which do not necessarily contain significant elements of high-tech inputs.

The paper has the following structure. In section 2 we present a short overview of methodology, data and software used in the assessment of structural transformation. Section 3 presents the main idea and computational aspects of the structural transformation indices. In chapter 4 using calculated indices we analyze the export structure and its productivity. Then based on the calculated indices we try to find the bundle of the "promising" goods which could be preferable for production and export diversification in Armenia. The last section concludes.

2. Methodology, data and software

The production of each good requires an input of a set of private and public resources, such as knowledge, physical assets, labor force, raw materials, infrastructure, property rights, and regulatory requirements. The production of any pairs of goods differs in required capabilities such as the ones above. However, capabilities required in the production of one good are an imperfect substitute for capabilities required for production of another good. According to Hausmann and Klinger (2006) the distance between the capabilities of a pair of goods is defined as follows: if the process of production requires very similar inputs then the products are "closer" to each other, on the other side if the capabilities are different then the distance between products is larger. To develop this measure we use product level data of exports. For a country to have revealed comparative advantage in a good, it must have appropriate resources to produce and export this good successfully. If for example two goods have the same capabilities, there should also be higher probability that the country has revealed comparative advantage in both goods. Thus, according to Hausmann and Klinger (2006) approach the measure of distance between two goods in period t can be defined as:

$$\varphi_{i,j,t} = min\{P(x_{i,t}|x_{j,t}), P(x_{j,t}|x_{i,t})\} \qquad (1)$$

Where for any country c

$$x_{i,c,t} = \{1, if\ RCA_{i,c,t} > 1$$

$$x_{i,c,t} = \{0, if\ RCA_{i,c,t} < 1$$

As a measure for RCA we use a measure that was proposed by Balassa (1965):

$$RCA_{c,i,t} = \frac{xval_{c,i,t} / \sum_i xval_{c,i,t}}{\sum_c xval_{c,i,t} / \sum_i \sum_c xval_{c,i,t}} \qquad (2)$$

In order to understand how in practice we can compute the $\varphi_{i,j,t}$ proximity measure let's bring the following example. For instance, in the 2008, 17 countries

exported wine, 24 exported grapes and 11 exported both, all with RCA>1. Then, according to the Hausmann and Klinger (2006) methodology the proximity (distance) between wines and grapes will be equal to 11/24=0.46. In this similar manner we can compute the proximity measure for all possible pairs of goods. For example, table 1 shows the proximity of men's, boys' shirts to other products. The higher the proximity value, the larger the similarity between products. The data presented in table 1 show that the proximity values of shirts and other clothing are higher than those of umbrellas and sun umbrellas, photographic cameras, equipment for photographic laboratories, drawing, mathematical, length measuring instruments.

Table 1

Proximity of men's, boys shirts, knit or crochet (code 6105)

Code	Product	Proximity
6110	Jerseys, pullovers, cardigans, etc, knit or crochet	0.70
6111	Women's suits,dresses,skirt etc&short, knit/croch	0.68
6106	Women's, girls blouses & shirts, knit or crochet	0.71
6114	Babies' garments, knitted or crocheted	0.66
6601	Umbrellas and sun umbrellas	0.09
9006	Photographic cameras (except cine), accessories	0.06
9010	Equipment for photographic laboratories nes	0.03
9017	Drawing, mathematical, length measuring instruments	0.13

In the current research paper the data from UN Comtrade and International Trade Center database are used. Export data of 185 countries from 2001 to 2012 have been used; HS02 four-digit classification incorporating 1242 products names have been taken as the basis.

One of the main contributions of the current paper is that the empirical analysis is based on a special software of own development. This software was developed using object oriented programming language like Visual C# (Visual Studio 2010). This software can be expected to conduct various analyses related to the indices of structural transformation and export sophistication for any countries of the world. In particular, the software has the following capabilities:

1. Calculate revealed comparative advantage (RCA) indices for any country or a group of countries,
2. Calculate proximity (distance) and density values for any pairs of commodities and any groups of countries,
3. Calculate indices of export sophistication for a group of countries,
4. Calculate potential for exports diversification for a group of countries,
5. To find the most attractive ("promising") bundle of commodities for a given country's for future export expansion and diversification.

This software is free and can be provided by request.

3. The main indices of structural transformation

As mentioned in the previous chapter, the structural transformation process can be tested with using the distance measure proposed by Hausmann and Klinger (2006). They proposed to use indicator $PRODY_{i,t}$ which is calculated as a weighted mean of per capita GDP's of countries producing a particular product, using the relative share of this product in total exports as weights:

$$PRODY_{i,t} = \sum_c \left[\frac{\left(xval_{c,i,t} / \sum_i xval_{c,i,t} \right)}{\sum_c \left(xval_{c,i,t} / \sum_i xval_{c,i,t} \right)} \times GDPpercapita_{c,t} \right], \qquad (4)$$

where, the numerator comprises the share of product i in exports of country c in period t, the denominator represents the sum of product i shares in exports of each country c, GDPpercapita is per capita GDP of country c based on PPP in period t (according to the World Bank data). The $PRODY_{i,t}$ indicator is used in computing the other important indicator called $EXPY_{c,t}$. This indicator is computed by multiplying $PRODY_{i,t}$ of each export goods with its share in export structure of country c:

$$EXPY_{c,t} = \sum_i \left(\frac{xval_{c,i,t}}{\sum_i xval_{c,i,t}} \times PRODY_{i,t} \right) \qquad (5)$$

The probability of developing RCA in a particular good in the future is affected by the ease with which the current capabilities in the economy can be adapted to the new product. Hence it is important how close the new product to the existing export structure. To test this R. Hausmann and B. Klinger (7) uses the pairwise proximity measures for each element of the country's entire export basket. They call this measure density. For each product, it measures the degree to which a country's current exports 'surround' the particular product under consideration. It is the sum of all paths leading to the product in which the country is present, scaled by the total number of paths leading to the product. Density values can varies between 0 and 1, with the higher value indicating that the particular product could be included in the country's exports in the future. The density can be calculated as follows:

$$density_{i,c,t} = \left(\frac{\sum_k \varphi_{i,k,t} x_{c,k,t}}{\sum_k \varphi_{i,k,t}} \right) \qquad (6)$$

Where the numerator is the sum of proximities to the respective product of all the goods with comparative advantage, whereas the dominator shows the sum of proximities to the respective product of all goods.

According to the proposed measure of density, firms are more likely to move to new products if the distance is low, or the density is high. This fact was demonstrated empirically in the paper by Hausmann and Klinger (2006).

4. The productivity of the Armenian export

In this part of the paper, based on actual export data of 1242 products, we present an empirical calculations related to the export productivity of the Armenian exports. The indices presented in the previous section of the current paper have been used to estimate and analyze the productivity and export sophistication. In Figure 1 we show the relation between average productivity values and GDP per capita for the countries in our sample in 2005.

Figure 1: ExpY and GDP per capita PPP (2005, US$)

