OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

FOCUS ON EUROPEAN ECONOMIC INTEGRATION

Stability and Security.

Q3/14

This publication presents economic analyses and outlooks as well as analytical studies on macroeconomic and macrofinancial issues with a regional focus on Central, Eastern and Southeastern Europe.

Publisher and editor	*Oesterreichische Nationalbank* *Otto-Wagner-Platz 3, 1090 Vienna* *PO Box 61, 1011 Vienna, Austria* *www.oenb.at* *oenb.info@oenb.at* *Phone (+43-1) 40420-6666* *Fax (+43-1) 40420-046698*
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Design	*Communications and Publications Division*
Printing and production	*Oesterreichische Nationalbank, 1090 Vienna*

DVR 0031577

ISSN 2310-5259 (print)
ISSN 2310-5291 (online)

Printed according to the Austrian Ecolabel guideline for printed matter.

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Opinions expressed by the authors of studies do not necessarily reflect the official viewpoint of the Oesterreichische Nationalbank or of the Eurosystem.

Call for Entries: Olga Radzyner Award 2014 for Scientific Work on European Economic Integration

In 2000, the Oesterreichische Nationalbank (OeNB) established an award to commemorate Olga Radzyner, former Head of the OeNB's Foreign Research Division, who pioneered the OeNB's CESEE-related research activities. The award is bestowed on young economists for excellent research on topics of European economic integration and is conferred annually. In 2014, four applicants are eligible to receive a single payment of EUR 3,000 each from an annual total of EUR 12,000.

Submitted papers should cover European economic integration issues and be in English or German. They should not exceed 30 pages and should preferably be in the form of a working paper or scientific article. Authors shall submit their work before their 35th birthday and shall be citizens of any of the following countries: Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, FYR Macedonia, Hungary, Kosovo, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia or Ukraine. Previous winners of the Olga Radzyner Award, ESCB central bank employees as well as current and former OeNB staff are not eligible. In case of co-authored work, each of the co-authors has to fulfill all the entry criteria.

Authors shall send their submissions either by electronic mail to *eva.gehringer-wasserbauer@oenb.at* or by postal mail – with the envelope marked "Olga Radzyner Award 2014" – to the Oesterreichische Nationalbank, Foreign Research Division, Otto-Wagner-Platz 3, POB 61, 1011 Vienna, Austria. Entries for the 2014 award should arrive by September 19, 2014, at the latest. Together with their submissions, applicants shall provide copies of their birth or citizenship certificates and a brief CV.

For detailed information, please visit the OeNB's website at *www.oenb.at/en/About-Us/Research-Promotion/Grants/Olga-Radzyner-Award.html* or contact Ms. Eva Gehringer-Wasserbauer in the OeNB's Foreign Research Division (write to *eva.gehringer-wasserbauer@oenb.at* or phone +43-1-40420-5205).

Call for Applications: Visiting Research Program

The Oesterreichische Nationalbank (OeNB) invites applications from external researchers for participation in a Visiting Research Program established by the OeNB's Economic Analysis and Research Department. The purpose of this program is to enhance cooperation with members of academic and research institutions (preferably postdoc) who work in the fields of macroeconomics, international economics or financial economics and/or pursue a regional focus on Central, Eastern and Southeastern Europe.

The OeNB offers a stimulating and professional research environment in close proximity to the policymaking process. Visiting researchers are expected to collaborate with the OeNB's research staff on a prespecified topic and to participate actively in the department's internal seminars and other research activities. They will be provided with accommodation on demand and will, as a rule, have access to the department's computer resources. Their research output may be published in one of the department's publication outlets or as an OeNB Working Paper. Research visits should ideally last between three and six months, but timing is flexible.

Applications (in English) should include

- a curriculum vitae,
- a research proposal that motivates and clearly describes the envisaged research project,
- an indication of the period envisaged for the research visit, and
- information on previous scientific work.

Applications for 2015 should be e-mailed to *eva.gehringer-wasserbauer@oenb.at* by November 1, 2014.

Applicants will be notified of the jury's decision by mid-December. The following round of applications will close on May 1, 2015.

Studies

Using a Threshold Approach to Flag Vulnerabilities in CESEE Economies

Martin Feldkircher,
Thomas Gruber,
Isabella Moder[1]

In this paper we examine macroeconomic, external and financial vulnerabilities of 22 Central, Eastern and Southeastern European (CESEE) economies. Our assessment is based on a nonparametric signaling or threshold approach, which involves monitoring selected indicators that show unusual behavior in the periods leading to a crisis. For that purpose, we have collected annual data on more than 90 emerging economies spanning the period from 1995 to 2012. Our dataset covers a broad range of potential early warning indicators related to the banking sector, the external side, and the macroeconomic and fiscal situation of the economy. Our in-sample test shows that the threshold approach identifies 73% of crisis events correctly while issuing false alarms only for 31% of the noncrisis observations. For the purpose of this paper, crisis events comprise banking crises, currency crises and sovereign debt crises. Applying a composite vulnerability indicator to CESEE economies using the latest available data (2012), we identify Turkey, Belarus and Moldova as the countries that appear especially vulnerable to an unexpected adverse event based on our threshold approach.

JEL classification: F31, F47
Keywords: Vulnerabilities, threshold approach, CESEE

In this paper, we propose a threshold approach akin to the one employed by the IMF (see e.g. IMF, 2010) and fully described in Chamon and Crowe (2013). Our dataset covers a wide range of potential early warning indicators related to the external, macroeconomic and banking sector of the economy. Our approach incorporates various enhancements compared to the original model. First of all, we do not focus solely on currency crises but also take into account sovereign debt crises and banking crises, as the frequency of these crises has increased over the past decades. Moreover, we are interested in vulnerabilities to any type of crisis that might occur in the future. Additionally, we use an extended dataset not only of CESEE countries but also of other emerging economies to incorporate as many crises in the sample as possible.

The paper is structured as follows: Section 1 provides a summarized literature review, while the next section briefly describes the methodology we applied and, specifically, how we calculated the thresholds we used. In section 3 we explain our data selection. Section 4 outlines how we compiled our composite vulnerability indicator and summarizes the individual threshold indicators. Our empirical results are discussed in section 5, and section 6 concludes.

1 Literature Review

Since the 1950s, researchers have tried to predict the likelihood of a crisis, mainly focusing on currency crises in developing countries. Early work was based on qualitative discussions or divided countries into a crisis and a noncrisis control group to identify possible differences between the two groups.

The de facto collapse of the European Exchange Rate Mechanism and the emerging market crises in the 1990s gave a new impetus to research on early warning systems. Since then, two main empirical approaches have evolved. The first early warning approach was developed by Frankel and Rose (1996), who

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modeled currency crashes using a probit regression model with annual data for developing countries from 1971 to 1992. They found that sharply decreasing FDI inflows, low reserves, high domestic credit growth, high interest rates in industrial countries and overvalued real exchange rates are good predictors of currency crashes. Since then, the strand of literature employing logit or probit panel regressions has been widely drawn on (see e.g. Berg and Pattillo, 1999; Comelli, 2013; or Bussière, 2013a).

The other main approach is the so-called signaling or threshold approach, which was introduced by Kaminsky and Reinhart (1999). The idea behind this nonparametric approach is to select a certain threshold for indicators that show altered behavior some periods ahead of a crisis. As soon as an indicator exceeds the defined threshold value, this can be interpreted as a warning signal that a crisis might occur shortly after. The threshold value is chosen by minimizing the sum of type I errors (missing a crisis because the indicator chosen was too strict) and type II errors (false alarms because the indicator chosen was too loose). Kaminsky et al. (1998) identify international reserves, the real exchange rate, inflation and credit-related variables as the leading indicators with the best predictive power to signal currency crises.

This strand of the literature was further developed by a number of scholars (e.g. Edison, 2003). Brüggemann and Linne (2002) combined the different indicators to form a composite indicator for five CESEE countries (Bulgaria, Czech Republic, Romania, Russia and Turkey) that experienced a currency crisis up to 2001.[2] Their results show that especially an overvalued exchange rate, weak exports and diminishing currency reserves are indicators of crisis vulnerabilities in these countries. By contrast, variables related to external debt as well as the current account balance and interest rate differentials did not prove useful as early warning indicators in other studies (Kaminsky et al., 1998). In addition, there is little evidence that markets' or analysts' views as expressed in spreads or ratings are reliable crisis predictors (Berg et al., 2005). More recently, Csortos and Szalai (2014) used Boolean combinations of signals from a small set of indicators to predict macroeconomic imbalances for ten Central and Eastern European economies. Their measures involved real exchange rate and capital flow misalignments and the credit-to-GDP gap.

Apart from the two main approaches, alternative methods have also been employed, for example binary classification trees (developed by Ghosh and Ghosh, 2003; see also Chamon et al., 2007), Markov switching models (Abiad, 2003) or Bayesian model averaging (Crespo Cuaresma and Slačík, 2009; Babecký et al., 2013; Christofides et al., 2012).

Traditionally, the goal of early warning systems has been predicting currency crises (e.g. the Asian crisis of 1997). The recent global financial crisis and the following economic and sovereign debt crises of 2008 and 2009 extended the use of early warning systems beyond the scope of currency crises (see for example Barrell et al., 2010, on bank crises, Manasse and Roubini, 2009, on sovereign debt crises and Babecký et al., 2013, on economic crises).

A few scholars have undertaken comprehensive meta-analyses of early warning systems to identify common indicators across the different methods, country and

[2] *For predicting currency crises in CESEE see also Schardax (2002).*

time samples, for example Kaminsky et al. (1998) or Abiad (2003). The most recent metastudy was conducted by Frankel and Saravelos (2012), who investigated more than 80 papers written between 1950 and 2002. The top two indicators identified in the review turned out to be the level of international reserves and real exchange rate overvaluation.

As regards the forecast period, different models use different time horizons, usually between 12 and 24 months. Kaminsky et al. (1998) show that in their model, the indicators, on average, send the first signal between one year and one-and-a-half years prior to the outbreak of a crisis. However, the time horizon has been proved not to be decisive for the performance of an indicator (see Berg and Pattillo, 1999).

So far, research on early warning models has shown that these models are subject to important limitations. One of the most important limitations is outlined by Berg and Pattillo. (1999, p. 109), who argue that because the number of crises in the historical data is relatively small, searches through the large number of early warning indicators may yield spurious success in explaining crises. Thus, it is not surprising that there is no "one-size-fits-all" list of early warning indicators (Claessens, 2010). Furthermore, there are a number of issues, including political and institutional ones, that may be relevant for a particular country and that are not reflected in the model.[3] Other limitations of early warning tools are problems associated with the assessment of the predictions of such tools. Prudent policymakers might act upon early warning signals and hence prevent the economy from slipping into a crisis. Since crises cannot be correctly predicted and avoided at the same time, this implies that early warning systems cannot work properly by definition (Berg and Pattillo, 1999, Bussière, 2013b). The same applies in a reverse scenario: If early warning assessments are made public and market participants act upon signals issued, the warning might become a "self-fulfilling prophecy" (Bussière, 2013b; Kaminsky et al., 1998). Finally, countries may be highly vulnerable for a longer period without experiencing a crisis, since it usually takes some time for vulnerabilities to become unsustainable. Instead, as Chamon and Crowe (2013) argue, it is far more promising to use these early warning models to identify vulnerabilities rather than the timing of a crisis. Against this background, it becomes clear from the literature that early warning tools must be complemented by a policy-oriented analysis and in-depth country surveillance (see Edison, 2003; Brüggemann, 2002).

2 Methodology

Our definition of a crisis period follows the classification of Laeven and Valencia (2008, 2012), who distinguish between currency crises, sovereign debt crises and banking crises. For currency crises, they follow the definition put forward in Frankel and Rose (1996). Accordingly, a currency crisis is deemed to have occurred if the nominal year-on-year depreciation of a currency vis-à-vis the U.S. dollar reaches at least 30% and if the increase in the rate of depreciation compared to the year before is at least 10%. Episodes of sovereign debt default and restructuring are defined by qualitative and quantitative information provided by IMF staff, the World Bank and other sources (see Laeven and Valencia, 2008, for a detailed description). In the model, only systemic banking crises are considered;

[3] *See Kaminsky et al. (1998) for possible indicators that account for political and institutional aspects.*

banking crises qualify as systemic banking crises only under the following conditions: significant signs of financial distress in the banking system, and at least three significant banking policy intervention measures, such as extensive liquidity support, bank nationalizations, issued guarantees, asset purchases, deposit freezes and forced bank holidays.

Following Chamon and Crowe (2013), we calculate a threshold by minimizing the sum of the percentage of crises missed and the percentage of false alarms. Depending on the indicator under scrutiny, values that exceed or go below a threshold indicate a vulnerability of the examined country to an unexpected negative shock.

We denote potential early warning indicators by $X_{i,t}$, with t denoting annual data spanning the period from 1995 to 2012, and i denoting the country in question. These variables are related to a binary crisis indicator, $y_{i,t}$, for which we draw on the classification proposed by Laeven and Valencia (2012), who date currency crises, sovereign debt crises and banking crises. Although leading indicators might depend on the specific type of crisis, we opt for pooling the information on the crisis subcategories for reasons of data availability. That is, $y_{i,t}=1$ if any of the above-mentioned types of crisis occurred in country i in period t. Similar to Chamon and Crowe (2013), we choose one year as the forecast horizon and relate macroeconomic and financial market conditions $X_{i,t-1}$ to crises occurring in period $y_{i,t}$. Since we are interested in the predictive power of the independent variables and not the behavior they show during a crisis, we drop observations for crisis years when the year before has already been marked as a crisis year. Finally, we exclude observations for the year that follows a crisis, since we do not expect variables to show noncrisis (i.e. normal) behavior during periods of recovery (Chamon and Crowe, 2013).

To calculate the thresholds, we have divided the sample for each of the potential indicators into a crisis and a noncrisis subsample. The information these subsamples contain for a specific vulnerability indicator can be summarized as follows:

Based on the sample classification in table 1, a strong indicator will minimize the sum of the share of crises missed (C/(A+C), type I error) and the share of false alarms (B/(B+D), type II error). More specifically, the threshold value δ for each indicator variable k is chosen according to the following objective function:

$$\min_{\delta}\left(\theta\frac{\mathrm{C}(\delta)}{\mathrm{A}(\delta)+\mathrm{C}(\delta)}+(1-\theta)\frac{\mathrm{B}(\delta)}{\mathrm{B}(\delta)+\mathrm{D}(\delta)}\right) \quad (1)$$

By minimizing (1) we assume a particular loss function for the policymaker that trades off type I versus type II errors by selecting θ. Since crises are rare (i.e., A+C is typically much smaller than B+D), and fixing $\theta=½$ minimization of (1) implies that for selecting a threshold, missing a crisis event becomes much more costly than issuing a false alarm (Chamon and Crowe, 2013). Note that while varying θ for each indicator would increase the overall flexibility of the signaling approach, resulting indicators might be severely prone to the risk of overfitting. More general loss functions are discussed in detail in

Table 1

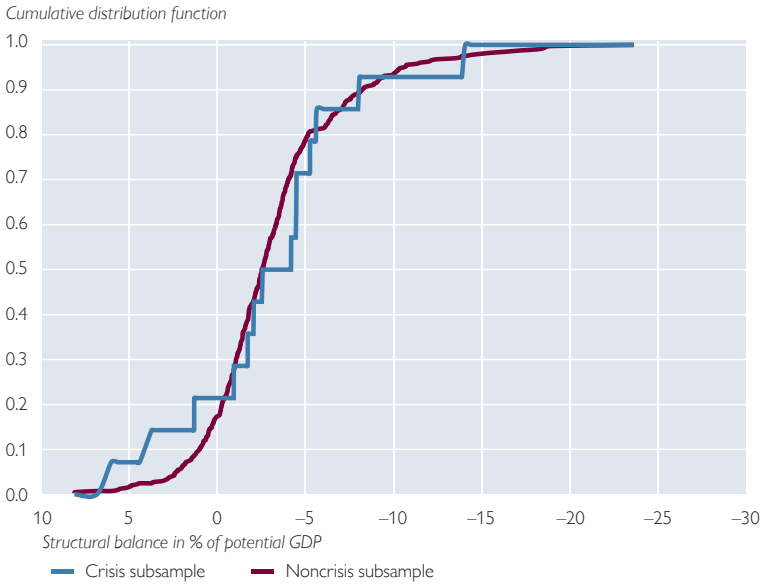
Sample Classification

	Crisis	Noncrisis
Signal issued	A	B
No signal issued	C	D
Number of crises	A + C	–
Number of noncrises	–	B + D

Source: Authors' classification.

Chart 1

Cumulative Distribution Function for "Structural Balance" Indicator



Source: Authors' calculations.

Elliott and Lieli (2013) and Csortos and Szalai (2014).[4]

In line with Chamon and Crowe (2013), we proceed by calculating common thresholds for all countries, thus deviating from the original signaling approach put forward in Kaminsky et al. (1998). Country-specific thresholds might potentially better cover countries with weak macrofundamentals that have never experienced a crisis event. The "resilience" of these countries, however, might be attributed to extraordinarily strong performance in other indicators. While the information about how different risks offset each other in an economy is lost with country-specific thresholds, for common thresholds to work, it is essential to have a broad portfolio of vulnerability indicators.

The threshold approach can be graphically illustrated by examining the cumulative distribution functions (CDFs) of the crisis and noncrisis subsamples. Chart 1 provides the respective cumulative distributions of crisis and noncrisis events for the indicator "structural balance."

Note that data points lying further to the right on the x-axis indicate a deterioration of the indicator, i.e. a higher risk of crisis exposure. Minimizing the sum of the shares of missed crises and false alarms in the illustration above would result in a threshold of –4% for the structural balance. As a consequence, for countries that feature a structural balance of –4% or an even larger deficit, the indicator would issue a warning signal. After having selected a threshold for each indicator in our dataset according to the method described above, we calculate a goodness-of-fit measure as follows:

$$\left(g = \frac{1}{2} * \frac{B + C}{A + B + C + D} \; ; g \in [0,1] \right) \tag{2}$$

The goodness-of-fit measure enables us to evaluate the quality of an indicator compared to other indicators.

The approach described above has several advantages: First, if data points are missing, the observations do not drop out completely, which would be the case when applying a probit or logit regression model. Our dataset includes 93 emerging economies observed over a period of 17 years; thus, many observations would have

[4] *See Jorda and Taylor (2011) for loss-function free approaches for early warning assessments. A receiver operating characteristic (ROC) curve is constructed for each indicator evaluating the performance of the indicator for all possible threshold values as opposed to picking a single threshold. Indicators are then chosen that maximize the area under the curve.*

to be dropped. Second, probit or logit regressions calculate the marginal effect of each of the independent variables on the probability of a crisis, holding all other variables equal. However, this ceteris paribus assumption is not suitable for precrisis periods, as especially the interactions between variables might determine a country's vulnerability to external shocks.

Additionally, we employ a number of independent variables that are closely related and thus might drop out of a regression because of multicollinearity. However, these variables might also drop out when using binary classification trees in case they are slightly outperformed by another variable, thus making the selection of relevant crisis indicators in the early warning system very sensitive to slight changes in the country sample or time period.

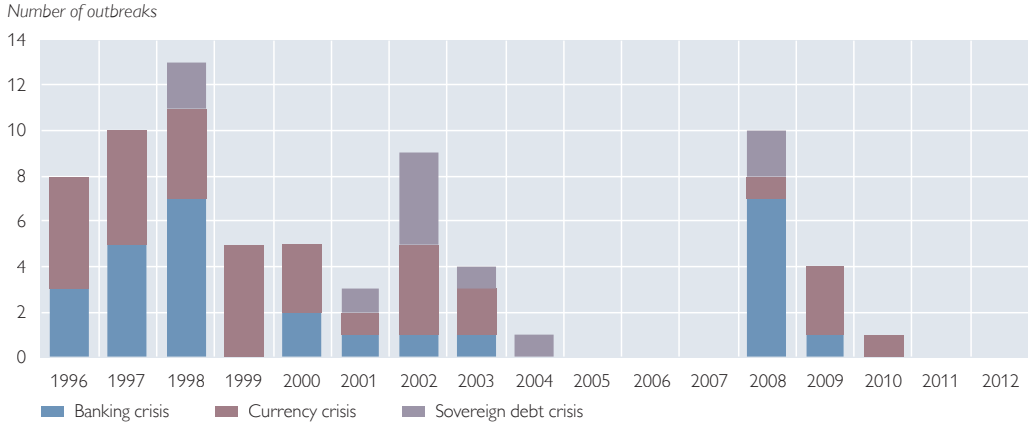
Finally, assessing the forecast performance of early warning systems is cumbersome and might depend crucially on the periods and countries under study. While Edison (2003) and Berg et al. (2005) find that the signaling approach delivers a superior and robust forecasting performance, the results provided in Manasse and Roubini (2009) are less spectacular. Recently, Comelli (2013) has found that parametric models can outperform the signaling approach on an out-of-sample basis.

3 Data

Originally, we collected data on 128 countries over the period from 1995 to 2012. While this leaves us with an extensive coverage of emerging markets, the country composition is largely tilted toward African countries. This bias might have been problematic for the purpose of this study, i.e. the assessment of vulnerabilities for countries in the CESEE region. Consequently, we decided to reduce the number of countries to limit cross-country heterogeneity of the sample. For this purpose, we collected data on GDP per capita at constant (2005) U.S. dollar prices and dropped countries belonging to the lower quartile of the distribution. This leaves us with a broadly balanced set of emerging markets comprising 25 Latin American and Caribbean countries, 31 Middle Eastern and African countries, 14 Asian and Pacific economies and 23 CESEE countries.

Chart 2

Crisis Outbreaks between 1996 and 2012



Source: Authors' calculations based on the database of Laeven and Valencia, which is fully described in Laeven and Valencia (2012).

Out of 1,581 observations in our sample, 60 are marked as crisis events (3.8%). These events often share characteristics that are common to various types of crises. However, since we drop observations belonging to the immediate post-crisis period, the number of "twin" or "triplet" crises is rather small. More specifically, we have only five observations for currency crises that occurred simultaneously with sovereign debt crises, as well as five observations for currency crises coupled with banking crises. For concurrent sovereign debt and banking crises, the number of observations is four. We also count four observations of triple crises. Because there are so few twin and triplet crisis episodes, we do not give them special treatment in our procedure. Chart 2 shows the number of outbreaks of the various types of crises in our country sample between 1996 and 2012, indicating that crisis outbreaks occur in waves.

4 Building a Composite Vulnerability Indicator

The literature review has shown that an effective warning system should consider a broad variety of indicators (Kaminsky et al., 1998). Below, we consider 48 potential early warning indicators. More specifically, we have collected 9 indicators related to the banking sector, 18 indicating vulnerabilities on the external side of the economy, and 21 indicators pertinent to the macroeconomic and fiscal situation. Table A2 in the annex provides the full set of indicators with detailed descriptions. The number of crises contained in each indicator dataset ranges from 13 (three-year average of net portfolio inflows) to 66 (basic balance). On average, each indicator dataset consists of 44 crisis periods and 1,200 noncrisis observations.

Before we aggregated the single indicators into one composite vulnerability indicator, we narrowed the set of 48 potential indicators based on three considerations: First, we selected the indicators that correctly flag crisis incidents in more than 40% of cases.[5] Second, we ranked the variables according to their goodness-of-fit quality, and third, we aimed to produce a broad set that includes at least three indicators from each category. This leaves us with the following 18 indicators.

Banking/financial sector

- *Lending rate*[6]*:* The lending rate is the rate at which banks usually meet the short- and medium-term financing needs of the private sector. The terms and conditions attached to these rates differ from country to country, limiting their comparability. Large values might indicate disruptions in the banking sector and/or a high risk perception and thus resemble financial system fragility.
- *Interaction of domestic credit growth (three-year average) and credit in % of GDP:* Various empirical studies point out the link between (excessive) credit growth and the incidence of financial crises (see e.g. Jordà et al., 2011, and Feldkircher, 2014, on the recent global financial crisis). Since the rate of credit growth might depend on the level of financial deepening (Arpa et al., 2005, Herwartz and Walle, 2014), we multiply the three-year average of domestic credit growth by the level of credit to GDP. This variable identifies highly leveraged economies with strong lending growth as vulnerable.

[5] *Note that as pointed out earlier, we had to trade off identifying crises and issuing false alarms when selecting indicators.*

[6] *In a robustness exercise CPI-deflated lending rates performed slightly worse in terms of goodness-of-fit than the nominal rates.*

- *Capital-to-assets ratio (CAR):* This ratio represents bank capital and reserves to total assets. Low CAR levels might imply insufficient buffers of the financial system to withstand unexpected shocks and are thus flagged as a source of vulnerability for the country under scrutiny.

External sector

- *Current account balance in % of GDP (three-year moving average):* Historical evidence suggests that economies with persistent and pronounced current account deficits are prone to risks of sudden capital stops or currency crises. The empirical evidence is rather mixed, however (see findings provided in Kaminsky et al., 1998, on the one hand, and Frankel and Saravelos, 2012, on the other hand). Nevertheless, we include the current account as an indicator of vulnerability because it features prominently in other international early warning exercises like the Macroeconomic Imbalance Procedure (MIP) of the European Commission.[7]
- *Basic balance:* This refers to the part of the current account (deficit) that is not financed by net FDI inflows but by other sources considered more volatile than FDI. As above, larger deficits are likely to reflect greater vulnerability to external events.
- *Short-term external debt in % of external debt:* This variable is an estimate for the short-run external refinancing needs of the economy. Countries with a large share of short-term external debt in total external debt are regarded as more vulnerable, since they depend more strongly on current global refinancing conditions.
- *Total external debt service in % of exports:* This corresponds to the sum of principal repayments and interest on long-term external debt, interest paid on short-term debt, and repayments to the IMF. The indicator is measured as a share of exports, which reflects the economy's ability to obtain foreign exchange to service its external debt obligations. Economies that exhibit an elevated ratio of external debt service to exports are assumed to be more vulnerable to the occurrence of external shocks.
- *External debt in % of exports:* As a third measure of external debt sustainability, we calculate total external debt as a share of exports. Economies with a high ratio are expected to be less resilient to crises events.[8]
- *Annual change in export volumes:* Export growth features prominently among leading indicators (Eichengreen et al., 1995, Kaminsky and Reinhart, 1999). Economies with stagnating exports are more vulnerable to crisis events.
- *Exchange rate misalignments:* We use two factors to capture exchange rate misalignments as several empirical studies reveal the importance of exchange rate overvaluation as a leading indicator for (currency) crises (see e.g. Bussière, 2013a; Kaminsky et al., 1998; Frankel and Saravelos, 2012).

[7] *On top of the limited evidence in the literature, cross-country comparability of current account deficits might be limited for countries for which EU transfers are sizeable since the latter may be booked on either the current or the capital account depending on the type of transfer.*

[8] *Note that we follow the literature in employing the selected external debt indicators. In particular in countries that host special purpose entities and/or multinational holding companies, such as Hungary, external debt figures might be biased upward since these companies lead to an expansion of both external assets and liabilities.*

  - The first factor is the *annual growth of the real effective exchange rate* (maximum annual change of three-quarter moving average). A positive change in the exchange rate is associated with a real appreciation. Pronounced growth of the real effective exchange rate might trigger pressures on the currency and hence might make a subsequent depreciation more likely.
  - The second indicator to capture misalignments in the exchange rate is the *exchange market pressure* (EMP) index, which is defined as:

$$EMP_t = \left(\frac{e_t - e_{t-1}}{e_{t-1}} - \frac{ir_t - ir_{t-1}}{ir_{t-1}} \right),$$

    with e_t denoting the monthly nominal exchange rate per 1 U.S. dollar and ir_t international reserves (minus gold) in U.S. dollar at time t (Aizenman and Pasricha, 2012). An increase in the EMP index reflects depreciation pressure on the currency under consideration. We aggregate data on the monthly EMP index by selecting the maximum value per year (i.e., the value for the month in which the strongest pressure on the currency was observed).[9]
- *Total reserves in months of imports:* The empirical literature frequently flags the level of international reserves as an important buffer to adverse external events (e.g. Frankel and Saravelos, 2012). We expect countries with a low level of reserves to be more vulnerable, as they have less room for maneuver in case a crisis hits.

Macroeconomic and fiscal risks

- *Risk premium on lending:* This corresponds to the interest rate banks charge on loans to private sector customers minus the "risk free" Treasury bill interest rate at which short-term government securities are issued or traded in the market. A large and positive risk premium indicates potential financing problems of the private sector.
- *Multiplication of gross debt (in % of GDP) by fiscal balance:* This should indicate fiscal vulnerability for countries that simultaneously have a fiscal deficit and a high debt burden.
- *Three-year average of year-on-year CPI inflation:* Periods of high inflation are often associated with economic booms that induce economic crises (Babecký et al., 2013). We thus calculate a three-year average of year-on-year CPI inflation and expect countries with high inflation rates to be more prone to crises.
- *Money growth:* This refers to the average annual growth rate in money and quasi-money.[10] Considerable growth in money might indicate overheating tendencies of the economy and is hence flagged as a potential vulnerability.
- *Deviation from real GDP trend growth:* We compute the deviation from a three-year average and calculate both a negative and a positive threshold in the empirical exercise. The positive threshold should reflect tendencies of overheating while

[9] *Both exchange rate misalignment indicators have been alternatively calculated by taking the mean instead of the maximum over the respective periods stated in the definition above. The results do not change qualitatively, while the fit tends to deteriorate.*

[10] *In a robustness exercise we also examined real money growth as a potential vulnerability indicator. The results, however, where slightly worse compared to money growth in nominal terms.*

the threshold attributed to the negative deviation from trend growth might pick up first signs of a recession that can manifest itself into an economic crisis.

- *Structural balance in % of potential GDP:* The structural budget balance refers to the general government balance cyclically adjusted for nonstructural elements of the economic cycle. It is expected to indicate a worsening in debt sustainability independently of cyclical factors. Consequently, larger deficits are expected to point to an increased fiscal vulnerability of the underlying country.

Since we are ultimately interested in assessing vulnerabilities for the CESEE region, it is essential that data coverage of the selected indicators is sufficiently large for these particular countries. Table A.1 in the annex details the data availability for each of the 18 indicators per country as well as the crisis events as defined by Laeven and Valencia (2012). The table shows that only Bosnia and Herzegovina, Estonia and Poland did not witness a crisis event during the period under study. By contrast, three crises were recorded in Belarus, Turkey and Ukraine. With respect to the indicators, total reserves in months of imports are only available from 2005 onward. While data coverage is thus smaller compared to the remaining indicators, the threshold itself was evaluated based on more than 600 observations.

We proceed with aggregating these 18 indicators into a *composite leading indicator.*[11] The single indicators are assigned weights that resemble their goodness-of-fit properties and are then pooled in each of the three crisis categories. Finally, the composite indicator is put together in three different ways: First, we assign to each category the same weight of one-third. Second, we attach a higher weight to the external category (two-thirds external, one-sixth macro, one-sixth banking), since crises related to emerging markets are often associated with the external side of the economy. Last, we downweight the banking category (two-fifths external, two-fifths macro, one-fifth banking), since data on this subgroup is less available than for the other subgroups.

