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The impact of exchange rate changes on imports of capital and high-tech goods: A quantitative assessment

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Executive Summary

There are good economic reasons why the current foreign exchange policy of Ukraine should be changed towards a more flexible regime. Under current conditions, such a change will most probably involve certain depreciation, and affect a number of economic variables in turn. Specifically, policy makers are concerned about the impact on the import of capital and high tech goods, which play a major role for investment and thus contribute to the modernisation of Ukraine's often outdated capital stock.

In order to assess the quantitative impact of depreciation on these import categories, we use a simple trade simulation tool. Specifically, we model the effects of a 10% nominal depreciation, which we think is fundamentally justified, on the demand for capital and high-tech goods imports.

The results of our assessment can be summarized in the following table:

Import category	Import decrease, %	% of total imports
Capital goods	13.1 – 17.3	1.5 – 2.0
High-tech goods	9.0	0.4
Combined	12.5 – 16.1	1.7 – 2.2

Using trade data for 2011, we arrive at import reductions in the relevant import categories of between 13-17% (for capital goods), 9% (high-tech goods) and 15-20% (combined). Given as a share of total merchandise imports, the reductions are in the range of 0.4-2.2%. However, our assessment is based on a set of strong assumptions, e.g. that exchange rate changes are fully and instantaneously reflected in local price changes, which are unlikely to hold in practice, and thus the results can be considered as a "worst case" scenario.

What lessons can policy makers draw from our analysis? Our quantitative assessment suggests that the direct negative effects of a depreciation of 10% on capital goods and high-tech goods imports are noticeable, but should not be overstated. Furthermore, a number of positive effects of a more flexible exchange rate on investment demand, for example reduction in interest rates/financing costs, a more stable macroeconomic environment, will likely outweigh such drawbacks, in particular in the medium and long-term.

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1. Background

The exchange rate policy in Ukraine is not sustainable and a change in the system seems inevitable as we argue in our policy paper "Towards a sustainable and growth supportive FX policy in Ukraine[1]". Any such change would involve under current economic conditions a certain depreciation of the hryvnia.

This depreciation would impact the economy through different channels. One particular aspect is the impact on imports, which will become more expensive and thus less affordable. This result should be in general welcome, as it helps to improve the unsustainable external balance of the country. However, the government is right to be concerned about the impact of depreciation on certain categories of imports. A number of import goods are of particular interest in this regard, specifically:

- Capital goods, which are of great importance for the modernisation of Ukraine's often outdated capital stock, and
- High-tech goods, which are characterized by a high research and development (R&D) intensity and which can be considered "critical imports" as they cannot be easily substituted, at least not in the short term.

The purpose of this paper is to provide a quantitative and qualitative assessment of the likely impact of the required depreciation on these two import categories. The paper is structured as follows: In the next chapter we discuss the role of imports of capital and high tech goods to Ukraine's economy given the need to modernize the country's capital stock. Chapter 3 explains the methods and results of our empirical analysis. In chapter 4 we discuss and interpret the results and provide conclusions.

2. The Economic Importance of Capital and High-Tech Goods Imports

2.1 Ukraine's imports of capital and high tech goods

As mentioned, in the following assessment, we focus two categories of imported goods: capital goods and high-tech goods.

The classification of *capital goods imports* is based on the UN's Broad Economic Categories (BEC). Capital goods are usually defined by the following product groups:

- BEC 41: Capital goods (except transport equipment)
- BEC 521: Industrial transport equipment

High-tech good imports are defined as imports that contain technical products involving a high R&D intensity. Such products can be manufactured by different industries such as aerospace, biotechnology, information technology, telecommunications, and many others. The list is based on an OECD definition and available in Annex D.

Clearly, there exist a number of import goods that can be classified in both categories.