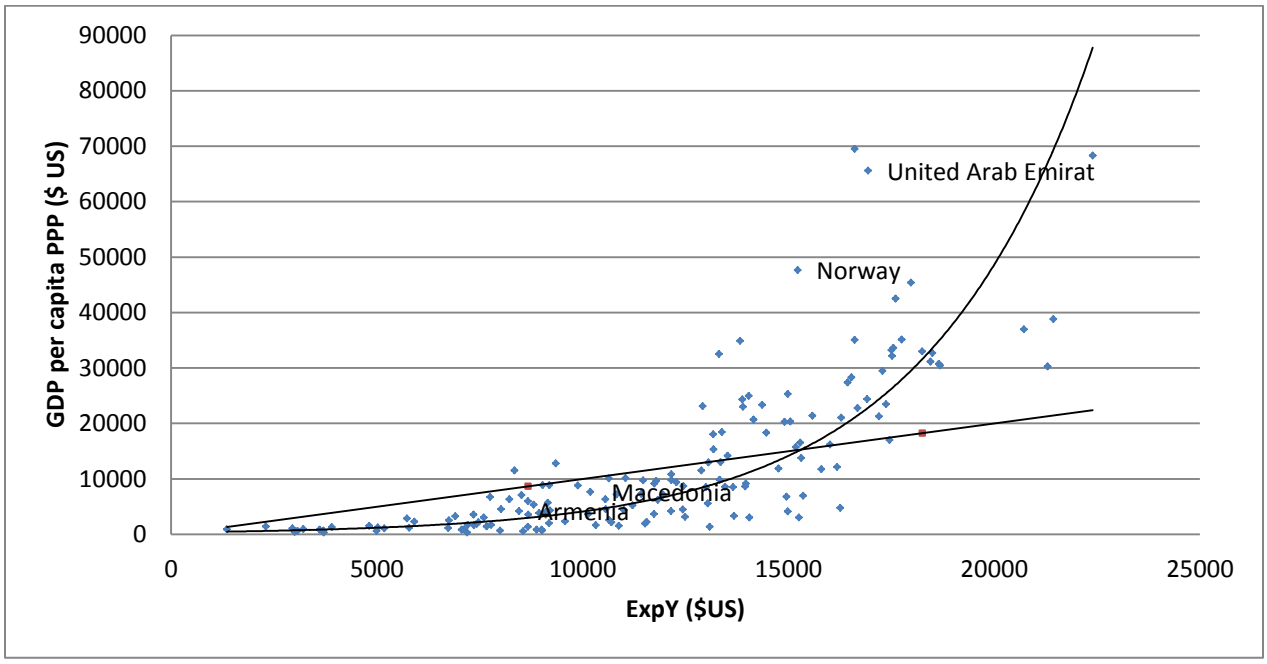
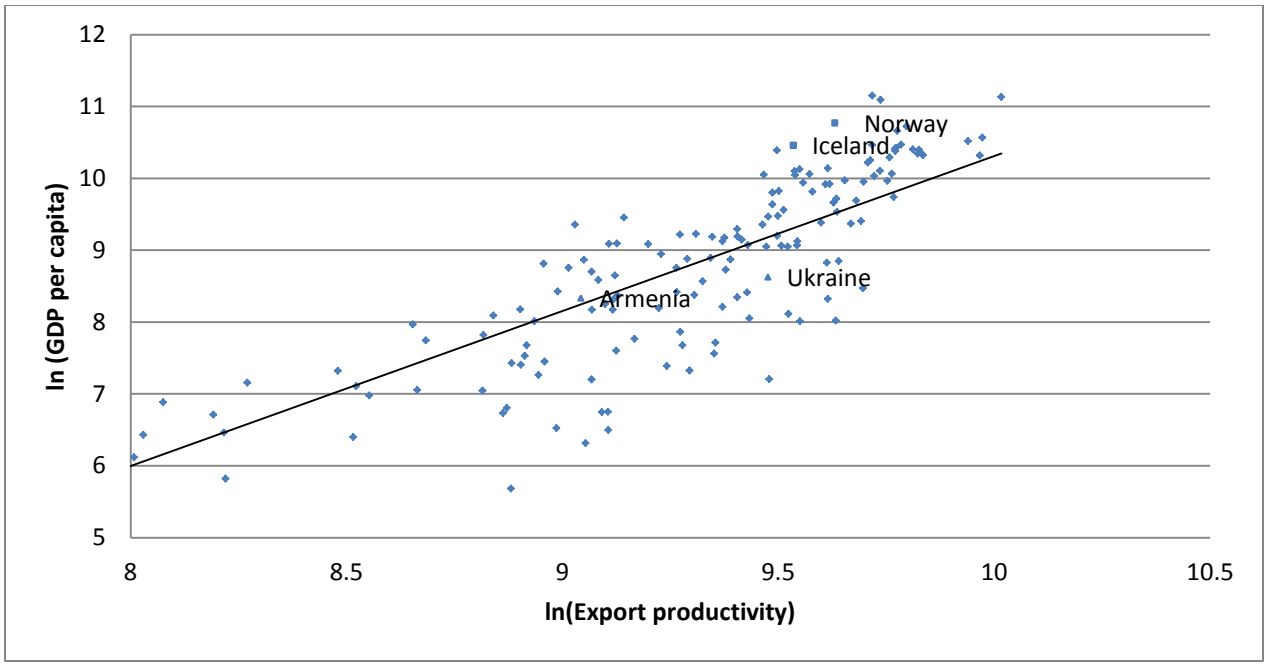


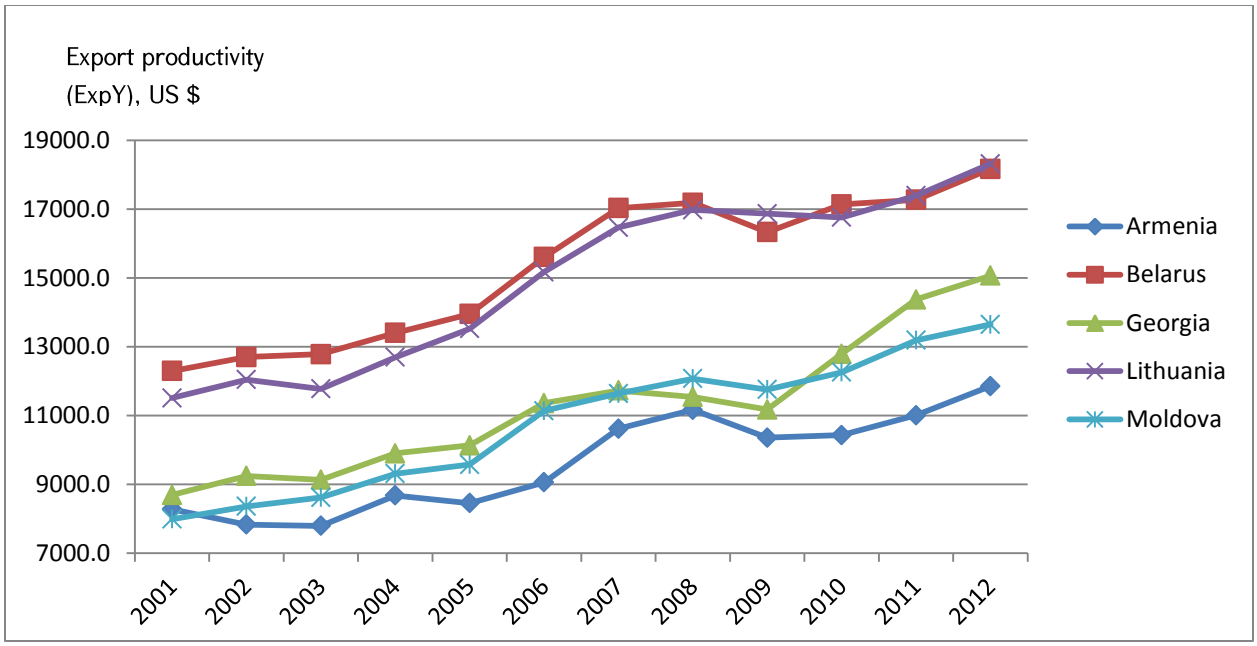
Figure 2: Export productivity (ExpY) and GDP per capita ($UD, PPP) (in logarithmic scale), 2005



Figures 1 or 2 shows a positive correlation between the two variables, with GDP per capita growing exponentially with ExpY. Hausman, Hwang and Rodric (2005) found that ExpY is a strong and robust predictor of subsequent economic growth. This means that countries which have an ExpY value that is higher than their GDP per capita will tend to grow faster than countries in the reverse situation. In other words, countries which are placed below 45^0 line in the figure 1 (for example Armenia, Macedonia etc) will see their GDP per capita growing faster that countries located above the line (for example Norway, United Arab Emirates etc). The same conclusion can be made from the figure 2, where presented the correlation between export productivity and GDP per capita in the logarithmic scale. We see that both Armenia and Ukraine will grow faster than countries located above the line (Norway, Iceland etc).

Figure 3 presents the dynamics of export productivity for some countries with similar economic development trends like Armenia.

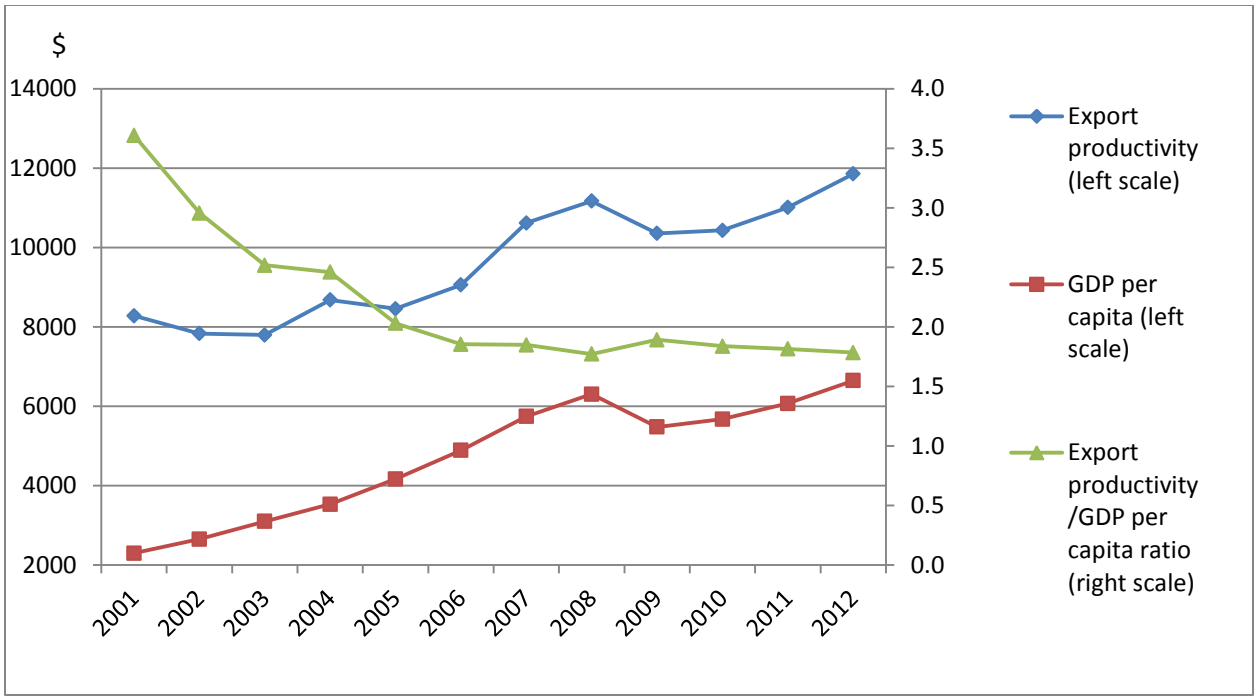
Figure3: Dynamics in average export productivity, ExpY (USD) 2001 – 2012



From the above figure we can see, that the rate of diversification and introduction of the new products are much higher in Belarus, Moldova and Georgia. For example, in 2001 the export productivity in Armenian's exports was less than the corresponding indicator in Georgia by approximately 5.0%, while in 2012 - already by 27%. Comparing with the Republic of Moldova, for example in 2001 we have approximately the same export productivity, while in 2012 – already by 15%. Comparing with Belarus we can indicate that in 2001 the export productivity was less by approximately 48,0% and 39,0% respectively, while in 2012 already by 53,0% and 54.5% respectively. Thus this figures demonstrates that above mentioned countries (Belarus, Georgia, Moldova and Lithuania), have a much higher rate of introduction of the new products and diversification of exports than Armenia.