For each of the composite vulnerability variants we evaluate its associated in-sample performance using the same method as in section 2. That is, we calculate the respective shares of correctly issued alarms, false alarms, crises missed and correctly not-issued warnings. While the composite indicators lie in the range of 0 to 1 and hence allow for a continuous assessment of vulnerability, for the purpose of a performance evaluation we have to decide on an overall threshold value which is indicative of a crisis event. Again, we define the threshold value in an empirical fashion evaluating the 0 to 1 grid of potential threshold values and picking

Table 2

In-Sample Evaluation of the Composite Vulnerability Indicator

	Crisis	Noncrisis
	%	
Uniform weighting		
Signal issued	72.83	30.63
No signal issued	27.16	69.37
More weight to external risk subcategory		
Signal issued	77.78	33.27
No signal issued	22.22	66.73
Less weight to banking subcategory		
Signal issued	70.37	32.33
No signal issued	29.63	67.67

Source: Authors' calculations.

Note: The table shows the share of crisis/noncrisis events for which a signal was issued/no signal was issued.

[11] *See the recent contribution by Csortos and Szalai (2014) for an approach that advocates Boolean combination of the single indicators rather than constructing a composite indicator.*

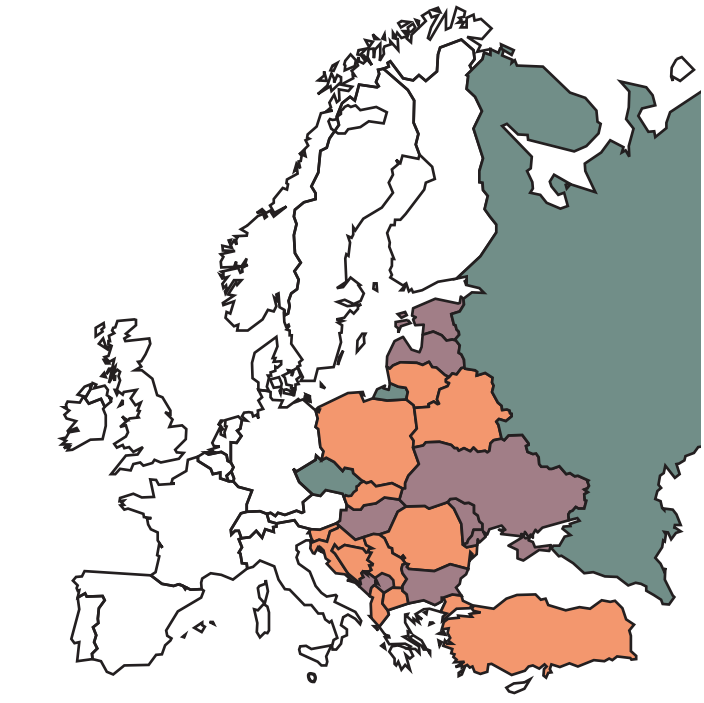
the threshold that yields both the largest share of correctly identified crises and correctly not-issued warnings.

For all three variants of overall vulnerability, this exercise yields a threshold of 0.4. Consequently, a country with an overall vulnerability of 0.45 is rather likely to experience a crisis episode in one year's time. The results for the three composite indicator variants based on this threshold are summarized in table 2.

Table 2 indicates only small performance differences across the different weighting schemes. The composite indicator that is based on a uniform weighting identifies roughly 73% of all crises correctly. In almost 70% of noncrisis periods, the indicator did correctly not issue a warning signal. The composite indicator attaching more weight to the external risk subcategory shows a slightly better in-sample performance in correctly identifying crisis periods, while it produces slightly more false alarms (some 33% compared to 31%). The weighting scheme putting less emphasis on the banking category produces very similar results. For the sake of simplicity we stick with the uniform composite indicator, for which we discuss the respective country results in the next section.

Chart 3

Vulnerability Indicators for CESEE in 2007



Source: Authors' calculations.

5 Discussion of Results

To get another impression of the quality of the composite indicator besides the in-sample evaluation above, we take a look at how the indicator would have performed in the past. Thus, we compute the results for 2007, i.e. one year prior to the outbreak of the global financial crisis. We divide the countries into three groups, depending on the outcome of the composite indicator. Countries with composite indicator values below 0.2 are categorized as exhibiting low vulnerabilities, countries with values between 0.2 and 0.4 as moderate, and finally countries where the composite indicator takes on a value of more than 0.4 are considered critical. The outcome is shown in chart 3.

The picture flags strong vulnerabilities for most of the countries under consideration. In particular, we find substantial vulnerabilities for Estonia, Latvia, Ukraine, Moldova, Hungary and Bulgaria.[12]

And indeed, we see that in 2008 three countries under consideration did

[12] *For Kosovo and Montenegro there are only a few indicators available for 2007; although the two countries appear to have been vulnerable in 2007, we therefore do not discuss the outcome of the composite indicator for 2007.*

actually experience a crisis according to the definition put forward in Laeven and Valencia (2008, 2012), namely Hungary, Latvia and Ukraine. Turning to these countries, we take a brief look at what vulnerabilities our indicators flagged.

In *Hungary,* vulnerabilities were mainly related to very high current account and fiscal deficits as well as public debt levels. What our indicators do not capture is the increasing vulnerability of the financial sector at that time, also related to a high share of (mostly unhedged) foreign currency-denominated loans coupled with an insufficient deposit base.[13]

In 2008, *Latvia* was hit by the most pronounced boom-bust cycle in CESEE. Latvia had accumulated substantial imbalances already long before the crisis. Two-digit growth rates, large capital inflows from Nordic banks, rapid credit expansion and a bubble in real estate prices hit the country massively once the crisis started to unfold. Real GDP growth fell from 10% in 2007 to –3.3% in 2008 (and even –17.7% in 2009) (see also Bakker and Klingen, 2012).

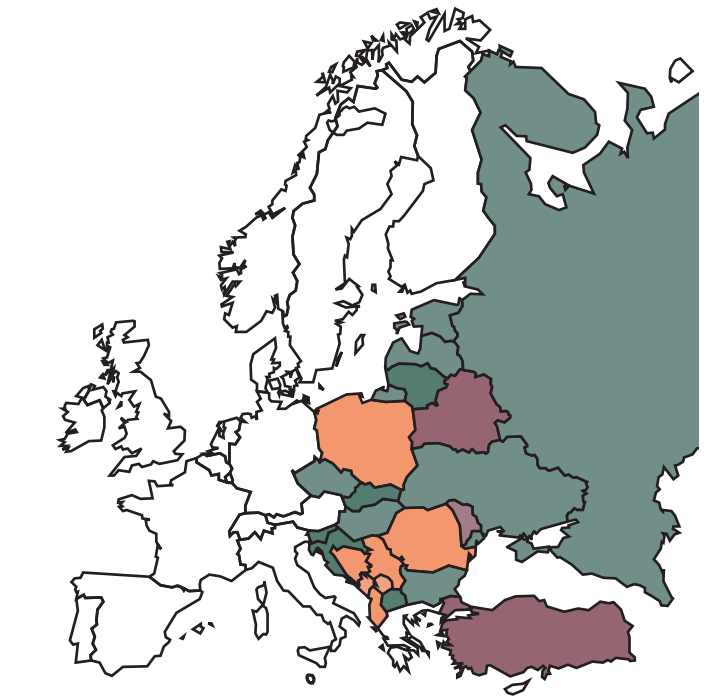
Ukraine has been the only country in CESEE that has proven nearly equally vulnerable to adverse developments stemming either from the European Union or from Russia (see EBRD, 2012). Thus, it comes as no surprise that the country slipped into a deep recession in 2009, when sluggish demand, compounded by the reversal of capital flows from the EU and Russia (followed by a strong depreciation of the exchange rate) and cuts in energy subsidies from Russia, caused fiscal deficits and public debt to increase sharply.

Although Bulgaria, Estonia and Moldova did not experience a crisis in 2008 as defined by Laeven and Valencia (2008, 2012), the three countries subsequently experienced recessions with strong GDP contractions, especially in the year 2009. By contrast, among those CESEE countries that showed the lowest vulnerabilities in 2007 were notably the Czech Republic and Russia. However, Russia experienced a recession in 2009, but mainly because of a steep fall in oil prices in 2008, a factor which is not included in our composite indicator. All in all, the composite indicator we developed would have done well predicting crises in 2007.

Based on the vulnerability indicator for 2012, three countries with worrisome vulnerabilities could be identified (see chart 4).

Chart 4

Vulnerability Indicators for CESEE in 2012



Source: Authors' calculations.

[13] *Unfortunately, the degree of dollarization (or euroization) could not be tested as a vulnerability indicator due to low data availability for the countries under consideration.*

The highest critical value is exhibited by *Belarus,* which experienced a crisis in early 2009. In the wake of that crisis, the Belarusian economy has not yet overcome existing deficiencies in a sustainable manner. Thus, for 2012[14] our composite indicator shows a high vulnerability level for Belarus, in particular due to some serious impairment of the current account balance and total reserves in months of imports. In addition, although Belarus' banking sector is sufficiently capitalized with a capital-to-assets ratio of 15.1, this is partly because the government employs substantial parafiscal measures (2% to 4% of GDP per year) to support the capitalization of banks. We consider this a signal of serious fragilities in the Belarusian banking sector. Furthermore, the country retains many elements of central planning, so state involvement in the economy is substantial. According to our composite indicator, Belarus is therefore very vulnerable to a crisis. However, the Belarusian economy and its foreign exchange reserves have received a boost from Russian loans. Thus, if Russia continues its financial support, the Belarusian economy might have enough of a cushion to deflect a severe crisis.

As chart 4 shows, another country with serious vulnerabilities in 2012 appears to be *Turkey*. Price pressure remains strong and consumer price inflation is well above the central bank's inflation target of 5%. Turkey has recorded large current account deficits financed mainly by portfolio and other investment inflows. On the back of soaring manufacturing unit labor costs, the real exchange rate of the Turkish lira appreciated substantially vis-à-vis the euro until the first half of 2013. Unit labor costs were fueled by strong wage increases granted to partially offset pronounced inflation, whereas productivity stagnated. Given the tapering of the U.S. Fed's quantitative easing program, the fragile financing structure of the Turkish current account exposes the economy to the risk of sudden capital outflows. A very strong expansion of credit to companies and (only in local currency) to households outpaced substantial deposit growth and increased the deposit funding shortfall substantially on the back of a large rise in net foreign liabilities.

Finally, our vulnerability indicators point to a severe vulnerability of *Moldova* for 2012, especially in the external and in the real sector. Moldova exhibits a very high current account deficit (7% of GDP in 2012), which is financed by short-term external debt, putting the country in a fragile external position. Additionally, the economy experienced strong money growth and thus an acceleration of price dynamics, accompanied by a recession in 2012.

For the remainder of the countries under consideration, the composite indicator does not suggest major vulnerabilities in 2012.[15] This outcome is not surprising, since many CESEE economies are still feeling the aftermath of the global financial crisis and are in the process of removing the legacies of unsustainable developments in the boom years.

[14] *Only very few data for 2013 have become available for the countries covered in this study.*

[15] *In chart 4, Ukraine has not been designated as vulnerable based on 2012 data as it exhibited only minor vulnerabilities in the external sector and none in the real and banking sectors. Only at the beginning of 2013, and triggered by political circumstances, did the depreciation of the hryvnia and the decline of official reserves start. The authors want to emphasize that the present early warning system is not aimed at political crises.*

6 Conclusions

Based on the idea that certain indicators alter their behavior in the run-up to a crisis, we developed an early warning system using a threshold approach. To evaluate the vulnerability of the CESEE region, we employed a global sample of 93 emerging economies over 17 years. We looked at three types of crises, namely currency crises, sovereign debt crises and banking crises, and tested the usefulness of 48 potential warning indicators. Out of these, 18 indicators proved to be valuable in building a composite indicator that evaluates a country's vulnerability in the external sector, the macroeconomic and fiscal positions, and the banking sector. Overall, we found that in 2012 only three countries in CESEE appear to be particularly vulnerable: Belarus, Turkey and Moldova. In an in-sample test we found that, out of 81 crisis periods, our composite indicator identifies about 73% correctly. In almost 70% out of 1,593 noncrisis periods, the indicator correctly did not issue a warning signal. This result indicates that our approach will be useful for monitoring economic developments in CESEE in the future.

However, the approach also has certain drawbacks. First of all, we are not able to incorporate structural indicators, such as indices that measure corruption or the quality of institutions, although they do in fact play a large role in the economic development of emerging economies. The reason is that structural indicators do not tend to alter their behavior much in the run-up to a crisis and therefore do not have good crisis prediction qualities. Another issue is that an early warning system built on economic indicators cannot predict political crises. Thus, it is very important to monitor the political and social developments in the respective countries as an additional input to the assessment of crisis vulnerability. Last but not least, we rely on annual data in our sample and have not examined the usefulness of high frequency indicators. A promising avenue for future research would be to develop an extended model that features vulnerability indicators with observations of higher frequency. Moreover, a more detailed assessment of how early each of the proposed indicators issues a warning might yield further important insights.

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Annex

Table A1

Data Availability for the Individual CESEE Countries and Indicators

	Crisis	Lending rate	Interaction of domestic credit growth and credit in % of GDP	Capital-to-assets ratio	Current account balance in % of GDP	Basic balance	Short-term external debt in % of external debt	Total debt service in % of exports	External debt in % of exports	Annual change in export volumes
	Years	*% (data availability)*								
Albania	1997	88.89	88.89	50	100	100	100	100	100	88.89
Belarus	1995, 1999, 2009	100	88.89	61.11	100	100	100	100	100	100
Bosnia and Herzegovina		77.78	72.22	66.67	83.33	83.33	77.78	77.78	77.78	77.78
Bulgaria	1996	100	100	72.22	100	100	100	100	100	100
Croatia	1998	100	94.44	72.22	100	100	0	0	0	100
Czech Republic	1996	100	94.44	72.22	100	100	0	0	0	94.44
Estonia		100	100	72.22	100	100	0	0	0	100
Hungary	2008	100	100	61.11	100	100	100	44.44	44.44	100
Latvia	1995, 2008	100	94.44	72.22	100	100	0	0	0	100
Lithuania	1995	88.89	94.44	72.22	100	100	0	0	0	0
Moldova	1999, 2002	94.44	100	72.22	100	100	100	100	100	100
Poland		66.67	100	72.22	100	100	0	0	0	94.44
Romania	1996	0	0	0	100	0	0	0	0	100
Russia	1998, 2008	100	94.44	72.22	100	100	0	0	0	100
Serbia	2000	88.89	72.22	55.56	72.22	72.22	100	33.33	33.33	72.22
Slovakia	1998	77.78	72.22	72.22	100	94.44	0	0	0	100
Slovenia	2008	83.33	100	61.11	100	100	0	0	0	100
Turkey	1996, 2000, 2001	0	100	72.22	100	100	100	100	100	100
Ukraine	1998, 2008, 2009	100	100	72.22	100	100	100	100	100	100

Source: Authors' calculations.

Note: The table provides the percentage of available data for the period from 1995 to 2012 per CESEE country and indicator. Total reserves in months of imports available from 2005 onward only.

Table A1 continued

Data Availability for the Individual CESEE Countries and Indicators

	Change in the real effective exchange rate	Exchange market pressure	Total reserves in months of imports	Risk premium on lending	Gross debt x fiscal balance	CPI inflation	Money growth	Deviation from real GDP trend growth	Structural balance in % of potential GDP
	% (data availability)								
Albania	0	100	44.44	88.89	88.89	94.44	100	100	0
Belarus	0	100	44.44	0	50	88.89	100	100	0
Bosnia and Herzegovina	0	83.33	44.44	0	0	94.44	83.33	72.22	72.22
Bulgaria	100	100	44.44	94.44	61.11	94.44	100	100	72.22
Croatia	100	100	44.44	0	61.11	94.44	100	100	61.11
Czech Republic	100	100	44.44	100	100	94.44	100	88.89	100
Estonia	100	100	44.44	0	55.56	94.44	88.89	100	0
Hungary	100	100	44.44	100	88.89	94.44	100	100	44.44
Latvia	100	100	44.44	100	55.56	94.44	100	100	33.33
Lithuania	100	100	44.44	88.89	72.22	16.67	100	88.89	72.22
Moldova	100	100	44.44	94.44	0	94.44	100	100	0
Poland	100	100	44.44	66.67	100	94.44	100	100	72.22
Romania	100	100	0	0	50	88.89	0	100	50
Russia	100	100	44.44	38.89	77.78	94.44	100	100	83.33
Serbia	0	0	33.33	55.56	0	94.44	83.33	72.22	27.78
Slovakia	100	100	44.44	0	88.89	94.44	77.78	100	88.89
Slovenia	100	100	44.44	61.11	100	94.44	0	100	94.44
Turkey	100	100	44.44	0	50	100	100	100	61.11
Ukraine	100	100	44.44	0	88.89	94.44	100	100	55.56

Source: Authors' calculations.

Note: The table provides the percentage of available data for the period from 1995 to 2012 per CESEE country and indicator. Total reserves in months of imports available from 2005 onward only.

Table A2

Description of Indicators

No.	Category	Indicator	Description	Source	Number of observations	Number of crises	Goodness of fit (g)	Crises missed: C/(A+C)	Noncrises misclassified: B/(B+D)
1	Banking	Three-year average credit growth x domestic credit provided by the banking sector in % of GDP	Multiplication of three-year average credit growth by domestic credit provided by the banking sector in % of GDP.	Authors' calculations	1,454	52	0.64	0.48	0.23
2	Banking	Domestic credit growth, three-year average	Three-year average of year-on-year domestic credit growth. Domestic credit refers to the sum of net claims on the central government and claims on other sectors of the domestic economy.	WDI	1,504	52	0.66	0.29	0.39
3	Banking	Change in domestic credit over three years	Change in domestic credit over three years. Domestic credit refers to the sum of net claims on the central government and claims on other sectors of the domestic economy.	WDI	1,494	53	0.66	0.30	0.37
4	Banking	Domestic credit provided by the banking sector in % of GDP	Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is calculated on a net basis.	WDI	1,532	58	0.56	0.14	0.74
5	Banking	Lending rate	Bank rate at which the short- and medium-term financing needs of the private sector are usually met.	WDI	1,366	51	0.65	0.41	0.30
6	Banking	Capital-to-assets ratio in %	Ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions and valuation adjustments. Total assets include all nonfinancial and financial assets.	WDI	678	15	0.41	0.47	0.71
7	Banking	Interest rate spread	Interest rate banks charge on loans to private sector customers minus the interest rate paid by commercial or similar banks for demand, time or savings deposits.	WDI	1,341	51	0.57	0.67	0.20
8	Banking	NPLs in % of total loans	Value of nonperforming loans (gross value of the loan as recorded on the balance sheet) divided by the total value of the loan portfolio.	WDI	693	18	0.44	0.89	0.23
9	Banking	Domestic credit to private sector in % of GDP	Domestic credit to the private sector refers to financial resources provided to the private sector, e.g. through loans, purchases of nonequity securities, trade credits and other accounts receivable, that establish a claim for repayment.	WDI	1,531	57	0.51	0.77	0.21
10	External/ BoP	Total reserves in months of imports	Holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities.	WDI	605	14	0.68	0.50	0.14
11	External/ BoP	Total reserves in % of external debt	International reserves to total external debt stocks.	WDI	1,304	52	0.64	0.19	0.54
12	External/ BoP	Short term external debt in % of external debt	Short-term external debt is defined as debt that has an original maturity of one year or less, both public and private nonguaranteed.	WDI	1,312	52	0.62	0.46	0.29

Source: Authors' calculations, BIS, IFS, IMF (World Economic Outlook), UNSTAT, World Bank (World Development Indicators).

Table A2 continued

Description of Indicators

No.	Category	Indicator	Description	Source	Number of observations	Number of crises	Goodness of fit (g)	Crises missed: C/(A+C)	Noncrises misclassified: B/(B+D)
13	External/ BoP	Exchange market pressure (EMP)	Defined as the difference between the change in the nominal exchange rate (expressed as local currency vis-à-vis the U.S. dollar) and the change in international reserves. Calculations of the EMP are based on monthly data, which have been aggregated to yearly figures by choosing the maximum EMP for each year. See Aizenman and Pasricha (2012), Klaassen and Jager (2011) for a discussion on the definition of the EMP and Feldkircher et al. (2014) on macroeconomic determinants that drive the EMP in crisis times.	IFS data, authors' calculations	1,372	56	0.62	0.52	0.24
14	External/ BoP	Maximum of three-quarter moving average of year-on-year change in real effective exchange rate	The BIS calculates effective exchange rate (EER) indices for a total of 58 economies (including individual euro area countries and, separately, the euro area as an entity). Nominal EERs are calculated as geometric weighted averages of bilateral exchange rates. Real EERs are the same weighted averages of bilateral exchange rates adjusted for relative consumer prices. The weighting pattern is time-varying, and the most recent weights are based on trade in 2005–07. The EER indices are available as monthly averages.	BIS, IFS	557	30	0.60	0.30	0.70
15	External/ BoP	Real effective exchange rate (2005=100)	Nominal effective exchange rate divided by a price deflator or index of costs.	WDI	752	36	0.60	0.47	0.32
16	External/ BoP	Current account balance in % of GDP	The current account balance is the sum of net exports of goods and services, net primary income and net secondary income.	WDI	1,304	52	0.58	0.28	0.57
17	External/ BoP	Annual change in export volumes	Annual change in export of goods volumes.	WEO	1,042	36	0.57	0.45	0.42
18	External/ BoP	External debt in % of exports	Total external debt stocks to exports of goods, services and income.	WDI	1,221	49	0.57	0.57	0.28
19	External/ BoP	Total debt service in % of exports	Sum of principal repayments and interest actually paid in currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the IMF in % of exports of goods, services and income.	WDI	1,221	49	0.56	0.55	0.33
20	External/ BoP	Basic balance	Sum of the current account balance and net FDI flows.	Authors' calculations	1,589	66	0.52	0.12	0.84
21	External/ BoP	Current account balance in % of GDP, three-year moving average.	Three-year moving average of the current account balance.	WDI	1,077	45	0.40	0.5	0.6

Source: Authors' calculations, BIS, IFS, IMF (World Economic Outlook), UNSTAT, World Bank (World Development Indicators).

Table A2 continued

Description of Indicators

No.	Category	Indicator	Description	Source	Number of observations	Number of crises	Goodness of fit (g)	Crises missed: C/(A+C)	Noncrises misclassified: B/(B+D)
22	External/ BoP	Total change in external debt stocks in % of GDP	International reserves to total external debt stocks.	WDI	1,304	52	0.57	0.24	0.62
23	External/ BoP	Net flows on external debt in % of external debt	Net flows on external debt are disbursements on long-term external debt and IMF purchases minus principal repayments on long-term external debt and IMF repurchases and the change in stock of short-term debt (including interest arrears for long-term debt).	WDI	1,312	52	0.61	0.37	0.42
24	External/ BoP	Net FDI flows	Net inflow of investments into a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor.	WDI	1,344	46	0.57	0.39	0.48
25	External/ BoP	Net portfolio inflows in % of GDP, three-year average	Portfolio investment covers transactions in equity securities and debt securities.	WDI	389	13	0.61	0.69	0.10
26	External/ BoP	Nominal unit labor costs, year on year	Based on data for compensation of employees; consists of all payments in cash, as well as in kind (such as food and housing), to employees in return for services rendered, and government contributions to social insurance schemes such as social security and pensions that provide benefits to employees.	WDI, authors' calculations	1,170	51	0.59	0.73	0.10
27	External/ BoP	External debt in % of gross national income (GNI)	Total external debt stocks to gross national income. Total external debt: debt owed to nonresidents repayable in currency, goods, or services; the sum of public, publicly guaranteed and private nonguaranteed long-term debt, use of IMF credit, and short-term debt.	WDI	1,298	51	0.55	0.73	0.17
28	Macro	Money growth in %, year on year	Average annual growth rate of money and quasi-money.	WDI	1,530	58	0.65	0.45	0.26
29	Macro	CPI inflation in %, year on year	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	WDI	1,471	56	0.63	0.46	0.27
30	Macro	CPI inflation, three-year average	Three-year average of (29)	WDI	1,361	50	0.64	0.30	0.42
31	Macro	Risk premium on lending	Interest rate charged by banks on loans to private sector customers minus the "risk free" Treasury bill interest rate at which short-term government securities are issued or traded in the market.	WDI	698	22	0.61	0.36	0.42
32	Macro	Structural balance in % of potential GDP	The structural budget balance refers to the cyclically adjusted general government balance further adjusted for nonstructural elements beyond the economic cycle.	WEO	419	14	0.61	0.50	0.29

Source: Authors' calculations, BIS, IFS, IMF (World Economic Outlook), UNSTAT, World Bank (World Development Indicators).

Table A2 continued

Description of Indicators

No.	Category	Indicator	Description	Source	Number of observations	Number of crises	Goodness of fit (g)	Crises missed: C/(A+C)	Noncrises misclassified: B/(B+D)
33	Macro	Multiplication of gross debt (in % of GDP) by the fiscal balance	Multiplication of gross debt (in % of GDP) by the general government primary net lending/borrowing, which resembles net lending (+)/borrowing (-) plus net interest payable/paid (interest expense minus interest revenue).	WEO, authors' calculations	385	15	0.57	0.33	0.53
34	Macro	Deviation from the three-year average real GDP growth rate	Gross domestic product at constant prices.	WEO	1,498	57	0.44	0.57	0.48
35	Macro	GDP growth, three-year average	Average three-year growth of real GDP.	WEO	1,547	58	0.41	0.29	0.89
36	Macro	GDP contribution: exports	Contribution of exports to GDP growth.	UNSTAT	1,495	58	0.43	0.45	0.69
37	Macro	GDP contribution: changes in inventories	Contribution of changes in inventories to GDP growth.	UNSTAT	1,304	51	0.57	0.45	0.40
38	Macro	Primary balance in % of GDP	Primary net lending/borrowing is net lending (+)/borrowing (–) plus net interest payable/paid (interest expense minus interest revenue).	WEO	879	26	0.57	0.46	0.41
39	Macro	Market capitalization in % of GDP	Market capitalization (also known as market value) is the share price times the number of shares outstanding.	WDI	974	39	0.41	0.51	0.68
40	Macro	GDP contribution: government consumption	Contribution of government consumption to GDP growth.	UNSTAT	1,496	58	0.44	0.47	0.66
41	Macro	Stocks traded in % of GDP	Total value of shares traded during a given period in % of GDP.	WDI	961	41	0.46	0.44	0.65
42	Macro	Gross debt in % of GDP	Gross debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. This includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts payable.	WEO	1,270	37	0.41	0.54	0.63
43	Macro	Stocks traded, turnover ratio	Total value of shares traded during the period divided by the average market capitalization for the period.	WDI	922	34	0.57	0.56	0.30
44	Macro	GDP contribution: household consumption	Contribution of household consumption to GDP growth.	UNSTAT	1,512	59	0.57	0.58	0.29

Source: Authors' calculations, BIS, IFS, IMF (World Economic Outlook), UNSTAT, World Bank (World Development Indicators).

Table A2 continued

Description of Indicators

No.	Category	Indicator	Description	Source	Number of observations	Number of crises	Goodness of fit (g)	Crises missed: C/(A+C)	Noncrises misclassified: B/(B+D)
45	Macro	GDP contribution: imports	Contribution of imports to GDP growth	UNSTAT	1,496	58	0.58	0.62	0.21
46	Macro	GDP contribution: gross fixed capital formation	Contribution of gross fixed capital formation to GDP growth.	UNSTAT	1,511	59	0.57	0.63	0.23
47	Macro	Overall balance in % of GDP	Net lending (+)/ borrowing (–) is calculated as revenue minus total expenditure.	WEO	1,373	43	0.57	0.65	0.21
48	Macro	Gross savings in % of GDP	Gross savings are calculated as gross national income less total consumption, plus net transfers.	WDI	1,295	47	0.45	0.72	0.38

Source: Authors' calculations, BIS, IFS, IMF (World Economic Outlook), UNSTAT, World Bank (World Development Indicators).

Assessing the Full Extent of Trade Integration between the EU and Russia – A Global Value Chain Perspective

Konstantīns Beņkovskis, Jūlija Pastušenko, Julia Wörz[1]

We analyze trade linkages between EU Member States and Russia, taking into account indirect trade links in global value chains. Our analysis is based on data for 2011 from the World Input-Output Database combined with gross trade flows between Russia and individual EU economies. We derive our conclusions from three indicators: gross exports in final use, value added in final use and value added in output. The latter two novel indicators are able to capture direct and indirect links jointly by allocating the full amount of value added from Russia in EU final domestic use and output, and inversely, the full amount of EU value added in Russia's final domestic use and output. Russia represents the EU's fourth-largest trade partner in terms of direct export shares, while the EU is Russia's largest trade partner. In the same vein, Russia's economy is considerably more dependent on European value added for both final use and output production than vice versa. However, the degree of integration varies greatly among EU Member States. For example, the Baltic states are notably more dependent on value added from Russia than vice versa, and certain economic sectors in the EU, such as the energy sector, utilities and air transport, are strongly dependent on inputs from Russia.

JEL classification: F12, F15, F51
Keywords: Trade integration, global value chains, Russia, European Union

Recent geopolitical tensions and discussions of trade sanctions have sparked widespread interest in economic linkages between the EU-27[2] and Russia. In this article, we assess the status quo of trade integration between Russia and individual EU-27 Member States. While we realize that it may well be impossible to cover all aspects of interconnectedness, we have nevertheless aimed to gauge the degree of interdependence as comprehensively as possible. We focus on trade linkages, but above and beyond existing studies, we take into account global (i.e. direct and indirect trade) linkages to get a fuller picture. We would like to emphasize that our analysis is not an attempt to estimate the impact of current and possible further sanctions, but a broad investigation of the state of trade links prior to the current crisis.

Several publications on global value chains (GVCs) have demonstrated that a narrow focus on direct trade flows that does not take into account global interdependencies gives an incomplete picture of mutual trade interdependencies. The international fragmentation of production is an important element of global economic activity today. Stehrer et al. (2012) find that international linkages have increased globally over the past ten years. More generally, they observe an overall increase in interconnectedness, i.e. stronger domestic and international linkages between industries. According to their results, the Central, Eastern and Southeastern European (CESEE) EU members appear to be the most interlinked region, exhibiting strong bilateral linkages with EU-15 members.

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[2] *Since we base our analysis on data for 2011, we focus on the EU-27, i.e. the EU prior to Croatia's accession.*

Riad et al. (2012) also observe an increase in trade interconnectedness, which increases the transmission of shocks between countries through the trade channel. Besides noting the rapid rise of China as a systemically important trading partner, they observe that European countries are "central" in the trade network primarily due to their high degree of interconnectedness rather than their economic size.

Baldwin and Lopez-Gonzalez (2013) also draw attention to the radical changes in trade linked to international production networks that they determine to have taken place between 1985 and 1995. Like Riad et al. (2012), they emphasize the rise of China in what they call "global supply-chain trade." Conceptually, they distinguish between "importing-to-produce (I2P)," which describes the use of foreign intermediates (goods and services) in a country's total production, and "importing-to-export (I2E)," which refers to the use of imported inputs in exported goods and services (and is thus a subset of I2P). The authors' analysis contains some stylized facts with possible relevance for the relationship between Russia and the EU-27. For example, they find that I2E trade is more regionally concentrated than aggregate trade. They further emphasize that GVCs in fact remain structured into three main regions ("Factory Asia, Factory Europe, and Factory North America") with the three corresponding hubs U.S.A., Germany and China. Another stylized fact postulates that countries which are smaller and more closely located to one of the three major supply networks are more dependent on intermediate inputs from other countries in the respective regional value chain. However, they also note that trade patterns for raw materials are less regionalized. In our context, this would imply an asymmetric relationship between Russia and EU countries, with Russia being more strongly dependent on intermediate inputs from EU members located closer to Russia while EU members are likely to depend on Russia for raw materials (especially energy products).