[1] http://beratergruppe-ukraine.de/download/Beraterpapiere/2012/PP_05_2012_en.pdf

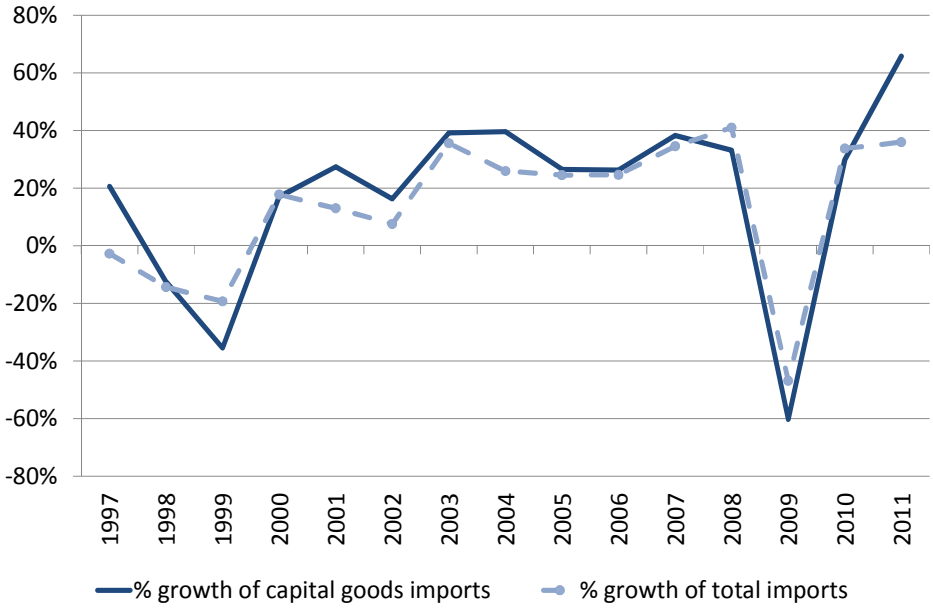
Out of total merchandise imports of USD 82.6 bn in 2011, capital goods imports amounted to USD 9.6 bn,[2] i.e. 12% of total merchandise imports. This share is roughly in line with the long-term average share of capital imports in the structure of Ukraine's merchandise imports.

High-tech goods imports into Ukraine in 2011 amounted to USD 3.3 bn, i.e. 4% of total merchandise imports. As mentioned, some goods can be classified as both, capital or high tech goods. This overlap between capital and high-tech goods amounted to USD 1.7 bn or 2% of total merchandise imports in 2011. The combined value of capital and high-tech goods imports, after adjusting for double-counting, was USD 11.3 bn.

Capital goods imports tend to grow faster than overall merchandise imports in Ukraine (Figure 1). However, it is also more sensitive to shocks. In two observed periods of crisis – 1998-1999 and 2008-2010 – imports of capital goods dropped more significantly than overall imports, implying higher than average elasticity.

Figure 1

Trends in capital goods imports in Ukraine, 1997-2011



Source: UN ComTrade, authors' estimates

Closer look at capital goods imports shows that in 2011 the Top-3 product categories, which constituted about 18% of total capital goods imports, were all machine-building products. Specifically, the top three categories were:

- DC motors, excluding universal AC/DC motors [HS 850134] (7.5% of total imports of capital goods);
- Fuel elements (cartridges), non-irradiated [HS 840130] (6.2%);
- Motor vehicles for transportation of goods [HS 870421] (4.7%).

[2] Here and further in the paper, all import values are calculated based on HS 6-digit codes, to which both BEC and SITC codes were mapped. This is done for modeling purposes. Due to the transformation process there some discrepancy with original data in BEC and SITC classification is possible.

Imports of high-tech products have been more concentrated. In 2011, the Top-3 product categories amounted to 32% of total high-tech imports. These categories were:

- Fuel elements (cartridges), non-irradiated [HS 540130] (17.9% of total high-tech imports);
- Polyethylene terephthalate, in primary forms [HS 390760] (8.4%);
- Medicaments containing other antibiotics [HS 300420] (5.7%).