Now let us review the dynamics of GDP per capita and export productivity for Armenia in more detail (see Figures 4).

Figure 4: GDP per capita (USD PPP), the average productivity (USD) of the Armenian export and their ratio, (2001 – 2012)

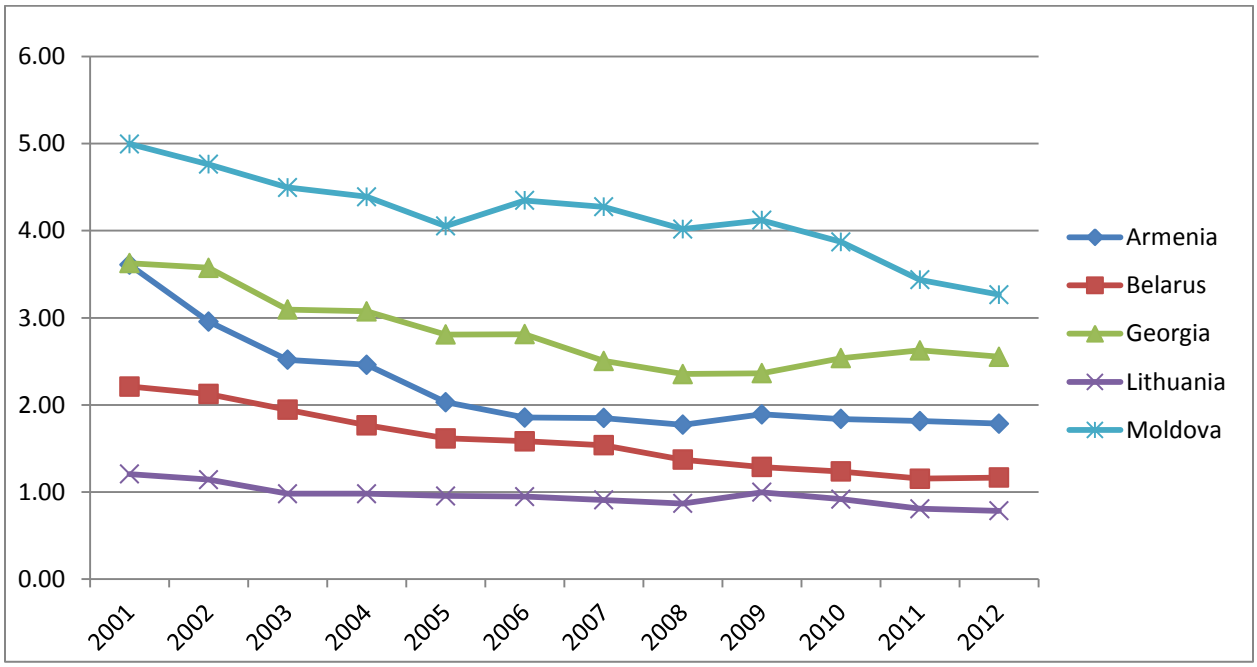


From the Figure 4 we can see that both GDP per capita and export productivity grew at stable rates during the whole period under review (except world global financial crisis, end of 2008). However, growth of export productivity was lower than the GDP per capita growth rate, which was reflected in the dynamics of their ratio. For example as we can see from the above figure in 2001 the ratio of export productivity to GDP per capita was around 3.6, while in the 2012 the same index was down to 1.7. It can be explained by the fact that significant part of total growth in export productivity have been caused by the growth in GDP per capita in the developed countries'.

The dynamics of the ratio of export productivity to GDP per capita for some other countries is presented in Figure 5.

As we can see from Figure 5 the largest and relatively stable (starting from 2006) value of the ratio of export productivity to GDP per capita is demonstrated by Moldova and Georgia, which according to the Hausmann et al. allow us to conclude that these country's have a potential of medium-term economic growth.

Figure 5: Ratio of export productivity to GDP per capita (in PPP) for a number of countries, 2002 - 2012



In order to distinguish those products that are rather promising in terms of economic growth and the same time creating good opportunities for further export diversification we can use the density measure between each of the products and the overall basket of products in the world. The density measure can be computed as it was shown in the part 3 of the current paper. The higher is this value; the more attractive it is to develop the production and export of such a product. The higher is the difference between the product's export productivity and the average productivity (ProdY – ExpY) of the country exports, the more attractive is the expansion of its exports for the economy. The list of the attractive goods is presented in table 3 and 4.

Table 3: 30 most attractive commodities with highest density and x = 0 (RCA < 1) in Armenia, 2005

Code	Description	Density	RCA	ProdY	ProdY-ExpY
302	Fish, fresh, whole	0.090	0.410	14461.4	6004.8
709	Vegetables nes, fresh or chilled	0.089	0.008	8913.1	456.6
1704	Sugar confectionery (incl white choc), not containing cocoa	0.086	0.111	9344.5	887.9
3923	Plastic packing goods or closures stoppers, lids, caps, closures, plas	0.086	0.158	11142.4	2685.9
305	Fish, cured or smoked and fish meal fit for human consumption	0.086	0.015	15262.8	6806.2
1905	Bread, biscuits, wafers, cakes and pastries	0.085	0.098	12871.5	4415.0
1604	Prepared/preserved fish & caviar	0.084	0.099	12778.9	4322.4
2005	Prepared or preserved vegetables nes (excl. frozen)	0.083	0.453	11256.5	2800.0
710	Frozen vegetables	0.082	0.003	9491.2	1034.7
2106	Food preparations, nes	0.082	0.116	16020.4	7563.9
304	Fish fillets and pieces, fresh, chilled or frozen	0.080	0.001	13404.5	4948.0
1806	Chocolate and other food preparations containing cocoa	0.080	0.148	12982.6	4526.1
2103	Sauces mixed condiments & mixed seasonings	0.080	0.040	12847.7	4391.2
4418	Builders' joinery & carpentry of wood	0.079	0.043	15490.5	7033.9
5607	Twine, cordage &cable, with rubber/plastic	0.079	0.008	8525.3	68.7
4409	Wood continuously shaped along any edges	0.079	0.005	9251.4	794.9
701	Potatoes	0.079	0.187	14493.7	6037.2
5209	Woven cotton fabrics, 85% or more cotton, weight over 200 g/m2	0.079	0.037	9440.4	983.9
3917	Tubes, pipes & hoses & fittings therefor of plastics	0.077	0.011	15496.6	7040.1
2515	Marble, travertine, ecaussine etc,	0.077	0.173	11571.5	3115.0
806	Grapes, fresh or dried	0.077	0.116	10180.5	1723.9
4818	Toilet paper, handkerchiefs, tissues, napkins, table cloths, diapers,	0.077	0.046	12128.7	3672.1
6401	W/p foot, outer sole/upper of rbr/pla upper not fixd to sole nor assemb	0.076	0.073	8496.0	39.5
3925	Builders' ware of plastics, nes	0.076	0.015	18323.2	9866.7
7604	Aluminum bars, rods and profiles	0.076	0.013	18370.0	9913.4
7306	Tubes, pipes and hollow profiles of iron or steel, nes	0.076	0.106	13368.1	4911.6
409	Natural honey	0.075	0.421	9516.0	1059.5
6403	Footwear, upper of leather	0.075	0.019	10589.1	2132.6
7114	Articles of goldsmith's/silversmith's wares & pts	0.075	0.223	11645.7	3189.1
1601	Sausages and similar products, of meat, offal or blood	0.075	0.036	16260.1	7803.6

Table 4: 30 most attractive commodities with highest density and x = 0 (RCA < 1) in Armenia, 2012

Code	Description	Density	RCA	ProdY	ProdY-ExpY
1905	Bread, biscuits, wafers, cakes and pastries	0.12	0.34	13980.7	2122.5
305	Fish, cured or smoked and fish meal fit for human consumption	0.11	0.12	14633.6	2775.5
4407	Wood sawn/chipped lengthwise, sliced/peeled	0.11	0.10	12480.5	622.3
1704	Sugar confectionery (incl white choc), not containing cocoa	0.11	0.71	13122.5	1264.3
4819	Packing containers, of paper, paperboard, cellulose wadding, webs	0.11	0.13	12926.9	1068.8
4818	Toilet paper, handkerchiefs, tissues, napkins, table cloths, diapers,	0.10	0.02	12961.0	1102.8
1604	Prepared/preserved fish & caviar	0.10	0.40	14385.8	2527.6
2106	Food preparations, nes	0.10	0.22	18847.3	6989.1
3917	Tubes, pipes & hoses & fittings therefor of plastics	0.10	0.40	18755.1	6896.9
304	Fish fillets and pieces, fresh, chilled or frozen	0.10	0.00	20439.3	8581.1
811	Frozen fruits & nuts	0.10	0.18	13015.9	1157.7
2517	Pebbles, gravel, broken/crushed stone; macadam of slag or dross	0.10	0.11	14338.3	2480.1
4415	Packaging materials of wood	0.10	0.05	20632.4	8774.2
1806	Chocolate and other food preparations containing cocoa	0.10	0.80	17017.0	5158.8
7112	Waste & scrap of precious metal	0.10	0.23	12927.7	1069.5
3305	Hair preparations	0.10	0.53	17239.8	5381.6
7801	Unwrought lead	0.10	0.00	16411.6	4553.4
4901	Printed books, brochures, leaflets & similar printed matter	0.10	0.11	19051.9	7193.7
3102	Mineral or chemical fertilizers, nitrogenous	0.10	0.01	14968.3	3110.1
3004	Medicament mixtures (not 3002, 3005, 3006), put in dosage	0.10	0.24	24253.1	12394.9
3925	Builders' ware of plastics, nes	0.10	0.57	21024.2	9166.1
4820	Registers, acct, note, order books etc; other stationary articles of paper	0.10	0.04	12293.2	435.0
1904	Breakfast cereals & cereal bars	0.10	0.04	15283.3	3425.1
7314	Cloth, grill, netting & fencing, of iron & steel wire	0.10	0.08	19421.1	7562.9
9404	Mattress supports; mattresses, quilts, etc	0.10	0.01	16368.5	4510.3
2309	Animal feed preparations, nes	0.10	0.02	16233.6	4375.4
7310	Iron &steel tank, cask, drum can, boxes (cap<=300l)	0.10	0.17	16171.6	4313.4
710	Frozen vegetables	0.10	0.03	15156.7	3298.6
3924	Tableware, kitchenware, toiletry articles, of plastic	0.10	0.04	17049.2	5191.0
6810	Articles of cement, concrete or artic. stone	0.10	0.01	20435.7	8577.5