Overall, backward linkages are more important than forward linkages, highlighting the importance of sourcing from abroad. This finding is particularly relevant in our context, as Russia is a major source country of energy products. Stehrer et al. (2012) support this view by stating that backward linkages to the BRII countries (Brazil, Russia, India and Indonesia) are particularly relevant for the CESEE EU members in the chemical sector.

Our contribution to the analysis is to scrutinize the extent of interconnectedness between the EU-27 and Russia for final use and total output. Thus, in the notation introduced by Baldwin and Lopez-Gonzalez (2013), we analyze I2P patterns. Our analysis of trade integration is based on data for 2011 from the World Input-Output Database. This database offers a world input-output table by combining national input-output tables with global trade data. Hence, using this database enables us to take account of direct as well as indirect trade flows between EU-27 Member States and Russia. This means that in any bilateral comparison, we can identify the full amount of foreign value added in total output and final use. Calculations show that Russia's value added is more important for EU final use than direct imports suggest, while EU value added is even more important in Russia's final use. Also, EU-27 output shows a higher amount of Russia's value added compared to EU-27 final demand, while Russian producers are on average even more dependent on EU value added than vice versa. There are large differences within the EU-27: Some EU Member States (Latvia, Lithuania, Estonia, Finland, Bulgaria, Hungary) and certain industries could be severely affected by trade

disruptions with Russia, especially when the full amount of value added is taken into account.

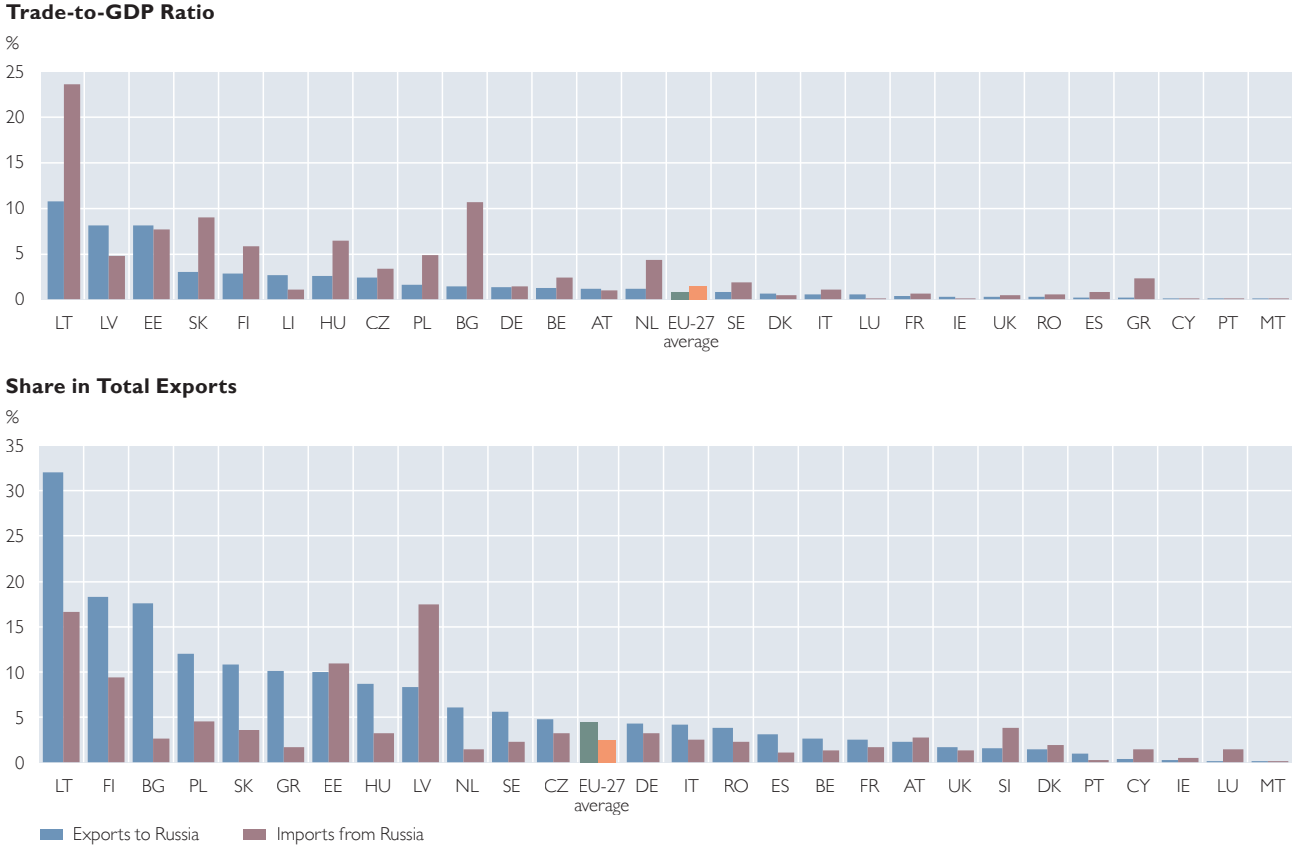
The article is structured as follows. In section 1, we provide an overview of bilateral trade relations between Russia and EU Member States based on traditional statistics. In section 2, we review the methodology used in the article to identify the extent of trade linkages between the EU and Russia using the GVC approach. We describe our findings in detail in section 3, and section 4 concludes.

1 Direct Bilateral Integration through Trade

If we restrict our focus to direct trade flows in goods between the EU and Russia, we find that Russia is the EU's fourth-most important trading partner (excluding intra-EU trade), while the EU represents the most important export destination for Russia's goods. Including intra-EU trade, Russia accounted for 2.5% of total EU-27 exports in 2011, equivalent to 0.8% of EU-27 GDP.[3] However, there are large differences between individual Member States (chart 1). Russia plays a much greater role as an export destination for the Baltic countries than for other EU

Chart 1

Bilateral Goods Trade between the EU-27 and Russia in 2011



Source: Latvijas Banka, OeNB calculations based on Eurostat.

[3] *These figures do not change much over time. In 2013, 2.6% of total EU-27 exports went to Russia. This corresponds to 0.9% of Russia's GDP.*

countries (Lithuania: 11% of GDP; Latvia and Estonia: 8%). The following eastern and northern European EU Member States recorded exports to Russia of about 2% to 3% of their respective GDP: Slovakia, Finland, Slovenia, Hungary, the Czech Republic and Poland.

Russia has traditionally been a more important trade partner for the EU countries in terms of imports, which averaged out at 1.5% of EU countries' GDP in 2011. Again, some Member States posted much higher figures, e.g. Lithuania (23.6% of GDP), followed by Bulgaria (10.7%), Slovakia (9.0%), Estonia (7.7%), Hungary (6.4%) and Finland (5.9%). However, for the following eight EU Member States, Russia's importance as a destination for exports exceeds its importance as a source of imports: Austria, Denmark, Estonia, Ireland, Latvia, Luxembourg and Slovenia.

The importance of Russia's imports for EU Member States is very strongly concentrated on raw materials. Russia is a main supplier of energy products for many EU Member States. Again, this dependence differs greatly among Member States. Slovakia is most dependent on energy imports from Russia; 70% of its oil and gas imports came from Russia in 2011. This share equaled between 30% and 50% in Finland, Latvia and Estonia. It has to be noted, though, that these figures only represent direct oil and gas supplies from Russia to Latvia and Estonia. Russia's oil and gas also enters those two countries indirectly via Lithuania and Belarus.[4] Austria's and Germany's shares were slightly lower at 28.8% and 27.3%, respectively. Some countries, e.g. Ireland, Cyprus, Malta, but also Portugal, do not report any direct oil or gas imports from Russia at all. Hence, Russia is an important direct trading partner for energy products and for some Member States (i.e. the Baltic countries).

2 Capturing Indirect Linkages

The international fragmentation of production has changed the nature of the international economy. As a result, trade flows (gross exports and imports) are no longer an appropriate indicator of a link between two countries. Products exported from country *s* to country *r* are only partly produced in country *s*, while, on the other hand, country *s* may reach consumers in country *r* via intermediate inputs in any third country. Thus, the simple analysis of Russia's exports to the EU-27 will ignore e.g. energy from Russia used in third countries to produce goods and services for the EU-27 market. This calls for refined indicators that are able to capture direct and indirect links jointly. To avoid double counting of gross trade flows that arise from imported intermediate goods embodied in exports, such indicators should in addition account for the share of value added in production.

In this article, we make use of three indices: a traditional one that relies on gross exports, and two novel GVC-compatible indices that focus on value added instead of trade flows. We further look at the importance of inputs from Russia for both final use (private and government consumption, gross fixed capital formation and changes in inventories) in EU-27 economies and total output. Thus, we capture both the demand side and the supply side of the economy. Our first two indicators calculate the relevance of inputs from Russia for final domestic demand (i.e. consumption and investment) in the EU-27. We distinguish between direct trade

[4] *In section 3 below, we focus on such indirect trade linkages and their respective importance for economic activity.*

flows from Russia (restricting our attention to gross exports of goods and services) and Russia's value added that enters the EU directly and indirectly through goods and services imported from third countries. Our third indicator assesses the importance of value added from Russia for EU-27 producers. Of course, we also calculate all three indicators with respect to the importance of EU-27 inputs for the Russian economy.

2.1 Gross Exports in Final Use

As a first indicator, we calculate the share of gross exports from country *s* that is to be found in domestic final use of country *r*. This reflects the portion of final domestic demand in country *r* that is served by imports from country *s* and is evaluated as follows:

$$E_{sr}^{ratio} = \frac{\sum_{n} E_{sn,r}}{\sum_{i}\sum_{n} Y_{in,r}}, \qquad (1)$$

where E_{sr}^{ratio} is the share of final use products exported from country *s* to country *r*, while $E_{sn,r}$ denotes the exports of final use product supplied by sector *n* of country *s* to country *r*. Equation (1) can be modified to calculate the share of final use products coming from a particular sector of country *s*. *E* denotes exports of the source country *s*, *Y* refers to final domestic demand of destination country *r*, with *i* being a running index of all source countries.

This indicator does not tell us anything about the value added produced in country *s*. Rather, it reflects the perception of country *r*'s consumers based on "made in country X" stickers. In our analysis, this indicator reflects the share of "made in Russia" products in EU-27 consumption and investments, as well as the share of "made in the EU" products in Russian final domestic demand. As mentioned before, reference to a country on a sticker is usually not equivalent to the country's ultimate role in the production process. Moreover, it does not account for the importance of a country via indirect links (e.g., it does not fully capture oil and gas from Russia, as a large part of mineral oil products are not consumed directly). However, the share of direct exports can serve as a useful benchmark.

2.2 Value Added in Final Use

It is useful to compare the rather traditional measure of gross exports in final use to the importance of value added that moves directly and indirectly from one country to another. This measure was initially introduced by Johnson and Noguera (2012) and is also termed "value-added exports" or "value-added trade." Value-added exports again focus on final use and can be described as "value added produced in source country *s* and absorbed in destination country *r*" (see Koopman et al., 2014, p. 462). This measure would decompose the final domestic demand (which contains private consumption, government consumption, and investments) of e.g. Russia into value added produced by various source countries (including Russia).

The decomposition of final domestic demand by the source of value added is given by:[5]

[5] *This decomposition is based on standard input-output analysis using the industry-specific technology assumption.*

$$VA^{USE} = V \cdot B \cdot Y = V \cdot \left(\mathrm{I} - A\right)^{-1} \cdot Y,$$

$$V \equiv \begin{bmatrix} diag\left(V_1\right) & 0 & \cdots & 0 \\ 0 & diag\left(V_2\right) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & diag\left(V_K\right) \end{bmatrix}, \quad V_r \equiv u\left(\mathrm{I} - \sum_s A_{sr}\right), \tag{2}$$

where:

- VA^{USE} is a $KN \times K$ matrix that provides disaggregated value added by producer country and sector in final domestic demand for each country. K is the number of countries and N is the number of sectors. Each row of VA^{USE} represents the particular country and sector from which the value added originates. Each column of VA^{USE} reflects a specific destination country. $VA^{USE}_{sn,r}$, an individual element of the VA^{USE} matrix, shows the value added produced by country s in sector n that is consumed in country r.
- Y is the $KN \times K$ matrix of final domestic demand (private consumption, government consumption, and investment). It contains blocks Y_{sr}, that is, the $N \times 1$ final domestic demand vector that describes demand in country r for final goods shipped from country s. $Y_{sn,r}$, the individual element of Y, denotes the final domestic demand of country r for the product of sector n supplied by country s.
- V is a $KN \times KN$ diagonal matrix, and V_r is a $1 \times N$ direct value-added coefficient vector. Each element gives the share of direct domestic value added in total output for each sector of country r.
- A is the $KN \times KN$ matrix of input-output coefficients that is constructed from the $N \times N$ blocks A_{rs}. Those blocks contain information on intermediate use by country s of the goods produced in country r.
- B is the Leontief inverse matrix $B = (I - A)^{-1}$.
- u is a 1×N unity vector.
- I denotes the $KN \times KN$ identity matrix.

The matrix VA^{USE} contains information on the decomposition of final domestic demand for the entire set of countries present in the world input-output table. If we want to calculate a particular subset of countries (source country s and destination country r), we use the following formula:

$$VA_{sr}^{USE\_ratio} = \frac{\sum_n VA_{sn,r}^{USE}}{\sum_i \sum_n Y_{in,r}}, \tag{3}$$

where $VA_{sr}^{USE\_ratio}$ denotes the share of value added directly and indirectly coming from country s and absorbed in country r. The denominator of equation (3) is the total final domestic demand of country r, while the numerator contains the total value added from s consumed in final destination country r. Equation (3) can be easily modified to show the share of value added coming from a particular sector of country s.

Unlike the gross exports indicator, value added in final use is not tied to the final assembly country only. It goes much deeper and reflects the direct and indirect contribution of every country in the production of a consumption or

investment good. More specifically, this indicator captures the indirect contribution of Russia's energy sector in EU-27 final domestic demand, but also accounts for inputs not coming from Russia in "made in Russia" final use products.

2.3 Value Added in Output

Both indicators described above characterize intercountry links from the expenditure side of the economy. However, we also need an indicator that describes the role of one country's inputs in another country's output, i.e. an indicator that takes into account vertical specialization (a country's specialization on particular stages of the production process). The usual way to assess vertical specialization is to calculate "value added in gross exports" (see Koopman et al., 2010; the indicator is closely related to "value added in trade" as presented in Stehrer, 2012). Value added in gross exports makes it possible to decompose gross exports by producer countries.

Value added in gross exports is useful to analyze the effect of globalization on international trade, while our goal is somewhat different and our focus is on total supply (output). However, the methodology used by Koopman et al. (2010) in decomposing gross exports can be applied to total output by simply replacing the gross exports matrix by the total output matrix:

$$VA^{OUTPUT} = V \cdot B \cdot X = V \cdot \left(\mathrm{I} - A\right)^{-1} \cdot X,$$

$$X \equiv \begin{bmatrix} diag\left(X_1\right) & 0 & \cdots & 0 \\ 0 & diag\left(X_2\right) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & diag\left(X_K\right) \end{bmatrix}, \tag{4}$$

where:

- VA^{OUTPUT} is a $KN \times KN$ matrix that decomposes the output of all sectors in all countries into value added by source country and sector. Each row of VA^{OUTPUT} represents the producer country and sector from which value added is originated. Each column of VA^{OUTPUT} shows the country and industry that uses this value added in its total output. $VA^{OUTPUT}{}_{sn,rm}$, an individual element of VA^{OUTPUT}, denotes the value added of country s's sector n that is contained in the output of country r's industry m.
- X is the $KN \times KN$ diagonal matrix of output. It contains $N \times N$ diagonal blocks X_s of output in country s. X_{sn}, the diagonal element of X, denotes the output of country s in sector n.

Information about a particular pair of countries (source country s and destination country r), can be derived using the following equation:

$$VA_{sr}^{OUTPUT\_ratio} = \frac{\sum_m \sum_n VA_{sn,rm}^{OUTPUT}}{\sum_m X_{rm}}, \tag{5}$$

where $VA_{sr}{}^{OUTPUT\_ratio}$ is the share of value added from county s directly and indirectly included in output of country r. X is total output and m refers to all industries of the destination country r that are producing output, while n refers to all industries

of the source country *s* that are delivering inputs. The numerator of equation (5) shows total value added of country *s* used in output of country *r*, while total output of country *r* appears in the denominator. Equation (5) can also be modified to assess more detailed information on particular sectors.

While in spirit, value added in output is similar to value added in final use, it describes linkages from a different perspective: Value added in output focuses on direct and indirect inputs from Russia in EU-27 output (and vice versa). For instance, it shows the contribution of Russia's energy sector in EU-27 production, capturing also the indirect inputs via third countries.

2.4 Database

We use the recently established World Input-Output Database (WIOD)[6] that combines information from national supply and use tables, National Accounts time series on industry output and final use, and data on bilateral trade in goods and services for 40 countries, 59 commodities and the period from 1995 to 2011 (see Timmer, 2012, for more details on the database and Stehrer, 2012, for empirical calculations based on WIOD). The database covers all EU Member States except Croatia. Therefore, we have to restrict our analysis of direct and indirect trade linkages to the EU-27. Further, although the latest available data are for the year 2011, we argue that they still reflect bilateral links between Russia and EU countries well, since input-output structures do not change rapidly.

3 Importance of Direct and Indirect Trade Linkages

In section 1, we sketched the importance of Russia as a direct trading partner for EU members, which is not fully representative in the presence of internationally fragmented production processes. In addition, we restricted our attention to trade in goods only. In this section, we broaden the view and employ the conceptual framework described in section 2 to assess the importance of Russia for economic activity in the EU Member States. In other words, we analyze how dependent EU economies are on inputs from Russia, regardless whether these inputs are sourced directly or whether they are embedded in intermediate inputs sourced from elsewhere in the world. As we base our calculations on globally connected input-output tables, we also capture the role of service inputs.

3.1 Importance of Bilateral Gross Exports and Value Added in Final Use Differs Between the EU and Russia

At first sight, inputs from Russia play only a minor role for European economies. On the demand side, direct imports from Russia amount to 0.07% of EU-27 final use (top panel of chart 2). If the full amount of Russian value added in European final domestic demand is taken into account, the share of Russian value added – which is absorbed directly and indirectly in the EU-27 through integration into GVCs – increases to 1.1% (bottom panel of chart 2).

Individual EU Member States exhibit very different degrees of integration with Russia's economy. The share of direct imports from Russia in final domestic use ranges from 0.01% for Portugal to 1.1% for Latvia. Including indirect inputs from Russia, Lithuania shows the highest dependence on value added from Russia (6.8%

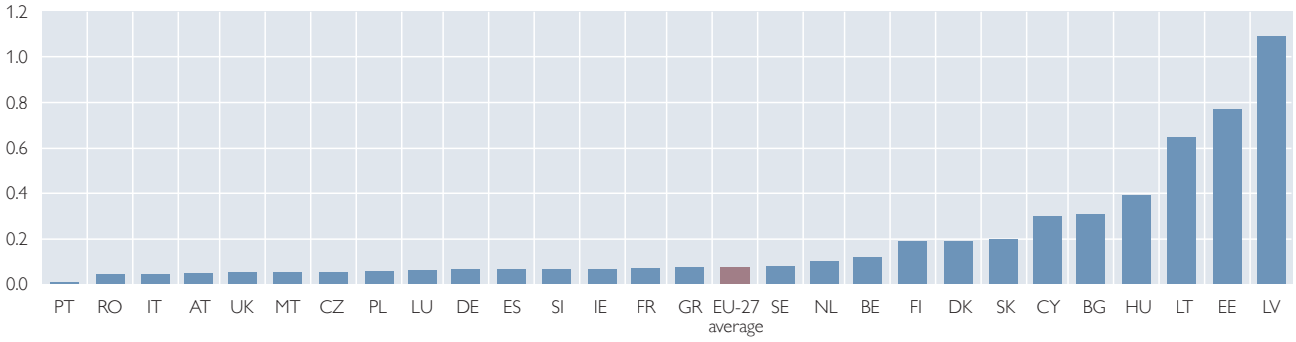
[6] *See www.wiod.org for details on the database.*

Chart 2

Share of Russian Gross Exports of Final Products and Value Added in EU-27 Domestic Final Use in 2011

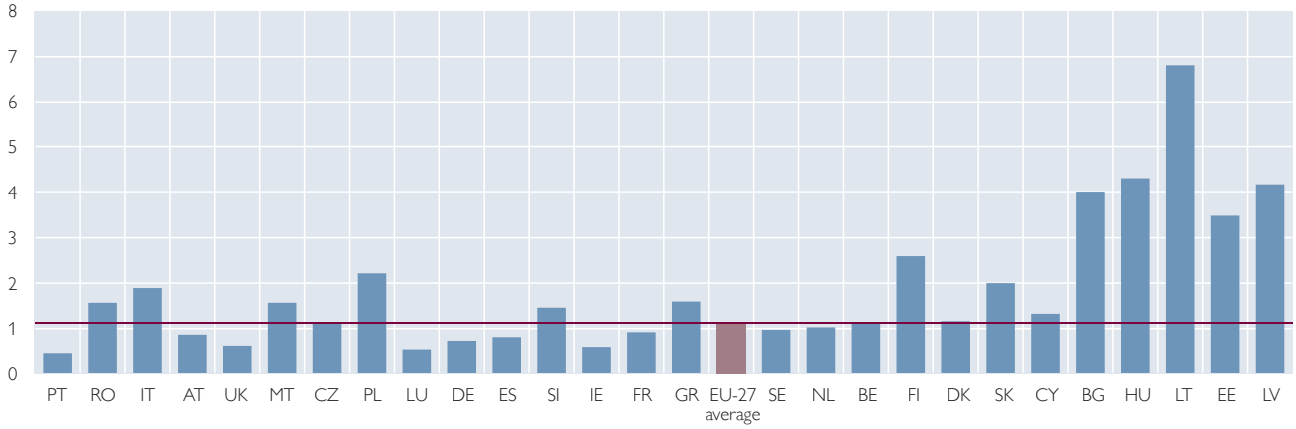
Gross Exports (Direct Trade Flows)

% of domestic final use



Value Added (Direct and Indirect Trade Flows)

% of domestic final use



Source: Latvijas Banka, OeNB calculations based on WIOD data.

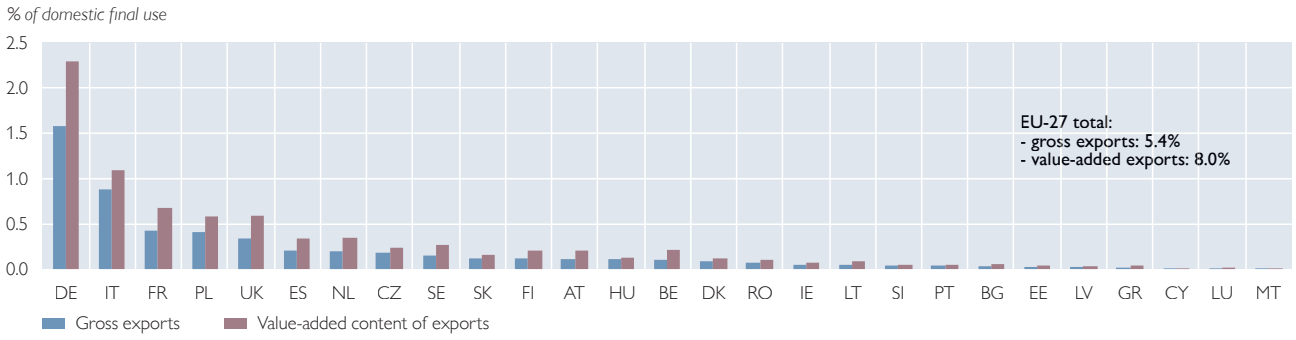
of final domestic demand). Portugal is again least integrated with a share of 0.4%. The integration in value-added terms is particularly pronounced for Hungary, Latvia, Bulgaria and Finland. Differences between direct trade exposure and value-added trade exposure are particularly pronounced for Poland, Italy and Greece. In Poland, the share of direct imports from Russia in final domestic use is 0.06%, while Russian value added in final domestic use amounts to 2.2%. The corresponding figures for Italy are 0.04% and 1.9%, respectively. This large discrepancy may be related to Fiat producing in Russia. Finally, for Greece, the importance of products from Russia in final domestic use rises from 0.07% (direct imports only) to 1.6% (value added).

More than half of the demand for direct imports from Russia emerges from the coke and petroleum industry. Even if the importance of Russia for EU final domestic use remains limited and highly concentrated, value added from Russia is more important for EU final use than direct imports only suggest.

Conversely, examining the impact of EU-27 exports on Russia, chart 3 reveals that EU value added is even more important in Russia's final domestic use than vice versa. Around 5.4% of the final domestic demand in Russia is directly depen-

Chart 3

Share of EU-27 Gross Exports of Final Products and Value Added in Russia's Domestic Final Use in 2011



Source: Latvijas Banka, OeNB calculations based on WIOD data.

dent on final products imported directly from the EU-27. The level of dependence increases to 8% when we also take into account indirect effects – i.e. when we focus on EU-27 value added instead of goods exported directly from the EU-27 to Russia. For instance, final goods that reach Russia may come from elsewhere in the world than the EU-27 via the participation of EU-27 exporters in global value chains. Hence, imports from non-EU countries also contain EU-27 value added.

A closer look at the data shows Germany as the most important EU-27 counterpart for Russia's final users, with 1.6% of Russia's final demand goods sourced from Germany directly. This figure increases to 2.3% including indirect effects. Less important, but nevertheless accounting for a significant share of Russia's final domestic use, are Italy, France, Poland and the United Kingdom. The other EU Member States play a less prominent role, both directly and indirectly.

The following industries in the EU-27 have the greatest relevance for final domestic use in Russia in terms of direct exposure: Transport equipment (European exports account for 1.4% of Russia's final use), chemicals and chemical products (0.6%), machinery (0.9%), and textiles and textile products (0.8%).[7] It is difficult to single out other industries, since some exposure is evident in many of them (never exceeding 0.5%, though). When considering the full value added content from the EU-27 (i.e. including European value added that is traded through third countries), two other categories emerge as more important than the rest, namely basic metals and fabricated metals (0.5%), and renting of machinery and equipment and other business activities (0.9%).[8]

To sum it up, Russia's consumers and investors are more dependent on EU inputs than vice versa. Thus we may assume that if trade is disrupted, Russia might need to refocus on other trading partners for substitution.

3.2 Value Added from Russia Is More Important for EU Output than for EU Final Use

The output approach allows us to assess to what extent European industries are dependent on inputs from Russia and how this dependence differs among countries

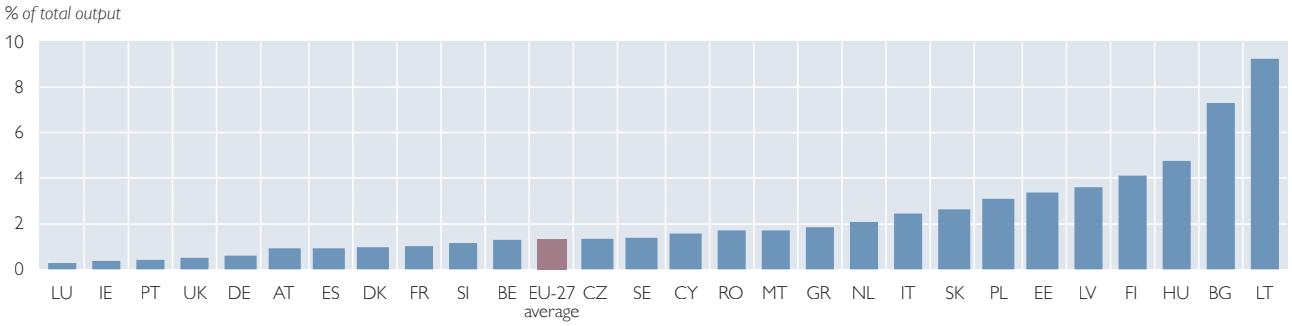
[7] *The classification of economic activities is taken from WIOD (see Timmer et al., 2012).*

[8] *Results are available from the authors on request.*

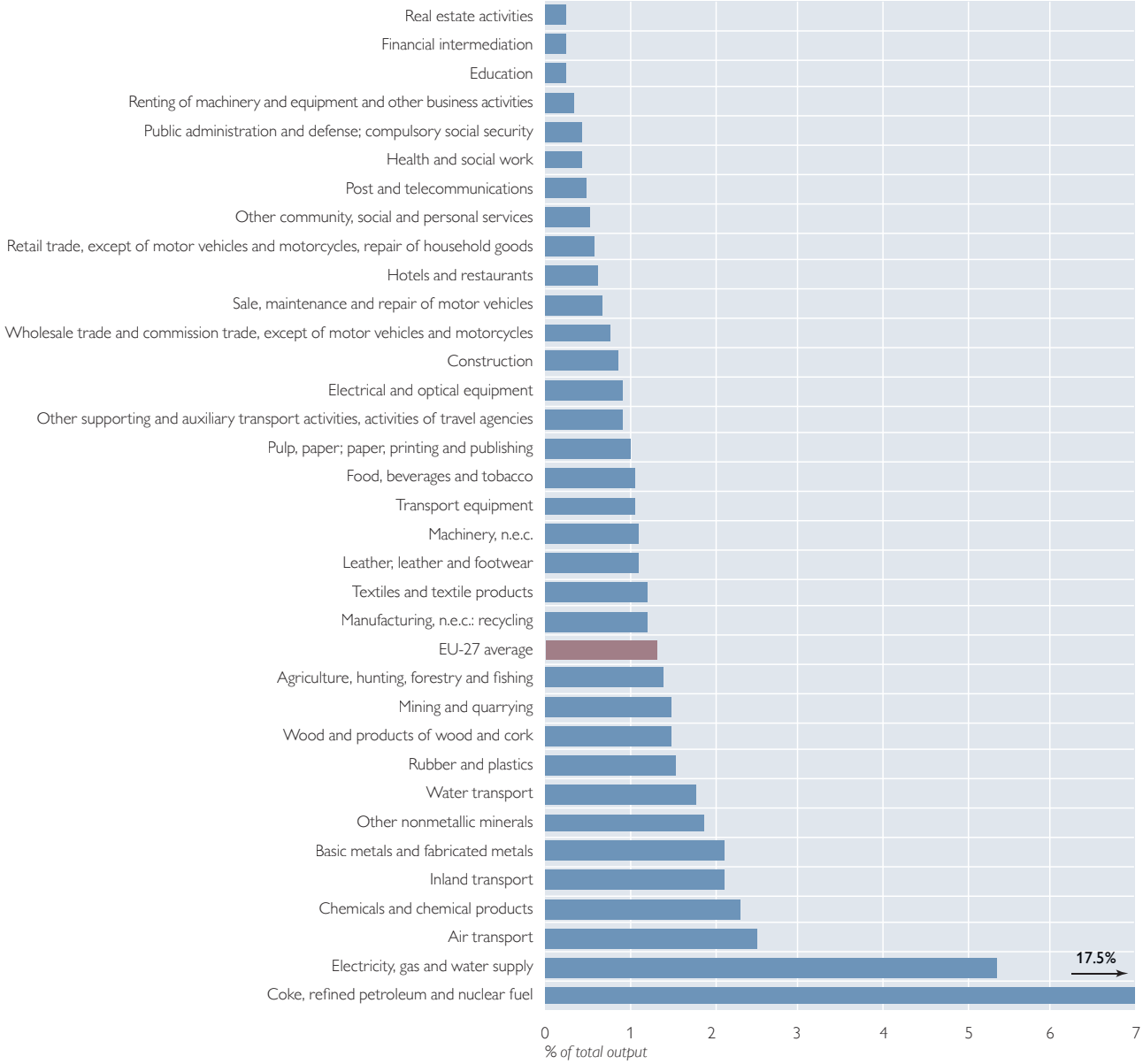
Chart 4

Share of Value Added from Russia in EU-27 Total Output in 2011

By Member States



By Industries



Source: Latvijas Banka, OeNB calculations based on WIOD data.