2.2 Contribution of imports to investments

Imports play an important role in Ukraine's fixed capital accumulation, in other words, in renovation and modernization of the economy. In 2006-2010, imported goods and services accounted for 37% on average of total gross fixed capital accumulation (Figure 2).

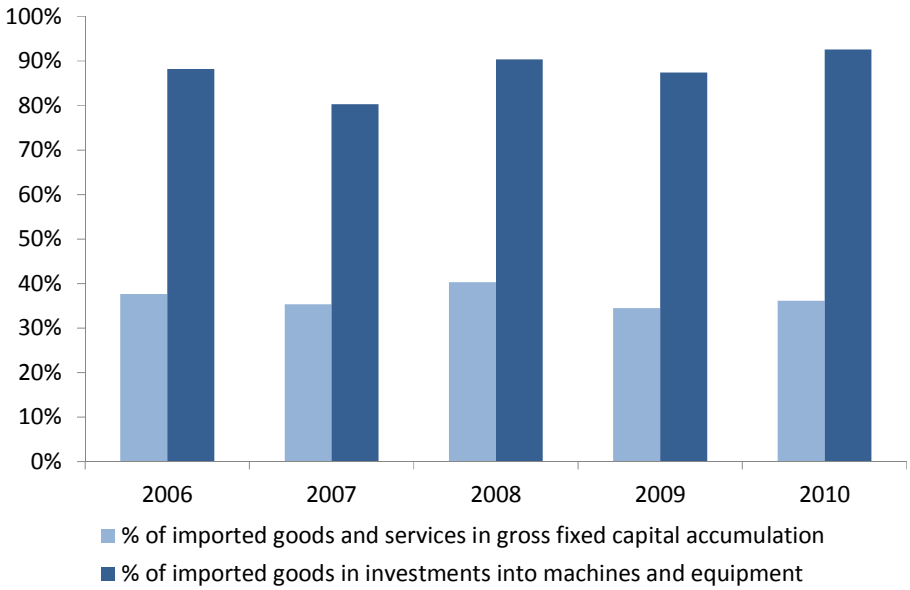
The majority of imported goods and services used for investments in Ukraine are machines and equipment, including transport equipment. It is important to note that unlike capital goods, high-tech goods are not necessarily investment goods but can also be intermediate or consumer goods, i.e. pharmaceutical products.

While two-thirds of the output of Ukraine's machine building industry is exported (about 64% of total output of machine building was exported in 2010), Ukrainian companies prefer to invest in foreign-made machines and equipment. The share of imported machine-building products in total investments into machine-building products was 88% on average in 2006-2010 (Figure 2).

The data also suggest that the sharp devaluation of hryvnia in 2008-2009 did not tip the balance towards domestic machine-building products, indicating a relatively low import substitution for this product category, at least in the short-run.

Figure 2

The share of imports in investments in Ukraine



Source: Ukrstat

3. Methodology and Results

In this section we present our approach and the result of our modelling exercise. The aim is to estimate how capital goods imports and high tech good import would react to assumed hryvnia depreciation.

3.1 Methodology

In our assessment, we distinguish three different variants. In Variant A, we deal with the imports of capital goods, Variant B covers high-tech goods, and Variant C combines both goods categories[3]. The source of all empirical trade data is the World Integrated Trade Solution (WITS) Global Tariff Cuts and Trade Simulator developed by the World Bank[4].

For the purpose of assessment, we mapped BEC and SITC codes of capital and high-tech goods respectively into HS 6-digit codes.

In our empirical assessment, the following methodology is applied to capital goods (Variant A), high-tech goods (Variant B) and the combined effect (Variant C)

Step 1: We assume a 10% depreciation of the hryvnia. This is in line with a fundamentally required devaluation as calculated by us in previous research[5] and also in line with research reported by other observers.