Table 5: 30 products with the highest ProdY and their density in Armenian's export in 2012

Code	Description	Density	RCA	ProdY
2924	Carboxyamid-functn compound;amide function compound of carbonic acid	0.07	0.03	41203.7
5603	Nonwovens, w/n impregnated, coated, covered or laminated	0.08	0.03	40167.9
8477	Machinery for wrkg rbr/plas/ for the mfr of prod from these material	0.07	0.09	38903.9
2930	Organo-sulphur compounds	0.06	0.05	37927.2
3919	Self-adhesive plates, sheets, film etc of plastic w/n in rolls	0.06	0.03	37725.3
2922	Oxygen-function amino-compounds	0.06	0.01	37565.5
2933	Heterocyclic compounds with nitrogen hetero-atom; nucleic acids & thei	0.07	0.00	37217.5
9027	Instruments for physical/chemical analysis;inst for viscosity,heat,etc	0.06	0.37	35446.3
9026	Instruments for measuring/checking the flow/level/pressure of liq/gase	0.06	0.05	33244.9
2909	Ethers, ether-alcohols, ether-phenols & peroxides & thier derivatives	0.06	0.01	33001.9
8481	Tap,cock,valve for pipe,tank for the like,incl pressure reducing valve	0.07	0.07	30971.1
2903	Halogenated derivatives of hydrocarbons	0.05	0.03	30349.7
2926	Nitrile-function compounds	0.06	0.02	30231.2
9032	Automatic regulating or controlling instruments and apparatus	0.06	0.28	28890.3
8424	Mechanical appl. for proj/dispersing/spray;sand blastg mach,etc	0.07	0.01	28648.5
8479	Machines&mech appl having indiv functions, nes	0.06	0.06	27941.3
8408	Diesel or semi-diesel engines	0.07	0.00	27483.8
8443	Printing machinery; machines for uses ancillary to printing	0.05	0.10	27314.0
8543	Electrical mach&app having individual function, nes	0.06	0.10	26985.5
8428	Lifting/handling/loading/unloadg machinery (excl. lift/escalator/conve	0.07	0.03	26818.9
9504	Articles for funfair, table/parlour games&auto bowling alley equipment	0.05	0.01	26715.0
8422	Dish washing machines; machinery for aerating bottles	0.07	0.05	26527.4
8413	Pumps for liquids; liquid elevators	0.07	0.10	26304.2
8438	Machinery, nes, for the ind preparation or mfr of food or drink	0.09	0.04	26209.8
8412	Engines and motors, nes	0.08	0.02	26008.2

8425	Pulley tackle & hoists other than skip hoists; winches&capstans; jacks	0.07	0.01	25813.3
2914	Ketones & quinones, & their derivatives	0.06	0.02	25604.1
8483	Transmission shafts&cranks, bearing housing; gearing; etc	0.06	0.08	25248.9
8482	Ball or roller bearings	0.07	0.00	25131.0

From tables 3 and 4 we can identify several major groups of effective products, particularly Foodstuffs, Animal and Animal Products, Vegetable Products, Stone/Glass, Metals, Textiles, Wood and Wood Products, Plastics/Rubbers, Mineral Products. As we can see all these products do not contain high-tech goods. Therefore we can conclude that for sustainable long-term economic growth it is not necessary to switch the production and export to the high-tech goods.

In the table 5 we present the products with highest ProdY and their density. For some other products, that have high export potential, but low density and RCA we present the dynamics for the whole periods from 2001 – 2012 in appendix 1. For example from the appendix we can see that some products have high level of ProdY. In case if production of those goods will be expanded then in the future for these goods we could have RCA more than 1.

Using our estimation of the proximity and export productivity in the product space, we can measure the 'option value' of a country's unexploited opportunities. Given the set of products a country is currently producing, we can measure the 'open forest' at its door set as the distance-weighted value of all the products it could potentially produce where the value is captured by ProdY. Formal calculation of open_forest is as follows.

$$open_forest_{c,t} = \sum_i \sum_j \left[\frac{\varphi_{i,j,t}}{\sum_i \varphi_{i,j,t}} (1 - x_{c,j,t}) x_{c,j,t} PRODY_{j,t} \right]$$

$$open_forest_{c,t} = \sum_j \left[density_{j,c,t} (1 - x_{j,c,t}) ProdY_{j,t} \right]$$

"Open_forest" is a potential capability to render export structure more complex. It means that the indicator of potential capabilities captures weighted ProdY of those

product groups that currently do not have comparative advantage ($x_{c,j,t} = 0$) determined by the existing structure of comparative advantages ($x_{c,j,t} = 1$), with density's used as weights. A scatter plot of open forest versus GDP per capita is shown in figure 6, 7 and 8.