(chart 4). For the EU-27 as a whole, value added from Russian is more important for the production of output (including the production of intermediate goods, final domestic use and exports) than for final use. On average, 1.3% of EU-27 output falls on value added by Russia. Again, linkages with Russia's economy vary greatly between individual EU members, ranging from 0.3% (Luxembourg) to 9.2% (Lithuania). Lithuania, followed by Bulgaria, Hungary, Finland, Latvia and Estonia, exhibits the strongest dependence on Russian value added.

We can determine which industries show the highest share of value added from Russia in EU-27 output: Besides the coke and petroleum industry (value added from Russia amounts to 17.5% of total EU-27 output), utilities (5.3%) and transportation services (around 2%) are most dependent on value added from Russia.

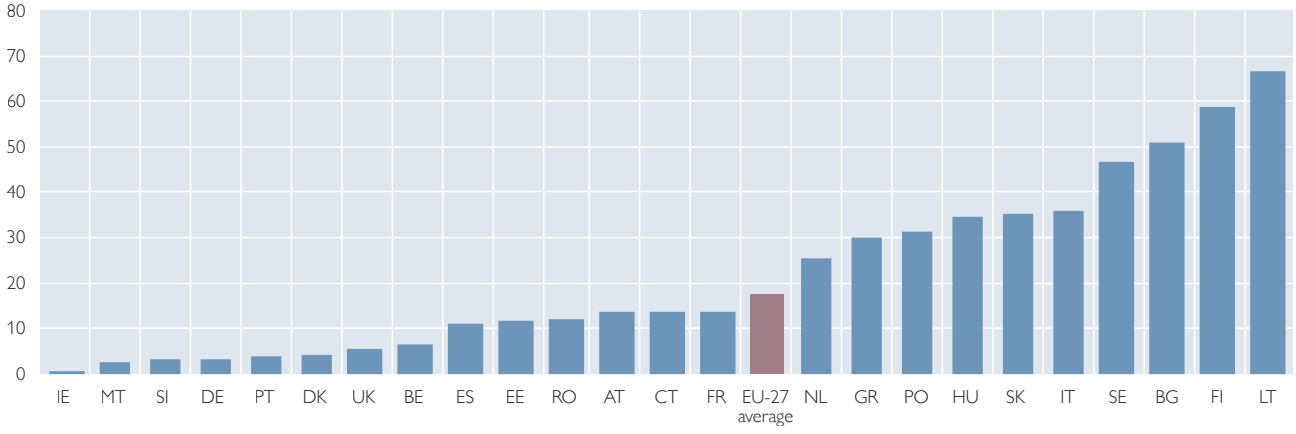
Chart 5 focuses on the regional differences within the EU-27 in the two industries where EU Member States show the highest share of value added from Russia in output (i.e. coke and petroleum, utilities). In line with our observation in chart 4, the CESEE EU Member States, Finland and Italy exhibit the largest share of value added from Russia in total output also in these two industries. Clearly, the actual impact that reducing trade flows between Russia and the EU would have depends not only on the importance of industrial linkages, but also on substitution possibilities. In this respect, some of the countries which are most strongly integrated

Chart 5

Share of Value Added from Russia in EU-27 in Selected Industries

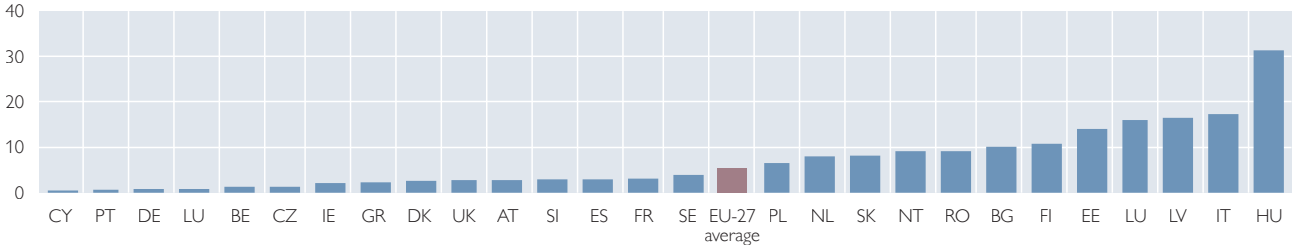
Coke, Refined Petroleum and Nuclear Fuel

Inputs from Russia in % of output



Electricity, Gas and Water Supply

Inputs from Russia in % of output



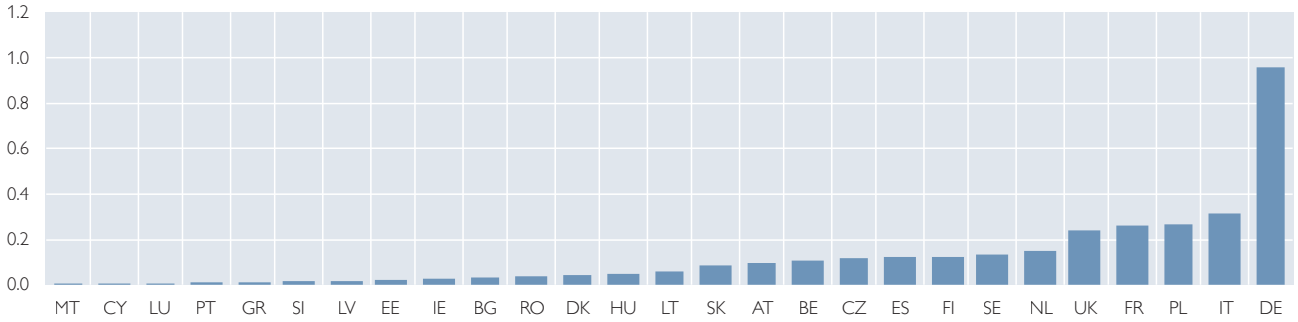
Source: Latvijas Banka, OeNB calculations based on WIOD data.

Chart 6

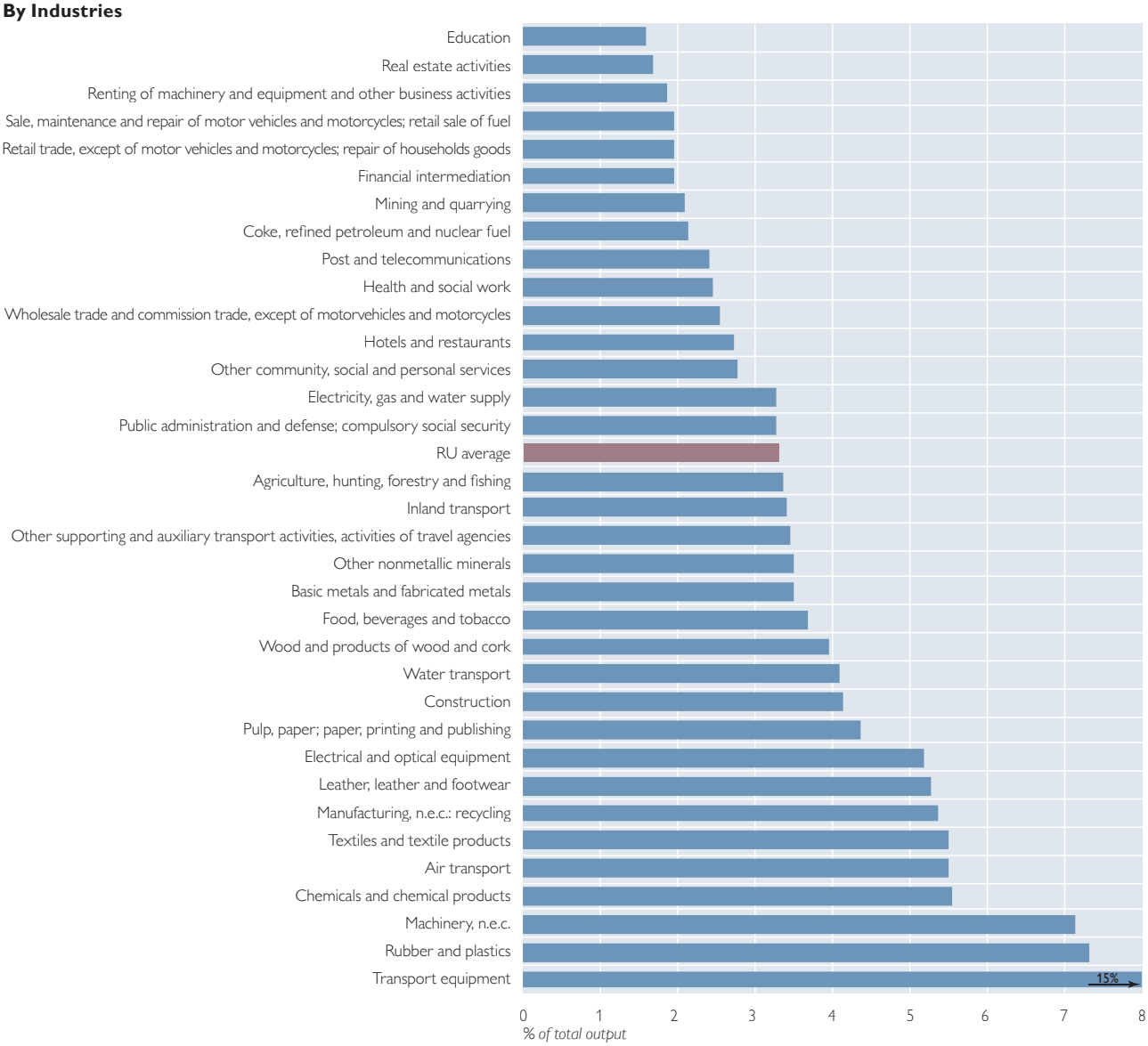
Share of EU-27 Value Added in Russia's Total Output in 2011

By Countries

% of total output



By Industries



Source: Latvijas Banka, OeNB calculations based on WIOD data.

with Russia's economy (in particular the Baltic countries) have very limited possibilities of switching from Russian suppliers to other suppliers in the short to medium run, especially in the most affected industries.

To sum it up, EU-27 output contains more value added from Russia than EU-27 final use. Yet as in the case of gross exports in final use, Russian producers are on average far more dependent on the EU in absolute terms. Chart 6 shows the dependence of Russia's output on EU-27 value added. On average, summing up over all Member States, about 3.3% of Russia's industrial output is (directly or indirectly) dependent on inputs from the EU-27 (see "RU average" in bottom panel). Country-wise, the most important counterpart for Russia's industrial production enterprises is Germany (about 1%), followed by Italy, Poland, France and the U.K. (top panel).

The importance of EU-27 value added for Russia's output is also somewhat more evenly distributed across industries than the highly skewed distribution of value added from Russia in EU output in chart 5. Transport equipment is the sector with the greatest share of EU value added (almost 15%, with more than one-third originating in Germany). Other heavily dependent sectors are rubber and plastics (7.3%) as well as machinery (7.1%) – with more than one-third originating in Germany again in both cases. Air transport (5.5%) and manufacturing (5.4%) follow closely behind. Russia's output in the remaining sectors contains at least 2% of value added from the EU-27.

In contrast to the pattern of dependence of EU-27 economies on Russia, Russia's economy emerges as being more dependent on EU-27 value added on the demand side than on the production side. The substantial reliance of Russia's industrial sector on EU value added means that in case of a trade disruption, Russian producers and consumers would need to find new input sources.

3.3 Summary of Mututal Dependence between the EU and Russia

To summarize the results, we find that Russia is clearly more dependent on the EU-27 than vice versa. This finding remains unaltered when we shift from direct trade linkages (gross exports) to direct and indirect linkages (value added), as well as when we study dependence from the consumer (final domestic use) and producer (output) perspective. The headline figures are reported in the table 1 below.

The importance of Russia for EU-27 consumers and investors increases more than tenfold when accounting for indirect linkages. This simply reflects that Russia's economy is an upstream producer mainly focused on intermediate goods and raw materials (i.e. oil, gas and metals). However, the relatively low importance of Russia for EU-27 final domestic demand and output flags the generally low degree of Russia's integration into GVCs.

Table 1

Summary of EU-Russia Trade Integration (Data for 2011)

	Gross exports in final use	Value added in final use	Value added in output
	%		
Importance of Russia for the EU-27	0.1	1.1	1.3
Importance of the EU-27 for Russia	5.4	8.0	3.3

Source: Latvijas Banka, OeNB calculations based on WIOD data.

For several reasons, the importance of the EU-27 for Russia's economy is significantly higher than Russia's importance for the EU-27: First, the EU-27 economy is much larger than that of

Russia. Second, many European producers are positioned downstream in the GVCs, which explains the larger share of gross exports from the EU-27 in final domestic use in Russia. Finally, higher participation in GVCs increases the importance of EU-27 value added for Russian consumers and producers.

4 Conclusions

This article summarizes the importance of trade integration between the EU-27 Member States and Russia. In our analysis, we go beyond the description of direct trade links; we take account of the international fragmentation of production and assess the importance of value added from Russia (from the EU) for final use and total output in the EU economies (in Russia). Our analysis of trade linkages across global value chains (GVCs) is based on data for 2011 from the World Input-Output Database. This database combines national input-output tables with global trade data. Hence, we examine direct as well as indirect trade flows between the EU-27 Member States and Russia. This means that in any bilateral comparison, we can identify the full amount of foreign value added in total output and final domestic use.

As an export destination, Russia is not really important for EU countries on average (0.9% of GDP), though it is the fourth-most important export destination when intra-EU trade is excluded. Russia attains a slightly more important position as a source of imports to the EU (1.6% of GDP, especially energy imports). Looking at direct trade flows, we already note that the importance of Russia as a trading partner differs greatly across individual EU Member States. We also observe strong differences between individual industries. Thus, the importance of Russia for the EU is highly concentrated both geographically and by industries.

However, a country's integration into GVCs implies that bilateral trade flows do not reflect the actual amount of linkages between modern economies well. If we include intermediate linkages to their full extent in our analysis, we find that both Russia and the EU would suffer to some extent from potential trade disruptions. On average, the degree of mutual integration through trade linkages remains low for EU Member States, even when indirect linkages are taken into account. However, among EU members, the degree of integration again varies greatly, with some Member States (i.e. the Baltic countries) being notably more dependent on value added from Russia than vice versa. Russia's economy is more dependent on EU direct imports and value added than vice versa. Furthermore, in line with the results for direct trade linkages, certain economic activities in the EU are strongly dependent on inputs from Russia, such as the energy sector, utilities and air transport.

Our results indicate the degree of trade integration by contrasting two different views: The results obtained from looking at direct trade flows (section 1) are relevant, as direct trade flows would be immediately affected by administrative measures such as trade sanctions. However, direct trade flows at the same time understate and overstate the real importance of Russia's economy for the EU: On the one hand, goods from Russia may be passed through European production processes, and hence the net value of trade with Russia for European consumers may be lower than these direct trade figures suggest. On the other hand, direct and all indirect trade flows are captured in the value-added view (section 3). This method reflects the full importance of value added originating from Russia for European producers and consumers.

Summing up the results we have calculated for the three proposed indicators of integration (two of which are compatible with GVCs), we find that Russia is more dependent on EU value added than vice versa. Final domestic use in Russia would be significantly affected by trade disruptions, as the share of EU inputs in final domestic use in Russia is between 5.4% (only direct inputs) and 8% (share of all direct and indirect value added of the EU inputs entering Russia, including via third countries). The corresponding figures for the EU-27 are as low as 0.07% and 1.1%, respectively. These findings reflect two features of Russia's economy: Its position in GVCs as an upstream producer that relies strongly on imports of final goods, and its generally low degree of integration into GVCs.

3.3% of Russian total output (comprising intermediate goods, final domestic use and exports) is based on EU-27 value added, while the fraction of Russia's value added in EU-27 total output is 1.3%. Hence, the extent of bilateral integration through global value chains is small, but clearly nonnegligible, especially not for Russia's economy.

While the share of value added from Russia is larger in EU total output than in EU final domestic use, the opposite holds for EU inputs in Russia: The share of EU value added is higher in final domestic use in Russia than in Russia's total output.

Notwithstanding the lower dependence of the EU-27 economic aggregate on imports and value added from Russia than vice versa, one has to take into account wide-ranging differences among the EU-27 Member States as well as among industries. Some countries (Latvia, Lithuania, Estonia, Finland, Bulgaria, Hungary) and particular industries (i.e. the coke and petroleum industry) could be severely affected by trade disruptions, especially if the full amount of value added from Russia is taken into account. The fraction of value added from Russia in total output ranges from 0.3% (Luxembourg) to 9.2% (Lithuania). Producers in Lithuania, followed by those in Bulgaria, Hungary, Finland, Latvia and Estonia, exhibit the strongest dependence on value added from Russia. Besides the coke and petroleum industry (value added from Russia amounts to 17.5% of total output), utilities (5.3%) and transportation services (around 2%) are most dependent on inputs from Russia (including indirect linkages).

The dependence on imports is greater for some goods and services than for others: Energy products from Russia exhibit a low degree of substitutability for several EU countries in the short to medium term. In fact, the great variation between individual Member States' dependency on energy imports calls for the completion of the single market in the energy and utility sector, the establishment of a suitable physical infrastructure across Europe, and the reduction of dependencies on single source countries.

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Macrofinancial Developments and Systemic Change in CIS Central Asia from 2009 to 2014[1]

Stephan Barisitz[2]

CIS Central Asia's structural heterogeneity may have deepened since the global crisis of 2008–09. Kazakhstan and Turkmenistan are relatively rich oil and gas exporters, the Kyrgyz Republic and Tajikistan are poor energy importers, and Uzbekistan is a more diversified but still rather poor economy. The rich hydrocarbon exporters typically achieve "twin surpluses" (current account and budget), while the hydrocarbon importers are often saddled with "twin deficits," but benefit from remittance inflows. In contrast to the poorer countries, the energy exporters tend to attract large amounts of FDI and have carried out generous infrastructure modernization programs. Per capita income growth of the rich and the poor countries has diverged in recent years. No recession had occurred in Central Asia in 2009 and mostly robust GDP growth has ensued since. Growth drivers have been: recovering energy and other resource prices and/or export volumes, generous private and public investment expenditures, and substantial remittances. Fixed exchange rates (to the U.S. dollar) tend to be opted for by the oil and gas countries, floating currencies are preferred by the others. While price stability policies vary and inflation rates have on average come down to below double digits, price levels remain strongly exposed to volatile international food and staples markets. Banking sectors are fragile across the region; they are either recovering from a legacy of collapsed credit booms or suffering from high nonperforming loans as a result of connected lending or they require periodic subsidies for performing quasi-fiscal activities.

JEL classification: E52, E63, G21, G28, P34
Keywords: State-led economy, structural reforms, heterogeneity, monetary policy, convertibility, exchange rate regime, banking, quasi-fiscal functions, Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

This article builds on a previous contribution on the same topic published in this journal five years ago (Barisitz, 2009). It is meant to provide a concise analytical overview and update (2009–14) of the institutional and economic policy frameworks as well as of macroeconomic policies and challenges in the five Central Asian countries of the Commonwealth of Independent States (CIS), i.e. Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. Special emphasis will be laid on monetary and exchange rate policies and on banking sector and financial stability developments. Some basic economic aspects of the region are not dealt with again. The study quickly enters into details.[3]

Section 1 starts with a horizontal flyover of the region, outlining political and economic regimes in the countries concerned, and comparing the evolution of structural, macroeconomic and selective banking indicators from the global crisis

[1] *This is a follow-up study to Barisitz, S. 2009. Macrofinancial Developments and Systemic Change in CIS Central Asia. In: Focus on European Economic Integration Q3/09. 38–61. Essential points of the present study were presented by the author on May 17, 2014, under the title "Central Asia: Extraordinary Structural and Institutional Heterogeneity at the Borderlands between Eastern Europe and East Asia" at the conference "Autocracy and Market Economy. The Transformation of Eastern Europe and East Asia in Comparison" organized by the Research Platform "Wiener Osteuropaforum" and the University of Vienna.*

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[3] *For those less acquainted with this region, which may appear relatively "exotic" to Western readers, it is suggested to consult Barisitz (2009) beforehand (section 2 "Macro-Structural Overview of Central Asia: Impressive Heterogeneity").*

of 2008–09 to 2013, in some cases to 2014. This is followed by country-by-country close-ups in sections 2 to 6, which give country-specific information on evolving policy conditions and some essential details with respect to monetary policy and banking supervision experiences and reforms. An overall comparative assessment (section 7) summarizes analyzed facts and draws conclusions on salient institutional and structural developments, and on performances and challenges of economic policies in CIS Central Asia.

1 Macro-Structural Overview: Regional Diversity Has Become Entrenched in Recent Years

The political frameworks of most Central Asian countries are characterized by a variety of authoritarian regimes. Less political freedom typically goes hand in hand with fewer economic liberties. In this sense, the "highly authoritarian" political regimes (according to the Economist Intelligence Unit Democracy Index) in Turkmenistan and Uzbekistan correspond to "repressed" economic regimes (according to the Heritage Foundation Economic Freedom Scores).[4] In Tajikistan, a plainly authoritarian government goes with a mostly unfree economic environment. In Kyrgyzstan, a hybrid (no longer authoritarian) regime accompanies a mostly unfree economic setting. Kazakhstan finally features the combination of a mildly authoritarian regime with a moderately free business environment. The cases of Kazakhstan and the Kyrgyz Republic[5] are therefore somewhat at variance with the above principle of matching of political and economic freedom or lack of freedom.[6]

In terms of average wealth or GDP per capita (measured in U.S. dollars at market exchange rates), Kazakhstan (with USD 13,150 in 2013) remains by far the richest country of Central Asia, and, given its robust recent growth rates, is even approaching Russia's GDP per capita level (see table 6). Kazakhstan's relatively liberal business environment has certainly been helpful in this respect. Highly centralized Turkmenistan is number two, followed by interventionist Uzbekistan on a much lower per capita level.[7] Both Turkmenistan and Uzbekistan, however, (according to official data) recorded the most dynamic income growth of the region since the crisis of 2008–09. Finally, remote, small and politically unstable Kyrgyzstan and Tajikistan are the poorest Central Asian and CIS countries and have exhibited below-regional average income growth rates. Thus, regional income diversity has been on the increase recently.

To a considerable extent these income and wealth differences appear to be linked to sharply differing export and import structures. More than 80% of Turkmen, about two-thirds of Kazakh and one-third of Uzbek exports consist of oil, gas and other mineral products. Kazakhstan also exports metals, Uzbekistan cotton and metals. In contrast, the Kyrgyz Republic and Tajikistan do not sell

[4] *For more information on the EIU Democracy Index, see www.eiu.com/public/topical_report.aspx?campaignid=DemocracyIndex12; for more information on the HF Economic Freedom Scores, see www.heritage.org/index.*

[5] *The official term "Kyrgyz Republic" and "Kyrgyzstan" are used here as synonyms. The same applies here for the official term "Turkmenistan" and "Turkmenia."*

[6] *This particular issue will be taken up in more detail below.*

[7] *Given the pronounced degree of state dominance in the Turkmen and Uzbek economies, official statistical data on income, GDP and other economic categories have to be treated with caution.*

hydrocarbons (see chart 2). Gold and food are Kyrgyzstan's main exports, aluminum and cotton Tajikistan's. Import structures are largely complementary and have probably served to deepen existing regional disparities: Turkmenia, Uzbekistan and Kazakhstan import substantial shares of machinery and equipment (ranging from about 15% to over half of total imports), which may be used for modernizing the production apparatus and infrastructure (see below). On the other hand, expectedly, energy and food feature among Kyrgyzstan's and Tajikistan's main staples purchased from abroad (see chart 3).

The balance of migrants' remittance flows seems to present a reverse mirror image of Central Asian countries' comparative wealth. Given low-income Tajikistan's and Kyrgyzstan's large number of guest workers earning money abroad – mostly in Russia and Kazakhstan –, workers' remittances make up no less than 45% of Tajik GDP[8] and 30% of Kyrgyz GDP (in 2012). Uzbek guest workers' remittances attain a size of about 7% of the country's GDP, while "rich" Kazakhstan's and Turkmenistan's remittances are (close to) zero (see table A2 in the annex).

Russia and China are the two largest trading partners of all five CIS Central Asian countries (as depicted in chart A1 of the annex). Central Asian trade with Russia on average still exceeds trade with China, but the latter is quickly catching up (Saint-Paul, 2013). Russia and China together account for about 30% to 40% of regional foreign trade turnover. Italy is Kazakhstan's third-largest trading partner and the EU as a whole accounts for about one-third of the country's trade turnover; in other words, the European Union is Kazakhstan's leading trading partner. This does not hold for the other four countries of the region.[9] The Eurasian Customs Union (CU) – established in 2010 and comprising Belarus, Kazakhstan and Russia – and the Eurasian Economic Union (EAU) – which will come into effect in January 2015 and may soon also include the Kyrgyz Republic and possibly Tajikistan as Central Asian members – may somewhat slow down the dynamics of trade reorientation toward China. While a lot remains to be implemented, the EAU formally envisages the free movement of goods, services, capital and labor between member countries.

In Central and Eastern Europe, the banking sectors' ownership structure is dominated by – mostly Western European – FDI. In Central Asia, in contrast, either state-owned banks (SOBs) are in control (Turkmenistan and Uzbekistan)[10] or domestically owned credit institutions hold sway (Kazakhstan and Tajikistan)[11]. Only in the Kyrgyz Republic is a large share (not quite half) of credit institutions' assets owned by foreigners – mostly Kazakh business groups (see chart 4). Regional banking sectors have remained rather weak financially; in Turkmenia, Uzbekistan, Tajikistan and the Kyrgyz Republic (to a smaller degree), banks have continued to fulfill quasi-fiscal functions. Therefore, such credit institutions have tended to

[8] *Almost half of the Tajik labor force reportedly works outside the country; in 2013, remittances even covered more than half of the country's GDP. Thus, Tajikistan is the most remittance-dependent country of the world (Emerging Europe Monitor: Russia & CIS, 2014a).*

[9] *Other salient trading partners of Central Asian countries are: Kazakhstan (the regional economic heavyweight), Turkey, Afghanistan, Iran, Switzerland and South Korea (see chart A1 in the annex).*

[10] *SOBs make up about 90% of Turkmen and approximately two-thirds of Uzbek banking assets.*

[11] *Domestic business groups, often well connected to current or past governments, account for more than half of Kazakh and more than three-quarters of Tajik banking assets.*

require recurrent ad-hoc liquidity injections, periodic bailouts or recapitalizations by the authorities.

Central Asia has not featured major economic reform advances as measured by EBRD transition indicators[12] in recent years. Privatization, governance, enterprise restructuring, and competition policy in the last five years largely stalled across the region; price liberalization, trade and foreign currency system reform showed slight improvements, particularly in Tajikistan and Turkmenistan. After having carried out steps of deregulation prior to the crisis of 2008–09, most countries reregulated their banking sectors in the last five years. More generally, looking at unweighted averages derived from EBRD transition indicators, one can conclude that all Central Asian countries had been moving on paths of modest reform progress (on different levels) prior to the crisis. However, after the crisis only two countries (Tajikistan and Turkmenistan) continued in this general direction, while the other three (Kazakhstan, the Kyrgyz Republic and Uzbekistan) did no longer exhibit any meaningful progress and actually slid back slightly.

Interestingly, while the EBRD as well as the Heritage Foundation view Turkmenistan and Uzbekistan as repressed or at least partially centrally planned economies, the reform performances of Kyrgyzstan, Kazakhstan and Tajikistan are considered to be quite comparable by the EBRD, with the Kyrgyz Republic in the lead, whereas (as mentioned above) the Heritage Foundation sees Kazakhstan – as a moderately free economy – in the lead.

Average annual economic growth in the six years from 2008 to 2013 remained impressively high across the region, although post-2008–09-crisis growth was doubtlessly lower than precrisis rates of increase. Thus, (unweighted) average annual GDP growth in the five CIS Central Asian countries, which had stood at 8.5% in the four years preceding the crisis, i.e. from 2004 to 2007, fell to 7.4% in the four years following the crisis (2010–13). In contrast to Russia and almost all CESEE and Western countries, no Central Asian country suffered a recession in 2008–09, as can be seen in chart 1. Kyrgyzstan did experience modest slumps in 2010 and in 2012; these were, however, not connected to the global crisis, but to domestic structural and economic problems (see below). From 2008 to 2013, annual CPI inflation (end-year) in Central Asia came down from levels of 8% to 20% to converge to between 5% and 7%, with Uzbekistan as an outlier at 12% (2013, see also below).

Given Central Asia's immense economic potential, FDI would certainly be needed across the region. FDI flows to the major energy exporters Kazakhstan and Turkmenistan have been generous in recent years. These two countries together with the energy exporter Uzbekistan also boast frequent or regular trade as well as current account surpluses. In contrast, the energy importers Kyrgyzstan and Tajikistan are typically saddled with current account deficits. Fiscal results appear to replicate this picture. The energy exporters including Uzbekistan feature budget surpluses, which, together with their positive current account balances, make up "twin surpluses," whereas the energy importers chalk up budget shortfalls and "twin deficits." Given that the Kyrgyz Republic and Tajikistan are poor countries, they receive international financial assistance. Both benefit from IMF

[12] *EBRD transition indicators range from 1 to 4+, with 1 representing little or no change from a rigid centrally planned economy, and 4+ representing the standards of a developed market economy.*

Chart 1

GDP Growth

%, in real terms

Source: IMF, national statistics.

Note: Data for 2014 are forecasts.

Extended Credit Facility Arrangements, from program loans and grants for budget support from external donors, and from foreign-financed Public Investment Programs (PIPs).

2 Kazakhstan: High Growth and Accumulating Wealth, but Tenacious Banking Problems

2.1 Some Salient Structural and Institutional Aspects

Together with Kyrgyzstan, Kazakhstan has in recent years remained the most market-oriented economy in the region (according to EBRD transition indicators as well as Heritage Foundation Economic Freedom Scores). In line with 2011 figures, more than half of the Kazakh banking sector's assets are privately owned by domestic business groups, about one-quarter is accounted for by state-owned or nationalized banks (see below) and about one-fifth is foreign owned. The country has a well-replenished oil stabilization fund, the National Fund of the Republic of Kazakhstan (NFRK, with assets corresponding to almost one-third of GDP). In recent years, Kazakhstan's public investment holding company and state development agency Samruk Kazyna (SK, established in 2008) has expanded its portfolio of state-owned enterprises across a number of sectors. SK managed over USD 78 billion in assets in 2010, which had risen to over USD 100 billion (or approximately 50% of GDP) by mid-2013 (Chazan, 2013). About three-quarters of SK's assets are accounted for by the oil, gas and financial sectors. Roughly one-third of corporate deposits in Kazakh banks belong to firms held by the development agency. SK plays a pivotal role as an instrument of industrial policy, which includes efforts to diversify the economy through the financing of non-oil projects. The Kazakh tenge is convertible for current, capital and financial account transactions (since 2007).