Step 2: We assume that this depreciation translates fully into a 10% price increase of capital goods imports in local currency

Step 3: For each HS 6-digit product code we obtained the corresponding import demand elasticity for Ukraine. This elasticity tells us approximately by how much import demand decreases if the import price goes up by 1%. The source of these elasticities is the World Integrated Trade Solution (WITS) Global Tariff Cuts and Trade Simulator.[6]

Step 4: Based on the expected 10% increase in prices we project the expected decrease in imports assuming constant elasticity of demand.[7]

Step 5: Aggregating the results over all relevant product codes we obtain the (approximate) reduction in total imports in either capital or high-tech goods as

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[3] Adjusted for double-counting, as a number of goods are classified as both capital and high-tech goods

[4] See Annex A for more information

[5] See our policy briefing PB/18/2011 „Equilibrium exchange rate in Ukraine: Quantitative assessment and policy implications for 2011/2012" http://beratergruppe-ukraine.de/download/PolicyBriefings/2011/PB_18_2011_eng.pdf

[6] This simulator contains empirical calculations of import demand elasticities for a wide range of products (HS 6-digit level) and trading countries, including Ukraine. For the underlying methodology, see Hiau Looi Kee & Alessandro Nicita & Marcelo Olarreaga, 2008. "Import Demand Elasticities and Trade Distortions," The Review of Economics and Statistics, MIT Press, vol. 90(4), pages 666-682, November. They estimated more than than 377,000 import demand elasticities across 117 countries and for 4900 HS 6-digit products

[7] Constant elasticity means that log of demand changes in proportion to log of prices. We use the following formula: Trade impact = imports*(1-exp(-ln(1+depreciation)*elasticity)). It follows from: ln(imports-trade impact)-ln(imports)=-elasticity*ln(1+depreciation)

well as weighted average elasticity of imports[8] and resulting from a 10% depreciation of the hryvnia.

3.2 Results

Variant A: Capital goods

Following steps 1-5, we can see that a 10% depreciation of the hryvnia would thus decrease capital goods imports by 17.3%, i.e. from USD 9.657 bn to USD 7.990 bn (USD -1.667 bn). Thus, for each one per cent of price increase capital goods imports tend to fall by around 2%.

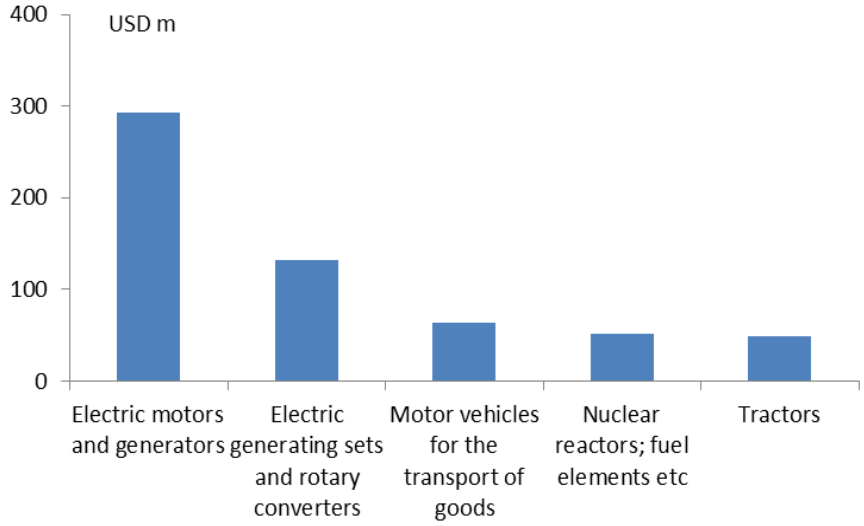
However, a detailed analysis of the capital goods import product code at the HS 6-digit level of the WITS database reveals a number of implausibly high elasticity values (up to 130!), likely generated by high noise and imperfections in large-scale modelling effort.