Figure 6: Open Forest vs. GDP per capita (in logs), 2005

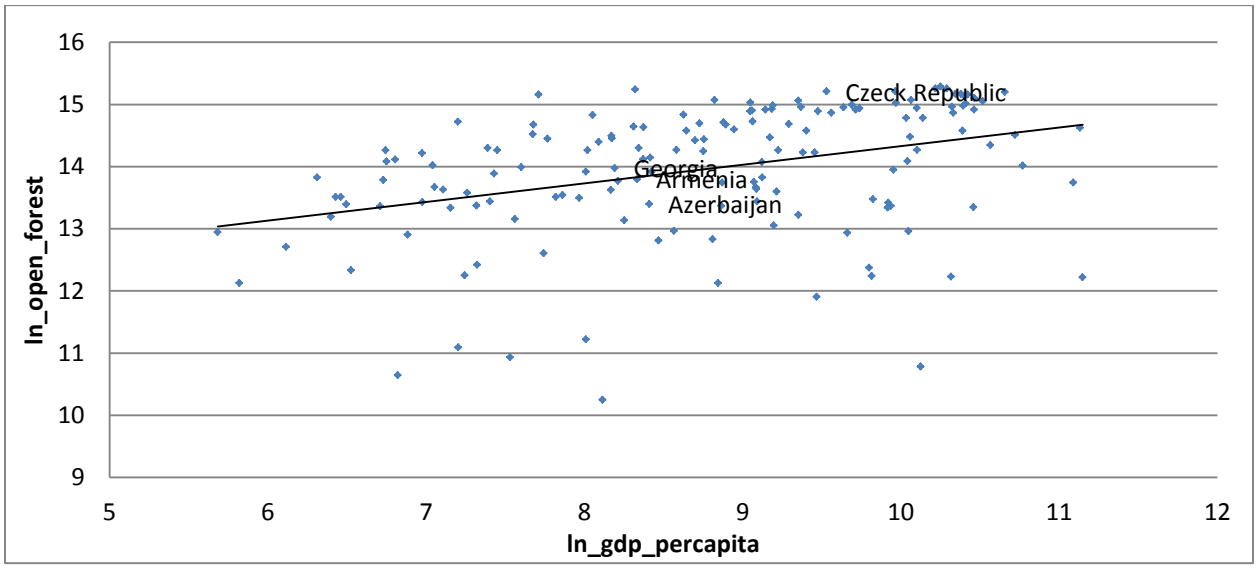


Figure 7: Open Forest vs. GDP per capita (in logs), 2011

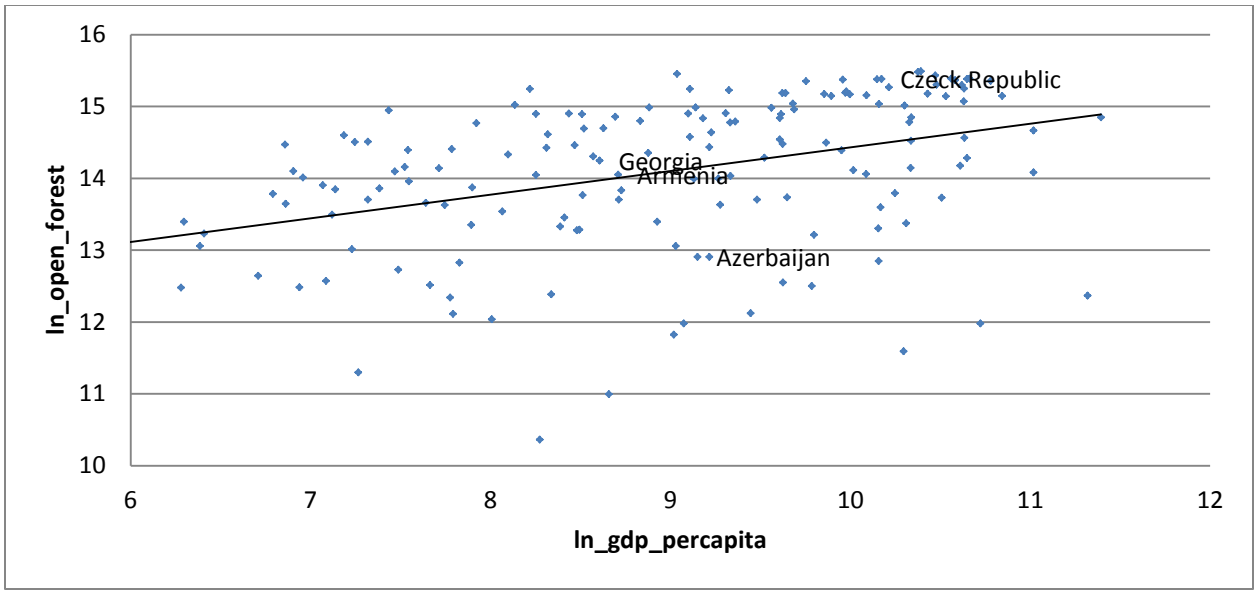


Figure 8: Open forest over time, Comparative

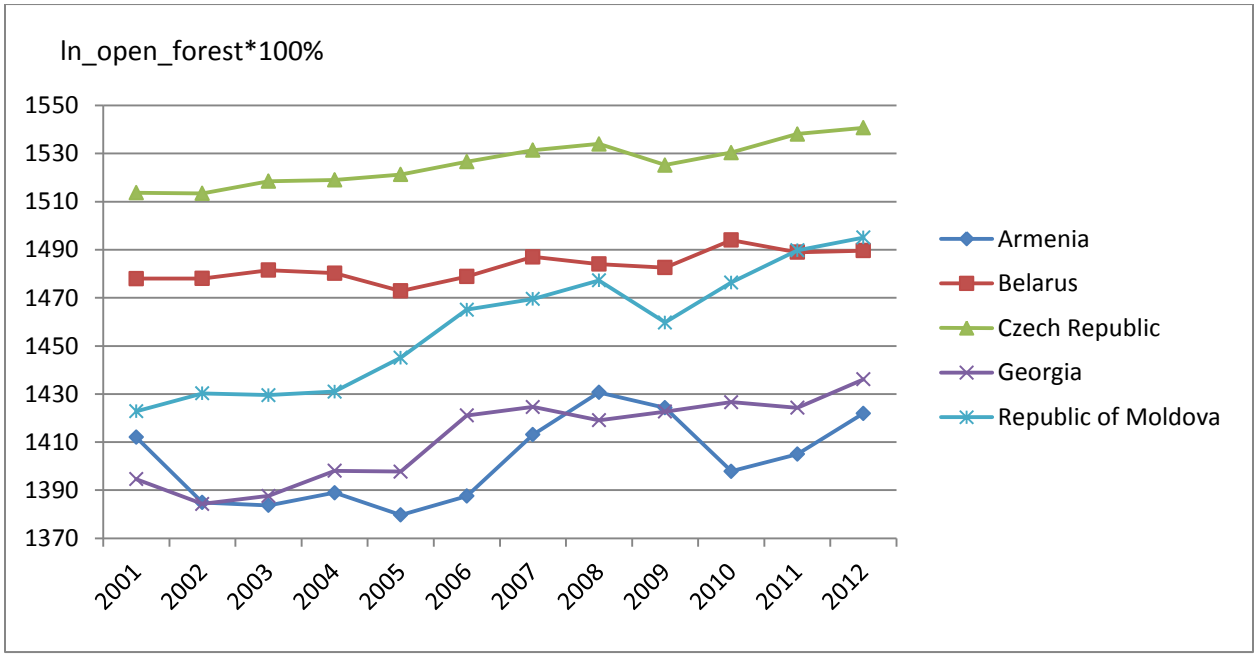
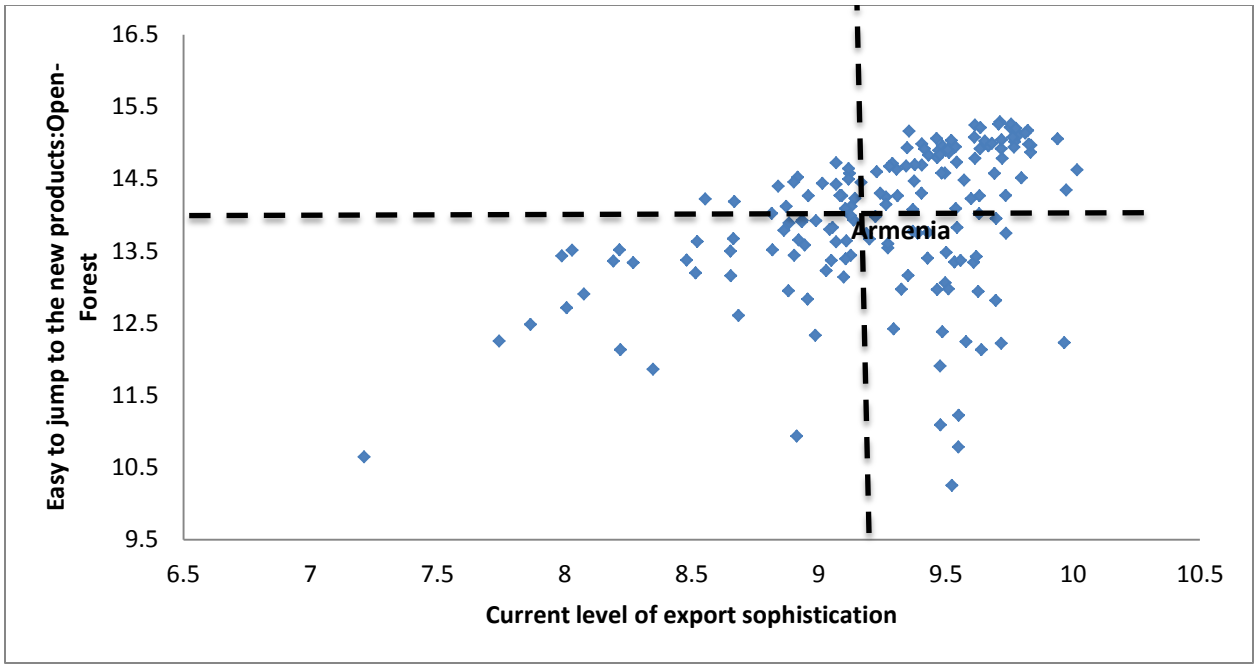


Figure 9: Current level of export sophistication



Countries differ widely in the value of their open forest. For example in 2005 the difference between the Czech Republic and Armenia is around 141.0%, while in 2011 already 131%, comparing with Azerbaijan in 2005 the difference is around 180%, while in 2011 already – 247%. In case of Georgia the difference in 2005 is 123%, while in 2011 already 114%. Thus we can conclude that the wealthier countries tend to be concentrated in a denser part of the forest while the poorest countries tend to be concentrated in the sparsest part of the forest. From the other side some Oil exporter countries also tend to cluster in the sparsest part. One reason is that these countries have few opportunities for future structural transformation.

Conclusions

In this paper we use the methodology developed by Hausman et al (2005, 2006) to construct productivity indices of exported products. Using this methodology we also

constructed indices of export sophistication for 2001-2012. Based on the productivity and per capita GDP we calculate the ratio ExpY/(GDP per capita), which is lower in Armenia than the same ratio In Belarus, Lithuania, Moldova and Georgia. This fact indicates that the medium-term growth prospects in Armenia are less favorable than in similar countries like Belarus, Lithuania, Moldova and Georgia. In accordance with the logics of Hausmann et al., to increase the rate of future economic growth it is necessary to launch or expand the production of export goods that satisfy two criteria: a relatively high value of export productivity and relatively small distance to the worldwide export basket (or large value of density). Based on these two criteria we identified a group of currently exported goods in Armenia, which future growth in production and exports is the most preferable to improve the potential of economic growth and export diversification. Using actual data and a set of calculations based on a software of our development we identify several major groups of effective products, particularly agricultural products, metals and its alloys, stones etc.. These products do not contain high-tech inputs. Thus, we can conclude that for sustainable economic growth it is not necessary to switch the production and export to high tech products, often the production of simpler goods can generate greater effects.