Table 1

Kazakhstan: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	8.9	3.2	1.2	7.3	7.5	5.0	6.0
Current account balance (% of GDP)	–8.1	4.7	–3.6	0,9	5.4	0.3	0.1
Net FDI flows (% of GDP)	7.7	9.7	8.7	2.5	4.9	6.0	3.6
Gross external debt (% of GDP)	93.9	79.8	97.9	79.9	66.6	69.5	68.5
Debt service ratio (% of exports of goods and services)	. .	41.7	63.2	32.1	24.2	33.7	26.0
Gross international reserves (% of GDP)[2]	17.1	14.7	20.0	19.1	15.6	14.0	15.5
NFRK[3] foreign assets (% of GDP)	20.4	20.3	21.2	20.9	23.2	28.5	31.4
General government budget balance (% of GDP)	4.7	1.1	–1.4	1.4	5.9	4.5	5.2
CPI inflation (year-end, %)	18.8	9.5	6.2	7.8	7.4	6.0	4.8
Exchange rate: KZT/USD (annual average)	122.6	120.3	147.5	147.4	146.7	149.2	150.3
Level of monetization (broad money/GDP, %)	36.6	38.5	43.4	39.2	35.4	34.8	35.3
Credit to the economy (% of GDP)	59.9	49.0	50.2	39.5	35.9	37.2	40.1
of which: foreign currency-denominated loans (%)	43	44	48	42	36	31	31
of which: nonperforming loans (%)	3	5	22	24	31	30	31
Asset share of foreign-owned banks (%)	38.5	12.9	17.2	17.5	22.0	. .	. .
Domestic credit (% of GDP)	41.0	54.2	54.6	45.4	40.3	42.5	41.8
Capital adequacy ratio (%)	14.2	14.9	–8.2	17.9	17.4	18.1	17.0
Memo items:							
GDP (nominal, KZT billion)	12,641	16,268	17,008	21,815	27,572	30,219	33,426
GDP (nominal, USD billion)	103.1	135.2	115.3	148.0	188.0	202.6	222.4

Source: National statistics, IMF, Asian Development Bank, World Bank, EBRD.

[1] Partly estimates.
[2] NFRK financial assets are not included.
[3] NFRK = National Fund of the Republic of Kazakhstan (oil stabilization fund).

2.2 Macroeconomic and Banking Sector Developments

While the Kazakh economy overall quickly recovered from the crisis of 2008–09 and economic growth rates have since remained robust, recent years have been marked by serious banking problems and the launching of strategies to solve them. Kazakhstan's relatively strong ties with the global economy and financial markets were reflected in the decline of the country's economic growth rate to 1.2% in 2009 and in its current account and budget deficits of 3.6% and 1.4% of GDP, respectively, that year. Moreover, as shown in table 1, Kazakh banks' nonperforming loans (NPLs) more than quadrupled (as a share of total loans) and the sector's capital adequacy ratio (CAR) turned negative that year.

The macroeconomic data also reflect the impact of the authorities' Anti-Crisis Plan (ACP), which comprised public support of a total amount of about USD 12 billion over 2009–10 (about 5% of annual GDP in both years) to four of the largest banks and the nationalization of three of them, financial assistance to SMEs, real estate, farming sectors, and other measures. The National Bank of Kazakhstan's (NBK's) devaluation of the tenge by 20% in February 2009 established a new stable exchange rate toward the U.S. dollar, or more precisely, a narrow trading band around a central parity of KZT 150/USD. The monetary authority also cut the refinancing rate (the main policy rate) by a total of 350 basis points to 7.0% and reduced banks' reserve requirements (Barisitz, 2010, pp. 56–58, 73–74). Despite the receipt of public assistance, three overleveraged banks (Bank Turan-Alem – BTA, Alliance Bank, Temir Bank) defaulted on their external obligations and entered into restructuring negotiations with their foreign creditors,

which produced agreements on substantial haircuts in 2010 (Barisitz, 2013, pp. 184–185).

The ACP stimulus, the fledgling recovery of the world economy and notably the recovery of oil, gas and other raw material prices contributed to Kazakhstan's economic upturn in 2010 and 2011 (Combe, 2012, p. 17). In early 2011, the NBK somewhat changed its policy emphasis from supporting the financial and real sectors to keeping inflation on a downward path: The refinancing rate was raised to 7.5% and thus the easing cycle implemented during the crisis was partly reversed. To sterilize inflows of capital, the monetary authority also sharply increased its issuance of short-term notes. Even administrative measures were applied to combat price rises: Price caps were introduced on staple food items and the periodic adjustment of utility tariffs was postponed. Inflation slightly declined to 7.4% at end-2011. However, credit institutions did not benefit much from the upswing, given that the most dynamic sectors (e.g. oil, other natural resources, metallurgy) relied little on bank funding and that banks remained bogged down by their legacy of past poor lending, particularly to the real estate and construction sectors. Many credit institutions, especially some of the larger ones, continued to be burdened with high and even increasing NPLs.[13]

With continuing global economic weakness in 2012 and 2013, Kazakh GDP growth moderated to between 5% and 6%, while NFRK foreign assets reached record levels (31% of GDP in 2013, see table 1)[14]. Persisting and teething problems with bad assets, both domestic and external (probably also connected to fraudulent practices) contributed to BTA's renewed default on its external obligations. This triggered some additional recapitalization measures by its government shareholders and the launch of negotiations on a second debt restructuring round in early 2012. The authorities then developed a new mechanism to deal with impaired bank loans, combining a centralized bank Problem Loans Fund (PLF), financed by the NBK and other investors, with special purpose vehicles (SPVs), set up in a decentralized manner with individual banks and benefiting from preferential provisioning requirements. The PLF has focused on NPLs other than bad real estate loans, while SPVs were assigned to real estate and construction loans. Implementation of the new mechanism has so far been slow, though. In 2013, the authorities attempted another, more administrative approach to improving credit quality: The NBK introduced regulatory NPL ceilings, which appear ambitious (15% of total loans by end-2014, 10% by end-2015) (IMF, 2012a, p. 12; IMF, 2014a, p. 11).

Given the renewed weight of banking problems[15] and the simultaneous weakening of inflationary pressures, the NBK moved back to a more accommodative monetary policy stance by cutting its policy rate by 200 basis points to 5½% in the

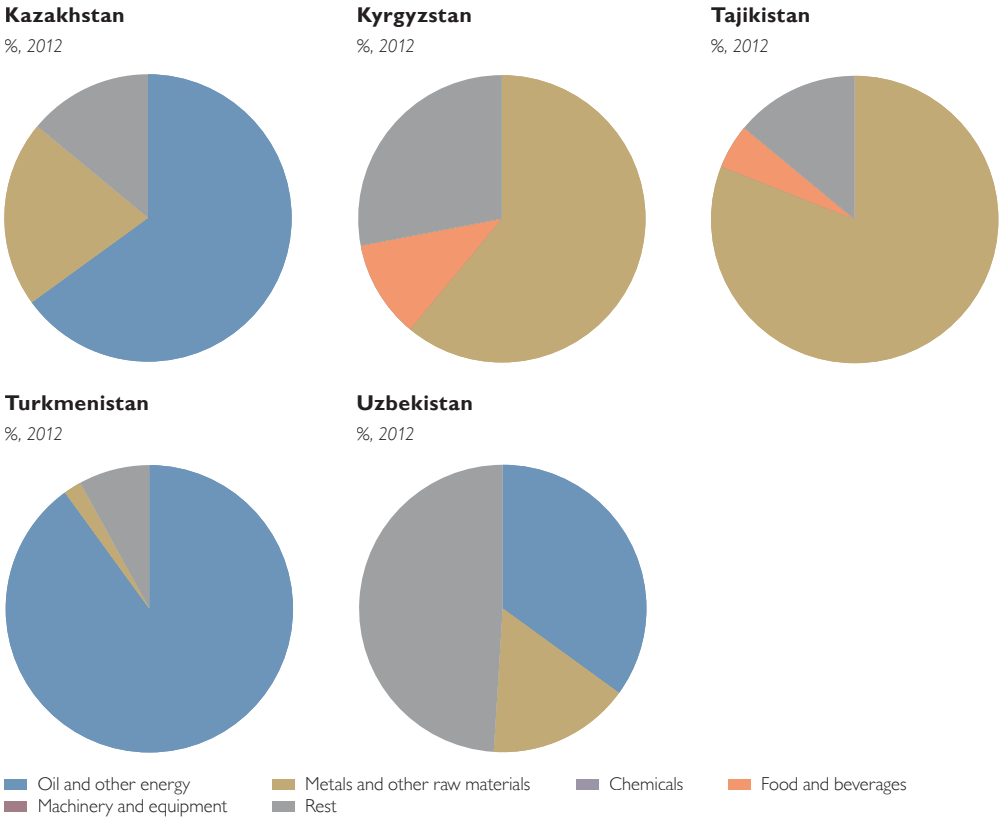
[13] *Overall, NPLs came to 31% of total loans in 2011 and have remained largely at this level since then (see table 1).*

[14] *While the oil and gas business is certainly at the core of the Kazakh economy's still robust expansion, hydrocarbon projects also bear high risks, as exemplified by the Kashagan project, which is related to one of the largest oil deposits on earth. Kashagan oil is located beneath the bottom of the northern Caspian Sea, but is difficult to access, because it lies very deep and is under great pressure. Compared to originally planned deadlines and project budgets, the Kashagan venture has (so far) accumulated a delay of eight years and cost overruns of about 400%: Instead of the planned USD 10 billion, the project – jointly undertaken by a number of Western corporations, a Chinese firm and the Kazakh national resource company Kazmunaigaz – has so far cost almost USD 50 billion and is still not successfully extracting the "black gold" (Feitz, 2014; Gente, 2014).*

[15] *There has lately been one exception to the overall sluggish banking activity (compared to the precrisis period), namely the reacceleration of consumer credit since 2012.*

Chart 2

Major Exported Goods



Source: National statistics.

summer of 2012. The tenge's real appreciation since 2009, but particularly the strong devaluation of the Russian ruble in the first two months of 2014 (on top of its modest slide in 2013), prompted the NBK to devalue the national currency by another 19% in February 2014, exactly five years after the previous large devaluation. At KZT 185/USD, the Kazakh currency is again managed within a narrow corridor (table 6). Despite some price controls, the devaluation has fueled inflation, which reached 6.9% at end-May 2014 (year on year), and it may have a negative impact on consumer credit quality.

3 Kyrgyzstan: Reform Oriented, but Jolted by Recurrent Political Instability

3.1 Some Salient Structural and Institutional Aspects

The Kyrgyz Republic and Kazakhstan are assessed to be very close with regard to the overall economic reform progress achieved (as mentioned above). One particular difference between the two is that Kyrgyzstan has been a member of the WTO (since 1998)[16], while the Kazakh tenge is the only fully convertible currency of the region. An important structural aspect of the Kyrgyz economy is its dependence

[16] *The WTO counts two member states in CIS Central Asia – the Kyrgyz Republic and Tajikistan (the latter joined in 2013, see below).*

Table 2

Kyrgyzstan: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	8.5	7.6	2.9	–0.5	6.0	–0.9	10.5
Current account balance (% of GDP)	–6.0	–8.1	0.7	–6.4	–6.5	–15.1	–14.1
Net FDI flows (% of GDP)	5.5	5.2	4.1	9.1	11.2	4.4	10.5
Gross external debt (% of GDP)	60.3	70.0	88.0	91.4	78.6	83.5	80.1
Debt service ratio (% of exports of goods and services)	14.0	26.8	41.4	25.9	11.1	11.3	11.3
Gross international reserves (% of GDP)	29.1	22.5	32.0	33.6	29.5	31.8	30.8
General government budget balance (% of GDP)[2]	–0.3	0.0	–3.5	–6.5	–4.6	–5.4	–4.0
CPI inflation (year-end, %)	20.1	20.1	0.0	18.9	5.7	7.5	4.0
Exchange rate: KGS/USD (annual average)	37.3	36.6	42.9	46.0	46.1	47.0	48.4
Level of monetization (broad money/GDP, %)	29.6	25.2	28.4	31.1	27.8	31.7	34.5
Credit to the private sector (% of GDP)	15.5	14.2	12.9	12.5	11.7	13.5	16.3
of which: foreign currency-denominated loans (%)	62.5	63.7	59.6	52.9	52.5	51.9	50.7
of which: nonperforming loans (%)	3.5	5.3	8.2	15.8	10.2	7.2	5.9
Capital adequacy ratio (%)	31.0	32.6	33.5	31.0	30.3	28.3	24.6
Memo items:							
GDP (nominal, KGS billion)	141.90	187.79	201.24	220.45	285.98	310.50	350.00
GDP (nominal, USD billion)	3.804	5.131	4.680	4.794	6.199	6.603	7.225

Source: National statistics, IMF, Asian Development Bank, World Bank, EBRD.

[1] *Partly estimates.*
[2] *Excluding externally financed programs.*

on gold extraction (15% of GDP) and gold exports (between 30% and 35% of total exports). Gold production, carried out by a foreign investor in one large open-pit mining site (Kumtor) in the central Tienshan range, has repeatedly been the subject of controversy, worker unrest and tensions between the investor and the authorities.

Almost half of the country's banking sector's assets (2010) are owned by foreign – mostly Kazakh – businessmen, while about one-third is owned by private domestic banks. Due to banking turbulences and some nationalizations, state-owned banks' share expanded recently. The Kyrgyz authorities manage some limited practices of directed lending: Under the Affordable Loans for Farmers (ALF) program and some other government-supported schemes, the authorities lend to state-owned banks, particularly the Settlement and Savings Company (SSC, the largest state-owned bank) for further onlending to agriculturalists and other beneficiaries at predetermined (subsidized) interest rates (IMF, 2012b, p. 6; see also table 6). Kyrgyzstan is Central Asia's most open country (in terms of exports and imports of goods and nonfactor services to GDP, see table A1 in the annex), and its openness further increased in recent years. Given the country's small size and its exposure to external and internal economic instability, Kyrgyz inflation tends to be very volatile.

3.2 Macroeconomic and Banking Sector Developments

While the Kyrgyz economy did not experience a recession as a consequence of the global economic crisis, it did witness repeated bouts of economic contraction (in 2010 and 2012), caused by domestic political turmoil or industrial unrest.[17]

[17] *The country had already gone through comparable domestically triggered slumps in 2002 and 2005 (Barisitz, 2009, p. 39).*

Kyrgyzstan therefore witnessed the weakest average GDP growth rate of the region in the six years from 2008 to 2013 (4.2% p.a.).

The authorities' macroeconomic stance was somewhat loosened in order to overcome the impact of the crisis of 2008–09. Inflation had practically disappeared at end-2009, largely due to the crisis-triggered reversal in international commodity prices and the slowdown of activity. The National Bank of the Kyrgyz Republic's (NBKR's) flexible managed floating policy facilitated the downward adjustment of the external value of the Kyrgyz som in 2009 and 2010. In 2009, the Russian Federation also provided some generous budgetary support and debt relief.

However, in 2010, the Kyrgyz economy was struck by a deep political crisis: In April, a popular uprising[18] toppled the previous regime, and in June, ethnic conflict in the south of the country exacerbated the already difficult political situation. The subsequent constitutional referendum and parliamentary elections in October 2010 helped stabilize the situation and put the economy back on a path of recovery, though the political environment has remained tenuous. The economy was seriously disrupted in 2010, with GDP declining by 0.5% and twin deficits (fiscal and current account shortfalls) reappearing. However, following a global spike of food and fuel prices, annual inflation shot back up to 18.9% in 2010. In response, the NBKR tightened monetary policy by significantly increasing its sales of short-term notes and raising reserve requirements. Receding global food prices in 2011 helped bring down price dynamics.

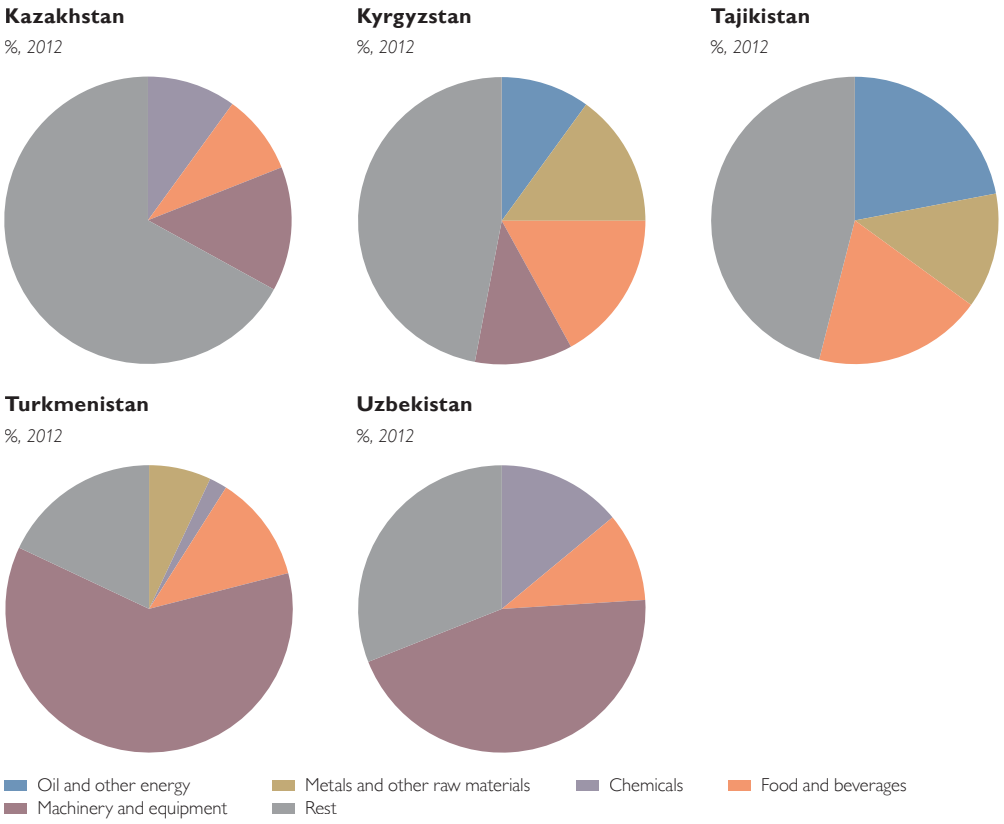
Given the crisis-related credit crunch, the share of NPLs in total loans tripled (to 16%) from end-2008 to end-2010. In late 2010, the NBKR introduced temporary administration in Asia Universal Bank (AUB), the largest bank, and in four other credit institutions after AUB had experienced a significant outflow of nonresident deposits, allegedly linked to the previous rulers, and after it had become known that a sizeable portion of its liquid assets placed abroad was nonrecoverable. AUB was subsequently nationalized and the four other banks placed in conservatorship. Deposits in the above five delinquent banks were shifted to entities believed to be safer, particularly foreign banks and the largest state-owned bank, the SSC (see above). AUB was split into a "good bank" – Zalkar bank – and a "bad bank" absorbing AUB's impaired assets. With substantial delay, Zalkar was finally sold to a Russian investor (ITB Bank) in 2013 (IMF, 2013a, p. 14).

2011 witnessed economic stabilization, which however turned out to be much shorter than expected, since the outbreak of industrial unrest and disruptions in gold production triggered a renewed home-grown recession the following year (GDP: –0.9%). The current account gap widened sharply (to above 15% of GDP in 2012). Fiscal as well as monetary policy were again slightly eased in response to the economic weakening and the moderation of inflation. Thus, the monetary authority reduced its policy rate to 3%. Although distributional disputes between the gold mining company and the government went on, prolonging uncertainty, economic growth bounced back strongly (+11%) in 2013 (table 2). Once the crisis had been overcome, monetary reins were tightened again: The central bank stepped up its sterilization efforts via NBKR notes. In early 2014, after a two-year dispute, the authorities finally reached a new agreement on the Kumtor gold mining

[18] *Protests were fueled by allegations of authoritarianism and corruption.*

Chart 3

Major Imported Goods



Source: National statistics.

site with the foreign investor, which should have positive effects on the business environment.

In the first quarter of 2014, the Kyrgyz som came under pressure due to the decline of the Russian ruble and the devaluation of the Kazakh tenge. To smooth sharp fluctuations, the NBKR intervened, selling about USD 200 million or around 9% of its foreign reserves. The monetary authority also raised its policy rate to 6% and tightened a limit on banks' net open foreign exchange positions. The Kyrgyz currency's depreciation against the U.S. dollar spiked at 22% in March, but more recently around half of the loss was recouped, and reserves have been reaccumulating (IMF, 2014b, p. 6).

4 Tajikistan: On the Catching-Up Route, but Remaining under the Sway of International Price Movements and Directed Lending Practices

4.1 Some Salient Structural and Institutional Aspects

In terms of the depth of economic reforms carried out, Tajikistan occupies a middle position among the countries of Central Asia (according to the assessment of the EBRD as well as of the Heritage Foundation). Tajikistan joined the WTO in March 2013. The small mountainous country's main exports are aluminum (more than half of total exports), cotton (about one-fifth), and electricity. More than three-quarters of Tajik commercial banks are owned by domestic business groups.

Table 3

Tajikistan: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	7.8	7.9	3.9	6.5	7.4	7.5	7.4
Current account balance (% of GDP)	–8.6	–7.6	–5.9	–1.2	–4.7	–2.0	–1.9
Net FDI flows (% of GDP)	4.3	5.8	0.7	0.3	1.0	1.9	1.8
Gross external debt (% of GDP)[2]	33.7	29.2	33.2	33.9	32.1	29.8	25.2
Debt service ratio (% of exports of goods and services)	13.0	10.5	20.3	7.5	5.1	. .	. .
Gross international reserves (% of GDP)	2.3	2.9	5.6	8.4	8.8	8.7	8.1
General government budget balance (% of GDP)[3]	1.6	1.4	–0.5	–0.4	0.9	1.9	–0.1
CPI inflation (year-end, %)	19.8	11.9	5.0	9.8	9.3	6.4	6.1
Exchange rate: TJS/USD (annual average)	3.44	3.43	4.14	4.38	4.61	4.76	4.76
Level of monetization (broad money/GDP, %)	21.4	16.5	19.6	20.6	24.6	23.6	24.1
Credit to the private sector (% of GDP)	29.7	25.7	21.5	13.3	13.6	12.3	12.5
of which: foreign currency-denominated loans (%)	68.2	63.8	63.4	54.2	59.3	. .	. .
of which: nonperforming loans (%)[4]	2.8	5.4	10.4	7.5	7.2	9.5	. .
Capital adequacy ratio (%)	19.4	24.2	25.4	24.5	21.3	23.3	. .
Memo items:							
GDP (nominal, TJS billion)	12.780	17.609	20.623	24.705	30.069	36.161	41.690
GDP (nominal, USD billion)	3.712	5.135	4.982	5.642	6.523	7.592	8.537

Source: National statistics, IMF, Asian Development Bank, World Bank, EBRD.

[1] *Partly estimates.*
[2] *Public and publicly guaranteed external liabilities.*
[3] *Excluding externally financed programs.*
[4] *Including loans more than 30 days overdue.*

Monetary policy and banking supervision are saddled with considerable structural weaknesses: The interbank market is virtually nonexistent and functioning money markets are absent. Directed lending to agriculture, particularly to the cotton sector, has constituted an important function of the country's banking system. The Tajik somoni (TJS) became convertible for current account transactions in 2004. Similar to the case of Kyrgyzstan, the small size of the Tajik economy and its dependence on food and fuel supplies from external markets contribute to explaining its highly volatile rate of inflation.

4.2 Macroeconomic and Banking Sector Developments

Tajik economic expansion moderated from about 8% in 2008 to 4% in 2009. In the framework of countercyclical fiscal policy, small budget deficits (about ½% of GDP) were incurred in 2009 and 2010.[19] Using its managed floating exchange rate regime in a flexible manner (not unlike the NBKR), the National Bank of Tajikistan (NBT) let the Tajik somoni depreciate by about 28% in the course of 2009 and 2010, as a result of which the current account deficit narrowed substantially. In light of a benign turn of international commodity prices, inflation declined from double digits at the beginning of the year to 5% in December 2009, before regaining momentum (table 3). Credit to the private sector contracted in 2009 and 2010, probably due to efforts to rein in directed lending policies.

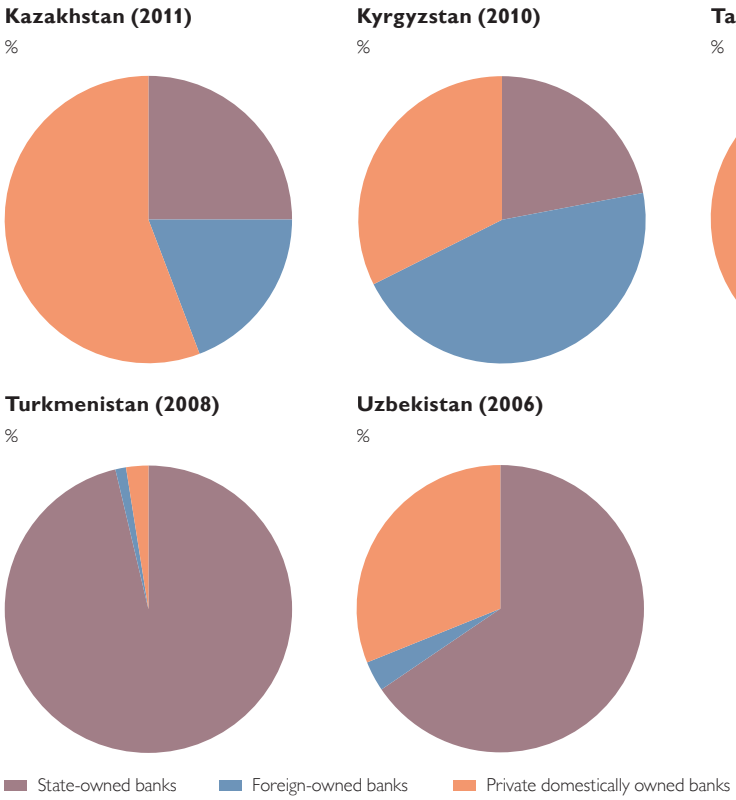
[19] *This figure excludes the externally financed Public Investment Program (PIP) and related grants, which made up about 3% to 5% of GDP.*

In order to break with the long-standing practice of allocating directed NBT credits via commercial banks to state-owned enterprises (SOEs) and private firms of the cotton sector, the government launched a cotton debt resolution strategy in 2009–10. The strategy envisaged the write-off of all farm debt – principally directed cotton loans – of about TJS 2.3 billion (i.e. a tenth of GDP or half of the entire credit volume). It further envisaged the issuance of around TJS 450 million of T-bills to commercial banks, and other assistance measures. The monetary authority's cotton debt department was closed in mid-2009 and a recapitalization strategy was adopted for the NBT. Moreover, prudential norms were tightened and supervision was stepped up; the supervisor demanded in 2010 that those banks with the highest NPLs present time-bound action plans to deal with potential capital losses (IMF, 2010, pp. 7, 11).

Pushed by roller-coaster global commodity prices, particularly of grain, flour and fuel, and by somoni depreciation, inflation rose back to almost 10% at end-2010. This gave rise to some post-crisis tightening efforts in early 2011: Policy rates were sharply increased, and the government even imported food products and sold food products from strategic reserves in an attempt to ensure adequate market supplies and curb any speculative distortions. Still, headline inflation remained largely under the sway of international food prices; after peaking at 14.8% in May 2011, inflation was down at 9.3% at the end of the year and stood at 6.4% at end-2012, as shown in table 3.

Chart 4

Ownership Structure of the Central Asian Banking Sectors



Source: National statistics.

Soon the financial sector required renewed attention. Against the background of insufficient capital levels at some banks, NBT liquidity injections were stepped up in late 2010 and 2011, which in turn fueled credit expansion. Then the monetary authority's liquidity support fell sharply, following the government bailout of Agroinvestbank (AIB) in mid-2012, the largest Tajik credit institution by assets and mostly associated with agricultural and SOE financing (table 6). The government purchased bad loans at virtually no discount and provided capital. The operation came at a total fiscal cost of 2% of GDP, and gave the authorities a majority stake in AIB, while leaving existing private shareholders with the remaining equity and effective control over the bank's management.

Meanwhile, the recapitalization of the NBT continued, but at a slower pace than anticipated. Overall, notwithstanding the above effort to write off all farm debt and achieve a clean slate, NBT-managed directed credits and lending to related parties seem to persist as familiar traits of the Tajik banking sector and continue to contribute to its modest profitability (IMF, 2013b, pp. 8–9).

5 Turkmenistan: Impressive Economic Opening Up while Remaining the Most Centrally Planned Economy in the Region

5.1 Some Salient Structural and Institutional Aspects

While having made some progress in the reform of foreign exchange regulations and in price liberalization, Turkmenia has remained the most centrally directed and state-planned economy of Central Asia (according to EBRD transition indicators). Central planning is the main tool for allocating resources. The overwhelmingly government-owned banking sector (about 95%; see chart 4) continues to play a key role as an agent of quasi-fiscal policy by carrying out directed lending instructions. Such instructions have also been a constituent part of a large-scale program of infrastructural investment and modernization, which has contributed to promoting economic growth and, more notably, to successful export diversification.

Some extrabudgetary institutions have helped channel funds to realize the authorities' goals. As a case in point, the Foreign Exchange Reserve Fund (FERF) has been used to save shares of hydrocarbon export revenues. The Stabilization Fund of Turkmenistan (SFT, established in 2008) has accumulated state budget surpluses. And the State Development Bank (SDB) was created in 2011 to foster economic development by taking over some directed lending activities from state-owned banks (table 6). The SDB has also acquired funding for these activities from the SFT. In 2010, the FERF was estimated to account for about two-thirds of all fiscal resources. It has remained outside the state budget and is managed by the Central Bank of Turkmenistan (CBT). In mid-2013, the SDB held about one-third of the total assets and one-fourth of the total credit of the banking sector. In pursuing their objectives, these three entities, to some extent, appear to lack a comprehensive coordination strategy.