Thus, in the following, we decided to refine our analysis regarding import demand elasticities further. We consider an alternative variant where we impose a threshold elasticity value of 5 for every product code whose elasticity is shown as being higher than 5. While this threshold is to some extent arbitrary, it is in line with estimates from economic modelling and removes the impact from outlier elasticity values whose basis is of doubtful origin.

Rerunning our analysis with adjusted elasticity, we see that a 10% depreciation of the hryvnia would decrease capital goods imports by 13.1%, i.e. from USD 9.657 bn to USD 8.390 bn (USD -1.267 bn). This implies weighted average import elasticity of 1.56 – that is, each one per cent price increase would reduce import demand by 1.6%.

Figure 3

Top-5 product groups most affected within capital goods imports[9]



Source: WITS, own calculations

[8] Average elasticity is calculated as -ln(1-trade impact/imports)/ln(1+depreciation)

[9] In Annex B, we provide a more detailed overview of the Top-20 product groups affected by our analysis.

A closer examination of our results suggests that the estimated reduction of capital goods imports by around USD 1.3 bn is concentrated in a number of product groups (Figure 3).

Almost half of the decrease in imports (USD 590 m) is concentrated in 5 product groups. Most affected is the import of "electric motors and generators" (USD 293 m), "electric generating sets and rotary converters" (USD 132 m) and "motor vehicles for the transport of goods" (USD 64 m).

Variant B: High-tech goods

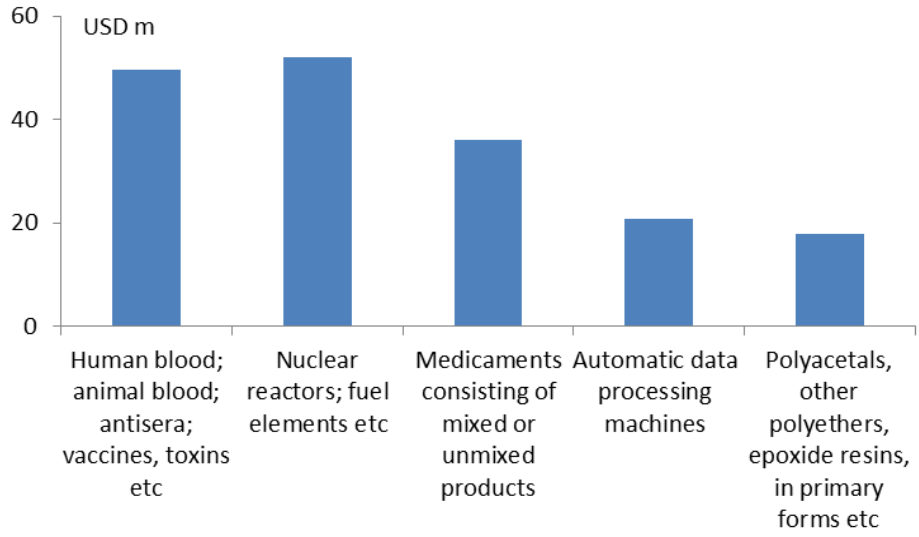
Following steps 1-5, we see that a 10% depreciation of the hryvnia would decrease high-tech goods imports by 8.82%, i.e. from USD 3.345 bn to USD 3.050 bn (USD -294.9 m). This implies that high tech goods imports would decline by around 1% for each 1% price increase.

If we use elasticities bounded at 5, we obtain almost identical results. A 10% depreciation of the hryvnia would decrease high-tech goods imports by 8.78%, i.e. from USD 3.345 bn to USD 3.051 bn (USD -293.5 m).

The reduction in high-tech goods imports by around USD 294 m is concentrated in a number of product groups, as the following figure shows:

Figure 4

TOP-5 product groups most affected within high-tech goods imports[10]



Source: WITS, own calculations

About three fifths of the decrease in imports (USD 176 m) is concentrated in 5 product groups. Most affected is the import of "nuclear reactors, fuel elements, etc." (USD 52 m), "human blood, animal blood, antisera vaccines, toxins, etc." (USD 50 m) and "medicaments consisting of mixed or unmixed products" (USD 36 m).