References

1. Aghion, P. & P. Howitt. 1992. A model of growth through creative distruction. Econometrica 60(2):323-351.
2. Balassa, Bela A. Trade liberalization and Revealed Comparative Advantage. Manchester School of Economic and Social Studies, vol. 33, No. 2, 1965, pp.99-123.
3. Grossman, G & E. Helpman. 1989. Product development and international trade.. The journal of political economy 97(6):1261-1283.
4. Hausmann, Ricardo, Hwang, Jason, Rodrik, Dani. What you export matters. NBER working paper, No. 11905, December 2005.
5. Hausmann, Ricardo, Klinger, Bailey. Structural transformation and patterns of comparative advantage in the Product Space. CID Working Paper, No. 128, August 2006.
6. Hausmann R., and Klinger, B., 2007 “Structural Transformation in Chile”, Working Paper, …

7. Hausmann, Ricardo, Rodrik, dani. Economic development as self-discovery. Journal of development economics, vol. 72, No. 2, December 2003, pp. 603-633.
8. Hidalgo, C., Klinger, B, B. Barabasi, A., Hausmann, R., 2007. "The Product space Conditions the Development of Nations"; Science, 317, 482-487.
9. Leamer Edward E. Source of Comparative advantage:Theory and evidence. 1984, Cambridge MA: The MIT Press.
10. Vitole, K., and Davidsons G., 2008. "Structural Transformation of Exports in a Product Space Model", Working Paper, Latvijas bank

Appendix 1

Products with the largest export potential but lowest density

Figure 1: Medicament mixtures (not 3002, 3005, 3006), put in dosage (code 3004)

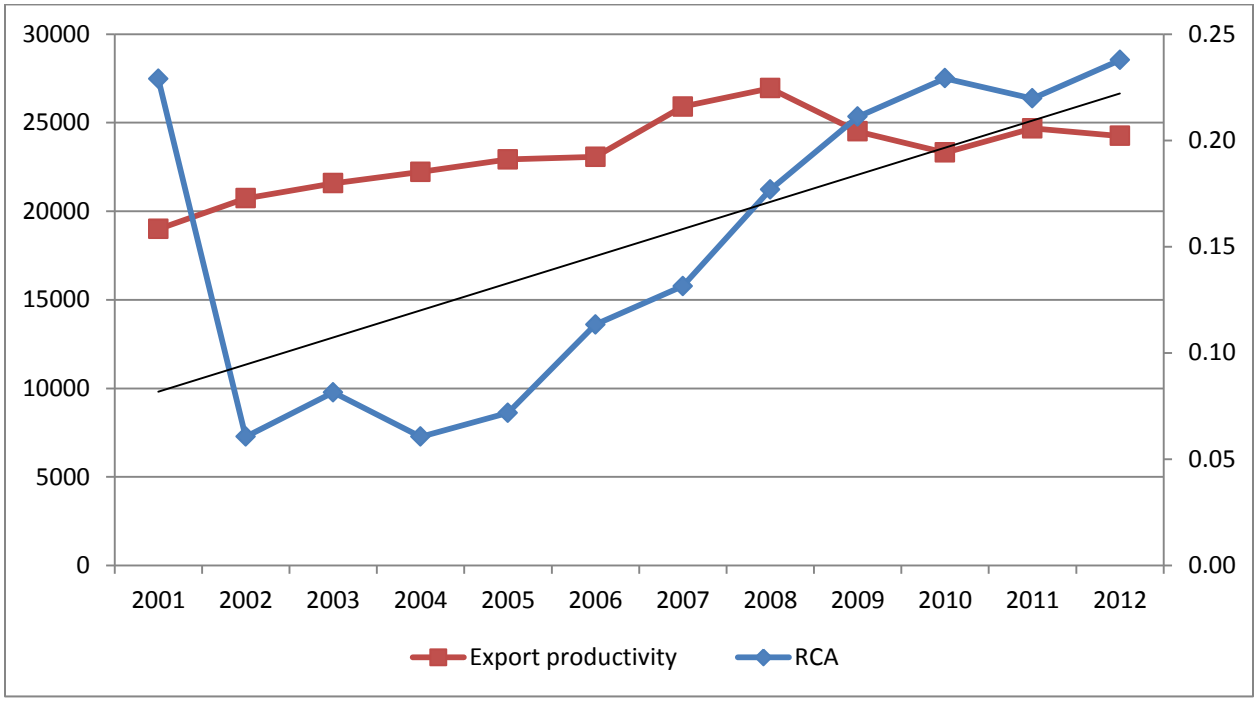


Figure 2: Electrical app for switch (ex fuse,switche,etc) not exceedg 1000 volt (code 8536)

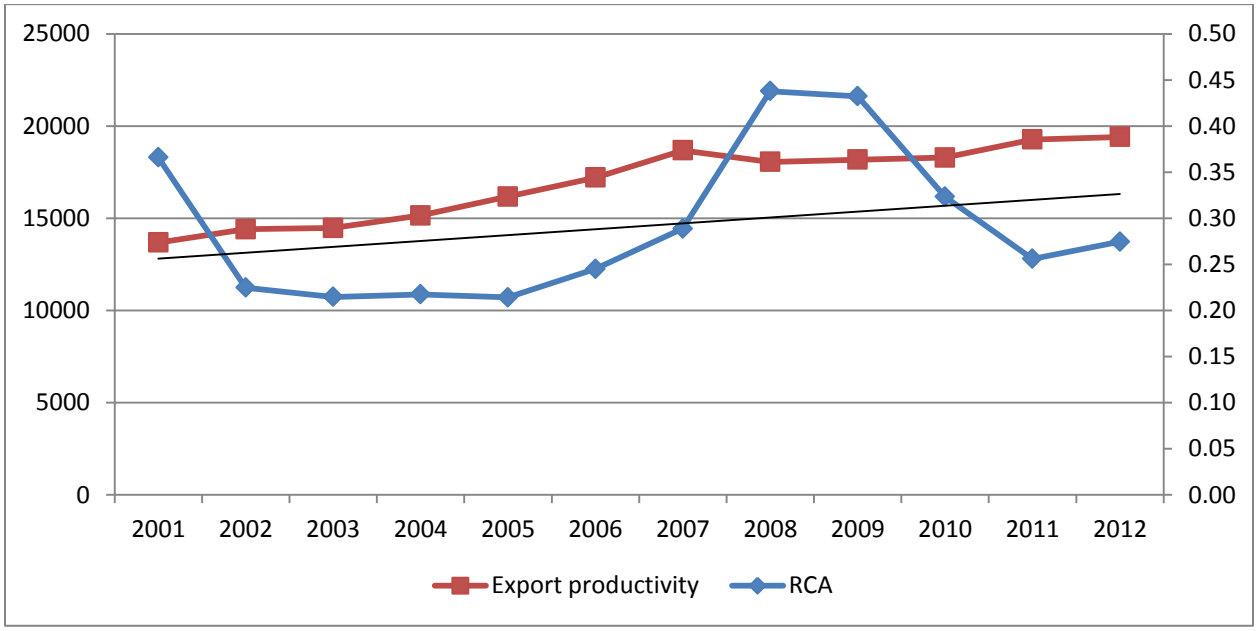


Figure 3: Prepared glues & adhesives nes; glue packaged (code 3506)

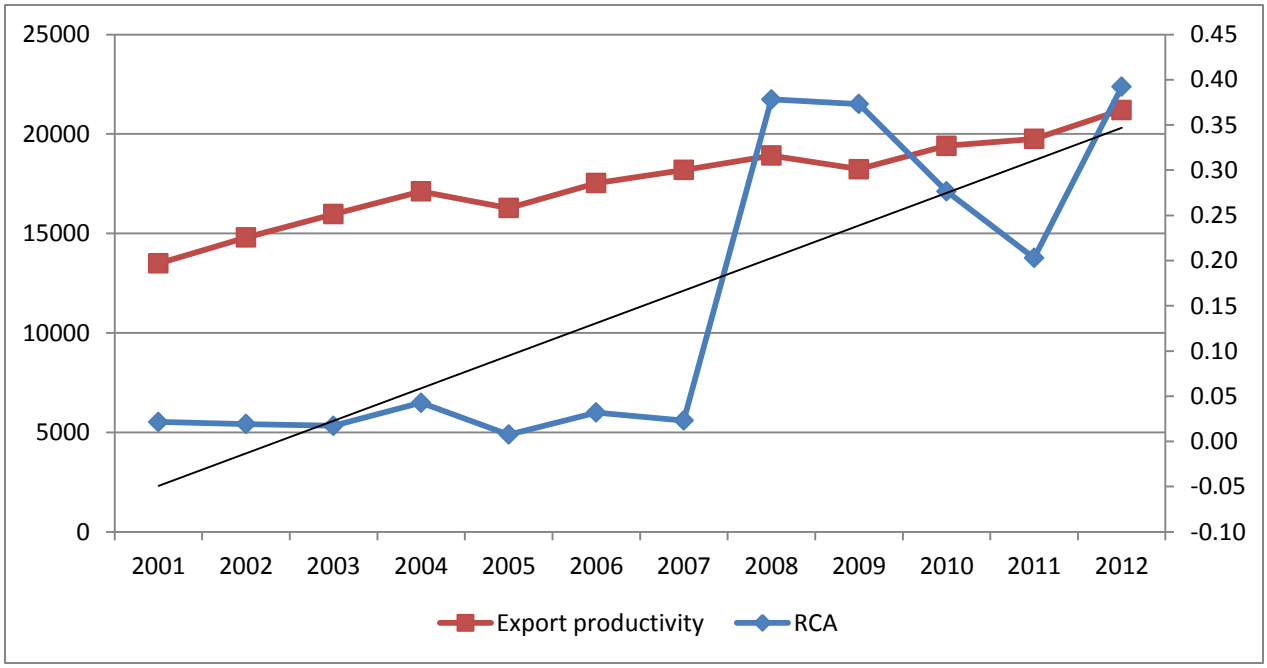


Figure 4: Footwear, upper of leather (code 6403)