The country unified its previously dual exchange rate system in mid-2008 and partly liberalized access to foreign exchange for current international transactions in 2009. Nevertheless, prepayments continue to be required for exports and imports, and banks are not permitted to conduct foreign exchange transactions with nonpublic customers without seeking prior approval of the monetary authority. With the exchange rate unification and currency redenomination, the CBT pegged the Turkmen manat to the U.S. dollar (exchange rate: 2.85 TMT/USD). While the

Table 4

Turkmenistan: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	11.1	14.7	6.1	9.2	14.7	11.1	10.2
Current account balance (% of GDP)	15.5	16.5	–14.7	–10.6	2.0	0.0	0.5
Net FDI flows (% of GDP)	3.3	5.9	22.5	16.4	11.6	8.9	7.5
Gross external debt (% of GDP)	2.4	2.8	2.4	4.1	10.0	18.1	19.6
Debt service ratio (% of exports of goods and services)	1.2	1.4	5.1	23.3	16.8	29.0	34.1
Gross international reserves (% of GDP)	50.9	77.4	93.8	84.8	76.5	75.1	72.2
General government budget balance (% of GDP)	16.6	31.5	15.5	–0.7	12.5	16,1	8.6
CPI inflation (year-end, %)	8.6	8.9	0.1	4.8	5.6	7.8	7.0
Exchange rate: TMT/USD (official, annual average)	1.04	2.30	2.85	2.85	2.85	2.85	2.85
Level of monetization (M2/GDP, %)	48.9	48.5	57.2	74.9	77.3	87.2	97.9
Credit to the economy (% of GDP)	24.2	20.1	22.6	27.3	25.4	26.0	25.3
of which: foreign currency-denominated loans (%)	59.3	54.3	49.4	43.1	33.1	26.6	27.0
of which: nonperforming loans (%)	0.4	0.1	0.1	0.1	0.0	0.0	..
Capital adequacy ratio (%)	15.9	30.9	16.5	17.2	19.4	45.3	..
Memo items:							
GDP (nominal, TMT billion)	27.00	49.47	57.61	63.12	83.32	100.22	115.56
GDP (nominal, USD billion)[2]	25.96	21.52	20.21	22.15	29.23	35.16	40.56

Source: National statistics, IMF, Asian Development Bank, World Bank, EBRD.

[1] Partly estimates.
[2] Valued at the official exchange rate.

manat is formally nonconvertible for balance of payments transactions,[20] the currency may, with some regulatory exceptions, actually have approximated current account convertibility according to the IMF (2013c, p. 2). Contrary to most of its regional peers and despite its overall rigid state-controlled system, Turkmenistan from 2007 to 2012 moved from being the most secluded economy to one of the most open economies of the region (see table 4 and table A1 in the annex).

5.2 Macroeconomic and Banking Sector Developments

Turkmen economic growth (according to official data) was not more than dented during the crisis (dropping to 6.1% in 2009), and remained very strong in recent years. Economic expansion was supported during the crisis by large public investments in the construction of gas export pipelines and other infrastructure within the framework of the National Program of Social and Economic Development. A major public expenditure effort was carried out in 2009 and 2010: The budget balance (including the FERF) declined from a positive 32% of GDP in 2008 to –1% in 2010, while the current account swung from a surplus of 17% of GDP in 2008 to deficits of almost the same size in the following two years. However, as one might expect in the context of such a huge capital formation program, the resulting current account shortfall was largely caused and more than covered by FDI inflows.

Credit to the economy was also on the rise in these years, reflecting stepped-up program financing by directed loans. The temporary sharp decline of inflation (to 0.1%) in 2009 was primarily due to falling import prices coupled with the

[20] *The Turkmen authorities continue to avail themselves of Article XIV of the IMF Articles of Agreement.*

stabilization of the exchange rate and a selective liberalization of the trade and foreign exchange regime. In the following years, food price increases and accommodative policies contributed to the rekindling of inflation. This happened notwithstanding widespread administrative controls and frequent supply-side government interventions, including the saturation of domestic markets with targeted imports (IMF, 2011, p. 13).

Once new gas pipelines aimed at diversifying export markets to China and Iran had become operational in 2010, the growth of exports, GDP and imports accelerated in 2011 and remained in double digits in 2012 and 2013. In this way, the Turkmen economy's openness increased substantially. Public capital formation continued to expand through imported machinery and equipment; accordingly, the current account remained near balance and FDI inflows were substantial.[21] The budget balance reverted to a surplus position. Gross external debt grew quickly in recent years, but remains at a low level (20% of GDP in 2013, see table 4).

6 Uzbekistan: Continuing State-Directed Growth as Isolation Increases

6.1 Some Salient Structural and Institutional Aspects

Since the global economic crisis of 2008 and 2009, Uzbekistan has remained a strongly centralized and state-led economy. Uzbek economic growth is supported and partly directed by the government's Industrial Modernization and Infrastructure Development Program (IMP). State-owned banks continue to account for about 80% of total banking assets and go on carrying out non-core functions of credit institutions, including cash monitoring and controls of their clients as well as tax administration (table 6). State-owned banks remain prominent in carrying out directed lending (typically below market rates) in the framework of the above-mentioned IMP program and other official schemes (IMF, 2013d, pp. 14–15).

The Fund for Reconstruction and Development (FRD) contributes to this activity. Established in 2006, the FRD accumulates revenue in excess of established cut-off prices on mineral resources and thus aims to shield the state budget from the effects of volatile commodity prices as well as to stimulate investment and economic development by extending long-term loans to banks for cofinancing government-selected projects. The FRD's resources quickly multiplied from about USD 1 billion at end-September 2008 to USD 11 billion four years later. The country continues to feature formal – but not de facto – current account convertibility, as foreign currency rationing for imports and other exchange restrictions (e.g. surrender requirements at 100% for cotton and gold and at 50% for other exports) remain commonplace. Like that of most Central Asian economies, Uzbekistan's trade openness (exports and imports of goods and nonfactor services to GDP) declined from 2007 to 2012. Moreover, Uzbekistan – although a relatively large economy – became the least open country of the region (see table A1 in the annex).[22]

[21] *In 2013, production at the world's second-largest gas field, Galkynysh (formerly called Yolotan, in the Mary oasis in southeastern Turkmenia) was inaugurated. Further investment, export expansion and diversification is planned through the construction of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline, which, however, faces considerable bureaucratic and security challenges (Emerging Europe Monitor: Russia & CIS, 2014b).*

[22] *This is in utter contrast to the development of neighboring, even more centrally managed, Turkmenia.*

Table 5

Uzbekistan: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	9.5	9.0	8.1	8.5	8.3	8.2	8.0
Current account balance (% of GDP)	7.3	8.7	2.2	6.2	5.8	2.7	3.7
Net FDI and portfolio investment flows (% of GDP)	3.1	2.5	2.5	4.2	3.6	1.7	1.7
Gross external debt (% of GDP)	17.5	13.1	15.0	14.8	13.4	13.1	18.9
Debt service ratio (% of exports of goods and services)	8.6	6.2	5.8	4.1	3.6	6.4	3.3
Gross international reserves (% of GDP)	33.6	33.3	36.5	37.4	39.8	35.9	34.3
General government budget balance (% of GDP)[2]	5.2	10.2	2.8	4.9	8.8	4.7	1.8
CPI inflation (year-end, %)[3]	11.9	14.4	10.6	12.1	13.3	10.4	11.8
Exchange rate: UZS/USD (annual average)	1,264	1,320	1,466	1,577	1,711	1,885	2,079
Level of monetization (broad money/GDP, %)	16.6	17.2	18.7	22.6	23.8	24.4	25.4
Credit to the economy (% of GDP)	15.0	15.2	16.4	18.5	19.4	19.6	19.6
of which: foreign currency-denominated loans (%)	43.6	34.6	36.4	39.4	41.9	39.5[4]	..
of which: nonperforming loans (%)	2.8	3.0	1.2	1.0	0.7	0.5	..
Capital adequacy ratio (%)	23.8	23.2	23.4	23.4	24.2	24.3	..
Memo items:							
GDP (nominal, UZS billion)	28,196	37,747	49,043	61,794	77,751	96,664	117,386
GDP (nominal, USD billion)	22.31	28.61	33.46	38.96	45.35	51.17	56.47

Source: National statistics, IMF, Asian Development Bank, World Bank, EBRD.

[1] *Partly estimates.*
[2] *Including the Fund for Reconstruction and Development.*
[3] *Based on authorities' source data and IMF staff calculations using international methodology.*
[4] *As at end-September 2012.*

6.2 Macroeconomic and Banking Sector Developments

Uzbek economic growth (according to official data) continued during and after the crisis at about the same speed as before the crisis (between 7% and 9%, in real terms). The current account surplus declined post-2008, but remained positive. Gross external debt remained at low double digits (as a percentage of GDP). As table 5 shows, CPI inflation persisted in double digits (for various reasons, as explained below); the rising price level became a major preoccupation of the authorities.

Economic growth in the crisis year 2009 eased only slightly from 2008 (from 9.0% to 8.1%) as a result of the country's low exposure to global financial markets and thanks to important countercyclical measures, including higher industrial and infrastructure investment through FRD lending, largely in the IMP framework. Accordingly, the fiscal surplus shrank sharply in 2009. Apparently due to this increased liquidity and to continuing de facto foreign currency restrictions, a margin between the official exchange rate and the parallel rate in the unofficial cash foreign currency market emerged.

In 2010 and 2011, prices for Uzbekistan's main exports – cotton, hydrocarbons, steel and gold – recovered. Stimulus policy switched from a largely fiscal to a monetary nature: Driven by stepped-up foreign currency purchases by the Central Bank of Uzbekistan (CBU) and by strong credit growth, broad money growth accelerated. Yet, this contributed to the increase of inflation from 10.6% at end-2009 to 13.3% two years later. The expansion of foreign currency purchases took place as part of the authorities' attempt to lift the competitiveness of the export sector by somewhat accelerating the depreciation of the Uzbek sum within

the framework of the crawling peg-like exchange rate arrangement adopted in 2008. Other factors responsible for the swelling of the price level were: continued demand-boosting policies (linked to government programs and the FRD), and administrative price rises of fuel, utilities and bread aimed at achieving cost recovery.

Fiscal as well as monetary policies were tightened in 2011. The CBU enlarged its sterilization of excess liquidity resulting from the accumulation of foreign assets,[23] while the government increased its deposits with the monetary authority as well as the FRD. As a result, reserve and broad money growth decelerated in 2011 and 2012, and inflation came down again to 11%. The margin that had emerged in 2009 between the official exchange rate and the parallel rate narrowed somewhat in 2012, reflecting the more limited availability of the Uzbek sum. Given that the sustained state-led modernization expenditures, the continued official policy of gradual depreciation of the Uzbek sum and the (basically necessary) administrative price adjustments have constituted core elements of the authorities' economic strategy, the resulting "inflation trap" may not be that easy to escape.

The setbacks in the global recovery in 2013 and the stagnation of commodity prices had a dampening impact on Uzbek economic growth, which the authorities countered by serving a new fiscal stimulus. The budget surplus declined from 4.8% in 2012 to 1.8% in 2013 – and thus reached the lowest level in almost a decade (table 5). Given the banking sector's quasi-fiscal functions, its capital adequacy has continued to be under pressure since the crisis but has been upheld with sustained capital injections by the authorities. Of course, as long as these activities continue and as credit institutions are obliged to fulfill non-core functions (as mentioned above), public trust in banks will not grow and market-oriented financial deepening will not be possible in Uzbekistan (Coleman, 2012, pp. 107–109; EBRD, 2012, pp. 158–159).

7 Comparative Assessment and Conclusions: With Reforms Largely Ground to a Halt, the Role of Oil and Gas as a Determinant of Relative Prosperity Is Unbroken

7.1 Predominance of Political Authoritarianism and Economic Interventionism, Banking Sectors Often Instruments of Quasi-Fiscal Policies

As one might expect, less political freedom typically goes hand in hand with fewer economic liberties, also in Central Asia. This can be seen from a juxtaposition of the Economist Intelligence Unit Democracy Index with Heritage Foundation Economic Freedom Scores for the countries of the region: Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. However, there appears to be one exception, namely that the Kyrgyz Republic is assessed as a hybrid (non-authoritarian) regime by the Economist Intelligence Unit, yet at the same time as an economically mostly unfree country by the Heritage Foundation, while Kazakhstan is graded as mildly authoritarian, but moderately free for business. This seeming paradox might be explained by the fact that Kyrgyzstan, although it had experienced a pro-democracy uprising in 2010, which ushered in a parliamentary

[23] *Liquidity mopping-up operations included the sale of CBU certificates of deposit at more attractive interest rates in 2012 than before.*

regime, remains politically highly unstable and poor. Governance leaves a lot to be desired and implementation of laws remains weak. One can certainly argue that persistent political instability cannot but affect the business climate and economic freedom. At the same time, it would seem evident that in the Kazakh case, major hydrocarbon resource extraction and wealth generation have necessitated a minimum degree of transparency of rules for international corporations that possess needed technologies.

On the structural economic front, not much has changed since the crisis of 2008–09. Kazakhstan and Turkmenistan continue to be relatively rich (in terms of GDP per capita) hydrocarbon exporters, which have modernized their economies by importing considerable amounts of machinery and equipment. In contrast, the Kyrgyz Republic and Tajikistan remain relatively poor hydrocarbon importers and prominent recipients of remittance transfers (mostly from Kyrgyz or Tajik guest workers in Russia or Kazakhstan) (see chart 3 and table A2 in the annex). Well-financed modernization efforts by the hydrocarbon exporters and less leeway for comparable efforts on the part of the hydrocarbon importers may mark deepening regional disparities within Central Asia. Uzbekistan occupies a structural "middle position:" While it is a hydrocarbon exporter, it sells a more diversified product range than do Kazakhstan or Turkmenia. Uzbekistan is a rather low-income country (though richer than Kyrgyzstan and Tajikistan) and receives some limited remittances from its guest workers abroad. As to current account and budget developments, the hydrocarbon exporters (including Uzbekistan) typically achieve "twin surpluses" (of both balances)[24], while the hydrocarbon importers are usually saddled with "twin deficits" or at best only modest budget surpluses (Tajikistan).

Overall, across the region, EBRD transition indicators have not measured any major reform progress in Central Asia since the global crisis of 2008–09, while prior to the crisis, all countries of the region are assessed to have made some structural or institutional advances. Banking sector reforms are a case in point: Precrisis deregulation was followed by post-crisis reregulation, almost across the board. The recent tightening of state control of banking sectors happened against the background of credit institutions' financial weakness; in contrast to the precrisis era, bank lending no longer played an important role as a driver of economic growth if one disregards the recent reacceleration of retail credit expansion in Kazakhstan. The fragility of the Kazakh and Kyrgyz banking sectors (which, as a rule, do not fulfill quasi-fiscal functions) is due to the busts or downturns that followed their precrisis credit booms and whose legacies (e.g. partly dismal asset quality) continue to plague these sectors. The other Central Asian countries' banking sectors, which are more involved in directed and subsidized lending practices, also feature weaknesses because the exercise of these functions generally does not constitute a profit-oriented activity. Credit institutions carrying out quasi-fiscal activity are often state owned and receive either periodic capital injections or other repeated public financial assistance.[25]

[24] *The Turkmen current account deficits in 2009 and 2010 were a temporary exception here. They can be explained by major public investment and infrastructural modernization efforts (including large-scale export pipeline construction), which also reflected exceptionally high FDI inflows.*

[25] *For a more detailed discussion of the strengths and weaknesses of the Central Asian banking sectors, see Dzhagitian (2013).*

Table 6

Comparative Overview of Some Macroeconomic, Structural and Policy-Related Indicators in Central Asia (updated)

	Nominal GDP per capita (market exchange rate, USD)		Average annual GDP growth rate, % precrisis (2004–07)/ post-crisis (2010–13)	Domestic currency and convertibility	Exchange rate regime	Main monetary policy instruments (used 2008–13):		Budgetary stabilization and investment funds:	Quasi-fiscal functions of credit institutions:
	2008	2013				to control inflation	to deal with/ control the exchange rate	yes or no/if yes: which name, size (USD billion)	yes or no/if yes, which functions
Kazakhstan	8,683	13,152	9.7/6.4	Kazakh tenge (KZT); current, capital and financial account convertibility (since 2007)	Oct. 2007: de facto U.S. dollar peg; Feb. 2009: devaluation by 18% against USD, establishment of narrow trading band to USD; Feb. 2010: widening of trading band; Feb. 2011: abolishment of trading band and return to (pre-2007) managed floating; Feb. 2014: new devaluation of 19% against USD, re-establishment of a narrow corridor	Sales/purchases of NBK notes and government T-bills, NBK reserve requirements, refinancing rate, administrative measures (price controls on food items, postponement of adjustment of utility tariffs)	NBK interventions in the foreign currency market to ensure stable exchange rate to the U.S. dollar	Yes: National Fund of the Republic of Kazakhstan (NFRK, national oil fund, end-2013: USD 70.5 billion), Samruk-Kazyna (SK, state investment holding company, end-2012: over USD 100 billion)	No
Kyrgyz Republic	972	1,282	4.4/3.7	Kyrgyz som (KGS); current account convertibility (since 1995)	Managed floating with no pre-announced path for exchange rate	Sales/purchases of NBKR notes and government T-bills, NBKR policy rate, reserve requirements, fiscal tightening	NBKR interventions (often unsterilized) in the foreign currency market; since March 2014: policy rate	No	Yes: Settlement and Savings Company (SSC): subsidized lending to agriculturalists and other beneficiaries in the framework of the Affordable Loans for Farmers (ALF) program
Tajikistan	696	1,049	8.0/7.2	Tajik somoni (TJS); current account convertibility (since 2004)	Managed floating with no pre-announced path for exchange rate	NBT refinance rate and other policy rates, reserve requirements, variation of liquidity loans, administrative measures (food imports and sales from strategic reserves of food products)	NBT interventions (largely unsterilized) in the foreign currency market	No	Yes: Agroinvestbank (AIB), others: financing of cotton sector and state-owned enterprises

Source: National statistics, IMF Staff Reports, IMF Annual Report on Exchange Arrangements and Exchange Restrictions 2013, Asian Development Bank, EBRD.

Table 6 continued

Comparative Overview of Some Macroeconomic, Structural and Policy-Related Indicators in Central Asia (updated)

	Nominal GDP per capita (market exchange rate, USD)		Average annual GDP growth rate, % precrisis (2004–07)/ post-crisis (2010–13)	Domestic currency and convertibility	Exchange rate regime	Main monetary policy instruments (used 2008–13):		Budgetary stabilization and investment funds:	Quasi-fiscal functions of credit institutions:
	2008	2013				to control inflation	to deal with/ control the exchange rate	yes or no/if yes: which name, size (USD billion)	yes or no/if yes, which functions
Turkmenistan	4,060	7,110	12.7/11.3	Turkmen manat (TMT); official nonconvertibility	Dual exchange rate system, official rate pegged to the U.S. dollar; May 2008: exchange rate unification, USD peg	Administrative measures (price controls for food items, food imports and sales from strategic reserves of food products), variation of volume of directed credits, managment of reserve money growth	CBT interventions at Interbank Currency Exchange (ICE) to support rate pegged to the U.S. dollar, restrictions in access to foreign currency for foreign trade and other external transactions, buildup of official foreign currency reserves	Yes: Stabilization Fund of Turkmenistan (SFT, budgetary fund), Foreign Exchange Reserve Fund (FERF, entity for saving and investing hydrocarbon export proceeds), other funds (2012: total revenue of extrabudgetary funds: USD 12.4 billion, total expenditure: USD 8.9 billion)	Yes: Daykhanbank (Agricultural Bank), State Development Bank, Khalkbank (former Sberbank), Turkmenbashibank, Turkmenistanbank, Prezidentbank, others: lending to agricultural and industrial entities, SOEs, small businesses, mortgage borrowers; banks used as agents for financial oversight
Uzbekistan	1,039	1,895	7.9/8.2	Uzbek sum (UZS); formal – but not de facto – current account convertibility (since 2003; maintenance of foreign currency rationing and other exchange restrictions)	May 2006: U.S. dollar peg; Jan. 2008: crawl-like arrangement toward the USD	Sterilization of excess liquidity resulting from accumulation of foreign currency assets through CBU certificates of deposit, sterilization also through fiscal tightening and government deposits at CBU, variation of directed lending, CBU refinance rate, reserve requirements	CBU interventions in the foreign currency market (to ensure gradual depreciation of Uzbek sum), buildup of official foreign currency reserves	Yes: Fund for Reconstruction and Development (FRD, budget energy stabilization and investment fund, 2012: total resources USD 11 billion)	Yes: National Bank of Uzbekistan, Asakabank, Uzpromstroybank, Agrobank, Pakhtabank: financing of farming and industrial firms, SOEs, small businesses; credit institutions used as agents for financial monitoring and tax collection
Russia (for comparison)	11,665	14,634	7.2/3.4	Russian ruble (RUB); current, capital and financial account convertibility	Broad and adjustable trading band to USD/EUR basket; CBR has taken preliminary steps toward a free float/inflation targeting	CBR policy rate: refinancing rate, since Oct. 2013: rate on one-week open market operations, sales/ purchases of CBR notes and government T-bills, CBR reserve requirements, administrative measures	CBR interventions in the foreign currency market	Yes: Reserve Fund (oil stabilization fund, end-2013: USD 87.4 billion), National Wealth Fund in support of pension system (end-2013: USD 88.6 billion)	No

Source: National statistics, IMF Staff Reports, IMF Annual Report on Exchange Arrangements and Exchange Restrictions 2013, Asian Development Bank, EBRD.

7.2 Overall Impressive Commodity-Driven Growth, Great Variety of Price Stability Toolkits, Trade Orientation Gravitating between China and Russia

While average growth in the region has been somewhat lower in recent years than before 2008–09, strong economic expansion has continued in Central Asia even after the crisis; moreover in 2009, none of the five countries experienced a recession.[26] Growth in recent years has generally been driven by the recovery of oil, gas and non-hydrocarbon (including gold, aluminum, cotton) resource prices and demand. Moreover, where applicable, generous programs of infrastructural investment and modernization stimulated economic activity. The poorer countries benefited from recovering inflows of guest workers' remittances (Combe, 2013, pp. 21–22). However, in 2010 and 2012, Kyrgyzstan suffered some small slumps triggered by bouts of domestic political instability (see chart 1 and table 2). As table 6 indicates, per capita income growth rates of the relatively rich (hydrocarbon) countries and of the rather poor (non-hydrocarbon) countries of the region have tended to diverge in recent years. For systemic reasons, the very high official growth rates of the state-controlled Turkmen and Uzbek economies have to be treated with caution, since they partly reflect centrally driven "forced growth."

From 2008 to 2013, Central Asian countries' inflationary trends converged around rates of between 5% and 7% (end-year), with the outlier Uzbekistan, however, witnessing price increases remaining in double digits (2013: 12%). This peculiarity can be explained by the Uzbek crawl-like exchange rate arrangement and by continued demand-boosting policies. The other countries of the region have either pegged their currencies (Turkmenia), with a narrow corridor (Kazakhstan), or carry on managed floating without a preannounced path for the exchange rate (Kyrgyzstan, Tajikistan) (table 6). Here again we have a familiar dichotomy: Hydrocarbon countries tend to opt for fixed or tightly managed exchange rates, while non-hydrocarbon countries are more inclined to floating. Uzbekistan, the intermediary player, accordingly features a kind of hybrid currency regime.

Apart from increasing policy rates, raising reserve requirements and reducing circulating liquidity through open market operations (sale of central bank and T-bills), tightening fiscal policies (including the transfer of revenues to extrabudgetary funds) have served as anti-inflationary instruments. Not surprisingly, administrative interventions, like price caps on food and consumer staples, or even outright state supply-side intervention through the import and sale of food items in order to saturate retail markets, have prominently featured in Central Asian countries' price stability toolkits. Despite all policy efforts, global (mostly supply-side) economic forces appear to maintain a momentous impact on regional inflationary ups and downs. In 2014, price rises are expected to gain momentum in Kazakhstan and Kyrgyzstan due to the most recent ruble, tenge and som depreciations.

A number of factors may explain the above-described impressive economic and structural heterogeneity in the region. First, there is the evident geographic factor: Central Asian countries are sandwiched between more or less market-oriented

[26] *Average annual GDP growth (unweighted) in Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenia and Uzbekistan in the four years preceding the crisis of 2008–09, namely in 2004–07, had been 8.5%; this indicator declined to 7.4% in the four years following the crisis (2010–13).*

democracies and mildly authoritarian countries of Central and Eastern Europe on the one hand, and authoritarian but highly competitive China and the less authoritarian raw material producer Mongolia on the other. Second, as referred to above, the considerable variety of political regimes in the region contributes to explaining differing economic frameworks. Third, emerging market energy exporters (in Central Asia: Kazakhstan, Turkmenia, Uzbekistan) are typically richer and have more funds for development at their disposal than emerging market energy importers (here: the Kyrgyz Republic, Tajikistan). Accordingly, relatively poor energy importers are more likely to be a source of out-migration and to receive substantial guest workers' remittances as well as to benefit from international financial assistance.

However, more authoritarianism in Central Asia does not necessarily go together with lower economic growth or more modest per capita income, it can just as well be the contrary. In countries of the former Soviet Union – except for the Baltics – a decisive factor for economic prosperity appears to relate not so much to the issue whether a country is more or less authoritarian, but whether it possesses large hydrocarbon resources and is an oil/gas exporter or not.

Finally, one can also enumerate some elements of homogeneity in Central Asia: All countries of the region have featured relatively high economic growth in recent years and none experienced a contraction of GDP during the global recession of 2008–09. In the last decade, Central Asian countries witnessed little progress in economic reforms; moreover, since the crisis of 2008–09, reforms have largely stalled. All Central Asian countries' top trading partners are Russia and increasingly China (which together account for 30% to 40% of these countries' foreign trade turnover; see chart A1 in the annex). Only for Kazakhstan is the EU still the number one commercial partner. Russia may hope to recoup some ground in the coming years, with trade integration effects expected from the Eurasian Customs Union/Eurasian Economic Union (EAU; current members: Russia, Belarus and Kazakhstan).

Given the imposition of the new integration area's common customs tariff (which is higher than the previous Kazakh external tariff on many manufactured items, including machinery and equipment, vehicles, pharmaceuticals), and given the reduction of some nontariff barriers (e.g. the removal of border customs controls) on internal trade between members of the integration area, Kazakh trade within the EAU has clearly become easier (EBRD, 2012, p. 71). At the same time, imports from outside partners, like the European Union and China, have often become more expensive. Further to-be-expected EAU integration measures, like regulatory harmonization, will work in the same direction, unless harmonization converges toward EU standards. Thus, since the establishment of the Eurasian Customs Union and the EAU, Kazakhstan's trade with the EU has found itself at a relative disadvantage to its trade with Russia or with Belarus, in some cases also producing trade diversion effects, particularly with regard to industrial goods. However, Kazakhstan has apparently already seen rising shares of FDI inflows from outside the EAU as other countries – e.g. EU countries, which are the number one FDI source for Kazakhstan – seek to secure access to this integration area.

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Annex

Table A1

Trade Openness

	2007	2012
	Exports of goods and nonfactor services to GDP in %	
Kazakhstan	49.5	47.9
Kyrgyzstan	52.9	54.6
Tajikistan	20.7	18.2
Turkmenistan	36.8	58.5
Uzbekistan	39.7	27.9

	2007	2012
	Exports and imports of goods and nonfactor services to GDP in %	
Kazakhstan	92.4	77.5
Kyrgyzstan	137.1	154.3
Tajikistan	89.9	82.7
Turkmenistan	55.7	107.8
Uzbekistan	76.2	57.6

Source: National statistics.

Table A2

Migrants' Remittances or Current Transfers, 2010–13

	2010	2011	2012	2013[1]
	% of GDP, net			
Kazakhstan	–0.3	–0.2	–0.5	–0.7
Kyrgyzstan	27.4	28.3	30.3	29.8
Tajikistan	36.2	40.3	45.2	. .
Turkmenistan	0.5	0.3	0.2	0.2
Uzbekistan	4.5	6.0	6.8	6.6

Source: National statistics, IMF.

[1] *Partly estimates.*

Table A3

Russia: Key Macroeconomic and Financial Sector Indicators

	2007	2008	2009	2010	2011	2012	2013[1]
GDP growth (in real terms, %)	8.1	5.2	–7.8	4.5	4.3	3.4	1.3
Current account balance (% of GDP)	5.9	6.2	4.1	4.4	5.1	3.5	1.6
Net FDI flows (% of GDP)	0.7	1.2	–0.7	–0.6	–0.8	–0.4	–0.3
Gross external debt (% of GDP)	36.4	28.9	38.2	32.1	28.7	31.6	34.8
Debt service ratio (% of exports of goods and services)	28.3	28.9	30.5	23.7	15.8	17.9	. .
Gross international reserves (% of GDP)	35.4	30.3	34.2	31.5	28.8	26.7	24.2
Combined assets of Reserve Fund and of National Welfare Fund (% of GDP)[2]	12.0[3]	13.5	12.4	7.5	5.9	7.3	8.6
General government budget balance (% of GDP)	6.0	4.9	–6.3	–3.4	1.5	0.4	–0.6
CPI inflation (year-end, %)	11.9	13.3	8.8	8.8	6.1	6.6	6.5
Exchange rate: RUB/USD (annual average)	25.58	24.81	31.68	30.36	29.38	31.07	31.82
Level of monetization (broad money/GDP, %)	44.0	39.4	49.2	51.4	51.5	51.9	54.1
Credit to the economy (% of GDP)	36.9	40.0	41.5	39.1	41.7	45.1	50.0
of which: foreign currency-denominated loans (%)	22.8	24.8	23.7	22.1	20.5	16.3	17.0
of which: nonperforming loans (%)[4]	11.0	13.5	19.5	19.7	17.2	15.4	14.1
Asset share of foreign-owned banks (%)	17.2	18.7	18.3	18.0	16.9	17.8	15.3
Capital adequacy ratio (%)	15.5	16.8	20.9	18.1	14.7	13.7	13.5
Memo items:							
GDP (nominal, RUB billion)	33,248	41,277	38,809	46,322	55,967	62,218	66,577
GDP (nominal, USD billion)	1,300	1,664	1,225	1,526	1,905	2,017	2,092

Source: National statistics, IMF, World Bank, EBRD.

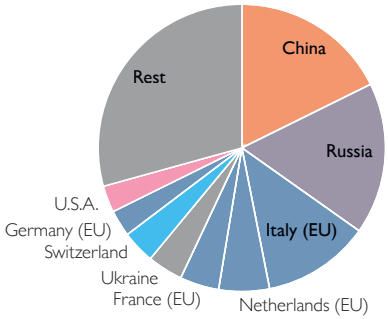
[1] *Partly estimates.*
[2] *Gross international reserves and assets of the Reserve Fund and the National Welfare Fund partly overlap.*
[3] *As at end-January 2008.*
[4] *Broader definition (share of doubtful, problem and bad loans in total loans).*

Chart A1

Major Trading Partners' Share in Total Merchandise Trade Volume

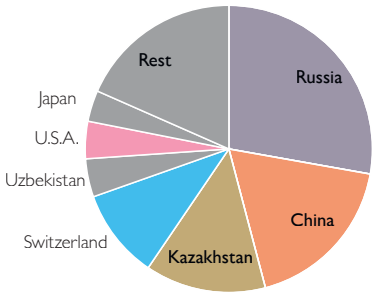
Kazakhstan

Exports and imports, %, 2012



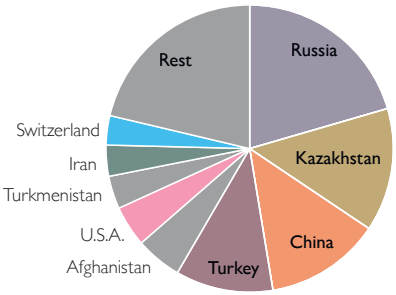
Kyrgyzstan

Exports and imports, %, 2012



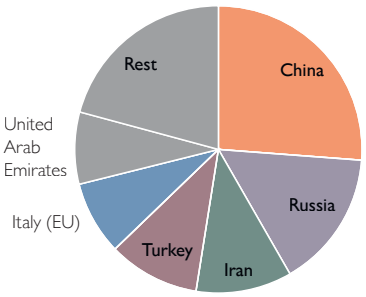
Tajikistan

Exports and imports, %, 2012



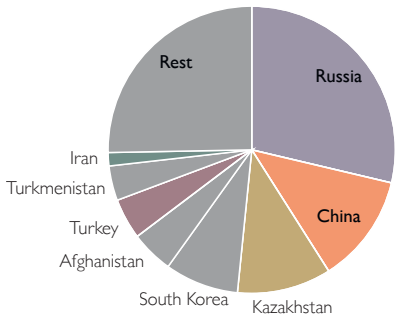
Turkmenistan

Exports and imports, %, 2012



Uzbekistan

Exports and imports, %, 2012



Source: National statistics.