[10] In Annex C, we provide a more detailed overview of the Top-20 product groups affected by our analysis.

Variant C: Combined effect

For the combined effect, a 10% depreciation of the hryvnia would thus decrease total imports of capital and high-tech goods by 16.1%, i.e. from USD 11.345 bn to USD 9.523 bn (USD -1.822 bn).

By imposing threshold elasticity value of 5 (see Variant A and B) and re-running our analysis, we can see more modest effect. A 10% depreciation of the hryvnia would decrease imports by 12.5%, i.e. from USD 11.345 bn to USD 9.925 bn (USD -1.420 bn) implying a weighted average import elasticity of 1.40.

4. Discussion and Conclusion

The purpose of this paper was to provide a quantitative assessment on the impact of a possible depreciation of the hryvnia on imports on capital and high-tech goods.

The combined impact on both capital and high-tech good imports is a decrease between USD 1.420 - 1.822 bn. This constitutes a 12.5-16.1% decline compared to 2011 import level of capital and high-tech goods. In relation to Ukraine's total imports of USD 82.608 bn, however, the impact would only constitute a modest 1.7-2.2% decline.

For capital goods, our results point to a maximum reduction imports by between USD 1.267–1.667 bn depending on the variant. This reduction must be put into perspective. Taking into account the overall size of imports in 2011, the decrease seems not very large, as the reduction would only amount to 1.5-2.0% of total imports. However, if benchmarked against the imports of capital goods, it implies a drop of between 13.1-17.3%.

Looking at high-tech imports, the import decrease is much smaller in absolute terms, between USD –294-295 m, i.e. 0.4% of total imports. When measured against high-tech imports only, the decrease rises to around 9%.

In order to interpret the results it is worth noting that our estimates are based on a number of strong assumptions. For example, we assume that the effects of depreciation are immediately and fully incorporated into local prices. In reality, however, an exchange rate change is often not fully reflected in price changes. Indeed, several arguments put forward by economists (e.g. "pricing-to-market") suggest that the increase in the local price can differ from the degree of depreciation of the local currency. Prices are thus "sticky", in particular in the short term, which limits any decrease in demand [11]. Furthermore, while a depreciation without doubt will make imports more expensive and thus have a negative effect on investments, there are a number of effects resulting from a depreciation that would support investment growth.

First, a depreciation would help to bring the currently very high interest rates (=financing costs) down, which are currently a major drag for investment. This decrease in interest rates will stimulate investment demand over time. A more flexible exchange rate is also a

[11] Of course, the actual relationship between exchange rate and price changes needs to be investigated further empirically in the context of Ukraine. Some stylized facts from previous periods of depreciation (e.g. 2008/09) suggest that this correlation is quite high.

cornerstone of a more stable macroeconomic situation. This is a pre-requisite of economic growth, and should also positively influence investment demand. Both arguments (improved financing costs and a better and more stable economic outlook) would also impact capital and high-tech goods imports in a positive manner. Finally, there is also some potential for import substitution (i.e. a shift towards domestic goods as prices of foreign goods go up), but the high share of imports in equipment and machinery over the last 10 years makes it unlikely to be a significant factor.

What lessons can be drawn for policymakers from above discussion? It is in our view safe to say that our results most probably overstate the true impact of depreciation on imports of capital and high tech goods, and should be rather seen as a "worst case". Furthermore, it is easy to identify additional positive effects from a more flexible exchange rate on the demand for investment goods, which will likely over-compensate any negative impact.