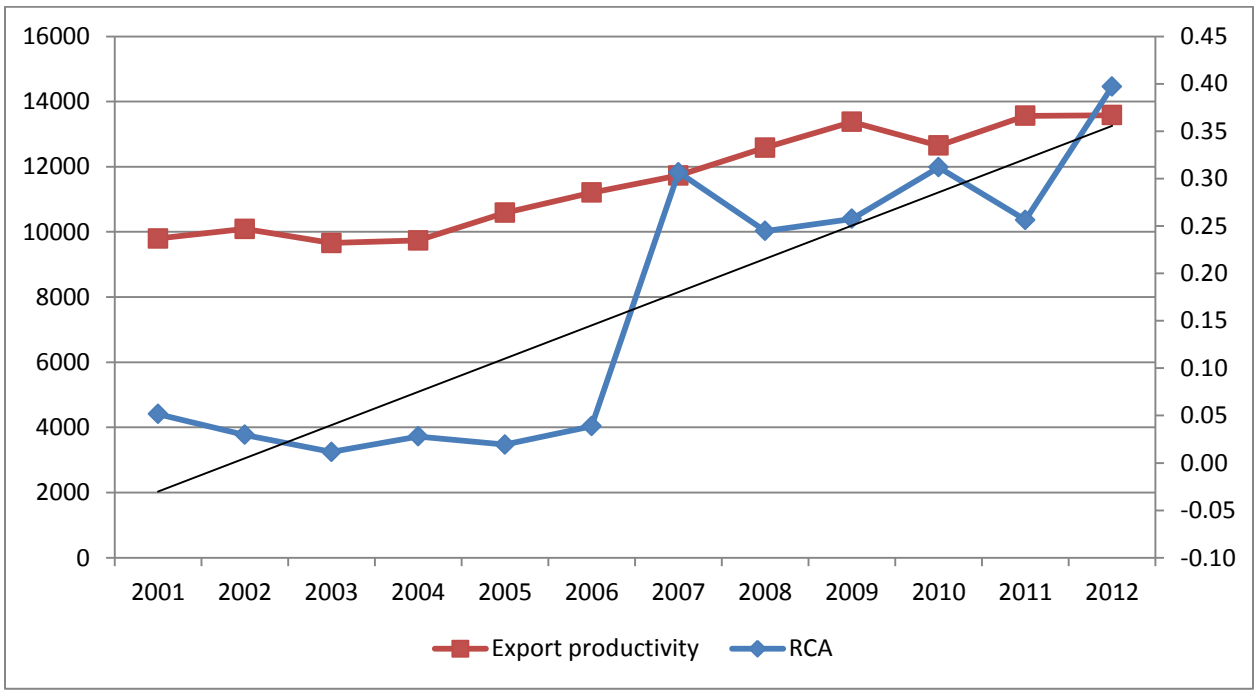


Figure 5: Printed matter nes, including printed pictures and photographs (code 4911)

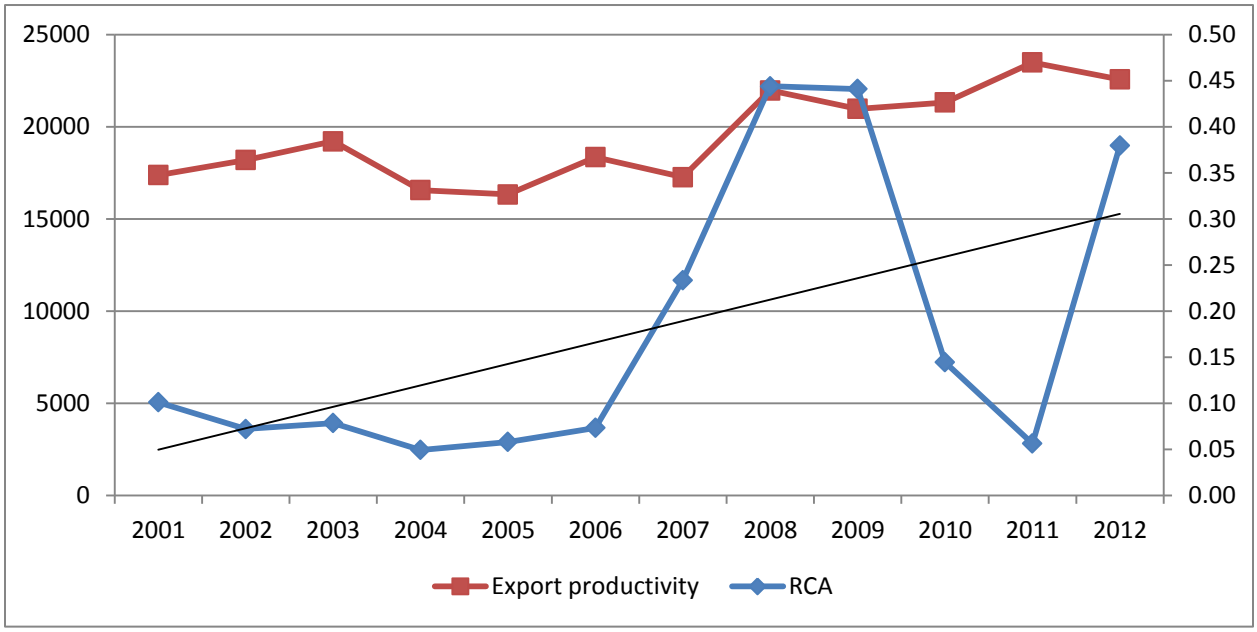


Figure 6: Air, vacuum pumps; hoods incorp a fan (code 8414)

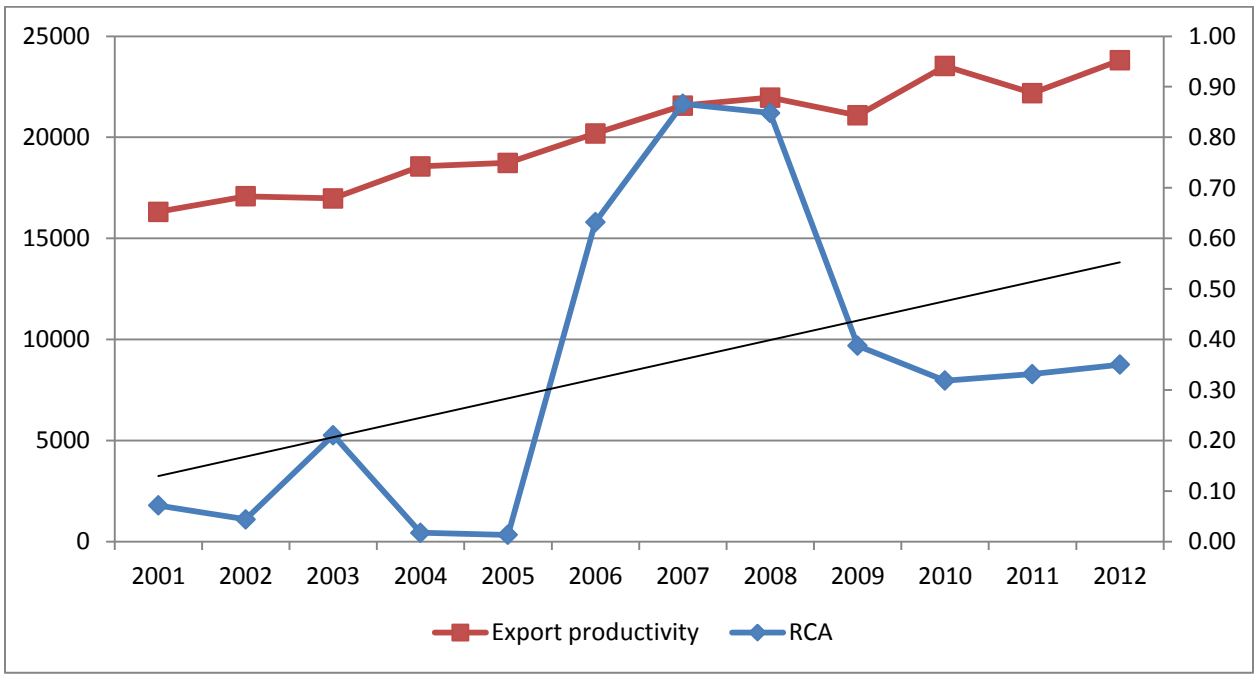


Figure 7: Instruments for physical/chemical analysis; inst for viscosity,heat,etc (code 9027)

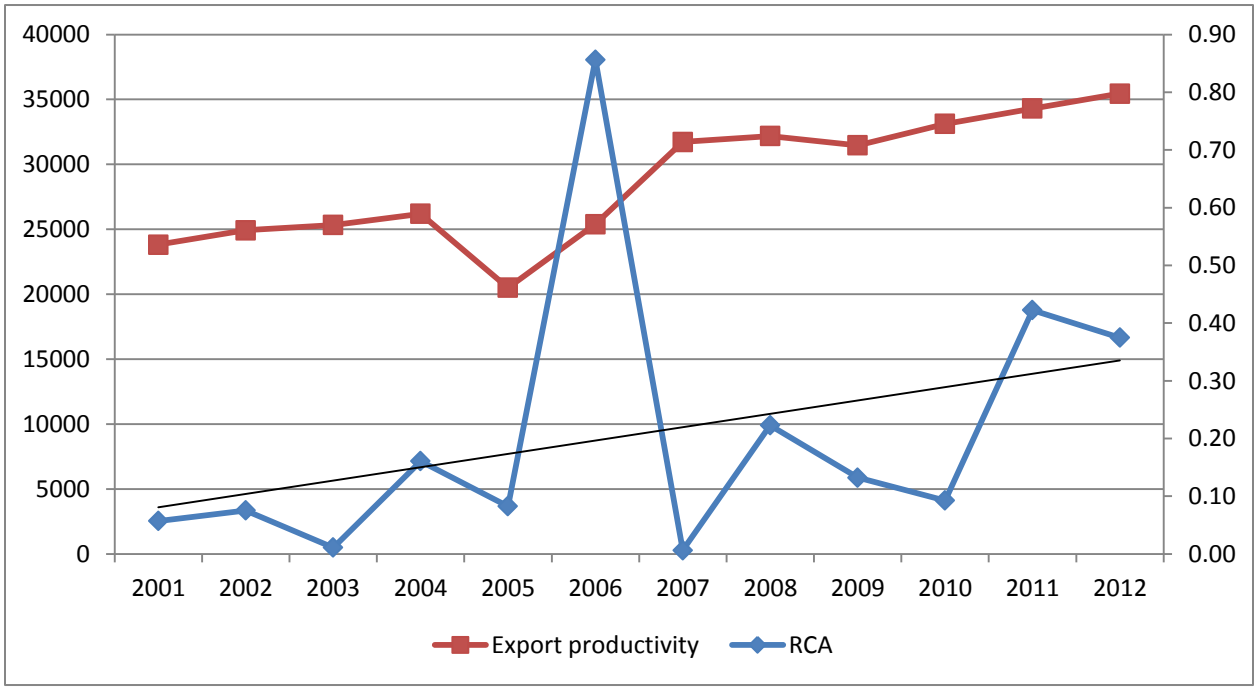


Figure 8: Food preparations, nes (code 2106)