To What Extent Can Czech Exporters Cushion Exchange Rate Shocks through Imported Inputs?

Peter Tóth[1]

This paper examines the role of imported inputs in cushioning exchange rate shocks by using a partial equilibrium model of heterogeneous firms. Producers in the model can serve the domestic market, export final goods, import inputs or engage in both exporting and importing. In the model, an exogenous exchange rate shock simultaneously affects the variable costs and revenues associated with exports and imports. The impact of a hypothetical 1% appreciation of the domestic currency on sales is estimated using a panel of 7,356 Czech manufacturing firms observed from 2003 to 2006. We focus on the above period to exploit the rich within-firm variation in trade strategies. This variation is likely to be associated with the lifting of trade barriers following the Czech Republic's EU accession in 2004. For firms that both export and import, the model predicts a drop in export sales of 0.8% as opposed to a 1% drop for price-taker exporters who do not use imported inputs.

JEL classification: C23, C26, D22, D24, F12
Keywords: Exchange rate pass-through, international trade, heterogeneous firms, monopolistic competition, total factor productivity, production function

Over recent years, there has been anecdotal evidence in the Czech Republic of domestic currency appreciation shocks causing alarm among the senior managers of large export-oriented industrial companies and industrial associations. These managers argued that a strong domestic currency negatively impacted the profit margins of Czech exporters, as export prices are usually contracted in foreign currency. At the same time, it is a well-known fact that the import intensity of Czech manufacturing exports has been high, especially since the Czech Republic joined the EU. This paper investigates the extent to which cheaper imported intermediate products compensate for a drop in export sales as a result of an appreciation of the local currency. Our answer to this question will be based on a model-backed estimate using firm-level panel data.

We apply a partial equilibrium model with monopolistically competing firms which are heterogeneous in their productivities. In the model setup, firms will serve the domestic market, export final goods or import inputs, depending on their productivity. Next we introduce an exogenous exchange rate shock, which simultaneously affects variable costs and the revenues associated with exports and imports. This allows us to estimate the impact of a hypothetical 1% appreciation of the domestic currency on sales according to different trade strategies. The predictions above will follow from the equilibrium sales equation implied by the model. The equation relates the log of total sales to exports, imports and productivity, and their coefficients are combinations of the model's structural parameters.

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In our effort to identify the coefficients in the sales equation, we face two main econometric problems. The first concerns the fact that firms tend to self-select into exporting and importing. According to our model, their selection is based mainly on firms' productivity and other industry-specific parameters. To correct the potential selection bias in the exporting and importing coefficients, we instrument them by the fitted probabilities of firms engaging in those activities. These probabilities are estimated from a year-by-year multinomial probit model. The model considers the choice between serving the domestic market only, exporting in addition, importing in addition or engaging in all these activities. The second problem is the productivity variable, which needs to be estimated. We fit total factor productivity from a standard firm-level production function extended by the possibility of using imported intermediate goods. Following recent studies in the literature, we use generalized method of moments (GMM) and instrumental variable estimation to correct for the measurement error in the capital stock variable.

To estimate exchange rate elasticities we use an unbalanced panel of 7,356 Czech manufacturing firms observed from 2003 to 2006. The studied interval is crucial for the identification of our estimates, as it can be characterized by high within-firm variation in exporting and importing strategies. The variation can probably be associated with the exogenous lifting of trade barriers following Czech EU accession in 2004. This lifting of trade barriers motivated an increasing share of firms to engage in importing intermediate goods and exporting final products.

The present paper extends the literature on heterogeneous firms and trade by offering a static alternative to the dynamic model proposed by Kasahara and Lapham (2013). Compared to their approach, our model is much simpler and leads to testable implications that are less computationally intensive to estimate. Further, in contrast to Bas and Strauss-Kahn (2011), who derive a variety of testable predictions on the effects of importing on a firm's export performance that are subsequently studied in a regression framework, we test the implications of the model through the equilibrium sales equation obtained directly from the model. The main novelty of this paper lies in studying exchange rate shocks in the context of heterogeneous firms and international trade whereas, in the related literature, it is common to estimate the impact of hypothetical changes in import tariffs.

The remaining part of this paper is organized as follows. Section 1 sets up the model and outlines its testable implications, section 2 describes the dataset, section 3 explains the estimation procedure, section 4 summarizes the results and the last section concludes.

1 The Model and Its Testable Implications

We consider N sectors in the economy, each of which produces differentiated products. Consumer expenditures on each sector's total output are exogenously fixed. At the beginning of a period, each firm i in a given sector experiences a productivity shock e_i. After e_i is revealed, firms decide whether to do business in their sector or not. If production will take place, firms can choose whether to serve the domestic market only *(X=0)* or, in addition to that, to export *(X=1)*. Furthermore, firms can decide to use domestic intermediate goods only *(M=0)* or to employ a mix of domestic and imported intermediates *(M=1)*. Firms' decisions to export or import will influence their fixed and variable costs associated with

trade. Moreover, if production includes imported intermediates, firms' productivity will increase to $e_i(M=1) = ne_i > e_i(M=0) = e_i$. As in Kasahara and Rodrigue (2008), we attribute this productivity increase to the higher quality of foreign intermediates or to the variety effect stemming from a more differentiated final good.[2]

Trading decisions are subject to the following fixed and variable costs. Running a production plant necessitates spending a fixed cost f. Serving foreign markets bears additional fixed costs f_X associated with expenditures on marketing and maintaining logistic networks abroad. Similarly, importing intermediates also involves extra fixed costs f_M. Participation in trade is additionally associated with variable costs of transportation. As is common in the literature, we assume melting-iceberg transport costs for exports $\tau_X > 1$ and imports $\tau_M > 1$, which require τ units to be shipped for one unit to arrive. The full structure of variable costs $c(X,M)$ and fixed costs $f(X,M)$ looks as follows:

$$c(X=0, M=0) = c, \qquad f(X=0, M=0) = f,$$

$$c(X=0, M=1) = c\tau_M, \qquad f(X=0, M=1) = f + f_M,$$

$$c(X=1, M=0) = c\tau_X, \qquad f(X=1, M=0) = f + f_X,$$

$$c(X=1, M=1) = c\tau_M\tau_X, \qquad f(X=1, M=1) = f + f_M + f_X$$

Firms compete in monopolistic competition[3] and preferences across varieties within a sector are modeled by a constant elasticity of substitution (CES) utility function[4,5]. The elasticity of substitution between varieties within a sector is a constant $\varepsilon = 1/(1-\alpha) > 1$, where $1/\alpha$ is the monopolistic price mark-up. Monopolistic competition and CES preferences imply the following demand function for the product of firm i in market j:

$$q_{ij} = A_j p_{ij}^{-\varepsilon} \tag{1}$$

where A_j is the constant sectoral demand level in market j, with values $A_{j=0} = A$ for the domestic market and $A_{j=x} = A_x$ for the foreign market. The values of A_j are assumed to be exogenous to the firm.

[2] *In the absence of product-level information on imported intermediates matched to firm-level data we are unable to differentiate the two effects empirically. Halpern et al. (2011) study such disaggregated data and conclude that two-thirds of the increase in firm productivity when imported intermediates are used is attributable to the variety effect.*

[3] *As monopolistic competition assumes an infinite number of atomistic firms producing different varieties of a good, we checked the degree of market share concentration within each manufacturing sector by two-digit NACE codes. NACE is a European standard for classifying the economic activity of firms. Using the standard Herfindahl index of sales, all sectors were found to be highly unconcentrated, with index values below 0.01. Note that the Herfindahl index ranges from 0 to 1 and is computed as:*

$H = \sum_{i=1}^{N} (s^2_i)$, *where* s_i *is the market share of firm* i *and* N *is the number of firms.*

[4] *The CES utility function over h varieties of goods x within a sector takes the standard form:* $u(x) = (x_1^\alpha + x_2^\alpha + \ldots + x_h^\alpha)^{1/\alpha}$, *where* $\alpha = (\varepsilon-1)/\varepsilon$.

[5] *The assumption of CES utility can be relaxed while maintaining the main results of the model. Mrázová and Neary (2011) show that if the operating profits function satisfies supermodularity conditions, the equilibria of the model and the productivity cutoffs presented in chart 1 can be maintained. Supermodularity would be satisfied, for example, by quadratic preferences, other things being equal. We leave extensions of the model into this direction for future research.*

The production function is a simplified version of Kasahara and Rodrigue (2008) and extends Helpman et al. (2004) by introducing productivity-increasing imported intermediates. We define production as:

$$q_i = e_i(M) I_i \tag{2}$$

where $e(M)$ is the productivity coefficient as a function of the binary import indicator M, and I_i is the amount of intermediate goods used in production.

Using demand (1), production (2) and cost functions $c(X,M)$ and $f(X,M)$, we can write firm i's profit from serving market j as:

$$\begin{aligned} \Pi_{ij}(M) &= A_j p_{ij}^{1-\varepsilon} - c(X,M) I_{ij} - f(X,M) = \\ &= A_j p_{ij}^{1-\varepsilon} - c(X,M) q_{ij} / e_i(M) - f(X,M) = \\ &= A_j p_{ij}^{1-\varepsilon} - c(X,M) A(X) p_{ij}^{-\varepsilon} / e_i(M) - f(X,M) \end{aligned} \tag{3}$$

The profit-maximizing unit price then becomes:

$$p_{ij}^* = p_i^* = \varepsilon c(X,M) / \left[e_i(M)(\varepsilon - 1) \right] \tag{4}$$

Plugging the above equilibrium prices (4) into the profit function (3), we get the following equilibrium profits for various trade strategies:[6]

$$\begin{aligned} \Pi_i^*(X,M) &= \Pi_{i0}^*(M) + \Pi_{ix}^*(M) \\ \Pi_i^*(0,0) &= EA \left[e_i(0) / c \right]^{\varepsilon-1} - f \\ \Pi_i^*(0,1) &= EA \left[e_i(1) / c\tau_M \right]^{\varepsilon-1} - f - f_M \\ \Pi_i^*(1,0) &= E\left(A + A_x \tau_X^{1-\varepsilon} \right) \left[e_i(0) / c \right]^{\varepsilon-1} - f - f_X \\ \Pi_i^*(1,1) &= E\left(A + A_x \tau_X^{1-\varepsilon} \right) \left[e_i(1) / c\tau_M \right]^{\varepsilon-1} - f - f_M - f_X \end{aligned} \tag{5}$$

where $E = \varepsilon^{-\varepsilon} (\varepsilon - 1)^{\varepsilon+1}$ is a positive constant. In equilibrium, each firm i will select the trade strategy (X,M) with the highest profit for firm i or will exit if none of $\Pi_i^*(X,M) > 0$.

Note that all parameters of $\Pi_i^*(X,M)$ are constant for a given sector, except the firm-specific productivities e_i. Therefore, the equilibrium trade strategies (X,M) within a sector will differ only by e_i. Plotting all $\Pi_i^*(X,M)$ against $[e_i(0)]^{\varepsilon-1}$ results in a linear graph which offers helpful insights into the model's equilibrium trade strategies (chart 1). Notably, we find firms in our dataset self-selecting into all four (X,M) strategies within each manufacturing subsector.[7] We therefore focus on a set of parameters that implies the existence of all trade strategies in sectoral equilibrium.

[6] *Note that equilibrium requires* $\Pi_{ij}^* > 0$.

[7] *In our empirical analysis we use the first two digits of firms' NACE codes.*

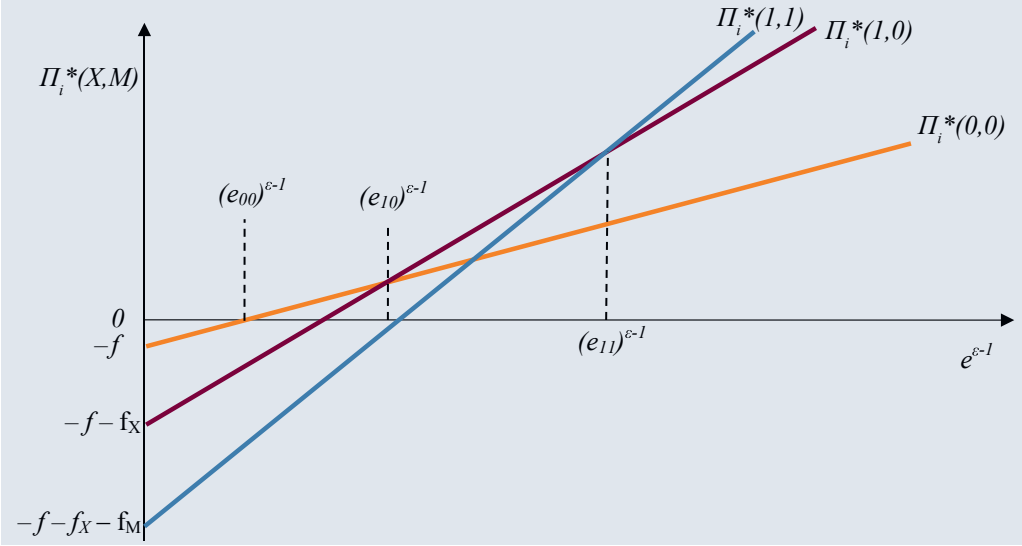
Furthermore, we assume the following ranking of cutoff productivities that imply equilibrium trade strategies for firms in terms of e_i: $0 < e_{00} < e_{10} < e_{01} < e_{11}$. This means that the least productive firms, with $e_i < e_{00}$, will not do business. Next, firms with e_i falling into any of the latter four intervals will optimally choose the *(X,M)* strategy as indicated by the subscript of each interval's lower bound e_{XM}. The ranking of productivity cutoffs above is justified by our data. As we will show in section 2 below,[8] the average firm size in the subsamples broken down by trade strategies follows the same order as our assumption about firm's productivity ranking. In the model, a higher productivity coefficient e_i implies higher profits and revenues and therefore a larger firm size.

We can argue that if all *(X,M)* strategies are to be observed in sectoral equilibrium, e_{00} must come first and e_{11} last. This is because the slope of $\Pi_i^*(1,1)$ with respect to $[e_i(0)]^{\varepsilon-1}$ is the highest and the intercept the smallest among $\Pi_i^*(X,M)$. The other extreme is $\Pi_i^*(0,0)$, with the smallest slope and the largest intercept. Although both alternative positions of e_{10} and e_{01} can exist in different sectoral equilibria, we will discuss only the $e_{10} < e_{01}$ case as suggested by our data. In the following, we outline the assumptions about the parameters of $\Pi_i^*(X,M)$ other than e_i that are necessary to arrive at the productivity ranking mentioned above.

If $\Pi_i^*(0,0)$ is to earn positive profits, productivity e_i must exceed the cutoff point $(e_{00})^{\varepsilon-1} = (fc^{\varepsilon-1}) / EA$. Given that $\Pi_i^*(0,1)$ and $\Pi_i^*(1,0)$ have a lower intercept than $\Pi_i^*(0,0)$, strategies *(0,1)* and *(1,0)* will exist in equilibrium only if the slopes of $\Pi_i^*(0,1)$ and $\Pi_i^*(1,0)$ with respect to $[e_i(0)]^{\varepsilon-1}$ are greater than the slope of $\Pi_i^*(0,0)$.

Chart 1

The Most Productive Firms Both Import and Export



Source: Author's calculations.

Note: For better tractability, let us assume that $\Pi_i^*(1,0) = \Pi_i^*(0,1)$ and $f_X = f_M$.

[8] *See sales, real value added, real capital, labor, energy and material inputs in table 4 in section 2 and table A1 in appendix 1 of the working paper version of this article (Tóth, 2013).*

This requires $[n / \tau_M]^{\varepsilon-1} > 1$ in the case of $\Pi_i^*(0,1)$ and $A_x \tau_X^{1-\varepsilon} > 0$ for $\Pi_i^*(1,0)$. From inequalities $e_{10} < e_{01}$, $e_{00} < e_{01}$ and $e_{00} < e_{10}$ we get further conditions. We further assume that $f_M > f_X$ and $A(n/\tau_M)^{\varepsilon-1} > (A+A_x \tau_X^{1-\varepsilon})$. This will ensure that the equilibrium is located within the relevant positive range of $[e_i(0)]^{\varepsilon-1}$, where the latter inequality is the relationship between the slopes of $\Pi_i^*(1,0)$ and $\Pi_i^*(1,0)$ with respect to $[e_i(0)]^{\varepsilon-1}$. The condition $e_{10} < e_{01}$ further requires $f_M(A^{-1}A_x \tau_X^{1-\varepsilon}) > f_X[(n/\tau_M)^{\varepsilon-1} - 1]$.

The remaining equilibrium profit function, $\Pi_i^*(1,1)$, has the lowest intercept of all the trade strategies employed, amounting to $-f-f_M-f_X$. The profit of the strategy of simultaneously exporting and importing will thus exceed that of other strategies if, and only if, the slope of $\Pi_i^*(1,1)$ with respect to $[e_i(0)]^{\varepsilon-1}$ is larger than the slopes of the other three $\Pi_i^*(.,.)$. This requires $[n / \tau_M]^{\varepsilon-1} > 1$ and $A_x \tau_X^{1-\varepsilon} > 0$, which is in accordance with all the assumptions above. Chart 1 depicts the sectoral equilibrium with profit lines for different trade strategies.

In the remaining part of section 1, we derive the estimating equation for the equilibrium sales[9] equations of our model. The estimates from the sales equations enable us to quantify the impact of a hypothetical exchange rate shock on firm sales depending on different trade strategies. At the end of the section, we derive the exchange rate elasticity estimates obtained from the sales equations.

Using (1) and (4), the equilibrium sales equation of firm i serving market j can be written as:

$$S_{ij}(X,M) = A_j\left(p_{ij}^*\right)^{1-\varepsilon} = A_j E' c(X,M)^{1-\varepsilon} e_i(M)^{\varepsilon-1} \tag{6}$$

where $E' = [\varepsilon/(\varepsilon-1)]^{1-\varepsilon}$ is a positive constant. Using (6) we can also write total sales in all markets served as a function of trade strategies:

$$\begin{aligned}
S_i(X,M) &= S_{i0}(X,M) + S_{ix}(X,M) \\
S_i(0,0) &= AE' c^{1-\varepsilon} e_i(0)^{\varepsilon-1} \\
S_i(0,1) &= AE'(c\tau_M)^{1-\varepsilon} e_i(1)^{\varepsilon-1} \\
S_i(1,0) &= (A + A_x \tau_X^{1-\varepsilon}) E' c^{1-\varepsilon} e_i(0)^{\varepsilon-1} \\
S_i(1,1) &= (A + A_x \tau_X^{1-\varepsilon}) E' (c\tau_M)^{1-\varepsilon} e_i(1)^{\varepsilon-1}
\end{aligned} \tag{7}$$

Now let us introduce the exchange rate into the above sales equations with the aim of estimating the impact of a hypothetical exchange rate shock. We assume that the exchange rate $r > 1$ expresses the value of the foreign currency in terms of the domestic currency.[10] Furthermore, connecting to our anecdotal evidence from the Czech Republic mentioned in the introduction, we study the shock of an appreciating domestic currency reducing r and find that an appreciation results in decreased variable costs of acquiring imported intermediates τ_M and thus higher equilibrium profits and sales. At the same time a stronger domestic currency

[9] *We estimate sales equations rather than equilibrium profits, as in the former case we do not need to identify the fixed cost parameters f(X,M) for the exchange rate elasticity estimates. Note that in order to estimate fixed costs we would need further identifying assumptions.*

[10] *This is CZK/EUR in the Czech case.*

implies a decreased demand level in export markets A_x measured in the domestic currency. We examine the instant impact of the exchange rate shock on profit and sales assuming that the prices of imported intermediates and exported final goods are contracted in the foreign currency and that the firm is unhedged against currency movements. The next paragraph lends some support to our assumptions above.

Recent survey evidence by Čadek et al. (2011) on the hedging behavior of 184 Czech exporting firms in the period from 2005 to 2009 relates to our assumptions regarding the exchange rate shock. Specifically, more than 75% of exports of the firms surveyed are contracted in euro and about 90% go to the euro area and the rest of Europe. Next, about 30% of respondents are fully unhedged against currency movements. Furthermore, about 50% of those who at least partially hedge their foreign currency exposure use so-called natural hedging. This involves the temporal alignment of cash inflows and outflows denominated in foreign currencies. As is known, natural hedging does not perfectly eliminate foreign currency risk. Finally, the typical hedging horizon among respondents was also in line with our assumption of a short-run effect. Specifically, about 80% of hedgers typically considered a horizon of less than one year.

Now we implement the exchange rate shock in equations (6) and (7). According to our model, firms with different trade strategies are affected differently by the exchange rate shock.[11] Those which neither export nor import will not be impacted. Next, firms using imported inputs will be able to offer their product at a lower price and their equilibrium sales will increase, ceteris paribus. Furthermore, firms serving export markets will experience a decrease in their equilibrium export sales as the demand level goes down. Finally, the net effect of the exchange rate shock on the total sales of firms that both export and import can be either positive or negative. This is because their sales on domestic markets will increase as imported inputs become cheaper. At the same time, the negative effect of lower export demand may or may not fully outweigh the positive effect of cheaper imported inputs on export sales.

We can incorporate the exchange rate r into the equilibrium sales equations (7) as follows:

$$S_i(0,1) = S_{i0}(0,1) = AE'\left[c\tau_M r\right]^{1-\varepsilon} e_i(1)^{\varepsilon-1} \tag{8}$$

$$S_i(1,0) = S_{i0}(1,0) + S_{ix}(1,0) = \left(A + rA_x\tau_X^{1-\varepsilon}\right)E'c^{1-\varepsilon}e_i(0)^{\varepsilon-1} \tag{9}$$

$$S_i(1,1) = S_{i0}(1,1) + S_{ix}(1,1) = \left(A + rA_x\tau_X^{1-\varepsilon}\right)E'\left[c\tau_M r\right]^{1-\varepsilon} e_i(1)^{\varepsilon-1} \tag{10}$$

The equations above imply the following exchange rate elasticities of sales for the trade strategy *(X,M)* and the market served j, where $j=0$ denotes the domestic market and $j=x$ denotes export markets:

[11] *Here we focus on the intensive margin only, which means discussing the partial effects on firms in a given equilibrium trade strategy. At the same time we ignore the extensive margin, i.e. the effect of the exchange rate shock on some firms changing their trade strategies.*

$$\begin{aligned}
&\rho_j(X,M) = \left(r / S_{ij}\right) \partial S_{ij} / \partial r \ \ and \\
&\rho(X,M) = (r / \left(S_{i0+}S_{ix}\right) \partial(S_{i0+}S_{ix}) / \partial r \\
&\rho_0(0,1) = \rho(0,1) = \rho_0(1,1) = \left(1-\varepsilon\right) \\
&\rho_x(1,0) = 1
\end{aligned} \tag{11}$$

$$\rho_x(1,1) = \left(2 - \varepsilon\right) \tag{12}$$

$$\begin{aligned}
\rho(1,1) &= \left[\left(1 - \varepsilon\right)A + \left(2 - \varepsilon\right)rA_x\tau_X^{1-\varepsilon}\right] / \left(A + rA_x\tau_X^{1-\varepsilon}\right) = \\
&= \left[1 - \varepsilon + rA_x\tau_X^{1-\varepsilon} / \left(A + rA_x\tau_X^{1-\varepsilon}\right)\right] = \\
&= 1 - \varepsilon + R
\end{aligned} \tag{13}$$

where ratio $0 < R < 1$ on the right-hand side of the above equation is the share of the freight cost-discounted foreign demand level $rA_x\tau_X^{1-\varepsilon}$ in the total demand level exporters face.

Given that the elasticity of substitution between varieties in a given sector, ε, is assumed to be greater than one,[12] we expect a negative exchange rate elasticity of domestic sales $\rho_0(.,1)$. This means that the shock of an appreciating domestic currency implies positive sales growth on domestic markets for firms that import some of their intermediates. Furthermore, according to the equations above, export sales are unit elastic to the exchange rate when no intermediates are imported and therefore will decrease if the domestic currency appreciates. Next, the elasticity of export sales in case some intermediates are imported, $\rho_x(1,1)$, is negative if $\varepsilon > 2$ and nonnegative if $1 < \varepsilon < 2$. Hence it follows that firms with trade strategy $(1,1)$ can still experience increased export sales despite the exchange rate shock, i.e. $\rho_x(1,1) < 0$, if ε is large enough. In the above case, the positive effect of cheaper imported intermediates outweighs the effect of the virtual drop in foreign demand. Finally, the condition for a negative exchange rate elasticity of total sales for firms with trade strategy $(1,1)$ can be expressed as:

$$\varepsilon^* > 1 + R \tag{14}$$

As will be shown, the above condition (14), parameter ε and the listed partial effects (11)–(13) can be estimated from our data on Czech manufacturing firms. So, finally, we will test the hypothesis that the terms (11)–(13) are significantly different from zero.

To proceed, we take natural logarithms from the equilibrium sales equations (7)–(10) and combine them into one equation using mutually nonexclusive dummy

[12] *Please note that a constant ε across all sectors follows from the CES utility function. As we will see in section 4 below, the assumption of $\varepsilon > 1$ is consistent with our empirical estimates.*

variables[13] $d(1,.) = d(1,0) + d(1,1)$ and $d(.,1) = d(0,1) + d(1,1)$. As a result, we get the following relationship:

$$log\left[S_i(X,M)\right] = log\left(AE'\right) + (1-\varepsilon)log(c) + d(1,.)log\left(1+rA_xA^{-1}\tau_X^{1-\varepsilon}\right) + \\ + d(.,1)(1-\varepsilon)log\left(r\tau_M\right) + (\varepsilon-1)log\left(e_i(M)\right) \quad (15)$$

In order to convert (15) into an estimable format, let us assume that all the addends in (15) are constants[14] except the trade dummies $d(.,.)$ and the productivity term $log(e_i(M))$. Furthermore, as the productivity term $log(ei(M))$ is not directly observed, let us approximate it using an estimate of total factor productivity (TFP). Given all the above, and after adding a normal i.i.d., zero-mean error term θ_{it}, equation (15) can be rewritten as follows:

$$s_{it} = \alpha_0 + \alpha_1 d(1,.)_{it} + \alpha_2 d(.,1)_{it} + \alpha_3 TFP_{it} + \theta_{it} \quad (16)$$

where s_{it} is the log of total sales of firm i in time period t, $d(.,.)_{it}$ are dummy variables indicating trade strategies as in equation (15), and TFP_{it} is equal to $log(e_i(M))$, i.e. the firm's total factor productivity as a function of its importing strategy. The rest of the parameters of (15) are stacked into constants α_0 to α_3 of (16) as shown by the following expressions:

$$\alpha_0 = log\left(AE'\right) + (1-\varepsilon)log(c)$$
$$\alpha_1 = log(1+rA_xA^{-1}\tau_X^{\varepsilon-1})$$
$$\alpha_2 = (1-\varepsilon)log(r\tau_M)$$
$$\alpha_3 = \varepsilon-1$$

which leads to:

$$\varepsilon = \alpha_3 + 1$$
$$E' = \left[(\alpha_3+1)/\alpha_3\right]^{-\alpha 3}$$
$$r\tau_M = exp(\alpha_2/-\alpha_3)$$
$$rA_x\tau_X^{1-\varepsilon} = A\left[exp(\alpha_1) - 1\right]$$
$$R = A\left[exp(\alpha_1)-1\right]/\left[A + A\left(exp(\alpha_1)-1\right)\right] = 1 - exp(-\alpha_1)$$

[13] *Note that using mutually exclusive trade strategy dummies would lead to the overidentification of structural parameters.*

[14] *Note that some of the assumptions about these constants could be relaxed and made firm-specific or time-variant. For example, the term $rA_xA^{-1}\tau_X^{1-\varepsilon}$, i.e. the trade cost-weighted ratio of the foreign demand level to the domestic demand level, could be firm-specific based on the firm's exposure to foreign markets and the mix of foreign countries in its portfolio. Similarly, the productivity mark-up dummy for using imported intermediates, $e_i(M)$, could be continuous based on the share of imported goods in total intermediate products used. This would allow us to derive firm-specific exchange rate elasticities. This interesting extension is beyond the scope of the present paper and is left for future research.*

Furthermore, based on (11), (12) and (13), we can express the elasticities of a hypothetical 1% change in the value of the foreign currency vis-à-vis sales on market *j*, $\rho_j(X,M)$, in terms of the estimates of (16):

$$\rho_0(0,1) = \rho(0,1) = \rho_0(1,1) = -\alpha_3 \tag{17}$$

$$\rho_x(1,0) = 1 \qquad \rho_x(1,1) = 1 - \alpha_3 \tag{18}$$

$$\rho(1,1) = 1 - \alpha_3 - exp(-\alpha_1) \tag{19}$$

Following our assumptions in the model, we expect α_0, α_1 and α_3 to be positive and α_2 to be negative. Regarding the estimable structural parameters of interest, we expect $\varepsilon > 1$, $r\tau_M > 1$ and $0 < R < 1$. Furthermore, based on the model's predictions for $\rho_j(X,M)$, we anticipate a negative $\rho_0(1,1)$ and a positive $\rho_x(1,1)$. Finally, we are not able to predict the sign of $\rho(1,1)$ without making further assumptions about the model's parameters.

2 Data Base Used for Estimation

Our data sample consists of an unbalanced panel of 7,356 Czech manufacturing firms. The motivation to focus on the time period from 2003 to 2006 will be explained in more detail in the next paragraphs. The dataset was obtained from the Albertina database, which is collected by the private company Creditinfo Czech Republic, s.r.o. and available at Česká národní banka. Although several commercial firm databases exist in the Czech Republic, to our knowledge only Albertina contains information on exports and imports.

One of the key advantages of analyzing the exports and imports of Czech firms during the defined period arises from the Czech Republic's accession to the EU in 2004. EU entry represents an exogenous event for firms and is associated with the lifting of trade barriers within the European Union. This implies that several nontrading Czech firms were able to participate in international trade after 2004 as both fixed and variable costs of accessing foreign markets went down. Table 1 shows the tendency of several firms shifting toward exporting and importing strategies in our sample after 2004. In particular, the share of firms that both export and import, denoted by the dummy variable *d(1,1)*, increases from about 25% in 2003 and 2004 to around 40% in 2005 and 2006.[15]

Table 1

Czech Firms Engaged in Trade Strategies d(export, import)

Strategy	2003	2004	2005	2006
	%			
d(0,0)	58	63	42	44
d(1,0)	12	10	8	7
d(0,1)	5	4	8	10
d(1,1)	26	22	42	39
Total	100	100	100	100

Source: Author's calculations.