Annex A: World Integrated Trade Solution (WITS)

The World Integrated Trade Solution (WITS) is data consultation and extraction software with simulation capabilities. As such, it can serve as a gateway to global trade and protection statistics and an analytical and simulation tool to estimate consequences of changes in tariff. The WITS was developed by the World Bank in collaboration and consultation with various International Organisations including United Nations Conference on Trade and Development (UNCTAD), International Trade Centre (ITC), United Nations Statistical Division (UNSD) and the World Trade Organisation (WTO). The WITS has access to major international trade, tariffs and non-tariff data compilations: The UN COMTRADE database maintained by the UNSD, the TRAINS maintained by the UNCTAD and the IDB and CTS databases maintained by the WTO.

WITS contains different analytical modules that enable users to extract data, populate it with own data and run simulations. The "SMART" module is an ex-ante partial equilibrium model, measuring the first-round effects of the simulated policy changes. The model is largely used to simulate the impact of trade policy changes, like tariff cuts, preferential trade agreements etc.

For more information: http://wits.worldbank.org/wits/

Annex B: Top 20 affected capital goods (4 digit HS code)

Rank	Product code	Name	Trade before devaluation (USD m)	Trade effect (USD m)	Change
1	8501	Electric motors and generators (excluding generating sets)	856.3	293.2	-34%
2	8502	Electric generating sets and rotary converters	416.6	132.2	-32%
3	8704	Motor vehicles for the transport of goods	768.8	64.2	-8%
4	8401	Nuclear reactors; fuel elements (cartridges), etc.	597.1	51.6	-9%
5	8701	Tractors	559.1	48.8	-9%
6	8433	Harvesting or threshing machinery, etc.	431.1	39.0	-9%
7	8479	Machines and mechanical appliances having individual functions	318.7	34.7	-11%
8	8428	Other lifting, handling, loading or unloading machinery	254.3	23.4	-9%
9	8419	Machinery, plant or laboratory equipment, whether or not electrically heated	180.3	21.8	-12%
10	8471	Automatic data processing machines and units thereof	244.0	21.1	-9%
11	8429	Self-propelled bulldozers, angledozers, graders, etc.	174.6	20.9	-12%
12	8415	Air conditioning machines	159.8	20.7	-13%
13	9018	Instruments and appliances used in medical, surgical, dental or veterinary sciences	254.9	19.8	-8%
14	8716	Trailers and semi-trailers; other vehicles, not mechanically propelled	166.9	19.1	-11%
15	8403	Central heating boilers other than those of heading 8402	58.2	18.9	-33%
16	8432	Agricultural, horticultural or forestry machinery for soil preparation or cultivation	217.0	18.9	-9%
17	8421	Centrifuges, including centrifugal dryers; filtering or purifying machinery and apparatus	207.3	18.8	-9%
18	8426	Ships' derricks; cranes, etc.	51.8	17.0	-33%
19	8474	Machinery for sorting, screening, separating, washing, crushing, grinding, mixing or kneading earth, stone, ores	138.0	16.6	-12%
20	8413	Pumps for liquids, whether or not fitted with a measuring device; liquid elevators.	173.3	15.8	-9%

Source: WITS, own calculations

Note: Variant with imposed maximum elasticity of 5

Annex C: Top 20 affected high-tech goods (4 digit HS code)