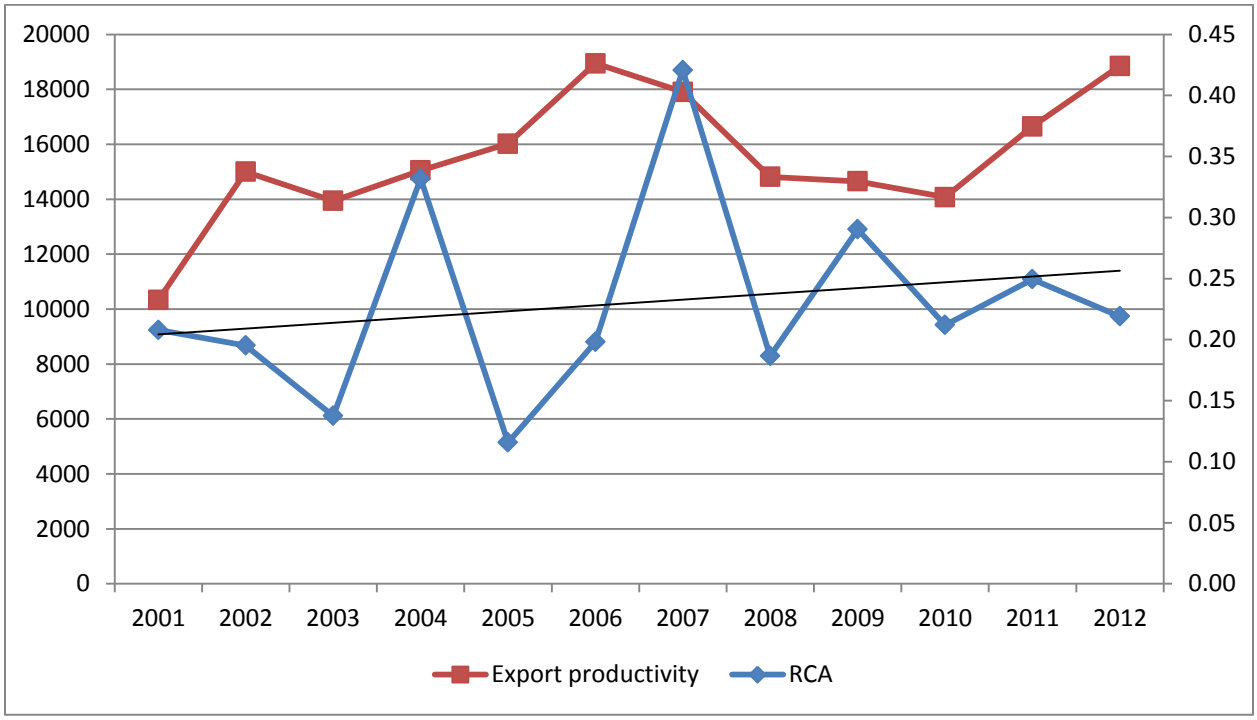


Figure 9: Chocolate and other food preparations containing cocoa (code 1806)

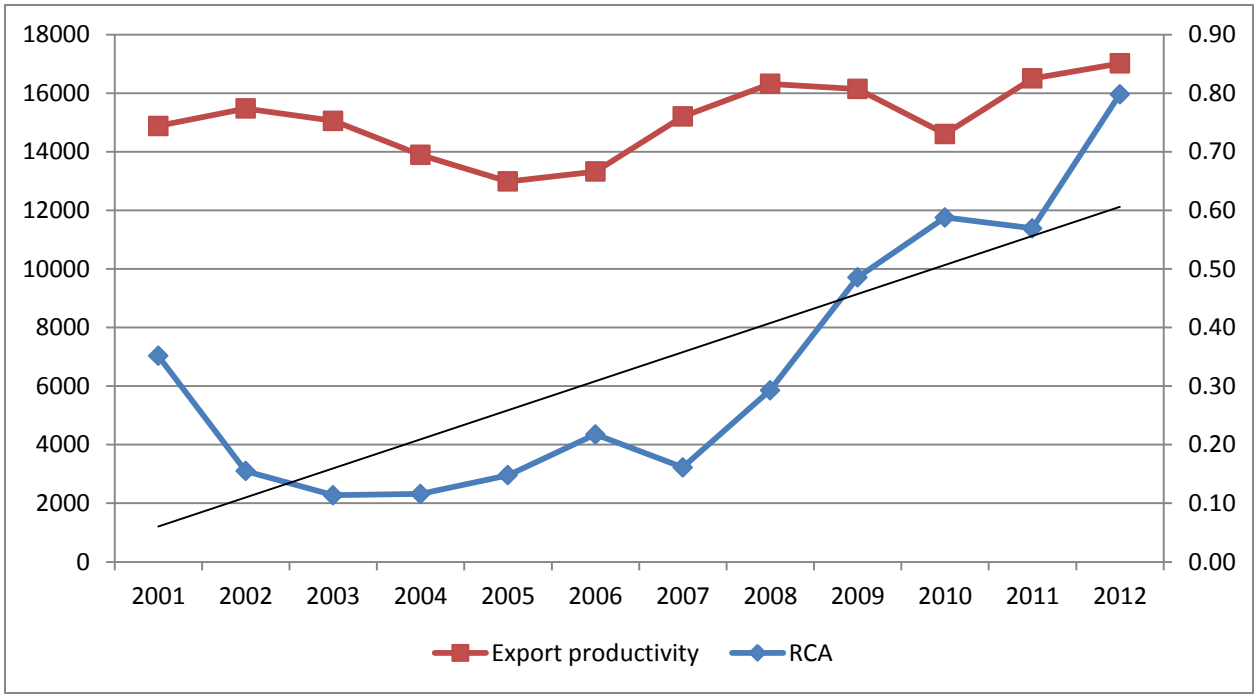
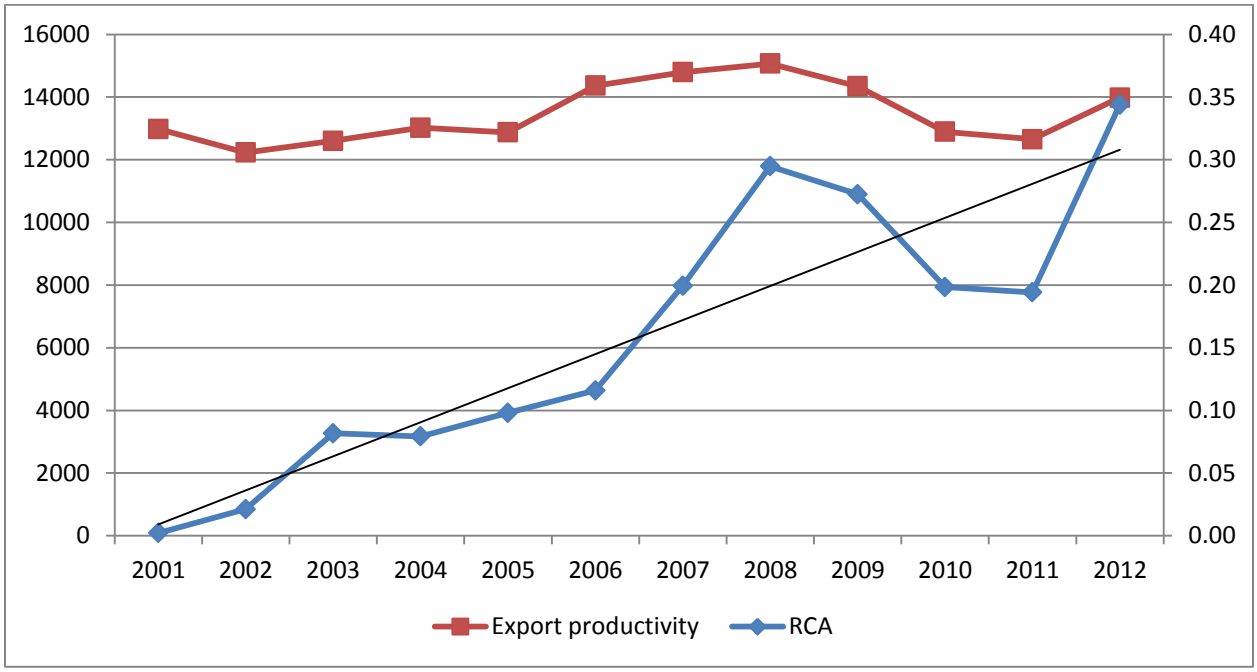



Figure 10: Bread, biscuits, wafers, cakes and pastries