[15] *For additional firm-level and macro evidence on high trade intensity in the Czech Republic, see tables A1 and A9 in the appendix of the working paper version of this article (Tóth, 2013).*

Table 2

Trade Strategy Switches from 2003 to 2006

	To strategy				Total
	d(0,0)	d(1,0)	d(0,1)	d(1,1)	
From strategy	%				
d(0,0)		12.1	13.8	22.2	48.1
d(1,0)	5.7		0.3	17.2	23.1
d(0,1)	4.6	0.3		7.1	12.0
d(1,1)	5.3	4.9	6.7		16.8
Total	15.6	17.2	20.7	46.6	100.0

Source: Author's calculations.

Note: The total number of switches during the period from 2003 to 2006 equals 2,630. Sums of all rows and sums of all columns add up to 100.

Table 3

Transitions between Trade Strategies from 2003 to 2006

	To strategy				Total
	d(0,0)	d(1,0)	d(0,1)	d(1,1)	
From strategy	%				
d(0,0)	38.8	2.9	3.3	5.4	50.4
d(1,0)	1.4	4.6	0.1	4.2	10.2
d(0,1)	1.1	0.1	3.3	1.7	6.2
d(1,1)	1.3	1.2	1.6	29.1	33.2
Total	42.6	8.7	8.3	40.4	100.0

Source: Author's calculations.

Note: The total number of switches during the period from 2003 to 2006 equals 2,630. Sums of all rows and sums of all columns add up to 100.

As our panel is unbalanced, we also checked whether the higher share of exporters and importers stems from trade strategy switchers or new entrants to the dataset. We are mostly interested in switchers, since our main results – the model-implied exchange rate elasticities – are functions of export and import dummy coefficient estimates[16] and switchers allow us to identify these dummy coefficients from within-firm variation in trade strategies after controlling for firm-specific fixed effects. Given the time period analyzed, within-firm variation in trade strategies is likely to be associated with exogenous EU accession. It turned out that more than 14% of the observations in the pooled sample are firms that switched their trade strategy since the preceding year.

Further stylized facts are consistent with the hypothesis of the lifting of trade barriers implied by the Czech Republic's EU accession. According to the last column of the first row in table 2, more than 48% of trade strategy shifts depart from a no-trade status quo. Next, according to the last row of column *d(1,1)* in table 2, up to 47% of trade strategy shifts lead to strategy *d(1,1)* of both exporting and importing. At the same time, table 3 shows that roughly 70% of the observations in the pooled sample consist of firms that do not switch their trade strategy of no-trade *d(0,0)* or full trade *d(1,1)* compared to that of the preceding year. This suggests that many firms cannot access foreign markets, but once a firm manages to export and import, it will tend to stay with that strategy. In other words, we observe substantial persistence in trade strategies on the micro level, which may imply the existence of sunk costs associated with those strategies.[17]

3 Details of the Estimation Procedure

In this section we describe the estimation of equation (16), which involves three main issues. First, the variable TFP_{it}, firm i's total factor productivity as a function of its importing strategy, is fitted from a production function in subsection 3.1. Second, as firms select into trade strategies $d(X,M)_{it}$ endogenously, we have to correct the estimates of α_1, α_2 and α_3 for the probability of having chosen in the respective

[16] *See sales equation (16).*

[17] *Roberts and Tybout (1997) find similar persistence patterns in the exporting activities of Colombian firms.*

strategies. The endogeneity of trade strategy selection follows from our model, where firms choose a trade strategy depending on their current TFP and sector-specific fixed and variable costs associated with trade. Therefore, current period realizations of the sector- and firm-specific cost parameters left in the error term θ_{it} may be correlated with dummies $d(0,1)_{it}$, $d(1,0)_{it}$ and $d(1,1)_{it}$. The probabilities of choosing different trade strategies are estimated from a multinomial probit model in subsection 3.2. The third estimation issue relates to the potential correlation of TFP_{it} with the error term θ_{it}, which is the current period realization of the sales shock. This can lead to a biased estimate of α_3. The solution to this issue is briefly described in subsection 3.3.

3.1 Estimation of the Production Function

Regarding the estimation of TFP as a function of the importing strategy, we consider a standard Cobb-Douglas production function extended to include imported inputs as an additional factor of production:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 d(.,1)_{it} + \omega_{it} + \eta_{it} \tag{20}$$

where y_{it} is the log of real value added, k_{it} is the log of the real capital stock, l_{it} is the log of the number of employees,[18] $d(.,1)_{it} = d(0,1)_{it} + d(1,1)_{it}$ is a dummy variable indicating the use of imported intermediates, ω_{it} is an unobserved firm-specific productivity shock and η_{it} is an i.i.d. error term from the normal distribution. As the unobserved productivity shock ω_{it} is correlated with the factor inputs and the import dummy, the OLS estimates of β_0 to β_3 are, in general, biased. To solve this endogeneity issue, we combine several approaches available in the literature and mainly follow Wooldridge (2009) and Galuščák and Lízal (2011).[19]

After fitting the production function (20), we save the estimate of total factor productivity in natural logarithm *(tfp)* as a function of the import strategy. We obtain *tfp* from the following expression:

$$tfp_{it} = y_{it} - \beta_1 k_{it} - \beta_2 l_{it} \tag{21}$$

This expression is used in the remaining stages of our estimation, i.e. the multinomial probit models of trade strategy choice and the equilibrium sales equation.

3.2 Estimation of the Probabilities of Choosing Trade Strategies

To address the problem of nonrandom samples of firms self-selecting into different trade strategies in equation (16), we estimate the probabilities of choosing each of the four trade strategies using a year-by-year multinomial probit model. The firm- and year-specific probabilities will then be used as instruments for dummy variables $d(1,.)_{it}$, $d(.,1)_{it}$ in equation (16). The multinomial probit approach is motivated by the unobserved ordering of trade strategies. As noted in section 1, trade strategy choice is determined by firm i's productivity parameter e_i and the

[18] *A more commonly used measure of labor input, namely hours worked, is not available in our dataset.*

[19] *For more details on the assumptions and the approach to estimate equation (20), please refer to the working paper version of this article (Tóth, 2013).*

cutoff productivities for each strategy depending on the relative slopes of trade strategy-specific equilibrium profit functions $\Pi_i^*(X,M)$. Using the multinomial probit, we do not have to make further assumptions about the parameters of $\Pi_i^*(X,M)$.

Trade strategy choice in the multinomial probit framework is modeled as follows. We introduce latent variables γ_{ij} indexed for each firm i and trade strategy choices j from the set $(X,M) = \{(0,0), (0,1), (1,0), (1,1)\}$ and consider a 1 x q row vector of exogenous firm-specific variables w_i:

$$\gamma_{ij} = \mathbf{w_i}\delta_j + \xi_{ij}$$

where ξ_{iX}, ξ_{iM}, and ξ_{iXM} are distributed independently and identically following a standard normal distribution. The firm chooses trade strategy k such that $\gamma_{ik} \geq \gamma_{im}$ for $m \neq k$. Taking the difference between γ_{ik} and γ_{im} we get:

$$\Gamma_{i,k,m} = \gamma_{ik} - \gamma_{im} = \mathbf{w_i}(\delta_k - \delta_m) + (\xi_{ik} - \xi_{im}) = \mathbf{w_i}\varphi_{k'} + \omega_{ik'}$$

where $Var(\omega_{ik'}) = Var(\xi_{ik} - \xi_{im}) = 2$ and $Cov(\omega_{ik'}, \omega_{il'}) = 1$ for $k' \neq l$. Using the above expressions, we can write the probabilities of choosing each of the four trade strategies as follows:

$$\begin{aligned}
Prob(i \text{ chooses } (0,0)) &= Prob(\Gamma_{i,00,01} \geq 0, \Gamma_{i,00,10} \geq 0, \Gamma_{i,00,11} \geq 0) \\
Prob(i \text{ chooses } (1,0)) &= Prob(\Gamma_{i,10,00} \geq 0, \Gamma_{i,10,01} \geq 0, \Gamma_{i,10,11} \geq 0) \\
Prob(i \text{ chooses } (0,1)) &= Prob(\Gamma_{i,01,00} \geq 0, \Gamma_{i,01,10} \geq 0, \Gamma_{i,01,11} \geq 0) \\
Prob(i \text{ chooses } (1,1)) &= Prob(\Gamma_{i,11,00} \geq 0, \Gamma_{i,11,01} \geq 0, \Gamma_{i,11,10} \geq 0)
\end{aligned}$$

The above probabilities indicate that choice in the multinomial probit model is based on the multivariate normal distribution $MVN(0,\Sigma)$, where Σ is a 3 x 3 variance-covariance matrix with 2-s on the diagonal and 1-s off the diagonal.

We estimate the year-by-year multinomial probits as defined above with exogenous firm-specific variables w_i including the log of capital approximating firm size, *tfp* as a function of importing from (21), a dummy for foreign ownership, a lagged trading dummy indicating engagement in any of the trade strategies except (0,0) in the preceding period[20] and a set of industry dummies. As a concluding step, the fitted probabilities for each firm and time period are recorded.

3.3 Estimation of the Equilibrium Sales Equation

Once tfp_{it} in (21) and the trade strategy probabilities have been fitted, all that remains is to estimate the equilibrium sales equation (16). We use an instrumental variables approach. More specifically, we apply a two-stage least squares (2SLS) estimator and use the firm- and year-specific fitted probabilities associated with

[20] *The indicator of prior trade experience is important given the observed persistence in trade strategies in our dataset. Past exporting activities were found to be a good predictor of future engagement in exports also by Roberts and Tybout (1997) based on a sample of Colombian firms.*

the export and import dummies $d(1,.)_{it}$ and $d(.,1)_{it}$ as instruments. We also consider firm-specific fixed effects in sales. Finally, we perform linear and nonlinear tests of combinations of the sales equation's coefficient estimates. This allows us to test some of the model's structural parameters and the implied exchange rate elasticities in (17)–(19), as presented in table 8 in the next section.

4 Results

Table 4 presents estimates of the production function based on several approaches. Columns (1) to (4) follow and extend the frameworks of Wooldridge (2009) and Galuščák and Lízal (2011) and deal with endogenous variables via GMM. Column (1) is the replication of Wooldridge (2009) on our Czech sample. This involves estimating the extended version of the production function by GMM and treating labor as endogenous. The estimates in column (2) result from the extension of Wooldridge (2009) as suggested by Galuščák and Lízal (2011). The latter authors suggested a measurement error correction in capital using e.g. depreciation and energy inputs as instruments apart from the treatment of endogenous labor. The models in columns (3) and (4) extend the specifications used in (1) and (2) to include an import dummy, which is assumed to be exogenous given the proxy for the productivity shock in the same period.

Comparing our estimates in columns (1) and (2) with those of Galuščák and Lízal (2011) we find similar results. Specifically, correcting for the measurement error in the capital stock variable is important, as the log capital coefficient increases sharply after the correction. At the same time, the elasticity of labor remains roughly the same. However, the sizes of the estimated coefficients are different in the two studies. This may be largely attributable to the fact that we use the number of employees instead of hours worked as the proxy for labor. Our choice of the number of employees was predetermined by data limitations.

The last four columns of table 4 present results from the models including firm-specific fixed effects; endogenous variables are treated by two-stage least squares. The specifications and the pattern of treating endogenous variables are the same as in the first half of table 4. Specifically, in the column (5) model, we use instruments for the labor stock variable but the measurement error in the capital stock variable is not corrected. In the column (6) estimates, we additionally use depreciation and energy and material costs as instruments for the capital stock. Columns (7) and (8) replicate the latter two columns while also including the import dummy.

Comparing the results in the two halves of the table, all the coefficient estimates are roughly halved but remain statistically significant after considering firm-specific fixed effects. This implies that fixed effects should not be disregarded in similar studies.

Regarding the coefficient on the import dummy – the estimate of key interest to us within the production function – we can say that imported intermediates tend to increase total factor productivity significantly. However, after correcting the potential measurement error in capital stock, the effect of imported intermediates is roughly halved. The same conclusion holds for both the GMM and the 2SLS fixed effects estimates. To sum up, the above results are in line with the assumptions made in our model and similar to other studies that

consider import dummies in the production function, such as Kasahara and Rodrigue (2008).

As we have concluded that both firm-specific fixed effects and the measurement error correction with respect to capital stocks are important, we will use estimates of TFP based on column (8) in the remainder of the empirical analysis. Note that, given data limitations, we were forced to estimate the production function based on a reduced sample. This meant considering only 4,815 to 5,180 different firms instead of the full sample of 7,356 firms, depending on the method of estimation and the associated data requirements. However, to recover a TFP estimate for each firm in the full sample, we only need to observe labor and capital and use the associated coefficient estimates from equations (20) and (21). Thanks to this fact we can also estimate TFP out of the production function sample. Therefore, as a sensitivity check, we will replicate the final results of our analysis for both the *full* and the *reduced* sample. By *full sample* we mean the sample also containing TFP estimates outside the sample considered for estimating the production function. Similarly, when referring to the *reduced sample,* we mean keeping only those observations which were used in the production function estimation.

The fitted TFP from above first enters the estimation of the probabilities of being in a particular trade strategy from the year-by-year multinomial probit models. To keep the summary of results to a manageable size, we present estimates only for the pooled sample for 2003 to 2006 in table 5.[21]

The coefficients on log real capital and log TFP in table 5 suggest that an increase in these variables improves the probabilities of being engaged in any form of trade compared to the base outcome of showing neither imports nor exports. The coefficients of these two regressors tend to be the largest for the full trade strategy *d(1,1)*, which implies that any increase in the two regressors increases the probability, for the firm in question, of being both an importer and an exporter by more than that of being an importer or exporter only. These findings, therefore, do not contradict our model in general. Furthermore, foreign ownership tends to increase the probability of a firm being involved in international trade. The size of the coefficient on the foreign ownership dummy, however, does not follow a clear systematic pattern over time and across different trade strategies. The coefficient on the lagged trade dummy is significantly positive, which suggests persistence in trade strategies.[22] We can also assert this because once a firm starts trading, it is likely to stick to its strategy. Finally, we can observe some systematic patterns in the coefficients on the listed industry dummies, though interpreting them is not the main focus of the present study.

After obtaining the fitted firm- and year-specific TFP and the probabilities of having chosen a particular trade strategy, we estimated the sales equation. This allows us to identify selected structural parameters of the model and to estimate the exchange rate elasticities of sales. The estimates of the sales equation itself, for both the full and the reduced samples, can be found in table 6 below. The signs of

[21] *For the year-by-year estimates, please refer to tables A2–A5 in appendix 2 of the working paper version of this article (Tóth, 2013).*

[22] *Persistence in trading activities is consistent with the findings of Roberts and Tybout (1997) on Colombian firm-level data.*

the export and import dummy coefficients and log TFP are as expected and in accordance with our model in both samples. Unfortunately, though, the coefficient estimate of the import dummy is insignificant in both versions of the dataset.[23] Note, however, that the imprecise estimate of α_2 in (16) only affects the estimate of the structural parameter $r\tau_M$ (table 7) discussed below and does not influence our main results regarding exchange rate elasticities (table 8).

By using the estimates of the sales equation in table 6, we can derive estimates of some of the model's structural parameters. These are summarized and tested in table 7. The estimate of the elasticity of substitution ε is greater than one and thus in accordance with our theoretical assumptions. The estimated share of the freight cost-discounted foreign demand level in the total demand level faced by exporter firms, R, lies between zero and one as expected. The product of the unit cost of importing and the nominal exchange rate $r\tau_M$ exceeds one, which is again in line with the model's assumptions. Notably, there are some differences between the three estimates depending on whether the full or the reduced sample is used, especially in the case of parameter $r\tau_M$. Moreover, the standard error of the latter estimate is relatively large, making the point estimate indistinguishable from zero. This is likely to be a result of the imprecise estimate of coefficient α_2 in sales equation (16).

Table 4

Estimates of the Production Function

	Estimator							
	GMM				IV-2SLS with fixed effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	5.644***	3.867***	5.266***	3.655***	7.899***	2.876***	7.858***	2.895***
	(0.474)	(0.871)	(0.48)	(0.858)	(0.43)	(0.578)	(0.429)	(0.576)
Log of number of employees	0.458***	0.426***	0.452***	0.422***	0.213***	0.287***	0.216***	0.287***
	(0.015)	(0.019)	(0.015)	(0.019)	(0.039)	(0.05)	(0.039)	(0.05)
Log of real capital	0.261***	1.528***	0.254***	1.489***	0.185***	0.760***	0.183***	0.756***
	(0.021)	(0.141)	(0.021)	(0.138)	(0.011)	(0.034)	(0.011)	(0.034)
Import dummy d(0,1)+d(1,1)	–	–	0.205***	0.099***	–	–	0.073***	0.039**
			(0.017)	(0.024)			(0.013)	(0.017)
R-squared	0.829	0.635	0.832	0.648	0.809	0.760	0.813	0.762
Number of observations	12,434	11,393	12,434	11,393	12,434	11,393	12,434	11,393
Number of firms	5,180	4,815	5,180	4,815	5,180	4,815	5,180	4,815

Source: Author's calculations.

*Note: The dependent variable is the log of real value added. Estimation period: 2003–06. Standard errors are reported in parentheses. *, **, and *** denote significance at the 90%, 95% and 99% levels. Year dummies were included in all regressions.*

Estimates: (1) follows Wooldridge (2009);
(2) Wooldridge (2009), real capital instrumented by depreciation and energy and material inputs;
(3) Wooldridge (2009), import dummy included;
(4) Wooldridge (2009), import dummy included and real capital instrumented by depreciation and energy and material costs;
(5) IV-2SLS version of Wooldridge (2009), fixed effects included;
(6) IV-2SLS version of Wooldridge (2009), fixed effects included and capital instrumented by depreciation and energy and material costs;
(7) IV-2SLS version of Wooldridge (2009), fixed effects and import dummy included;
(8) IV-2SLS version of Wooldridge (2009), fixed effects and import dummy included and capital instrumented by depreciation and energy and material costs.

[23] *The reason for the above result is probably the fact that the two trade dummies in equation (16) are correlated.*

Table 5

Estimates of the Multinomial Probit Model of Trade Strategy Choice

Choice outcomes	d(1,0)	d(0,1)	d(1,1)
Constant	–3.782***	–5.065***	–7.069***
	(0.227)	(0.323)	(0.257)
Log of real capital	0.211***	0.212***	0.458***
	(0.009)	(0.009)	(0.009)
Log of TFP	0.147***	0.206***	0.228***
	(0.012)	(0.013)	(0.011)
Foreign ownership dummy	0.657***	0.502***	0.497***
	(0.130)	(0.141)	(0.125)
Lagged trade dummy	1.640***	1.487***	2.176***
	(0.042)	(0.044)	(0.037)
Light industry dummy	–0.678***	0.428	0.354
	(0.206)	(0.308)	(0.238)
Raw materials industry dummy	–0.405**	0.482	0.444
	(0.206)	(0.308)	(0.238)
Machinery industry dummy	–0.042	0.458	0.813***
	(0.209)	(0.311)	(0.240)
Electric industry dummy	–0.730***	0.534*	0.697***
	(0.212)	(0.311)	(0.241)
Car manufacturing industry dummy	–0.614***	0.290	0.900***
	(0.232)	(0.328)	(0.252)
Number of observations	20,165		

Source: Author's calculations.

*Note: Estimates by choice outcomes d (export, import) with d(0,0) as the base outcome. Estimation period: 2003–06. Standard errors are reported in parentheses. *, **, and *** denote significance at the 90%, 95% and 99% levels. The above model was estimated on the pooled sample for 2003 to 2006 with the largest number of observations. In a further estimation, we use fitted choice probabilities estimated from year-by-year multinomial probit models. The year-on-year estimates of the model can be found in appendix 2 of Tóth (2013).*

Table 6

Estimates of the Equilibrium Sales Equation

	Coefficients of equation(16)	Full sample	Reduced sample
Constant	α_0	3.666***	3.989***
		(0.000)	(0.000)
Export dummy d(1,0)+d(1,1)	α_1	0.585**	0.907**
		(0.000)	(0.000)
Import dummy d(1,0)+d(1,1)	α_2	–0.008	–0.208
		(0.000)	(0.000)
Log of TFP as a function of import dummy	α_3	0.201***	0.227***
		(0.000)	(0.000)
R-squared		0.077	0.053
Number of observations		18,344	11,217
Number of firms		7,356	4,752

Source: Author's calculations.

*Note: The dependent variable is the log of total sales. The equation was estimated by 2SLS including fixed effects. Log of TFP was fitted from the production function in table 5, column 8. Standard errors are reported in parentheses. *, **, and *** denote significance at the 90%, 95% and 99% levels. The reduced sample corresponds to the observations used in table 5, column 8.*

In addition to the above structural parameters of the model, we can use the estimates of sales equation (16) to express the exchange rate elasticities of sales as predicted by the model. The elasticities tell us the percentage response of sales to a 1% depreciation of the nominal exchange rate. As the elasticities are symmetric with respect to a positive or a negative currency shock, we only need to invert the sign of the coefficient in order to look at the response of sales to an *appreciation* of the domestic currency in table 8 below. This is motivated by the fact that appreciation shocks usually receive more attention in Czech economic news reports than depreciation episodes.

According to our results as presented in table 8, a 1% appreciation of the domestic currency leads to a 0.2% rise in domestic sales for firms which import some of their inputs. For comparison, the same shock causes export sales to drop by 1% if the firm does not import inputs. This latter result follows from our assumption that exporters are price-takers on foreign markets and their contracts are written in the foreign currency. The similarly negative impact on export sales is somewhat reduced to 0.8% if the firm uses imported intermediate goods. Thus the negative effect of an appreciation on exports is somewhat cushioned by imported intermediates, still the negative exchange rate effect on export sales outweighs the positive effect on domestic sales. The appreciation shock leads to a drop of 0.2% or 0.4% in total sales of firms that both export and import, depending on whether the estimate is based on the full or the reduced sample. The above elasticity estimates are roughly comparable to our estimates on macro data.[24]

[24] *For more details on our macro estimates, see appendix 3 in the working paper version of this article (Tóth, 2013).*

Table 7

Estimates of Selected Structural Parameters

	Parameter (theoretical model)	Coefficients of equation (16)	Full sample	Reduced sample
Elasticity of substitution of the CES utility function	ε	$1 + \alpha_3$	1.201***	1.227***
			(0.072)	(0.073)
Share of freight cost-discounted foreign demand level in total demand level faced by exporters	R	$1 - \exp(-\alpha_1)$	0.443***	0.597***
			(0.148)	(0.159)
Variable unit cost of imports (CZK thousand)	$r\tau M$	$\exp(\alpha_2/-\alpha_3)$	1.042	2.501
			(0.929)	(2.505)
Number of observations			18,344	11,217
Number of firms			7,356	4,752

Source: Author's calculations.

*Note: Standard errors are reported in parentheses and are obtained by the delta method for the last two parameters. *, **, and *** denote significance at the 90%, 95% and 99% levels.*

Table 8

Implied Exchange Rate Elasticities of Sales

	Model	Coefficients of equation (16)	Full sample	Reduced sample
	Change in sales in % if domestic currency appreciates by 1%			
Domestic sales under strategies d(1,1) and d(0,1)	$-\rho 0(0,1) = -\rho(0,1) = -\rho 0(1,1)$	α_3	0.201***	0.227***
			(0.072)	(0.073)
Export sales under strategy d(1,1)	$-\rho x(1,1)$	$\alpha_3 - 1$	−0.799***	−0.775***
			(0.072)	(0.075)
Total sales under strategy d(1,1)	$-\rho(1,1)$	$\alpha_3 + \exp(-\alpha_1) - 1$	−0.243*	−0.370**
			(0.127)	(0.161)
Number of observations			18,344	11,217
Number of firms			7,356	4,752

Source: Author's calculations.

*Note: Standard errors are reported in parentheses. The delta method is used to obtain the standard error for the last elasticity. *, **, and *** denote significance at the 90%, 95% and 99% levels.*

5 Conclusion

In this paper, we studied the impact of a hypothetical currency shock on firm sales depending on a mix of firms' exporting and importing strategies. We argue that the exchange rate pass-through to sales is special in the case of firms that both export and import – a class of firms that became more widespread after the Czech Republic entered the European Union. Accordingly, we used within-firm variation in the time period around EU entry to identify our estimates. Our aim was to capture the exogenous effect of the lifting of trade barriers associated with EU entry on the participation of firms in international trade.

We found that importing firms are partially able to cushion the negative impact of an exchange rate shock on their export sales. In particular, export sales were found to drop by 0.8% as a result of a 1% appreciation of the domestic currency if the firm imports some of its intermediate goods, instead of dropping by 1%, as assumed, if a price-taker firm does not import inputs. At the same time, domestic sales are expected to rise by 0.2% and total sales to drop by 0.2% for the same subsample of firms. The above elasticities of export and total sales are roughly in

line with our estimates based on macro-level data. While a currency appreciation still hurts firms engaged in international trade (in the sense that their overall sales are reduced), this negative effect is softened as firms integrate into global value chains (i.e. by importing intermediates).

Our research is also interesting from the point of view of estimating production functions. Our findings concur with those of other studies regarding the importance of measurement error correction in capital stock data. In particular, Galuščák and Lízal (2011) came to the same conclusion from a different Czech dataset. Moreover, our estimates imply that firm-specific fixed effects should not be ignored when estimating production functions. Finally, we confirm that imported intermediates increase firms' total factor productivity, as found also by Bas and Strauss-Kahn (2011), Halpern et al. (2011) and Kasahara and Rodrigue (2008) on microdata from France, Hungary and Chile, respectively.

Our analysis contributes to the literature on heterogeneous firms and trade by studying the impact of a hypothetical exchange rate shock to firm sales, a topic which has not been studied before in this context to our knowledge. All the more, this topic has received heightened attention in the policy sphere and media recently, as Česká národní banka decided to weaken the Czech koruna by starting to carry out interventions on the foreign exchange markets for an undefined period last November. Regarding this policy shock to the Czech koruna, our findings suggest that the benefits from the recently improved price competitiveness of Czech exporters will be somewhat dampened if exporters have to rely on more expensive imported inputs.

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CESEE-Related Abstracts from Other OeNB Publications

The abstracts below alert readers to studies on CESEE topics in other OeNB publications. Please see *www.oenb.at* for the full-length versions of these studies.

The Priorities of Deleveraging in the Euro Area and Austria and Its Implications for CESEE

Judith Eidenberger, Stefan W. Schmitz, Katharina Steiner

Bank deleveraging is often used synonymously for a reduction in the supply of credit to the real economy, which hampers economic growth. In this paper, we investigate this hypothesis empirically. We define deleveraging as the increasing ratio of capital to total assets and aim at identifying the priorities of recent deleveraging in the euro area and Austria and its implications for Central, Eastern and Southeastern Europe (CESEE). The data analysis utilizes ECB balance sheet data for monetary financial institutions (MFIs) for the euro area and Austria; reporting data of Austrian banks at the consolidated level and BIS locational statistics are employed to study the impact of deleveraging on credit to the real economy in CESEE. We focus on the crisis and postcrisis period from October 2008 to February 2014 (latest available data). In addition, we study developments in the precrisis period from June 2003 to October 2008.

The data reveal that banks in the euro area and Austria did in fact deleverage. In the crisis and postcrisis period, the priorities of deleveraging are similar in the euro area and in Austria. The process was predominantly driven by the numerator (capital), which contributed 88% to deleveraging in the euro area and 73% in Austria.

The denominator of leverage (total assets) contributed the remaining shares. In both samples, the decrease in total assets was driven by reductions in interbank lending and external assets. Funding for the real economy increased in the euro area and in Austria.

As external asset reductions play a major role in deleveraging in both the euro area and Austria, we analyze the relevant developments in CESEE in detail. The priorities of Austrian banks' deleveraging in CESEE are similar to those of banks in the euro area and Austria: They were driven by capital increases (99%). The small reduction of total assets in the sample was due to reductions of interbank lending, cash and central bank reserves; funding for households and nonfinancial corporations slightly increased. In line with developments in the euro area and in Austria, banks' sovereign exposure in CESEE increased, too. However, at the disaggregate level, Austrian banks reduced their activities in some countries during the past five years. But these reductions did not translate into decreasing funding for households and nonfinancial corporations in these countries.

We conclude that from a macroprudential perspective, euro area and Austrian banks as well as their subsidiaries in CESEE have set the right priorities in deleveraging since October 2008.

Published in *Financial Stability Report 27*.

Macrofinancial Developments in Ukraine, Russia and Turkey from an Austrian Financial Stability Perspective

Tina Wittenberger, Daniela Widhalm, Mathias Lahnsteiner, Stephan Barisitz

Recent bouts of international financial market volatility and adverse geopolitical developments have put the spotlight on Ukraine, Russia and Turkey. While Austrian banks benefited from a benign macrofinancial environment in Russia and Turkey, in particular with regard to the swift recovery from the 2008–09 crisis period, they are burdened by legacy issues of the last credit boom in Ukraine. By discussing macrofinancial developments in Ukraine, Russia and Turkey, this study sets the scene for a more in-depth analysis of Austrian banks' activities in these countries.

Published in *Financial Stability Report 27*.

Capital Market Development in CESEE and the Need for Further Reform

Krisztina Jäger-Gyovai

Domestic capital markets in Central, Eastern and Southeastern Europe (CESEE) are still less developed than capital markets in more advanced economies. Unhedged foreign currency borrowing and dependence on external funding have been among the key vulnerabilities in CESEE during the global economic crisis. Therefore, there is a need for better developed local capital markets in the region, additional sources of domestic funding, and a reduction in foreign exchange exposure in domestic financial markets. International initiatives, such as the Vienna Initiative or the EBRD Local Currency and Capital Markets Development Initiative, support local capital market development in the region. Well-developed capital markets are not only a crucial component for generating economic output, but also foster more stable growth through the ability of diversified financial sources to offset a slowdown of economic activity caused by a credit crunch.

Published in *Financial Stability Report 27*.

Austria Holds Intra-EU Export Market Shares almost Constant despite Difficult Economic Environment

Klaus Vondra

Before the global recession, export growth outperformed economic growth across the EU. The economic crisis hit almost all EU countries through a steep fall in exports, especially exports of goods. Yet, as shown in this article, almost all countries in Europe were hit by the slump in exports simultaneously; hence, intra-EU export market shares were left broadly unchanged by the crisis. This article presents a market share analysis for both goods and services and explores some underlying factors for these developments. From a regional perspective, Central, Eastern and Southeastern European (CESEE) countries gained market shares in the period 2004 to 2012 at the expense of major pre-2004 EU countries (the U.K., France and Italy). From a product perspective, service market shares developed broadly in line with goods market shares. At the same time, service-oriented countries were able to compensate losses in goods market shares by expanding service market shares. Austria managed to keep its market share position almost constant, benefiting most from trade links with Germany. At the product level, Austria strengthened its exports of high-technology good products.

To be published in *Monetary Policy & the Economy Q3/14*.

Notes

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Monetary Policy & the Economy — English | quarterly

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Fakten zu Österreich und seinen Banken — German | twice a year
Facts on Austria and Its Banks — English | twice a year

This online publication provides a snapshot of the Austrian economy based on a range of structural data and indicators for the real economy and the banking sector. Comparative international measures enable readers to put the information into perspective.

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Financial Stability Report — English | twice a year

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