Rank	Product code	Name	Trade before devaluation (USD m)	Trade effect (USD m)	Change
1	8401	Nuclear reactors; fuel elements (cartridges), etc.	600.4	51.9	-9%
2	3002	Human blood; animal blood; antisera vaccines, toxins, etc.	321.0	49.5	-15%
3	3004	Medicaments (excluding goods of heading 30.02, 30.05 or 30.06) consisting of mixed or unmixed products	404.5	36.0	-9%
4	8471	Automatic data processing machines	239.9	20.7	-9%
5	3907	Polyacetals, other polyethers, epoxide resins, etc. in primary forms	281.4	18.0	-6%
6	9032	Automatic regulating or controlling instruments and apparatus	151.7	13.0	-9%
7	9022	Apparatus based on the use of X-rays or of alpha, beta or gamma radiations	135.1	12.6	-9%
8	8537	Boards, panels, consoles, desks, cabinets and other bases	139.7	11.5	-8%
9	9021	Orthopedic appliances, including crutches, surgical belts and trusses; splints and other fracture appliances	77.5	8.6	-11%
10	9027	Instruments and apparatus for physical or chemical analysis	66.8	5.6	-8%
11	9018	Instruments and appliances used in medical, surgical, dental or veterinary sciences	73.3	5.1	-7%
12	9026	Instruments and apparatus for measuring or checking the flow, level, pressure or other variables of liquids or gases	44.8	4.1	-9%
13	8518	Microphones and stands therefor; loudspeakers, whether or not mounted in their enclosures; headphones and earphones	36.2	4.0	-11%
14	8411	Turbo-jets, turbo-propellers and other gas turbines.	61.9	3.8	-6%
15	8802	Other aircraft (for example, helicopters, aeroplanes); spacecraft	40.0	2.9	-7%
16	8526	Radar apparatus, radio navigational aid apparatus and radio remote control apparatus.	33.6	2.6	-8%
17	8462	Machine-tools (including presses) for working metal by forging, hammering or die-stamping; machine-tools	53.1	2.5	-5%
18	8541	Diodes, transistors and similar semiconductor devices	27.0	2.3	-9%
19	8532	Electrical capacitors, fixed, variable or adjustable (pre-set)	18.5	2.3	-12%
20	8412	Other engines and motors	60.9	2.3	-4%

Source: WITS, own calculations

Note: Variant with imposed maximum elasticity of 5

Annex D: Detailed list of high technology products (SITC code Rev. 3)

Aerospace	Computers-Office machines	Electronics-Telecommunications	Pharmacy	Scientific instruments	Electrical machinery	Nonelectrical machinery	Chemistry	Armament
71408*	75113	76381	54131	77408*	77862	71489	52222	89108*
71441	75131	76383	54132	77411	77863	71499	52223	89111
71449	75132	76408*	54133	77412	77864	71871	52229	89112
71481	75134	76411	54139	77413	77865	71877	52269	89113
71491	75208*	76413	54151	77421	77867	71878	52508*	89114
79208*	75210	76415	54152	77422	77868	72847	52511	89121
79211	75220	76417	54153	77423	77871	73111	52513	89122
79215	75230	76419	54159	77429	77878	73112	52515	89123
79220	75260	76421	54161	87108*	77879	73113	52517	89124
79230	75270	76422	54162	87111	77884	73114	52519	89129
79240	75997	76423	54163	87115		73131	52591	89131
79250		76424	54164	87119		73135	52595	89139
79291		76425	54211	87131		73153	53108*	89191
79293		76426	54212	87139		73161	53111	89193
87411		76431	54213	87141		73163	53112	89195
		76432	54219	87143		73164	53113	89199
		76481	54221	87145		73165	53114	
		76482	54222	87149		73312	53115	
		76483	54223	87191		73314	53116	
		76491	54224	87192		73316	53117	
		76492	54229	87193		73591	53119	
		77220		87199		73595	53121	
		77261		87211		73733	53122	
		77318		87407		73735	57433	
		77625		87408*		73142	59108*	
		77627		87412		73144	59110	
		77631		87413		73151	59120	
		77632		87414			59130	
		77633		87431			59141	
		77635		87435			59149	
		77637		87437				
		77639		87439				
		77641		87441				
		77643		87442				
		77645		87443				
		77649		87444				
		77681		87445				
		77688		87446				
		77689		87449				
		89879		87451				
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				87477				
				87478				
				87479				
				87490				
				88111				
				88121				
				88411				
				88419				
				89961				
				89963				
				89966				
				89967				

*: The codes ending with "08" are used in case of confidential trade (no data available).
Example: The code "71408" corresponds to confidential trade of products belonging to the SITC section "714".

Source: Eurostat,
http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an4.pdf

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